IS 2019

Zbornik 22. mednarodne multikonference

INFORMACIJSKA DRUŽBA

Zvezek A

Proceedings of the 22nd International Multiconference

INFORMATION SOCIETY

Volume A

Uredili / Edited by

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Slovenian Conference on Artificial Intelligence

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Cognitive Science

Odkrivanje znanja in podatkovna skladišča - SiKDD
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7.–11. oktober 2019 / 7–11 October 2019
Ljubljana, Slovenia

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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2019

Multikonferenca Informaci družba (http://is.ijs.si) je z dvaindvajseto zaporedno prireditvijo tradicionalni osrednji srednjeevropski dogodek na področju informacijske družbe, računalništva in informatike. Informacijska družba, znanje in umetna inteligenca so - in to čedalje bolj – nosilci razvoja človeške civilizacije. Se bo neverjetna rast nadaljevala in nas ponesla v novo civilizacijsko obdobje? Bosta IKT in zlasti umetna inteligenca omogočila nadaljnji razcvet civilizacije ali pa bodo demografske, družbene, medčloveške in okoljske težave povzročile zadušitev rasti? Čedalje več pokazateljev kaže v oba ekstrema – da prehajamo v naslednje civilizacijsko obdobje, hkrati pa so notranji in zunanji konflikti sodobne družbe čedalje težje obvladljivi.

Letos smo v multikonferenco povezali 12 odličnih neodvisnih konferenc. Zajema okoli 300 predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic in 500 obiskovalcev. Prireditev bodo spremljale okrogle mize in razprave ter posebni dogodki, kot je svečana podelitev nagrad. Izbrani prispevki bodo izšli tudi v posebni številki revije Informatica (http://www.informatica.si/), ki se ponaša z 42-letno tradicijo odlične znanstvene revije.

Multikonferenco Informacijska družba 2019 sestavljajo naslednje samostojne konference:

- 6. študentska računalniška konferenca
- Etika in stroka
- Interakcija človek računalnik v informacijski družbi
- Izkopavanje znanja in podatkovna skladišča
- Kognitivna znanost
- Kognitonika
- Ljudje in okolje
- Mednarodna konferenca o prenosu tehnologij
- Robotika
- Slovenska konferenca o umetni inteligenci
- Srednje-evropska konferenca o uporabnih in teoretičnih računalniških znanostih
- Vzgoja in izobraževanje v informacijski družbi

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi tudi ACM Slovenija, SLAIS, DKZ in druga slovenska nacionalna akademija, Inženirska akademija Slovenije (IAS). V imenu organizatorjev konference se zahvaljujemo združenjem in institucijam, še posebej pa udeležencem za njihove dragocene prispevke in priložnost, da z nami delijo svoje izkušnje o informacijski družbi. Zahvaljujemo se tudi recenzentom za njihovo pomoč pri recenziranju.

V 2019 bomo sedmič podelili nagrado za življenjske dosežke v čast Donalda Michieja in Alana Turinga. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Marjan Mernik. Priznanje za dosežek leta pripada sodelavcem Odseka za inteligentne sisteme Instituta »Jožef Stefan«. Podeljujemo tudi nagradi »informacijska limona« in »informacijska jagoda« za najbolj (ne)uspešne poteze v zvezi z informacijsko družbo. Limono je dobil sistem »E-zdravje«, jagodo pa mobilna aplikacija »Veš, kaj ješ?!«. Čestitke nagrajencem!

Mojca Ciglarič, predsednica programskega odbora
Matjaž Gams, predsednik organizacijskega odbora

FOREWORD - INFORMATION SOCIETY 2019

The Information Society Multiconference (http://is.ijs.si) is the traditional Central European event in the field of information society, computer science and informatics for the twenty-second consecutive year. Information society, knowledge and artificial intelligence are - and increasingly so - the central pillars of human civilization. Will the incredible growth continue and take us into a new civilization period? Will ICT, and in particular artificial intelligence, allow civilization to flourish or will demographic, social, and environmental problems stifle growth? More and more indicators point to both extremes - that we are moving into the next civilization period, and at the same time the internal and external conflicts of modern society are becoming increasingly difficult to manage.

The Multiconference is running parallel sessions with 300 presentations of scientific papers at twelve conferences, many round tables, workshops and award ceremonies, and 500 attendees. Selected papers will be published in the Informatica journal with its 42-years tradition of excellent research publishing.

The Information Society 2019 Multiconference consists of the following conferences:

- 6. Student Computer Science Research Conference
- Professional Ethics
- Human – Computer Interaction in Information Society
- Data Mining and Data Warehouses
- Cognitive Science
- International Conference on Cognitonics
- People and Environment
- International Conference of Transfer of Technologies – ITTC
- Robotics
- Slovenian Conference on Artificial Intelligence
- Middle-European Conference on Applied Theoretical Computer Science
- Education in Information Society

The Multiconference is co-organized and supported by several major research institutions and societies, among them ACM Slovenia, i.e. the Slovenian chapter of the ACM, SLAIS, DKZ and the second national engineering academy, the Slovenian Engineering Academy. In the name of the conference organizers, we thank all the societies and institutions, and particularly all the participants for their valuable contribution and their interest in this event, and the reviewers for their thorough reviews.

For the fifteenth year, the award for life-long outstanding contributions will be presented in memory of Donald Michie and Alan Turing. The Michie-Turing award was given to Prof. Marjan Mernik for his life-long outstanding contribution to the development and promotion of information society in our country. In addition, a recognition for current achievements was awarded to members of Department of Intelligent Systems of Jožef Stefan Institute. The information lemon goes to the “E-Health” system, and the information strawberry to the mobile application “Veš, kaj ješ?!” (Do you know what you eat?!). Congratulations!

Mojca Ciglarič, Programme Committee Chair
Matjaž Gams, Organizing Committee Chair

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PREDGOVOR

Leto 2019 obeležuje petdesetletnica International Joint Conference on Artificial Intelligence, ki velja za najpomembnejši svetovni dogodek na področju umetne inteligence. Število prispevkov na konferenci se v zadnjem desetletju nenehno povečuje in je v zadnjih dveh leti zrastlo za več kot 30%. Letos je bilo oddanih približalo 5000 prispevkov, sprejetih je bilo 850 delež sprejetih pa je bil z manj kot 18% eden najnižjih doslej. Število referatov iz Kitajske (38%) je preseglo število referatov iz ZDA (169) in EU (152) skupaj, čeprav so glede nagrad, življenjskih dosežkov in vabljenih predavanj ZDA in EU še vedno prevladovale, saj se je število starejših raziskovalcev umetne inteligence v Aziji začelo povečevati šele pred kratkim.

Hiter napredek umetne inteligence je viden tudi pri številnih aplikacijah. Tako so na primer še pred nekaj 10 leti bili roboti nerodni in počasni mehanizmi, ki so se prevrnili čez vsako oviro, danes pa nekateri delajo salte in hodijo po težko prehodnem terenu. Pred desetletji so se avtonomna vozila zaletavala v parkirana in so pogosto obtičala, danes pa so najboljši avtonomni avtomobili do šestkrat varnejši kot povprečen avto s človeškim voznikom. Celo v šahu so programi globokih nevronskih mrež začeli premagovati najbolj napredne preiskovalne algoritme, pri čemer so se v nekaj urah naučili igrati le iz osnovnih pravil igre. Čeprav nekatere to navdaja s strahom, je po mnenju nekaterih raziskovalcev ravno razvoj superinteligence edini možni izhod iz problemov netrajnostnega razvoja – uničujemo planet in družbo, sami pa ne uspemo najti rešitev, ker presegajo naše sposobnosti.

Zanimive dosežke umetne inteligence predstavljamo tudi na Slovenski konferenci o umetni inteligenci (SKUI), ki je naslednica konference Inteligentni sistemi, le-ta pa je bila sestavni del multikonference Informacijska družba že od njenega začetka leta 1997. Slovensko društvo za umetno inteligenco šteje SKUI za svojo konferenco. Letos je bilo sprejetih 20 prispevkov, kar je 3 več kot prejšnja leta. Podobno kot pretekla leta jih je največ z Instituta »Jožef Stefan«, nekaj pa jih je prispevala Fakulteta za računalništvo in informatiko, ki ima skupaj z Institutom vodilno vlogo pri raziskavah umetne inteligence v Sloveniji. Upamo, da bo prispevkov iz industrije in nasploh izven Instituta prihodnja leta še več, saj je ključen cilj SKUI povezovanje vseh slovenskih raziskovalcev umetne inteligence. Dobrodošli so tudi prispevki iz tujine.

Mitja Luštrek, Rok Piltaver, Matjaž Gams

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Conceptual Design of a Decision Support Tool for Severe Accident Management in Nuclear Power Plants

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ABSTRACT

Safety is one of the major concerns connected with the operation of nuclear power plants. Severe accidents are very rare, but may cause very large consequences. The prevention and management of accidents requires carefully designed safety plans, guidelines and decision support tools. In this paper, we present a conceptual design of a decision support system for severe accident management. The system is aimed at providing essential information to the accident management team, in terms of the assessment of the damage state, prediction of possible progressions of the accident, and assessment of available management actions and their consequences. The system will employ components and models developed through probabilistic safety assessment and qualitative multi-criteria decision modeling. The software is being developed in the context of the EU H2020 project NARSIS. Its first prototype is expected in 2020.

Keywords

Nuclear Power Plant Safety, Severe Accident Management, Decision Support System, Probabilistic Safety Assessment.

1. INTRODUCTION

Electric energy is an indispensable resource in the modern world. Global electricity demand in 2018 increased by 4%, or 900 TWh, growing nearly twice as fast as the overall demand for energy [1]. About 11% of the world's electricity is generated by about 450 nuclear power plants (NPPs), and about 60 more are under construction [2]. NPPs provide high power output with relatively low operational costs and low impacts on the environment [3]. In the unlikely case of a severe accident, NPP may, however, cause significant and long-term consequences to people, the environment or the facility [4]. Those may include casualties, severe effects on individual's health, emitting radioactive isotopes to the environment, or melting the reactor core [5]. In spite of the remarkable reliability of current NPP safety procedures, the 2011 Fukushima Daiichi accident highlighted a number of challenging issues [6], among others the need (1) to seek out and act on new information about hazards, including combined natural events (such as the earthquake and tsunami in Fukushima), and (2) improve nuclear plant systems, resources, and training to enable effective responses to severe accidents.

Some of these challenges are addressed in an ongoing EU H2020 project NARSIS (*New Approach to Reactor Safety ImprovementS*) [7]. The project involves 18 partners from 9 European countries and aims to improve the current Probabilistic Safety Assessment (PSA) procedures by elements that take into account coincidental external events, vulnerability of the elements to complex aggressions, and better treatment of uncertainties through adoption of probabilistic framework for vulnerability curves and non-probabilistic approach to constraining the "expert judgments". PSA is, together with its deterministic counterpart, DSA, the main analytical method used for assessing nuclear safety, which allows practitioners to better understand the causes that can initiate nuclear accidents and to identify the most critical elements of the systems [7].

One of the goals of NARSIS is to develop a prototype Decision Support Tool for Severe Accident Management (hereafter called Severa). Severa will be aimed at supporting the NPP Technical Support Center (TSC), which is responsible for managing severe accidents through the assessment of the current situation, identifying and assessing available management actions and their consequences, selecting the actions, and monitoring the NPP response. In this stressful and complex decision situation, Severa will, based on measurements of operational parameters and using various insights or information from PSA models, assess the damage state of NPP barriers, predict possible progressions of the accident, and assess the available management actions. In this way, it will help the TSC to select the most appropriate management actions in a given situation, considering the likelihood of their successful implementation and possible impacts on the NPP and its environment.

Severa is currently under development, to be completed in 2020. In this paper, we present its conceptual design. We first describe the addressed decision problem. In section 3, we formulate the requirements for Severa and describe its intended use in a decision-making loop. In section 4, the main building blocks of Severa are proposed and described. Section 5 concludes the paper.

2. PROBLEM DESCRIPTION

A *severe accident* is characterized by circumstances that can cause severe core degradation, damage to the nuclear fuel, reactor pressure vessel and the NPP containment structures, possibly leading to a release of radioactivity to the environment. A severe accident may be initiated by internal (e.g., multiple equipment failures) or external (e.g. natural hazard) events, leading to NPP damage states that cannot be handled by normal operation procedures. In this case, a timely, accurate and well-justified management response is essential for preventing and mitigating the consequences of the event. For such situations, modern NPPs provide an extensive set of Severe Accident Management Guidelines (SAMGs), carefully designed and frequently reviewed written procedures for mitigating severe accidents.

SAMGs are meant to be activated in rare cases when critical parameters considerably exceed the normal operating values, for instance in the case of an unlikely accident scenario, under which the core exit temperature would exceed 650 °C. In such a case, the TSC would be formed, and the responsibility for accident management transferred from the operators in the control room to the TSC, so that the SAMGs would be used by the TSC members. The TSC would then be faced with the situation in which it has to diagnose the NPP status and recommend a sequence of management actions. Depending on the type of the accident, decisions may be time-critical and may need to be made in time windows measured in minutes after the accident.

The NPP is a complex system, and such would be decision making in real situations. At a very basic level, however, we consider that the NPP contains various barriers that prevent the emission from radioactive fuel and debris into the environment. The most important are three barriers: (1) Cladding of fuel in the Reactor Core (RC), (2) Reactor Coolant System (RCS), and (3) Containment. Accident management actions strive to prevent or minimize structural or operational damage to these barriers, for instance by identifying possible actions to decrease the core temperature or reactor pressure vessel and containment pressure. The main management strategies thus include actions such as (1) inject water into the steam generator, (2) depressurize the RCS, (3) inject water into the RCS and control containment conditions (pressure and temperature). The actual implementation of these strategies may vary depending on the current NPP status, available resources (e.g., external power supply), available equipment (e.g., mobile water pumps) and available staff. In a given situation, some of the actions may be unfeasible, may have negative effects on accident progression, or cannot resolve the problem within the required time constraints. All these factors, together with potentially severe consequences of wrong decisions, lead to an extremely complex decision problem that poses a large burden on the TSC team.

3. REQUIREMENTS FOR SEVERA

The objective of Severa is to provide an effective software tool for decision-support in the NPP severe accident management, relying on the PSA techniques and the current status of SAMGs. Severa will address the decision-analysis and decision-support needs of the TSC, once it has been formed and SAMGs have been activated. Severa is expected to support the following functions:

- Provide means to represent, store and monitor selected physical measurements of the NPP.
- Assess the current state of the vital NPP barriers: Core, RCS/Reactor Vessel, and Containment.
- Predict the future accident progression in the case that no action is undertaken by the TSC.
- Provide a list of possible management recovery strategies and courses of actions.
- Assess the applicability and feasibility of possible actions in the given situation.
- For each action: predict the consequences in terms of probability of the last barrier (containment) failure and estimated time window for failure.
- Evaluate and rank the feasible actions, providing recommendations for the TSC.

In the framework of NARSIS, only a prototype implementation of Severa is foreseen. It will be used mainly to demonstrate the feasibility of developing such a tool for actual NPPs and its potential for managing and reducing the residual risk from NPPs operation. It may also improve the training of TSC members. Due to the complexity of the decision problem, Severa will be further restricted to reasonably small, but relevant, subsets of system parameters and management actions. Severa's performance will be tuned and measured on the "Virtual NPP": an artificial, somewhat simplified, but sufficiently realistic NPP architecture, defined in the NARSIS project for research and testing purposes.

Severa is foreseen to be used in repeated decision-making cycles. Each cycle is expected to take about 10 to 20 minutes and will consist of the following main steps:

1. Monitor and assess the NPP status: relevant parameters (e.g., primary system or containment), and availability and performance of plant systems.
2. Collect the information concerning the current status of plant damage and accident progression; e.g., which barriers are challenged or may be soon, which functions are not available.
3. Identify possible alternatives (action courses); identified action courses should include the actions which are required by the SAMGs and should consider the availability of plant systems/functions and time window necessary for the action.
4. For each identified alternative establish the answers to the set of plant status questions, i.e., establish the input for the tool for each alternative action.
5. Quantify (assess, evaluate) each alternative using the models implemented in the tool.
6. Compare the alternatives based on the results from the tool and select the alternative to proceed with.
7. Implement the selected actions and observe plant's response.

4. CONCEPTUAL DESIGN

At the highest level, Severa will consist of two parts (Figure 1):

I. *Monitoring*: Observing and assessing the situation "as-is", without any human intervention.

II. *Management*: Facilitating the decision-analysis and decision-support activities of the TSC.

4.1 Monitoring

The objective of the monitoring part is to provide information about the current state of important NPP barriers and possible progressions of events. It consists of three modules: Input Parameters (IP), Diagnostic Module, and Prognostic Module.

4.1.1 Input Parameters

This module provides means to store and manage a time series of physical parameters, which are measured at critical operational points in the NPP:

- CET: Core Exit Thermocouples [°C]
- SGL: Steam Generator Level [m]
- RPVL: Reactor Pressure Vessel Level [%]
- Prcs: Reactor Coolant System Pressure [MPa]
- Pcont: Containment Pressure [MPa]
- Tcont: Containment Temperature [°C]
- H2: Hydrogen concentration [%]

Each parameter is represented in terms of a numerical measurement (e.g., SGL = 8.9 m, H2 = 0.21 %) and color-coded severity level (green, yellow, orange, red). The latter is determined by a discretization of the former. The orange and red levels denote a severe situation and generally require the activation of SAMGs.

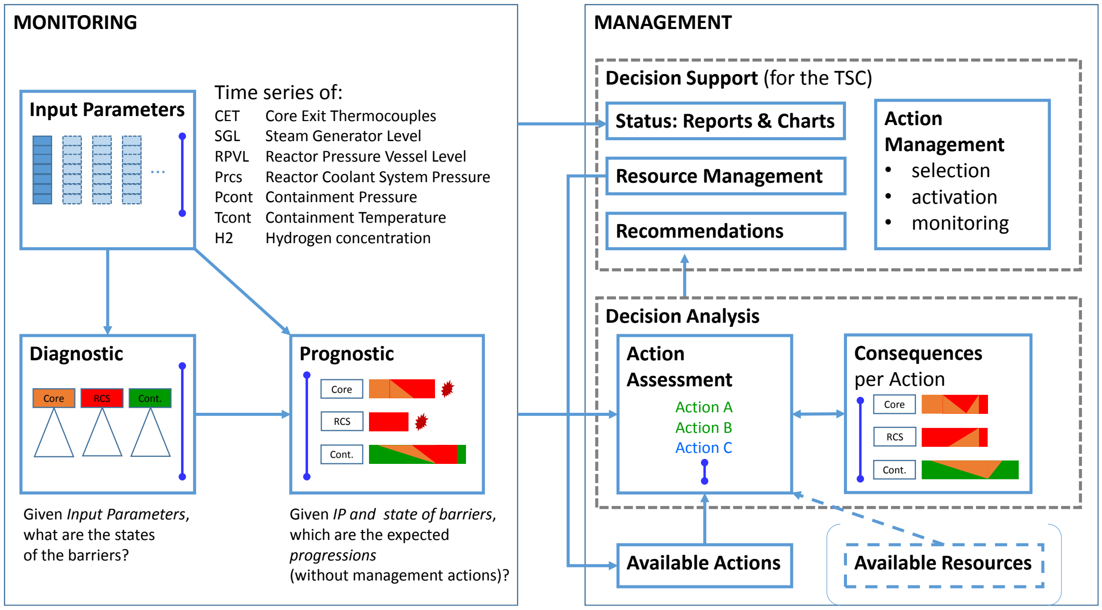

Figure 1: Building blocks of Severa. The symbol indicates the current time.

Even though these parameters can be measured continuously, a typical time granulation is expected to be about 10 to 20 minutes, corresponding to the expected time cycle of using the system.

4.1.2 Diagnostic Module

The purpose of this module is to determine the status of each of the three barriers: Core, RCS (vessel) and Containment. Each barrier has an individual set of possible states. For instance, states of the Core are OX (cladding oxidation), CD (core damage), EX (corium ex-vessel) or OK. For comprehensibility, the states are color-coded, too.

Barrier states are determined from the values of IP. They form a time series, which corresponds to the granularity of the IP, i.e., each set of barrier states corresponds to each IP vector.

Employed methods: Basic information about determining barrier states will be provided in terms of tables and/or decision trees. In Severa, states will be determined using DEX hierarchical models [9]: one model for each barrier. Decision rules in the DEX models will facilitate probabilistic assessment of states [9], for instance in cases of missing or inaccurate IP measurements.

4.1.3 Prognostic Module

Given the IP and outcomes of the Diagnostic Module, the purpose of the prognostic module is to predict the future progression of the barrier states if no management actions are undertaken. The progression information include:

- Identification of the future state(s) for each barrier.
- Estimation of time until the next state change.
- Time series of probabilistic distributions of predicted future states.

Methods: A combination of PSA modelling methods, primarily event trees and probabilistic assessment models [10].

4.2 Management

The management part of Severa will provide decision-analysis and decision-support functionality for the TSC. The main purpose is to inform the TSC about the current state of the NPP and to give advice about possible recovery actions and their consequences.

The management part of the system is particularly concerned with *management actions*. These represent possible decision alternatives, which are at the TSC's disposal at a given situation and time frame. The TSC has to consider the possible actions and assess their feasibility and consequences with respect to the integrity of the barriers. The TSC may select an action (possibly leading to a series of actions), allocate the necessary resources, and monitor the progress while the action is being carried out.

To help performing these activities, Severa will provide databases of available actions and resources, and two modules, called Decision Analysis Module and Decision Support Module.

4.2.1 Database of Available Actions

This database provides a collection of possible recovery actions envisioned in the SAMGs. Only a subset of actions may be feasible in a given situation. Thus, each action has associated a number of properties (or even models), aimed at determining:

- *Applicability* (relevance, entry conditions): Is the action relevant for recovering the current situation?
- *Feasibility*: Is the action feasible given the current IP, barrier states, available resources and available time for recovery?
- Possible *impacts* and *consequences* in terms of probability of barrier (containment) failure in a given time window.

4.2.2 Database of Available Resources

This is a foreseen collection of resources available for carrying out any actions, including material resources (electric energy supply, availability of pumps and generators, etc.) and human resources. The availability of resources primarily influences the feasibility, completion time and expected success of actions. When an action is activated, the corresponding resources are allocated or spent.

Because resources are usually vast and very specific to individual NPPs, this database will not be implemented explicitly in the Severa prototype; the availability of resources will be modelled implicitly through manual input to the decision analysis module.

4.2.3 Decision Analysis Module

Among all the available management actions, only a few of them may actually be relevant in a given situation. The purpose of the Decision Analysis Module is to:

- Identify actions that are applicable and feasible in the current situation.
- Predict possible consequences in terms of probability of barrier failure and assessed time window for failure.
- Assess the quality of actions according to multiple criteria.
- Make a priority ranking of actions to be recommended to the TSC.

In principle, the consequence prediction will be done similarly as in the Prognostic Module, that is, in a reusable way. The difference is that the Prognostic Module assumes no actions and the Decision Analysis Module depends on a specific action. The unification is foreseen by defining a special action *status-quo*, to be used in the diagnostic stage.

Methods: Actions will be described in terms of multiple parameters, whose probabilistic values will be assessed through a series of plant status and phenomenological questions [10]. An APET (Accident Progression Event Tree) [10], implemented as a DEX probabilistic model [9], will be employed to assess the expected probabilities of eventual radioactive emissions.

4.2.4 Decision Support Module

This module directly supports the decision-making process of the TSC, providing the following functionality:

- *Presenting* all the relevant information that comes from the other parts of the system, in a transparent and user-friendly way, mainly using charts and reports. This information includes:
  - *IP values* presented in tables and charts,
  - *diagnostic* and *prognostic* information from the monitoring subsystem,
  - *action recommendations* in terms of action ranking and assessment of consequences.
- *Resource management*: Allows the TSC to provide additional input data about resources that is needed in order to assess the feasibility and expected consequences of actions. For instance, the TSC may indicate that some resources are unavailable and cannot be used in recovery actions. For reasons that cannot be measured or determined by the system, the TSC may also manually enable or disable specific actions.
- *Action Management*: Actual selection, activation and monitoring of actions.

5. CONCLUSION

The immediate goal of the decision support system, whose conceptual design has been presented above, is to demonstrate the feasibility of developing such a tool, using the PSA and decision-modeling methods, for actual NPPs. The approach is novel in attempting to operationalize SAMGs for a specific severe accident situation, focusing on decision-support needs of the TSC.

Ultimately, such tools are expected to substantially contribute to severe accident management in NPPs as tools for the training of TSC members and as decision-support tools in real situations. The main contributions include:

- providing a timely and best available information about the state of NPPs barriers and potential future developments of the event;
- information support to the TSC team in an extremely difficult and stressful decision situation;
- operationalization of SAMGs for a specific situation;
- reducing the risk of overlooking important management actions and, consequently, making wrong decisions.

Further work will be focused on the implementation of the system (to be completed in 2020) and its experimental evaluation using the NARSIS' specification of the "Virtual NPP". The evaluation will address both the aspects of verification (compliance of Severa with the SAMGs) and validation (meeting the needs of the TSC in severe accident management). The latter will be assessed by comparing the performance of the TSC on selected accident scenarios with and without the support of Severa.

6. ACKNOWLEDGMENTS

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Analiza značilk za napovedovanje poslabšanja kroničnega srčnega popuščanja

Feature analysis for detecting different chronic heart failure stages

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POVZETEK

Kronično srčno popuščanje, pri katerem srce ne more črpati dovolj krvi, da bi zadostilo potrebam telesa, spada med kronične bolezni, ki pogosto prizadenejo predvsem starejše od 65 let. Ob poslabšanju stanja je pogosto potrebna hospitalizacija, kar predstavlja breme tako za pacienta kot za zdravstveni sistem. Naš cilj je razviti telemedicinsko metodo, ki na podlagi analize srčnih tonov z metodami strojnega učenja prepozna poslabšanje. Tu predstavimo začetno analizo značilk na podlagi zvoka pri 22 pacientih. Primerjali smo posamezne paciente v dveh fazah – v dekompenzirani in rekompenzirani fazi. Identificirali smo značilke, pri katerih je vrednost v eni od faz skoraj vedno večja od vrednosti v drugi fazi. Ta trend se je pokazal pri 20 od 22 pacientov (91 %). Te značilke nam bodo lahko v bodoče pomagale pri gradnji personaliziranih modelov za zaznavanje različnih faz kroničnega srčnega popuščanja.

Ključne besede

Srčno popuščanje, analiza zvoka, strojno učenje.

ABSTRACT

Chronic heart failure, where the heart cannot pump enough blood to supply the body's needs, is a chronic disease that affects especially people above 65. Worsening of the condition often requires hospital treatment, which is a burden both for the patient and for the health system. Our aim is to develop a telemonitoring method that will use advanced machine-learning methods on sound recordings to detect onset of worsening. Here, we present the initial analysis of sound-based features using recordings of 22 patients. The analysis is performed by comparing individuals in two stages of heart failure – in decompensated and recompensated phase. We identified features for which the value in the decompenastion phase is almost always bigger compared to the value of the same feature in the recompenasted phase. This trend was present for 20 out of 22 pairs patients (91% of the patients). Thus, these features may be useful for building personalized machine learning models for detecting decompensated and recompensated stages in CHF patients.

Keywords

Chronic heart failure, sound analysis, machine learning.

1. UVOD

Kronično srčno popuščanje (SP, angleško Chronic Heart Failure, CHF) je ena od epidemij sodobnega časa. Gre za kronično progresivno bolezen, kjer srce ni sposobno črpati dovolj krvi, da bi zadostilo potrebam telesa, kar se pri pacientih izraža kot izrazitejše poslabšanje telesne zmogljivosti, težje dihanje ter otekanje v okončine in/ali trebuh. Bolezen v razvitem svetu prizadene 1-2 % splošne populacije ter do 10 % populacije, starejše od 65 let. Po ocenah trenutno (podatek iz leta 2015) živi na svetu več kot 23 milijonov bolnikov s SP, od tega več kot 5 milijonov v ZDA. Študije ocenjujejo, da tam strošek za skrb za bolnike znaša 31 milijard dolarjev, kar bo do leta 2030 naraslo na 70 milijard [1][2].

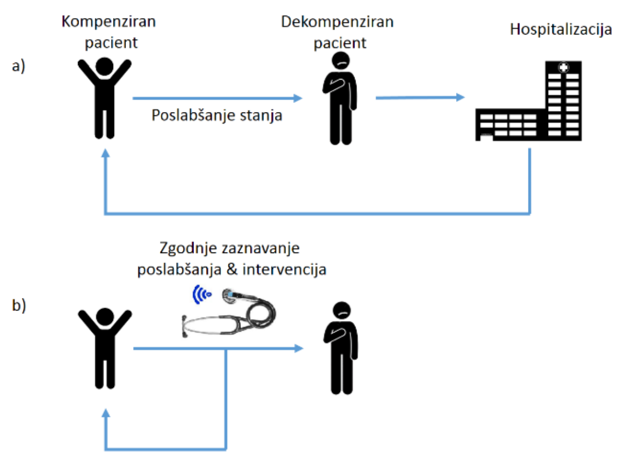
V kliničnem poteku SP se tipično izmenjujejo obdobja dobrega počutja (tj. kompenzirane faze) in obdobja poslabšanja SP (tj. faze dekompenzacije), ko pacient opaža zgoraj opisane simptome. Ob poslabšanju SP je pogosto potrebna hospitalizacija, kjer se bolnikom pomaga z intravenoznimi zdravili. Če se poslabšanje SP zazna dovolj zgodaj, lahko z ustreznimi terapevtskimi ukrepi, kot so omejitev vnosa tekočine in povečanjem odmerka diuretikov, bolniku prihranimo hospitalizacijo.

Izkušen zdravnik lahko poslabšanje SP prepozna ob pregledu bolnika, pogosto se poslabšanje izraža kot sprememba oz. pojavljanje dodatnih srčnih tonov (tipično tretji ton, ki se pojavi 0,1-0,2 s za drugim tonom), kar zdravnik spremlja s stetoskopom (fonokardiografija). Raziskave v zadnjem času kažejo, da se nekateri fiziološki parametri (npr. dodatni srčni toni, porast tlakov v pljučnem krvotoku) pričnejo spreminjati že nekaj tednov preden pride do klinično očitnega poslabšanja SP. Prve analize [3] že kažejo, da zgodnje ugotavljanje spreminjanja teh parametrov lahko pomeni precej učinkovitejšo obravnavo SP, saj je epizod polno razvitega poslabšanja srčnega popuščanja manj, s tem pa tudi manj potrebe po hospitalni obravnavi.

V pričujočem prispevku raziskujemo možnosti zaznavanja poslabšanja SP na podlagi analize srčnih tonov z metodami umetne inteligence. Raziskava je del daljšega projekta, cilj katerega je razviti metodo ali telemedicinsko napravo, s katero bo uporabnik lahko sam spremljal svoje zdravstveno stanje in ob nakazanem poslabšanju SP kontaktiral zdravnika, kar shematsko prikazuje Slika 1.

V preteklih analizah [4][5] smo razvili metodo, s katero uspešno ločujemo med posnetki srčnih tonov zdravih posameznikov ter bolnikov v dekompenzirani fazi SP. Metoda je sestavljena iz filtriranja, segmentacije, izračuna značilk in gradnje klasifikacijskih modelov strojnega učenja. Klasifikatorje smo kombinirali z uporabo pristopa zlaganja (stacking), kjer so osnovni klasifikatorji klasificirali posamezne segmente, meta-klasifikator pa je klasificiral celotne posnetke, saj vemo, da vsi segmenti nekega posnetka pripadajo istemu razredu. Metoda je v primerjavi z večinskim klasifikatorjem dosegla 15 % višjo natančnost.

V pričujočem prispevku se ukvarjamo z vprašanjem personalizacije. Zanima nas, če lahko ločujemo med posnetki pri posameznikih v različnih fazah SP. Na tej stopnji primerjamo posnetke pacientov v dekompenzirani fazi, ob sprejetju v bolnišnico, ter v rekompenzirani fazi, ko je pacient odpuščen iz bolnišnice.



Slika 1: Shematski prikaz razvoja poslabšanja srčnega popuščanja. V zgornjem primeru mora pacient zaradi poslabšanja SP v bolnišnico (hospitalizacija), v spodnjem primeru poslabšanje zaznamo dovolj zgodaj, da lahko z ustrezno intervencijo preprečimo poslabšanje in se hospitalizaciji izognemo.

2. MATERIALI IN METODE

2.1 Baza podatkov

V študiji smo obravnavali posnetke 22 bolnikov s kroničnim srčnim popuščanjem, ki so bili hospitalizirani zaradi poslabšanja zdravstvenega stanja. Prvi posnetek je nastal v dekompenzirani fazi (ob hospitalizaciji), drugi pa v rekompenzirani fazi, ob odpustu iz bolnišnice.

Za snemanje smo uporabili profesionalni medicinski digitalni stetoskop 3M Littmann Electronic Stethoscope Model 3200. Posnetek, fonokardiogram, je bil vedno sneman na Erbovi točki, nad tretjim medrebrnim prostorom levo od grodnice. Posamezen posnetek je dolg do 30 s, kar je omejitev stetoskopa.

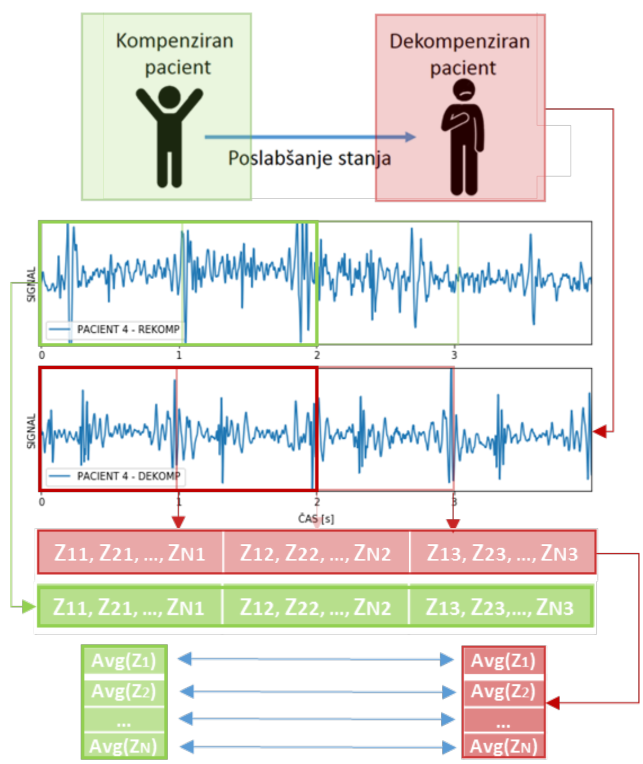
Pred začetkom študije smo pridobili pozitivno mnenje Komisije za medicinsko etiko.

2.2 Metoda

Za analizo smo uporabili orodje za klasifikacijo zvokov [6], ki smo ga razvili na platformi za delo s podatki Orange. Orodje za ekstrakcijo značilk uporablja programsko opremo OpenSMILE [7], ki je bila prvotno razvita leta 2009 za prepoznavanje čustev na podlagi zvoka, vendar se je kasneje začela uporabljati tudi v bolj splošne namene, kot je pridobivanje informacij iz glasbenih posnetkov.

Shema metode je predstavljena na Sliki 2. Za vsakega pacienta smo imeli 2 posnetka, enega v rekompenzirani fazi (zelena) in drugega v dekompenzirani fazi (rdeča). Najprej smo vse posnetke segmentirali z uporabo tehnike drsečega okna. Na Sliki 2 imamo posnetek dolžine dveh sekund. Za velikost drsečega okna dve sekundi in 50 % prekrivanja (dve sekundi) smo dobili za vsak posnetek tri segmente. Iz vsakega segmenta smo izračunali 1941 zvočnih značilk, med njimi statistične značilke (npr. varianco, koeficient simetrije, sploščenost), energijske značilke (npr. energije v intervalu med 250 Hz in 1 kHz), frekvenčne značilke (spektralna odstopna mesta pri 25 %, 50 %, 75 % in 90 %) in glasovne značilke (npr. tresenje, barva…, razmerje signal/šum). Celoten seznam značilk je opisan v članku Schuller in ostali [8]. Na Sliki 2 so značilke označene kot: Z_{11}, Z_{21}, ..., Z_{N1}, kjer prvi indeks označuje značilko (N značilk), drugi pa segment, na katerem je bila specifična značilka izračunana. V nadaljevanju se izračuna povprečne vrednosti značilk čez vse segmente (na Sliki 2 imamo povprečje treh segmentov). Tako dobimo za vsak posnetek vektor značilk: Avg(Z_1), Avg(Z_2), …, Avg(Z_N).

Za izbiro značilk, ki so najbolj primerne za ločevanje med obema fazama SP, smo uporabili Wilcoxonov statistični test [9], ki spada med neparametrične teste in testira, kdaj dva povezana vzorca izvirata iz iste distribucije. Statistične teste smo izvedli za okna velikosti: 10, 8, 6, 4, 2 in 1 sekunde s 50 % prekrivanjem. V Tabeli 1 je predstavljeno število značilk, za katere je bila vrednost p manjša kot 0.001. Iz rezultatov lahko razberemo, da imamo za vsako velikost okna najmanj sedem informativnih značilk. Poleg tega vidimo, da število informativnih značilk narašča ob krajšanju dolžine okna. Poskusi kažejo, da je optimalna velikost okna za našo podatkovno zbirko dve sekundi s 50 % prekrivanjem.



Slika 2: Shema metode.

Tabela 1: Število informativnih značilk, ki ločijo med rekompenzirano in dekompenzirano fazo, v odvisnosti od dolžine okna.

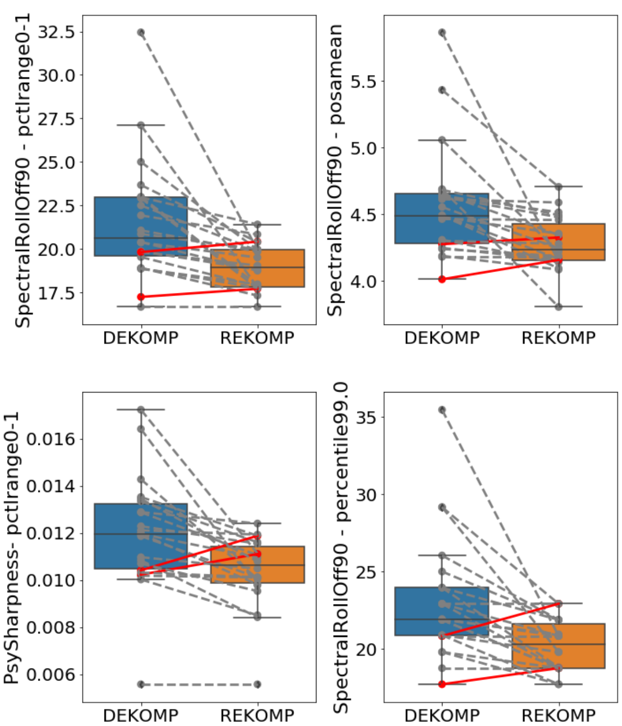
Velikost okna (v sekundah)	10	8	6	4	2	1
# informativnih značilk	7	11	14	14	16	14

Slika 3 predstavlja škatlaste diagrame za štiri naključno izbrane značilke izmed 16, ki smo jih dobili z uporabo okna dolžine 2 s.

Štiri značilke, ki jih prikažemo v tem primeru, so sledeče:

- fftMag_spectralRollOff90.0_sma_de_percentile1.0
- fftMag_spectralRollOff90.0_sma_de_percentile99.0
- fftMag_spectralRollOff90.0_sma_de_posamean
- fftMag_psySharpness_sma_de_pctlrange0-1

Vse značilke so povezane s spektralnimi lastnostmi segmenta. Prve tri značilke izračunajo Fourierovo transformacijo na kratkih oknih, izvedejo glajenje z drsečim oknom, izračunajo prvi odvod signala po času in določijo statistične označevalce, *posamean* pa predstavlja pozitivno aritmetično sredino. Značilka psySharpness se nanaša na spektralno strukturo signala, pri signalih, ki vsebujejo visoke frekvence, je vrednost te značilke višja. Podrobneje so te značilke opisane v [8].



Slika 3: Škatlasti diagrami za štiri značilke, ki jih statistični testi izberejo kot najbolj pomembne. Modra škatla predstavlja dekompenzirano fazo, oranžna rekompenzirano. Sive črte povezujejo vrednosti značilk za posamezne paciente, kjer je vrednost v dekompenzirani fazi večja od tiste v rekompenzirani, rdeče pa tiste, pri katerih velja obratno.

Modra škatla na Sliki 3 prikazuje vrednosti značilk izračunanih iz dekompenziranih posnetkov, oranžna pa vrednosti značilk iz rekompenziranih. Siva črta ponazarja mejo, kjer je vrednost rekompenzirane značilke manjša kot pripadajoča vrednost dekompenzirane značilke, rdeča črta pa ravno obratno. Iz slike je razvidno, da imamo za posamezno značilko zgolj dve rdeči črti. Če torej izvedemo binarno klasifikacijo na podlagi samo ene poljubne značilke izmed teh štirih, bomo napačno razvrstili dva izmed 22 parov posnetkov.

Prostora za izboljšave je sicer še veliko. Načeloma bi za klasifikacijo lahko kombinirali več značilk, vendar se izkaže, da gre pri rdečih črtah večinoma za iste posameznike – to je posledica dejstva, da so značilke korelirane med sabo. Poleg tega delamo z relativno majhnim vzorcem – na 22 posameznikih, kar bi lahko pripeljalo do tega, da bi zgradili model, ki bi bil preveč prilagojen danim podatkom.

3. ZAKLJUČEK

V prispevku prikažemo prve korake h gradnji personaliziranega modela, ki bo bolnikom omogočal spremljanje poslabšanja srčnega popuščanja. Identificirali smo vrsto značilk, ki nam lahko pomagajo pri gradnji personaliziranih modelov. Personalizacija je lahko nenadzorovana, od vsake značilke enostavno odštejemo povprečje te značilke za posamezno osebo. Začetna analiza kaže, da imamo vsaj štiri značilke, za katere je vrednost v dekompenzirani fazi skoraj vedno večja od tiste v rekompenzirani (pri 20 od 22 pacientov, torej v 91 % primerov). Rezultati so obetavni in nam bodo služili pri razvoju personaliziranih modelov za zaznavanje različnih faz kroničnega srčnega popuščanja.

Čeprav se zavedamo možnosti, da je analiza preveč dobro prilagojena podatkom zaradi majhnega števila pacientov, verjamemo, da so rezultati obetavni in uporabni v prihodnje. V prihodnje nameravamo izvesti analizo na posnetkih več posameznikov, poleg tega pa bomo vključili tudi posnetke v različnih fazah, ne le v skrajnih primerih, kot v predstavljeni študiji. Če spremljamo posameznika, lahko uporabimo personaliziran model – če v določeni točki posamezne značilke, ki jih izračunamo iz zvočnih posnetkov, začnejo odstopati od pričakovanih vrednosti za rekompenzirano fazo, lahko posumimo na možnost poslabšanja.

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Object Detection Overview

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ABSTRACT

In this paper, we present a brief review of some of the main algorithms adopted in the field of computer vision for the aim of object detection. We highlight the working principles of two main families of models, Region-based Convolutional Neural Network detectors ("R-CNN") and Single-Shot object detectors (SSD, YOLO), and present a comparison between them, with a focus on the trade-off between speed and accuracy and its dependence on various models parameters.

Keywords

computer vision, object detection, CNNs

1. INTRODUCTION

Most computer vision tasks can be roughly divided into three main categories [10]:

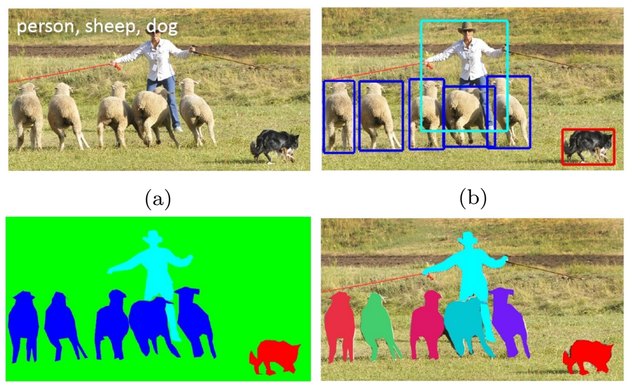
- **image classification**: determining whether a certain class of objects is present in the image or not (Fig. 1a);
- **object detection:** determining that an object belonging to a certain class is present, and localizing it within the image (Fig. 1b);
- **semantic scene labeling**: classification of each pixel of the image as belonging to a certain class. Individual instances of the same object are usually not segmented (Fig. 1c), but modern datasets [10, 9] provide labels to distinguish between them (Fig. 1d).

In less than a decade, techniques to solve these tasks have undergone a period of extremely rapid development, most notably fueled by the successful employment of Convolutional Neural Networks (CNN) in the field.

The adoption of CNN-based algorithms was kick-started by the paper by Alex Krizhevsky, Ilya Sutskever and Geoffrey Hinton [8]. This paper showed the effectiveness of CNNs in computer vision problems, and introduced a number of techniques that are still used today, such as the adoption of ReLU as activation functions and the use of data augmentation techniques. The standard structure of CNN-based models, basically consisting of simple stacking of convolutional and pooling layers followed by one or more fully-connected layers, has been successfully used for some time in order to solve localization, object detection and human pose estimation problems [17, 20, 1, 4, 21, 19]. Improvements were generally achieved by increasing the depth and width of the models, and by using larger amount of training data, at the cost of increasing the needed computational power and the risk of over-fitting [19]. This basic paradigm has been challenged by Google with the introduction of the "Inception" architecture [19], where parts of the network are not located sequentially, so that different operations such as pooling or convolution can be performed in parallel.

Among the many proposed architectures (see also [5, 24]), arguably one of the most impactful contributions to object detection has been given by the introduction of the Region-based Convolutional Neural Network detectors ("R-CNN") [4] and its modification (Fast R-CNN and Faster R-CNN [3, 15]). The accuracy of these detectors, however, comes at a computational cost, which can be reduced by the adoption of the so-called Single Shot detectors.

In this paper, we present an overview of the region-based and single-shot families of models. In Section 2, we describe a few methods to identify Regions of Interest (RoIs), i.e. areas of the picture where objects are located, which is a fundamental ingredient for region-based detection algorithms. Sections 3 and 4 are dedicated to region-based and single-shot detectors, respectively. In section 5, we summarize a comparison of the performances of these algorithms, and how their trade-off between speed and accuracy is influenced by different factors.



(a) (b)

(c) (d)

Figure 1: From [10], different types of computer vision tasks. Image classification (a), object detection (b), and semantic scene labeling (c,d).

2. REGIONS OF INTEREST (ROI) SELECTION ALGORITHMS

Region-based methods generally tackle object detection tasks by dividing it into two steps. First, it is necessary to locate the so-called Regions of Interest (RoI), i.e. areas of the image where possible objects are located. After this, the classification step takes place, where the previously located areas are classified. RoIs whose content is classified as belonging to one of the considered classes within a certain confidence are detected.

In the following, we make a short description of two of the main methods adopted to identify RoIs.

2.1 Selective search

Region proposal algorithms identify RoIs by adopting image segmentation techniques, which consist of grouping pixels based on their similarity according to some criteria. A commonly adopted method is Selective Search (SS); as shown in Fig. 2, groups of similar regions are created hierarchically, starting from single pixels, based on color, texture, size and shape compatibility [22]. A general important requirement for region proposal methods is that they should have a very high recall; false positives can then be rejected in the following classification phase.

Figure 2: From [22]. All possible ROIs during the merging.

2.2 Region Proposal Network (RPN)

Region proposal networks (RPN) are the distinctive feature of Faster R-CNNs detectors (see Section 3), and they eliminate the need to use an external algorithm for selecting RoIs. In this method, the feature map produced by the first convolutional layer of the detector is passed to a CNN that produces region proposals by predicting their bounding boxes and "objectness" scores, measuring whether each box contains an object or not [15].

3. REGION-BASED OBJECT DETECTORS (R-CNN, FAST R-CNN, FASTER R-CNN)

As mentioned earlier, region-based object detectors work in two steps, consisting of the determination of RoIs and their following classification.

The first suggested implementation of this algorithm, **R-CNN** [4], employs a region proposal method to create $\approx$ 2000 ROIs. As shown in Fig. 3 (top left panel), each of the identified RoIs is then resized and fed as input to a CNN, followed by fully connected layers to classify the object and refine the boundary box.

Even though the R-CNN algorithm is very accurate, it has also the downside of being quite slow. The high number of proposals makes the algorithm slow, since each RoI is processed by the CNN separately, which means that the whole feature extraction process is repeated 2000 times.

This limitation has been overcome in **Fast R-CNNs** [3], as depicted in Fig 3 (bottom left panel). In this architecture, features are extracted only once for the whole image by using a CNN, while an external region proposal method (such as selective search) is used to create RoIs. After this step, the feature map and the RoIs are combined, producing patches that, as in the previous case, are resized (RoI pooling layer) and passed as input to a fully connected layer for the object detection.

In the case of Fast R-CNNs, the main bottleneck is caused by the use of the external region proposal method, which usually runs on a CPU and is slower than the rest of the process; out of the 2.3 seconds needed by Fast R-CNN to make a prediction in testing, $\approx$2 seconds are used for generating the 2000 ROIs [3]. So, a further improvement in the algorithm speed has been provided with the introduction of **Faster R-CNN** [15], by substituting the external region proposal method with the convolutional Region Proposal Network (RPN) we presented in Sec. 2.2 (see Fig. 3, right panel).

4. SINGLE-SHOT OBJECT DETECTORS

Differently from region proposal detectors, which perform region proposals and region classifications in two steps, single-shot detectors simultaneously predict bounding boxes and the class as they processes the image in one shot.

4.1 SSD

SSD [11] is one of the fastest object detectors available. Its working principles can be summarized as follows:

- the image is passed through a series of convolutional layers, thus producing several sets of feature maps at different scales (4x4, 8x8, etc.);
- a pre-defined, default set of bounding boxes (similar to the "anchors" in RPN [15]) of different aspect ratios is provided for each location in all the produced feature maps;
- for each of these default boxes, both the offsets to the ground truth boxes and the confidence for all classes are predicted;
- default boxes are matched to ground truth boxes based on IoU (Intersection Over Union, [23]). The best predicted box is labeled a positive, along with all other boxes that have an IoU with the truth > 0.5 (see Fig. 4).

The downside of skipping region proposal is that SSD draws and classifies bounding boxes of many shapes and scales in every single position in the image, so that most of them are negative examples. For this reason, highly-overlapping

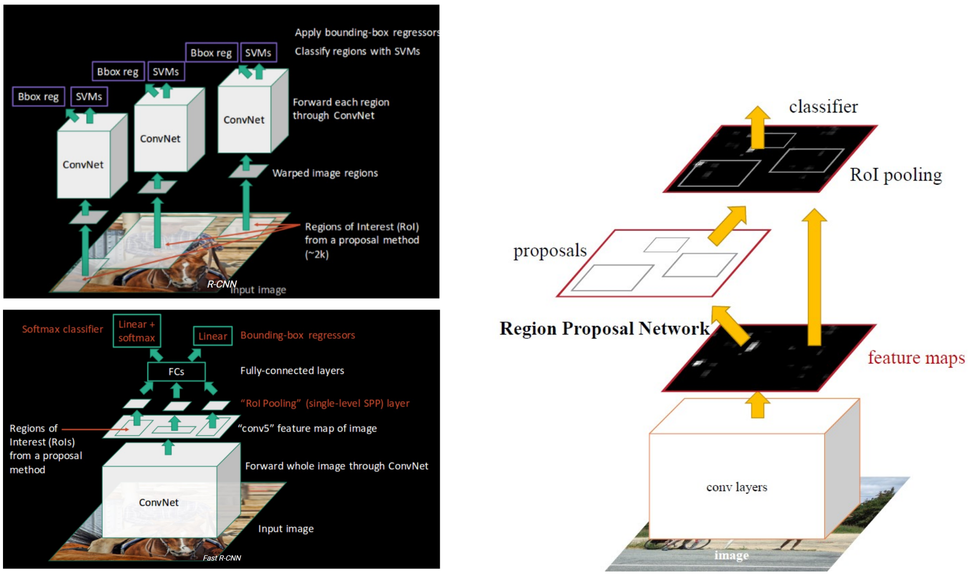
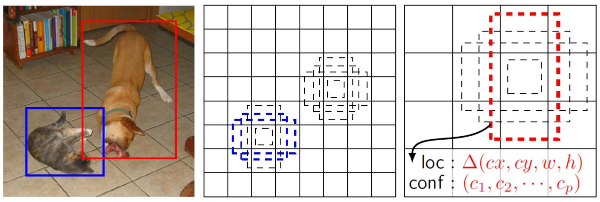


Figure 3: From `http://www.robots.ox.ac.uk/~tvg/publications/talks/fast-rcnn-slides.pdf`: model scheme for R-CNN (top left), Fast R-CNN (bottom left), Faster R-CNN (right).



(a) Image with GT boxes (b) 8×8 feature map (c) 4×4 feature map

Figure 4: From [11], SSD framework. Out of the many default boxes, two are matched with the cat and one with the dog, which are treated as positives and the rest as negatives

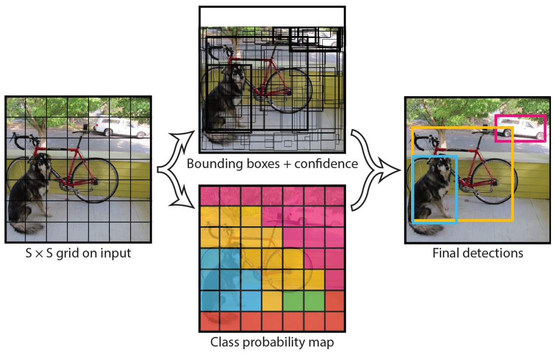


Figure 5: From [11], SSD framework. Out of the many default boxes, two are matched with the cat and one with the dog, which are treated as positives and the rest as negatives

boxes are grouped into a single one ("non-maximum suppression", [16]). Moreover, the high number of negatives leads to a significant imbalance between negative and positive samples for training, which is overcome by only using the ones with highest confidence loss (a part of the overall loss function, measuring how confident the network is of the "objectness" of the box), so that the ratio between the negatives and positives is at most 3:1 ("hard negative mining").

4.2 YOLO (You Only Look Once)

As in SSD, YOLO [12, 13, 14] uses a single neural network for detection (Fig. 5).

The input image is divided into a grid of SxS cells, and B bounding boxes are produced for each cell. For each box, a score is calculated, indicating the confidence for that box to contain an object (of any class) and the accuracy of the box in terms of its IoU with the ground truth ($Pr(Object) \times IOU^{truth}_{pred}$). For each cell, C (C = number of possible classes) probabilities calculated, conditioned on the grid cell itself containing an object. At test time, these conditional class probabilities and individual box confidence predictions are multiplied, in order to obtain class-specific confidence scores for each box.

5. COMPARISON

A performance comparison between the various presented algorithms, although being of great interest, can be tricky. Standard metrics like mAP [2] do not take into account factors like time and memory usage [7], which are of vital importance when real-time performance is required. On the other hand, greater speeds are obtained by sacrificing some accuracy, and it is important to be aware of the mechanisms influencing this trade-off. Finally, results reported by the various papers are generally obtained by using different settings, which makes their comparison less (if at all) significant. A work by Google research [7] offers a survey to study the trade-off between speed and accuracy for a series of models, including Faster R-CNN and SSD. The various presented models have been re-implemented in TensorFlow and trained on the MS COCO dataset. The effect of adopting different feature extraction architectures (MobileNet [6], VGG-16 [18], Inception, etc.) for each of the models has also been tested. In the following, we briefly summarize their main results.

- SSD models are faster on average, but cannot beat the Faster R-CNN in accuracy. Faster R-CNN requires at least 100 ms per image (Fig. 6), while SSD with MobileNet as feature extractor provides the best accuracy tradeoff within the fastest detectors. The highest accuracy is achieved by Faster R-CNN using Inception ResNet as feature extractor with 300 proposals, running at 1 second per image;
- Choice of feature extractors impacts detection accuracy for Faster R-CNN, but it is less important for SSD;
- For large objects, SSD can outperform Faster R-CNN in accuracy with faster extractors, but its accuracy drops significantly for smaller objects;
- Input image resolution strongly impacts performance: on average, reducing image size by half lowers accuracy by 15.88% and inference time by 27.4%;

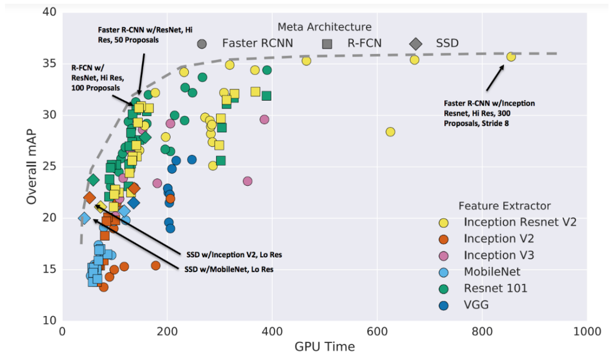


Figure 6: From [7], accuracy vs time. Different marker shapes indicate meta-architecture, while colors indicate feature extractor.

6. CONCLUSIONS

In this paper, we presented an overview of the region-based (R-CNN, Fast and Faster R-CNN) and of the single shot (SSD, YOLO) families of algorithms for object detection. An analysis of the speed and accuracy of the model parameters, and of how they are influenced by the choice of the models parameters, is briefly summarized.

7. ACKNOWLEDGMENTS

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EkoSmart asistent za iskanje po integracijski platformi

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Povzetek
V tem prispevku opišemo delovanje asistenta za iskanje po EkoSmart integracijski platformi. Namen asistenta je, da omogoči lažje in hitrejše iskanje informacij po integracijski platformi. Asistent je še posebej priročen za starejše in manj vešče uporabnike internetnih tehnologij. Asistent uporabi lematizator za določitev samostalnikov v uporabnikovem vprašanju. Asistent nato uporabi dobljene samostalnike za iskanje po integracijski platformi. Če asistent ne pridobi nobenih zadetkov za statistične podatke ali API-je, se obrne na starega EkoSmart asistenta za odgovor.

Ključne besede
Asistent, EkoSmart, integracijska platforma.

1. Uvod
Namen asistenta za iskanje po EkoSmart integracijski platformi, je da omogoči poenostavljeno iskanje po EkoSmart integracijski platformi, kjer so na voljo različni statistični podatki ter API-ji (npr. API za občinskega asistenta ter API za zdravstvene čakalne vrste).

Namen projekta EkoSmart je razviti ekosistem pametnega mesta z vsemi podpornimi mehanizmi, ki so potrebni za učinkovito, optimizirano in postopno integracijo posameznih področij v enovit in povezan sistem vrednostnih verig. Projekt se je začel 1. Avgusta 2016 ter končal 31. Julija 2019. Vrednost projekta ja 8,66 mio EUR. V projektu je sodelovalo 25 partnerjev.

Integracijska platforma je sestavljena iz treh delov: podatkov, produktov ter storitev. Kot rečeno, se z našim asistentom osredotočimo na iskanje po podatkih ter storitvah (API-jih). V času pisanja, so bili na integracijski platformi dostopni 4 nabori podatkov (z imeni »Transport«, »Slovenski kraji«, »Zdravje« in »Okolje«) ter 13 storitev (API-jev). Kot platforma za dostop do API-kev se uporablja odprto-kodna platforma **wso2** [1]. Le ta platforma omogoča objavljanje ter prenos API-jev. Prav tako platforma omogoča upravljanje z objavljenimi API-ji v smislu monetizacije API-jev (i.e. koliko API-jev za koliko denarja). Za podatke se uporablja odprto-kodna **ckan** [2] platforma, ki omogoča objavi ter prenos podatkov.

Uporabnik se pogovarja z asistentom preko uporabniškega vmesnika, ki je dostopen na [3]. Uporabnik v uporabniški vmesnik vnese stavek/vprašanja o stvari, ki ga zanima (npr. »zanima me slovenija«) nato asistenta s pomočjo razumevanja naravnega jezika obdela uporabnikov stavek/vprašanje, pridobi stvar zanimanja ter izvede iskanje po naboru podatkov ter API-jev ter vrne primerne zadetke. Asistent, deluje tako, da iz uporabnikovega stavka, s pomočjo lematizatorja, izlušči samostalnike ter jih pretvori v osnovno obliko. Tako dobljene lematizirane samostalnike nato uporabimo za iskanje po bazi podatkov ter API-jev. Za iskanje po bazi podatkov že imamo na voljo storitev, ki nam sama vrne ustrezne zadetke. Za uporabo te storitve moramo samo priskrbeti iskane besede, za le te uporabimo lematizirane samostalnike. Za iskanje po bazi API-jev nimamo na voljo iskalne storitve, zato moramo iskanje implementirati sami. Vsak API ima svoje oznake (angl. tags), ki služijo kot ključne besede. Princip iskanja po bazi API-jev je ta, da za API lematiziramo samostalnike v oznakah (kot to naredimo za uporabnikov stavek/vprašanje) ter nato primerjamo lematizirane samostalnike v oznakah z lematiziranimi samostalniki v uporabnikovem vprašanju ter si zabeležimo API kot zadetek v primeru ujemanja.

Uporaba asistentov/chatbotov-ov se je v zadnjem času z napredkom procesiranja naravnega jezika zelo povečala. Primer uporabe asistenta za avtomatsko sklicevanje sestankov je opisan v [4]. V tem članku je opisan asistent za sklicevanje sestankov preko elektronske pošte. Asistent iz naslova ter vsebine elektronske pošte, s pomočjo ključnih besed, identificira namen elektronske pošte. Če je namen sklic sestanka, asistent prebere celotno vsebino pošte ter s pomočjo tehnologije iskanja vzorcev izlušči ure ter kraj sestanka. Nato asistent preveri v koledarju če je sestanek mogoč, glede na to pošlje odgovor s podatki o možnosti sestanka. Z nekaj izmenjavami elektronske pošte, je asistent možen potrditi sestanek.

Podoben asistent za klepet, je opisan v [5]. Ta asistent je namenjen za namen servisiranja strank. In sicer, asistent dobi vprašanje/zahtevo od stranke, z uporabo procesiranja naravnega jezika je sposoben izluščiti namen in ključne besede povezane z namenom, s katerimi nato naredi iskanje po bazi znanja ter nato vrne odgovor stranki.

Prav tako je v [6] opisan sistem za tvorjenje asistenta za interakcijo s spletno stranjo. Asistenta uporabnik vodi/sprašuje z uporabo kazalca (na zaslonu) ter z govorom. Sistem je sposoben pretvoriti govor v tekst, ki ga nato pošlje asistentu. Sistem pregleda spletno stran, ko se le ta naloži, ter vstavi bazo znanja iz smiselnih semantičnih struktur (e.g. tabel, grafov, slik). Ko asistent sprejme tekstovni ukaz, pridobi namen ter entitete z uporabo agenta Watson. Z namenom ter entitetami nato pregleda bazo znanja ter ponudi odgovor. V primeru, da v bazi znanja ne odkrije želenih podatkov, asistent prosi uporabnika za bolj podrobne napotke (npr. lahko ga prosi, da z kazalnikom pokaže na stvar zanimanja e.g. stolpec v tabeli).

2. Mehanizem delovanja asistenta
Lematizator, uporabljen v asistentu, je narejen posebej za Slovenski ter Srbo-Hrvaški jezik in je prosto dostopen na [7].

2.1 Iskanje po bazi podatkov
Za iskanje po bazi podatkov (od integracijske platforme) se uporabi platformo, ki je dostopna na naslovu http://wso2.lavbic.net:5000/sl/. Preko te platforme nato iščemo zadetke za lematizirane samostalnike, npr. če želimo rezultate za samostalnik "Slovenija", uporabimo zahtevo http://wso2.lavbic.net:5000/api/3/action/package_search?q=slovenija, ki nam vrne odgovor v JSON formatu, ki vsebuje podatke o zadetkih iskanja. Za vsak zadetek iskanja (o podatkih), si nato shranimo

- Url naslov, kjer so podatki dostopni.
- Naslov podatkov.

- Opis podatkov.

API za iskanje po bazi podatkov http://wso2.lavbic.net:5000/api/3/action/package_search?q=, išče po oznakah podatkov ter po opisu podatkov, tako vrne vse zadetke, ki ustrezajo posredovanemu konceptu/besedi. Npr. če nas zanima ozračje lahko pošljemo zahtevek http://wso2.lavbic.net:5000/api/3/action/package_search?q=ozra%C4%8Dje ter dobimo JSON odgovor, del le tega je predstavljen v Slika 1. Najbolj pomemben del JSON odgovora je »resources« (slo. viri), ki je v delu »results« (slo. rezultati). Pod viri imamo ime podatkov (»name«), opis podatkov (»description«) ter spletni naslov podatkov (»url«).


```
"help": "http://wso2.lavbic.net:5000/api/3/action/help_show?name=package_s
"success": true,
"result": {
  "count": 1,
  "sort": "score desc, metadata_modified desc",
  "facets": {},
  "results": [{
    "license_title": "Drugo (javna domena)",
    "maintainer": "Statisti\u010dni urad RS",
    "relationships_as_object": [],
    "private": false,
    "maintainer_email": "",
    "num_tags": 2,
    "id": "e2cfec8f-0c32-44e4-9abb-01c23ed57e17",
    "metadata_created": "2018-09-10T09:14:45.014710",
    "metadata_modified": "2018-09-10T09:19:28.235189",
    "author": "",
    "author_email": "",
    "state": "active",
    "version": "",
    "creator_user_id": "1afa4ee7-387d-454b-8d1c-dc2ce1b95dce",
    "type": "dataset",
    "resources": [{
      "mimetype": null,
      "cache_url": null,
      "hash": "",
      "description": "NAMEA emisije v zrak (SKD 2008) , Slovenija, letno",
      "name": "Koli\u010dina izpustov v ozra\u010dje",
      "format": "CSV",
      "url": "https://cloud.lavbic.net/s/bKO6FywmRwMHQa7/download",
      "cache_last_updated": null,
      "package_id": "e2cfec8f-0c32-44e4-9abb-01c23ed57e17",
      "created": "2018-09-10T09:19:28.085789",
      "state": "active",
      "mimetype_inner": null
```


Slika 1:Primer dela API odgovora za iskanje po podatkih

2.2 Iskanje po bazi API-jev

Za iskanje po bazi podatkov o API-jih nimamo vgrajenega iskalnika v iskalni platformi (http://wso2.lavbic.net:5000/sl/). Zato pridobimo nabor API-jev z zahtevo https://wso2.lavbic.net:9443/api/am/store/v0.11/apis, ki nam vrne odgovor v JSON obliki (poglej sliko Slika 3 za primer odgovora). Ta odgovor vsebuje identifikacijski podatek (ID) za vsak API, z le tem podatkom pridobimo celotne podatke o določenim API-jem; npr. če želimo pridobiti celotne podatke o API-ju z ID-jem **218466a1-ac3b-464d-ba21-f2605f8391e8**, pošljemo sledečo zahtevo https://wso2.lavbic.net:9443/api/am/store/v0.11/apis/218466a1-ac3b-464d-ba21-f2605f8391e8. Ta zahteva nam vrne odgovor v JSON format, v katerem so vsi podatki o izbranem API-ju. Za potrebe našega asistenta, si shranimo sledeče podatke:

- Ime API-ja.
- Opis API-ja.
- Oznake API-ja.
- Lematizirane oznake API-ja.
- Url naslov, kjer izbran API na voljo.

Za lematizacjio API oznak uporabimo isti lematizator, kot za lematizacijo uporabnikovega vprašanja/stavka. Prav tako iz vsake oznake (za izbran API), z lematizatorjem, izluščimo samostalnike ter jih pretvorimo v korensko/osnovno obliko. Tako obdelane oznake imenujemo lematizirane oznaka (kot v zgornjem seznamu).

Za primer API oznak izberemo API z ID-jem **0815aeb4-b191-48ca-aad5-244f12be701c** in imenom **24alife**.

Primer JSON odgovora za ta API je na sliki Slika 2. Pomembni deli JSON odgovora so: ime (»name«), opis (»description«), oznake (»tags«) ter spletni naslovi (»https« in »http«).


```
id: "0815aeb4-b191-48ca-aad5-244f12be701c",
name: "24alife",
description: "Storitev za pridobitev: najbolj pogostih aktivnosti z
context: "/AlifePortal-Api/api/public/v1",
version: "v1",
provider: "ekosmart-ponudnik",
apiDefinition: "{"swagger":"2.0","paths":{"/top10Activities/{days}'
aktivnosti za posamezno obdobbje (danes - število dni)","x-auth-typ
[{"name":"activityCode","in":"path","allowMultiple":false,"requirec
aktivnost (koda aktivnosti, danes- število dni)","x-auth-type":"App
[{"name":"days","in":"path","allowMultiple":false,"required":true,'
pridobitev: najbolj pogostih aktivnosti za posamezno obdobje, najbc
wsdlUri: null,
status: "PUBLISHED",
isDefaultVersion: true,
transport: [
    "http",
    "https"
],
tags: [
    "eZdravje",
    "24alife",
    "aktivnost"
],
tiers: [
    "Bronze"
],
thumbnailUrl: "/registry/resource/_system/governance/apimgt/applica
endpointURLs: [
  - {
      - environmentURLs: {
            https: "https://wso2.lavbic.net:8243//AlifePortal-Api/a
            http: "http://wso2.lavbic.net:8280//AlifePortal-Api/api
        },
        environmentName: "Production and Sandbox",
        environmentType: "hybrid"
    }
],
businessInformation: {
    businessOwnerEmail: null,
    technicalOwnerEmail: "borut.radi@rc-ikts.si",
    technicalOwner: "RC IKTS Žalec d.o.o",
    businessOwner: "RC IKTS Žalec d.o.o"
}
```


Slika 2:Primer zahtevka za podatke o določenem API-ju

```
count: 11,
next: "",
previous: "",
list: [
  - {
        id: "0815aeb4-b191-48ca-aad5-244f12be701c",
        name: "24alife",
        description: "Storitev za pridobitev: najbolj pogostih aktivnosti za pos
        context: "/AlifePortal-Api/api/public/v1",
        version: "v1",
        provider: "ekosmart-ponudnik",
        status: "PUBLISHED"
    },
  - {
        id: "5892db13-f93e-4ff6-a812-0da0a941e7a6",
        name: "CakalneVrste",
        description: "Storitev, ki omogoča posredovanje informacij o čakalnih do
        context: "/cakalneVrste/v1.0.0",
        version: "v1.0.0",
        provider: "ekosmart-ponudnik",
        status: "PUBLISHED"
    },
  - {
        id: "6f13ab1c-e386-49f4-a8db-d1da07f91ea1",
        name: "cos_test-zgtva",
```


Slika 3: Primer odgovora na zahtevek za podatke o vseh API-jih

Ta API ima oznake (angl. tags) »**eZdravje**«, »**24alife**« in »**aktivnost**«. Te oznake služijo kot ključne besede, ki opišejo API. Kot rečeno, se oznake s pomočjo lematizatorja pretvorijo v osnovno obliko. V tem primeru so vse oznake že v osnovni obliki, tako da so lematizirane oznake »**eZdravje**«, »**24alife**« in »**aktivnost**«. V drugem primeru si ogledamo API z ID-jem **5892db13-f93e-4ff6-a812-0da0a941e7a6,** imenom »**CakalneVrste**« ter oznakami »**posegi**«, »**ezdravje**«, »**zdravnik**«, »**čakalne**«, »**zdravstvene ustanove**«. V oznakah obdržimo le samostalnike v osnovni obliki. V našem primeru je oznaka »**čakalne**« pridevnik, zato se te oznake ne upošteva. Prav tako se oznaka »**zdravstvene ustanove**« (v tej oznaki je samostalnik samo »ustanove«) s pomočjo lematizatorja pretvori v »**ustanova**«. Tako nam lematizator za ta primer vrne sledeče lematizirane oznake: »**poseg**«, »**ezdravje**«, »**zdravnik**«, »**ustanova**«.

Podatke o API-jih zaradi časovne zahtevnosti ni smiselno shranjevati vsakič, ko uporabnik vnese vprašanje/stavek, v ta namen uporabimo "caching", kar pomeni, da si vsakič, ko je spletna stran z uporabniškim vmesnikom ([3]) naložena, shranimo podatke o API-jih v podatkovno bazo, iz katere nato beremo API podatke.

Iskanje po API podatkih (ki jih shranimo ob naložitvi uporabniškega vmesnika) poteka po sledečem postopku. Vsak lematiziran samostalnik (iz uporabnikovega vprašanja/stavka) primerjamo z lematiziranimi API oznakami (za vsak shranjen API), primerjava je narejena eksaktno (obe besedi se morata ujemati), za vsako ujemanje si shranimo ujemajoč API. Na tak način naredimo iskanje po API podatkih.

Z postopkoma za iskanje po statističnih podatkih ter API-jih pridobimo podatke, ki jih nato v določeni meri prikažemo uporabniku. Za statistične podatke prikažemo največ štiri zadetke (za vse samostalnike v uporabnikovem vprašanju/stavku skupaj), prav tako za API-je prikažemo največ štiri zadetke (za vse samostalnike v uporabnikovem vprašanju/stavku skupaj). Štirje zadetki, ki so prikazani so prvi zadetki, ki so bili najdeni z iskanjem po bazi podatkov ter API-jev. Npr. če so v uporabniškem stavku trije samostalniki, potem je vrstni red samostalnikov za iskanje po bazi podatkov ter API-jev kar vrstni red samostalnikov v stavku; npr. za stavek »Zanima me zdravje, slovenija in okolje«, je vrstni red iskanja po bati podatkov (ter API-jev) »zdravje«, »slovenija«, »okolje«. Za vsak samostalnik pridobimo določeno število zadetkov, na koncu pa prikažemo (največ) prvi štiri zadetke, ki so bili najdeni (za vse samostalnike skupaj). Tak mehanizem velja za iskanje po bazi podatkov ter bazi API-jev. Npr. da za primer »Zanima me zdravje, slovenija in okolje« predpostavimo, da ima (prvi) samostalnik »zdravje« 5 zadetkov, potem prikažemo prve 4 zadetke, ki so bili najdeni za »zdravje«, če pa npr. ima »zdravje« 2 zadetka ter »slovenija« 3 zadetke, potem prikažemo 2 zadetka za »zdravje« ter prva 2 zadetka za »slovenija« (le te dva zadetka sta prva zadetka, ki sta bila najdena v bazi podatkov oz. bazi API-jev). Vrstni red prikazanih zadetkov za posamezen samostalnik, je enak vrstnemu redu zadetkov v JSON odgovoru (za iskanje po bazi samostalnikov) oz. vrstnemu redu API-jev v bazi za iskanje po bazi API-jev.

2.3 Stari EkoSmart asistent

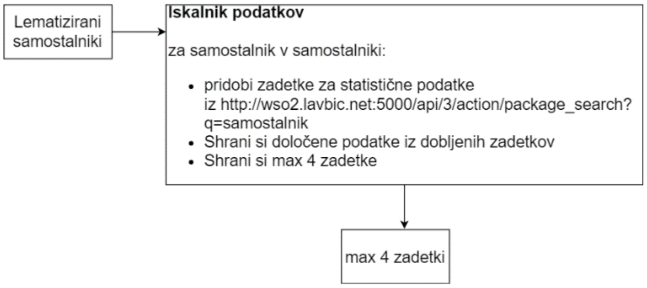
V primeru, da asistent ne najde nobenih zadetkov za statistične podatke in API-je, asistent posreduje uporabnikov stavek/vprašanje staremu EkoSmart asistentu. Poizvedba po starem EkoSmart asistentu je narejena s sledečo zahtevo http://www.projekt-asistent.si/ekosmart/ask?question=. Npr. če uporabnik vpraša/napiše "ekosmart" (in asistent ne najde nobenih zadetkov za statistične podatke ter API-je), dobimo odgovor starega EkoSmart asistenta s sledečim zahtevkom http://www.projekt-asistent.si/ekosmart/ask?question=ekosmart. Uporaba starega EkoSmart asistenta je uporabna za t.i. "small talk", ki ga le ta asistent razume.

3. Shema

Na sliki Slika 4 je shema mehanizma delovanja asistenta.

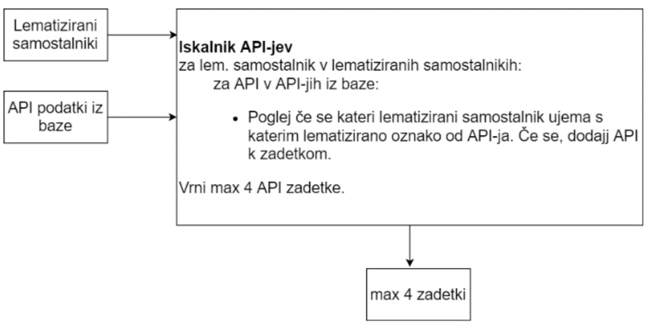
Slika 4: Shema delovanja EkoSmart asistenta za iskanje po integracijski platformi

Na sliki Slika 5 je ponazorjen mehanizem delovanja iskanja po bazi podatkov. Vhodni podatek v mehanizem so uporabnikovi lematizirani samostalniki (v osnovni obliki) izhodni podatek pa so maksimalno 4 zadetki.



Slika 5: Shema delovanja algoritma za iskanje po statističnih podatkih

Na sliki Slika 6 je opisan mehanizem za iskanje po bazi API-jev. Kot vhodna podatka sta uporabnikovi lematizirani samostalniki (v osnovni obliki) ter shranjeni API podatki iz baze, izhodni podatek pa so maksimalno 4 API zadetki.

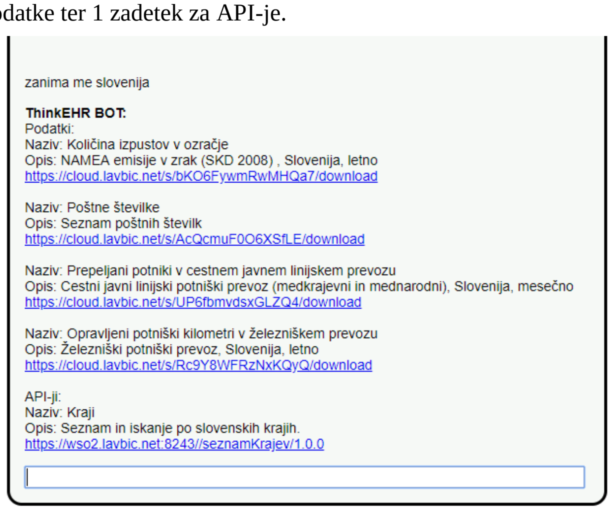


Slika 6: Shema delovanja algoritma za iskanje po API-jih

4. Rezultati in primeri.

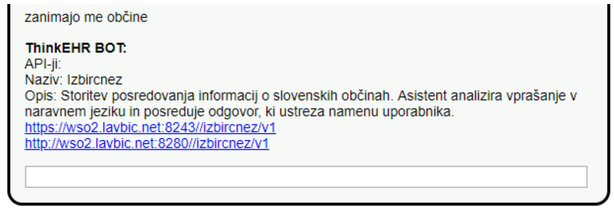
Prototipno rešitev smo namestili na spletno mesto [3]. Začetna inicializacija traja malce dalje (10-20 sekund) zaradi »prefetch« podatkov in njihovo pred procesiranje (kot je identifikacija samostalnikov ter njihova pretvorba v osnovno obliko). Nadaljnje poizvedbe se izvedejo brez časovnih zamikov.

Kot primer navedemo v uporabniškem vmesniku vprašamo "zanima me slovenija". Agent nam izpiše 4 zadetke za statistične podatke ter 1 zadetek za API-je.



Slika 7:Primer uporabe

Če npr. vprašamo "zanimajo me občine", dobimo kot odgovor 1 zadetek za API-je (izbirčnež).



Slika 8: Primer uporabe

Če pa v uporabniški vmesnik vnesemo "Živjo" (v tem primeru nimamo nobenih zadetkov za statistične podatke ter API-je, zato se asistent obrne na starega EkoSmart asistenta), nas agent pozdravi ter se predstavi.

Slika 9:Primer uporabe

5. Zaključek

V tem prispevku smo opisali delovanje EkoSmart asistenta za iskanje po integracijski platformi. Asistent uporablja robusten mehanizem za iskanje po bazi podatkov ter API-jev. In sicer asistent uporablja lematizator za identifikacijo samostalnikov in njihovo pretvorbo v osnovno obliko. Kljub malo daljši začetni inicializaciji poteka nadaljnja z asistentom nemoteno brez časovnih zamikov. Asistent je prestal različne preizkušnje uporabnikov ter se izkazal za robustna rešitev problema iskanja po integracijski platformi.

6. Literatura

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Virtual Assistant Aggregator for the Project Electronic and Mobile Health

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ABSTRACT
Electronic and mobile health (English: EMH, Slovene: EMZ) sub-project was part of the EcoSMART Smart Specialization program. During the EMZ sub-project, we developed several prototypes, products, and services that were integrated into a platform with the use of the Rocket.Chat application, which was developed as part of the AS-IT-IC project. Currently, ten entities and web services are integrated into the platform. Some of them like the municipality assistant consist of 200 single assistants. Others, like HEP-Y, an application for hepatitis, were designed before and represent a single entity. The EMZ platform simplifies the interaction with each of the services either by clicking or through natural language. When asked about healthcare, the platform searches through hundreds of possible replies and proposes the most promising.

Keywords
AS-IT-IC platform, Jaccard index, lemmatization, working agents, virtual assistants, Electronic and mobile health

1. INTRODUCTION
This paper describes a unifying platform addressing the specific needs of the healthcare domain and was developed as part of the EcoSMART S4 program [3]. It is based on the AS-IT-IC [6] platform which was developed in the cooperation of Austrian and Slovenian developers. AS-IT-IC, short for Austrian-Slovenian Tourist Information Center is a web application and a platform for assisting tourists who are traveling across Austria and Slovenia to plan a trip.

We have reorganized the internal structure of the source code and added new functionalities to meet the needs of the health care system. The EMZ platform implements several sub-applications, for example, ASPO [1] and HEP-Y [2], which are services for diagnosing and recognizing sexually transmitted diseases and hepatitis, respectively. The most important part of our platform is the ability to answer questions formulated in natural language by the user. The whole ecosystem is built and integrated into a popular and open-source application for messaging called Rocket.Chat.

During past projects, the Jožef Stefan Institute has already developed over 200 so-called chatbots or virtual assistants to be used on the web pages of the Institute and Slovenian municipalities. We integrated all of the existing chatbots into a single platform. Our platform is called in Slovenian language "Platforma za elektronsko in mobilno zdravje" or English "Platform for electronic and mobile health". The platform is for now in the Slovenian language, so it is intended for end-users who speak and understand Slovenian. The platform has three functionalities:

- It can answer questions posed in natural language.
- It can provide a link to the information we need.
- It can search through the database of Institute employees by applying lemmatization and stemming services to the search string and the data in the database.

In the following sections and subsections, we describe how the assistants, which are the building blocks of the platform, work, and which technologies we used to get the expected functionalities. Finally, we present some figures of the graphical interface and examples of conversations with the platform agent.

2. SYSTEM DESCRIPTION
Our top-level working agent in the EMZ platform works as follows:

- First, when a new question is received, the system processes the input. It asks all the working agents that are available about healthcare or the Eco-SMART project. These are the Summoner - Izbirčnež, the healthcare waiting queue assistant, the Eco-SMART assistant and the municipality assistants. Moreover, it also queries the database of prototypes and domains.
- If the question concerns assistants and not the database of prototypes and domains it sends the whole string by a POST or GET request to the online assistants. The assistants then perform lemmatization and stemming

of the text, search for the best answer, assign weights to all possible answers, and return the one with the highest weight.

- If the question concerns prototypes and domains, the system queries the database directly. However, before that, another set of lemmatization operations is applied. This process differs from the first since we integrated the search locally on the server where we read it from a file that is regularly updated.
- All the received answers are collected into a table. We filter the answers by selecting only those that the agent thinks are relevant to the initial query. Finally, we show them in the Rocket.Chat dialogue window.
- The user can select the most appropriate answer and start the conversation with the agent that provided the most appropriate response by clicking on one of the displayed responses. This functionality will be further described in the following text.

2.1 Assistans

Here we describe the assistants that provide possible answers to the requests in the EMZ platform. All are web applications and RESTful applications. REST is short for representational state transfer. This term means that we can communicate between different programs or processes by using HTTP requests. All of the agents are using JSON for the response format.

We will now provide a short description of the assistants.

2.1.1 Assistant for Queues in Healthcare [1]

The assistant identifies all medical institutions in Slovenia, where someone can apply for a medical procedure. It then displays the waiting time for the procedure in question at the institutions in a specific region, ordered by the waiting time from the shortest to the longest, to make it easier to identify where is it possible to get the procedure the fastest. The information about a medical facility includes contact information and the address. The system actively inquires the user for additional search constraints, such as the region in which we would like to receive the treatment and the urgency. It provides buttons that enable the user to see the available choices and to simplify communication.

2.1.2 Eco-SMART Assistant [2]

The assistant can answer general questions about the Eco-SMART project. It responds to questions about the institutions and companies which are involved in the project. Next, it can provide organizational data from the project or information or services related to the execution and results of the project.

2.1.3 JSI Assistant [3]

The JSI assistant called Robi is the first and most important assistant which was developed at the Institute. It's the fundamental building block for all other assistants. At first, it was implemented in Python 2.7, but we updated the code to Python 3.6. The main task was to delete all redundant code which was repeating. Now the assistant is slim and small, but we kept all functionalities from the older version. The assistant can answer questions about the people who are working on the Institute; it can open relevant web pages in the background for further searching. It has a multitude of available applications such as the Slovenian dictionary, a computer terminology dictionary and information about the menu at the canteen at the Institute. It also provides a quick way of informing the maintenance personnel of any problems requiring their attention.

2.1.4 Assistants for Municipalities in Slovenia [4]

The Republic of Slovenia has 212 municipalities, and 200 municipalities have their assistant. It can answer general questions about the mayor, municipal council, environment and transport in the municipality and several other from the municipality related domain. The assistants are based on the original assistant Robi which works on the official web page of the institute. This system was integrated into the EMZ platform since it was agreed with the project partners.

2.2 Rocket.Chat

One of the reasons why we selected Rocket.Chat, as the underlying communication platform and for the integration of text messaging and communication with the assistant, is that its a free and open-source project. The application provides hooks that make it easy to integrate a custom assistant. It makes it possible to send HTTP requests with the payload containing message inputs from the user, to a predefined address, and it displays the response to this request in the same chat room as the original inquiry. This mechanism was used to connect Rocket.Chat, which serves in the role of the front-end, with the developed back-end application written in Python using Flask.

Rocket.Chat also supports direct messaging, multiple rooms, and public channels. Since we are hosting Rocket.Chat ourselves, we have no limitations as we would if we were to use for example Slack, which limits the number of messages retained in history when using the free plan.

2.3 Lemmatization

Each text query to the platform is processed. First, it is split into individual words, producing a set of words. Second, we perform simple POS tagging on the text to identify nouns. This process is performed because nouns carry the most information when identifying the relevant entries in the prototypes and domain databases. Also, all punctuation is removed. Next, we apply lemmatization on the nouns and get a set of lemmas or dictionary from words. Then we calculate the Jaccard index on the lemmas, comparing words in the database to the words in the question string. The Jaccard index is described in more detail in the next subsection. Finally, we return the search result.

We have chosen lemmatization over stemming because it produced better results in our tests. Stemming only cuts off the extensions of the words. We need words in the dictionary

[1] https://df-chatbox.herokuapp.com/
[2] https://ekosmart.docker-e9.ijs.si/
[3] http://www.projekt-asistent.si/ijs
[4] https://asistenti-website.docker-e9.ijs.si/post/seznam-asistentov/

form. The downside of lemmatization is that it is slower and requires additional data in the form of a dictionary, which in our case was a model for Slovenian language, to apply morphological analysis. For this purpose we used a library that was also developed at JSI.

2.4 Jaccard Index

We can measure the similarity between two sets A and B with the Jaccard statistical formula (Equation 1).

First, we calculate the intersection between two sets and count the number of members. That number is our numerator. Then we calculate the union on the same two sets, count the number of members and put that number in the denominator. A result is always a number between 0 and 1 (as stated in Equation 2). If we multiply it with 100, we get a percentage. This method produces the Jaccard index, the higher the number we get, the more similar the two sets are. Complementary of the Jaccard index is the Jaccard distance. It measures how different two sets are.

$$J(A,B) = \frac{|A \cap B|}{|A \cup B|} \tag{1}$$

$$0 \le J(A,B) \le 1 \tag{2}$$

If both sets are empty, then we consider the Jaccard index to be equal to one. We have applied the Jaccard index to the set of words obtained from lemmatization of the question string and the set of concepts stored in the database file. The higher the Jaccard index, the more similar wee deem the question with the prototype or domain name. The system only returns the item with the highest score.

The Jaccard index is commonly used as an error measure when training convolutional neural networks to perform bounding box segmentation of images.

2.5 Blocking the Other Assistants When Talking to Just One

To prevent confusion when talking to multiple bots at the same time, we have implemented a function to focus the conversation to a selected assistant. This is achieved by tracing the value of the "talking" field associated with a particular assistant. Its value may be either True or False. When True then this assistant is also receiving questions, otherwise the working agent is "blocked" and does not participate in the conversation. The user sets the right value by clicking on the button to limit the conversation to a particular assistant. By clicking "Yes, I want to talk to the assistant" we set the "talking" field to True and for other assistants to False.

Besides allowing the user to have a more consistent conversation this also enables the users to select the conversation partner they believe will provide the right information even when the system is incapable of determining which answer to present correctly.

3. DEMONSTRATION OF THE PLATFORM

The platform works similarly as AS-IT-IC. It has two components, first the web page which provides information about projects, prototypes, and links to the relevant working agents. Second, the Rocket.Chat widget where we can search through the database or ask a question. Here we are talking to a bot, named EMZ-BOT. When we load the Rocket.Chat widget, we get an initial greeting from the bot (Figure 1). Here we can choose which working agent we want to talk to. If we don't choose an agent, the EMZ-BOT provides answers from all working agents or assistants that responded.

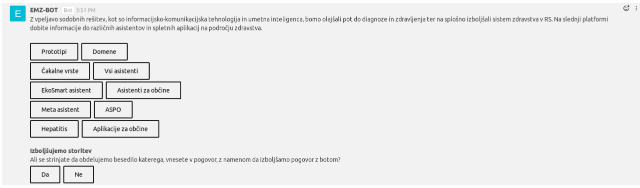

Figure 1: Example of an EMZ-BOT introductory greeting.

In the remainder of this section, we present 4 examples of interactions with the platform and communication with the different assistants.

We can ask the bot about the staff or people who work at the Institute. We receive an answer as shown in Figure 2.

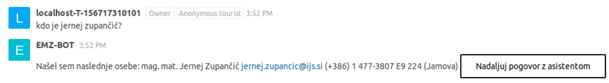

Figure 2: Example of an EMZ-BOT answer for looking up a person from JSI.

Next, if we have any medical problems, we can type it into the system. And the bot replies accordingly (see Figure 3).

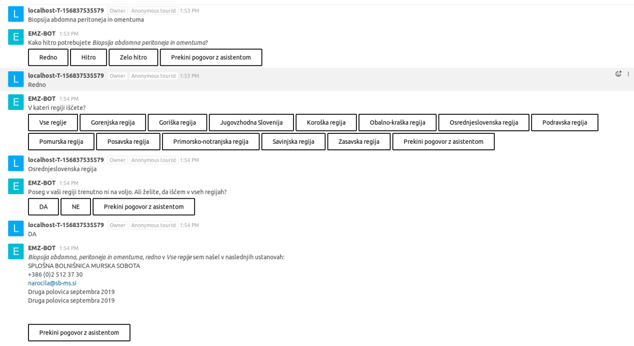

Figure 3: Example of a chat with EMZ-BOT when we need abdominal biopsy.

Also, we can search through the database of prototypes and domains. In Figure 4 we performed a search for heart failure. We get two answers, one from prototypes and one from domains or data. By comparing the answers, we can choose the assistant we want to talk to.

The last Figure 5 shows us the response from the bot when

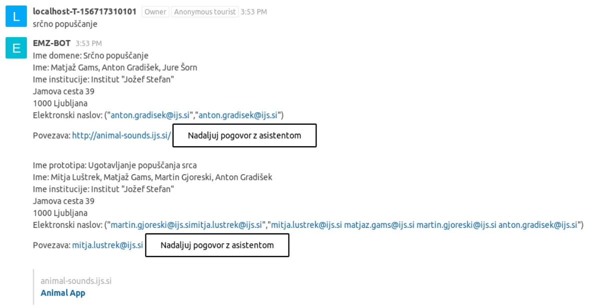

Figure 4: Example of an EMZ-BOT answer when we search for heart failure

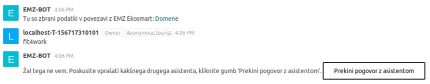

Figure 5: Example of an EMZ-BOT answer when looking for something which the assistant does not find

it did not find anything after we have chosen to talk to just one working agent. We have an option to click on the button to talk to all agents.

4. FUTURE DEVELOPMENT OF THE EMZ PLATFORM

We have identified several issues and possible research directions for future work. The most important thing is to shorten the general response time of the platform. One possible solution would be to define functions in Python as coroutines and adding asynchronous behavior which is an abstraction of using threads. The authors of the Summoner [5] showed that using threads can shorten the response time by a factor of four. However, before speeding up the system, we should also run tests to evaluate the system's ability to provide the correct answer. After this, we would be able to provide the assistants that are integrated into the system an improved and broader knowledgeable database. The assistants should learn from past questions and improve the database on the fly.

5. CONCLUSIONS

We have created a comprehensive platform using the latest information-communication technology based on the AS-IT-IC platform. One of the essential parts of this ecosystem is the EMZ-BOT. Users can communicate with it in natural language and obtain structured and informative answers. The system is intended to provide information and integrate services for the healthcare domain. Thus, it can be used by chronic patients and people with disabilities, as well as healthy individuals and the general population, who are just searching trough the platform and seeking information about healthcare, information regarding municipalities, active life, the Eco-SMART project, and other. Soon, there will be a need for advanced ICT solution since our healthcare system is overwhelmed and in need of digitalization to support the need of patients. Our solution to these problems is the EMZ platform.

6. ACKNOWLEDGMENTS

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Predictive Modelling of Feeling of Health for Congestive Heart Failure Patients

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ABSTRACT

This paper focuses on predictive modelling of feeling of health (FOH) for congestive heart failure (CHF) patients. The basis for models is the data obtained from HeartMan project clinical trials, which involved 66 patients. The main indicator was FOH, reported repeatedly by patients. We used the Decision trees and Extreme gradient boosting algorithms to build the predictive models. In case of missing data, we used k-Nearest Neighbours imputation method. The algorithms predicted the FOH with around 70% accuracy. The relations in decision tree are in line with medical knowledge about CHF.

Keywords

HeartMan project, Feeling of health, Predictive modelling

1. INTRODUCTION

CHF is a serious disease, affecting 1-2% of population in western world. The percentage rises to more than 10% among people older than 70 years. [9] There is no cure available. However, if the disease happens, proper disease management is crucial as it can improve patient's quality of life (QoL).

The main actions to improve the health of CHF patients are quite well established: they include medications, physical exercises, mental exercises, proper nutrition, pill intake monitoring, etc. Modern technology enables monitoring more parameters related to health and QoL than was possible ever before. Furthermore, QoL does not depend just on physical health, but is subjective and can only be reported by the patients themselves. Patient-reported outcomes (PROs) are thus becoming increasingly important in medicine. [3] For example, Kang et al. [5] included telemonitoring parameters and PROs in a model predicting rehospitalisation of CHF patients, achieving the AUC of 0.59. The HeartMan project built upon a somewhat similar Chiron project [2], which aimed at developing a decision-support system to estimate the health risk of the patients. The Chiron study included 24 patients, who used wearable devices, and provided information on how they felt each day. [7]

This paper deals with predicting self-reported FOH from parameters collected with monitoring technology. The data used in this paper was collected during the HeartMan project. [1] The project developed the application for self-management of the CHF. The data collected was also used to build predictive models of FOH. The idea of predictive modelling is to enable the choice of actions for improving patient's FOH. The HeartMan models provide short-term advice and interventions in comparison to more common long-term ones. [4] Furthermore, the advice could be personalized.

2. HEARTMAN CLINICAL STUDY

HeartMan clinical study was carried out in two trials: the first took place in Belgium, another in Italy. In Belgium, 36 patients were involved, 12 of which were in control group and 24 in intervention group. In Italy, 30 patients were involved. 80% of the patients were male. The mean age of patients was 63 years. Most of the patients were placed in New York Heart Association (NYHA) functional class II, other in NYHA class III, meaning they had (slightly) limited physical abilities. Most of the patients had been diagnosed with CHF for more than 18 months. The intervention group patients used the HeartMan system from 3 to 6 months. They were given the RuuviTag environmental sensor to gather information on air humidity, temperature and pressure. They wore HeartMan watch to gather the PPG signal, skin temperature, galvanic skin response, cortisol level readings, heart rate and RR intervals. Each day they measured their weight and blood pressure. They were given smartphone with HeartMan application.

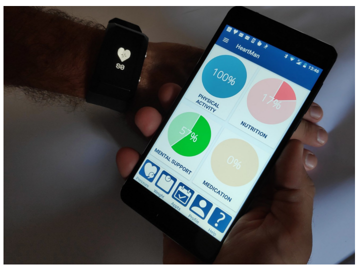

Figure 1: HeartMan watch and application.

HeartMan application gathered data from the HeartMan watch and sent it to the server. A crucial part of HeartMan application was the decision support system, which scheduled mental and physical exercises several times per week for each patient. On scheduled days, a notification was sent to the patient urging him to complete the exercise. Other than that, he could decide to do additional exercises. Each time a patient started one of the mental exercises, he was asked to answer a question: "How do you feel today?" He could then choose among the following answers:

- 1 = much better than usual
- 2 = somewhat better than usual
- 3 = about the same as usual
- 4 = somewhat worse than usual
- 5 = much worse than usual

The patient's answers regarding their FOH served as the input data for predictive models regarding the CHF patient's FOH. The distribution in Figure 2 shows us the number of FOH entries per patient from both Belgian and Italian trial. Some patients provided the information on their FOH every day, whereas some barely provided any.

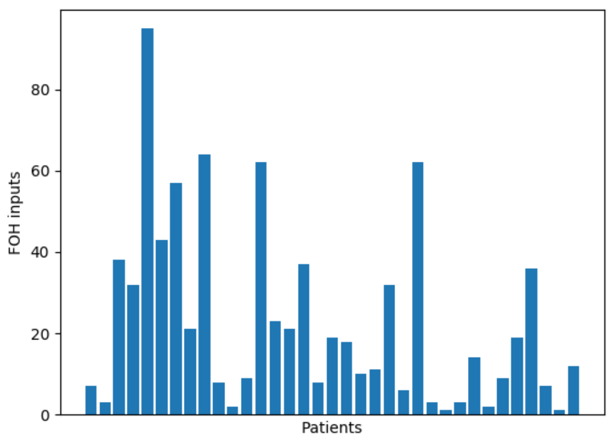

Figure 2: The distribution of FOH inputs per patient

3. PREDICTIVE MODELLING

3.1 Features

We used the following features collected by the HeartMan system:

- Air humidity, air temperature and air pressure, which were collected by RuuviTag sensor.
- Skin temperature, galvanic skin response and heart rate, which were collected by HeartMan wristband.
- Parameters from exercise report. The duration of the exercise, the type of exercise (endurance or resistance) and validity of exercise (check if pre-exercise requirements were met and the exercise was performed correctly) were generated by HeartMan application after exercise was performed by patient. The estimation of exercise intensity was input by patients.
- Systolic blood pressure and diastolic blood pressure, input by patients using HeartMan application.
- FOH, input by patients using HeartMan application.

Since the patients reported their FOH at most once per day, one instance for modelling corresponded to one day. We computed features describing the above parameters for each day. As a basis for calculation of features, we took the timestamp of patients' input on the FOH. Based on this timestamp, we calculated average and standard deviation of the parameters either for the same day as the FOH was recorded or for the previous day, or for last 3 or 24 hours. Table 1 shows the time intervals in which the various features were calculated.

Table 1: Dynamic features used for predictive modelling.

Parameters	Last 3 hours	The same day	Last 24 hours	Previous day
Skin temperature, Galvanic skin response, heart rate	✓	✗	✓	✗
Exercise parameters: duration, intensity, type, validity	✗	✓	✗	✓
Systolic blood pressure, diastolic blood pressure	✗	✓	✗	✓
Weight change since the previous day	✗	✓	✗	✗
FOH	✗	✓	✗	✗

We refer to the features in Table 1 as dynamic, because they were obtained daily via sensors. But we also considered static features from the patients' health records, which generally did not change during the trial, e.g. age, gender, body mass index, heart rate at rest, CHF etiology, patient's comorbidities, ergometry maximum load, ... In this paper we will focus on modelling dynamic features.

3.2 Modelling Methodology

We started the modelling with all the data of all the days when the patients reported their FOH. Then we had to address the issue of missing values: most features had the values for some of the days missing, and in many cases the missing values were quite numerous (because the patients did not use the HeartMan system fully on some days, or because of technical problems).

Missing values were filled in with imputation. The best imputation method on Chiron data proved to be k-Nearest Neighbours [8], which sets each missing value to the mean value of the same feature of k most similar instances. However, when a feature had a value missing on many days, imputation proved counterproductive, so we only used it on features with missing values on up to 30 days.

We then selected a number of thresholds for the maximum allowed number of missing values for a feature. We excluded all the features that had more missing values than each threshold, and we only included in further analysis the instances that had no missing values of the remaining features. Consequently, the stricter the threshold, the fewer features were left, and the more instances without missing values we could use.

The FOH was reported using the numerical representation, ranging from 1 (much better than usual) to 5 (much worse than usual). Like on the Chiron data, it proved too difficult to distinguish between all five classes, so we merged 1 and 2, as well as 4 and 5, ending up with three classes. Again, like on the Chiron data, even this proved challenging, so we removed the middle class in some experiments, reducing the prediction to only two classes.

Two machine learning algorithms were used to build predictive models: Sci-kit Learn implementation of Decision trees (DT) and Extreme gradient boosting (XGB). DT are human-understandable models that can be used to gain an insight into the relations in the data, whereas XGB models are ensembles of Decision trees that typically offer higher accuracy at the expense of understandability. We compared the results of these two algorithms to the majority model, which always returns the class with the most instances.

4. RESULTS

Our experiment consisted of building three- and two-class models on dynamic features. We compared them for various missing-value thresholds and both machine-learning algorithms. The results are shown in Table 2.

Table 2: Classification accuracy of prediction on dynamic features.

Dataset information					
Missing values	$<\infty$	<318	<205	<130	<50
Features	72	30	22	18	13
Instances – 3 classes	221	349	592	686	745
Instances – 2 classes	91	143	229	275	316
Results three classes					
Majority	0.59	0.59	0.62	0.61	0.61
DT	0.56	0.52	0.44	0.43	0.5
XGB	0.65	0.57	0.55	0.56	0.56
Results two classes					
Majority	0.52	0.52	0.53	0.51	0.52
DT	0.67	**0.63**	0.63	0.6	0.55
XGB	0.7	**0.68**	0.54	0.54	0.58

We can see that the results with two classes are not much better than those of the majority model, so we focused our experiments on two classes. To obtain reasonable accuracy, we needed enough features, so we had to accept features with many missing values. We find the most satisfactory results those with the missing-value threshold of 318 (in bold). If we exclude Italian data from our dataset, the XGB accuracy for a comparable missing-value threshold goes up to 0.76. This is probably because of the higher number of missing values in the Italian data.

Figure 3 shows the DT with the missing-value threshold of 318. Labels value = [x, y] denote the number of instances when the patient felt good (x) vs. bad (y). Orange colour denotes feeling good and blue colour feeling bad. We can see that low systolic blood pressure generally means feeling bad, which makes sense in CHF patients who have problems with heart output. [6] The main exception is when the standard deviation of the heart rate is high, which is also reasonable, since high deviation means that the heart can adapt to varying demands. When the blood pressure is high, patients nevertheless feel bad when their average heart rate is high, which is also in line with expectation. Other parts of the tree make only minor contribution to the overall prediction.

Table 3: Classification accuracy of prediction for individual patients.

Personal data	None	10%	20%
Majority	0.43	0.42	0.42
XGB	0.58	0.62	0.85

Since the idea of the HeartMan project was to use predictive models to advise patients on how to improve their (feeling of) health, in our second experiment we tested models on individual patients. For each patient, we first built models on data of other patients, and then added 10% and 20% of that patient's personal data. The results for two classes are shown in Table 3. We can see that person-independent models (personal data = None) did not perform well, although they still outperformed the majority classifier by 15 percentage points. Adding 10% or 20% of personal data to the training data for the models improved the accuracy substantially.

5. CONCLUSIONS

The general models built on HeartMan data proved reasonably accurate. A direct comparison with Chiron models is difficult because the majority classifier there had a much higher accuracy, but the results can be considered comparable. The relations in the models seem in line with the existing knowledge about CHF. Interestingly, the relations regarding ambient temperature and humidity, which were quite important in Chiron models, do not appear here.

The personalised models built on Chiron data were a disappointment, while they are fairly accurate in the case of HeartMan. It is difficult to say why this is the case. One possible reason is that the question about the FOH was such that the patients could answer more consistently: they were asked about their FOH compared to the usual one, whereas Chiron patients were asked about their FOH compared to the previous day. Regardless of the reason, these results are very encouraging, since building this type of models was a major objective of the HeartMan project. They certainly warrant further investigation, and are a strong argument for future research on predictive models in personal decision support systems and in health systems.

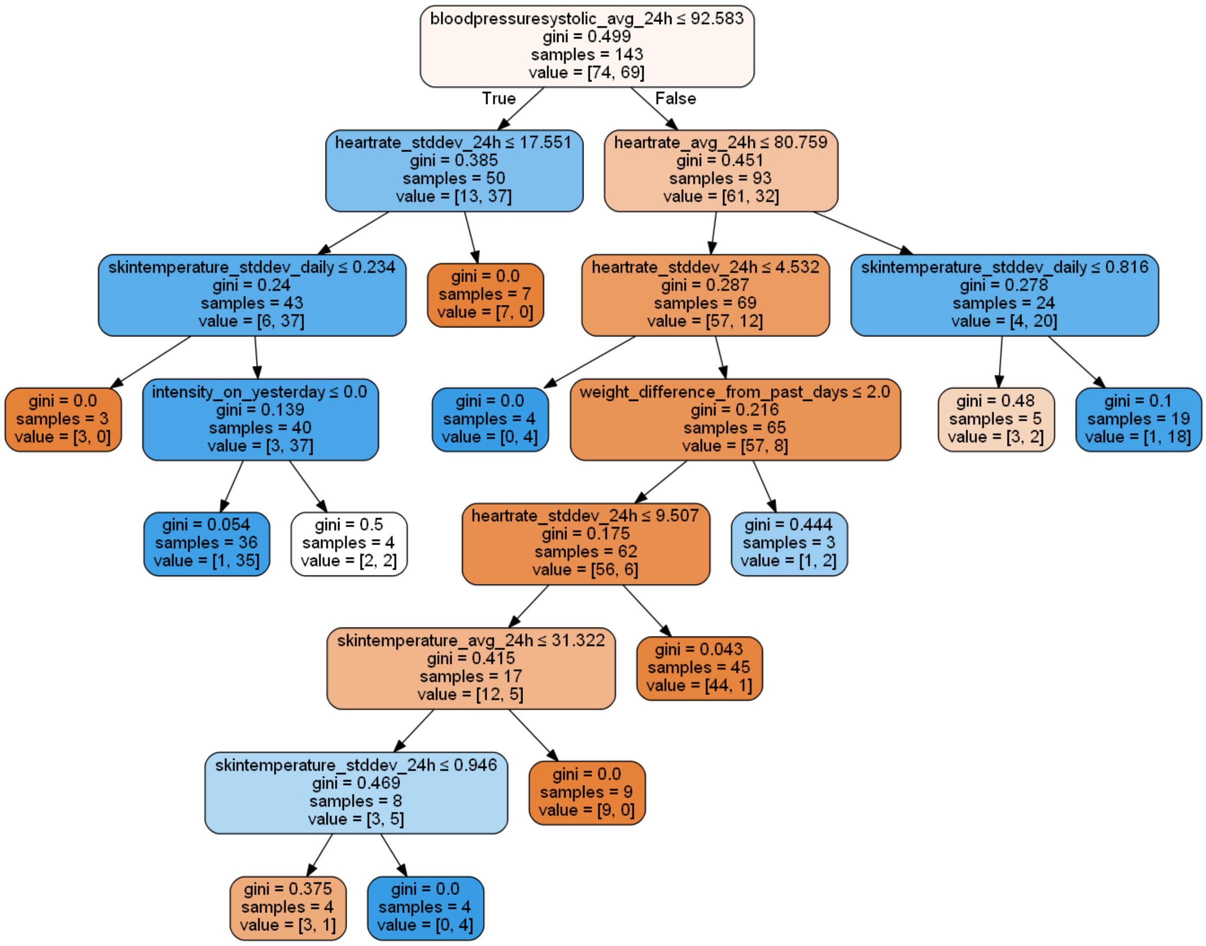

Figure 3: DT for two classes. Orange = feeling good and blue = feeling bad.

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Categorising Behavioural States of People with Profound Intellectual and Multiple Disabilities

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ABSTRACT
People with profound intellectual and multiple disabilities (PIMD) are a diverse group of individuals. They face extreme difficulties in communicating to the outside world. This paper presents two specialised machine learning (ML) methods that attempt to classify the behavioural states and communication attempts of people with PIMD based on annotations of non-verbal signals (NVS) and expert knowledge. The first is based on the idea of unique NVS that classify the behavioural state, e.g., a smile in happy healthy individuals. The second uses the arousal-valence model as a scaffold to generate a value for valance based on a group of NVS.

Keywords
Behavioural state, Communication, PIMD, Prolog, Intent detection

1. INTRODUCTION
People with profound intellectual and multiple disabilities (PIMD) are a heterogeneous group, suffering from different ailments and conditions, making them face extreme difficulties in their daily lives. Severe cognitive, motor and sensory disabilities makes this population reliant on outside care for most daily tasks, and thus extremely vulnerable. While these individuals are exactly the ones that would benefit most from intelligent systems in their vicinity, they are unable to use them due to relative high complexity. The main problem is their lack of symbolic communication – they are unable to express their desires in a consistent manner.

Most assistive technology relies on some form of symbolic communication, which makes it unusable for people with PIMD. The INSENSION project aims to develop a system that will observe behavioural state and non-symbolic communication attempts of people with PIMD and interpret them to people in the vicinity in order to allow them to render assistance or support if needed; and even automatically control their environment using external services. This will in turn help the people with PIMD to have greater agency in their environment and help people who are not as familiar with them to assist them in meting their daily needs.

The first step of the INSENSION system is to recognise non-verbal signals (NVS) expressed by people with PIMD (e.g., certain gestures [1] and facial expressions [7]) and important features of their environment (e.g., presence of a caregiver and objects, temperature). Afterwards, these are interpreted as behavioural states and communication attempts, and provided to a caregiver or external services. This paper deals with the interpretation of NVS once they are recognised by the sensoric and machine vision sub-systems.

Interpretation of NVS of people with PIMD is a challenging task, since each individual is unique with different abilities and signals. Thus, no general-purpose system can be developed and personalised classification methods must be used. Mappings between certain NVS and behavioural states are known to those close to the specific person, and this expert knowledge should be used in the decision making process. Due to no possible generalization, we are also dealing with low amounts of data per subject, as collecting a large set of annotated data for each individual is neither practical nor feasible. Finally, as context is important for interpretation of behavioural states, a database of relevant contexts should be built.

This paper is organised as follows. In Section 2 we present the related work on the subject. Section 3 discusses the data collected so far. Section 4 presents the two ML methods: the Unique Non-Verbal Signals model optimised for extremely small data sets, and the Valence model that works better with limited but somewhat larger data sets. Section 5 looks at the results and discusses current and future work. Finally, Section 6 draws the conclusions based on this paper.

2. RELATED WORK
Since our focus is on recognising the ambiguous feelings, desires and intentions of people with PIMD, which are expressed in unique and unexpected ways, we focus on work dealing with detection and understanding of human feelings. Arousal and valence are the standard metrics that are used to map human feelings onto a 2D plane. Arousal can be understood as the strength of a feeling, while valence is the positive or negative connotation of the feeling. There are several ways to map discrete feelings to this 2D space and the actual mapping is not agreed upon, leading to some ambiguity on this subject, but it is at this point one of the standard models [6].

A step towards understanding feelings that is closest to what INSENSION will use (from video and audio) was done by Metallinou et al. [3]. They use a different space, also includ-

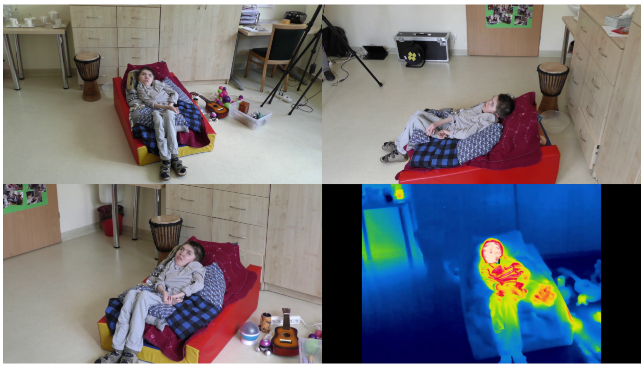

Figure 1: An example of the recorded videos. Computer vision algorithms are ran on all the streams and the results collated based on probability.

ing the dominance dimension. They used USC CreativeIT database consisting of acted-out scenes.

When it comes to extracting the context of the interaction, there are several approaches that produce interesting results. Probabilistic Event Calculus [4] is one of the approaches that can be used and extended to the case at hand. Case-based reasoning (CBR) [2] is another paradigm, in which knowledge is represented as a set of cases – events that happened, and the solutions that were used to solve the problem. Events that are detected are conformed into the closest case that is stored in the database and the solution of the problem is used. The solution is then evaluated and stored in the system based on the success of the solution.

3. DATA

Five PIMD people are currently involved in the INSENSION project. Expert knowledge was collected from their caregivers, who know them well, in the form of an extensive questionnaire. This data was then incorporated into the behavioural state recognition to improve decisions.

Visual data was collected in the facilities where the people with PIMD are cared for, and took the form of multiple-angle recordings with normal and thermal cameras (see Figure 1 for examples). Videos were annotated by hand, using the ELAN [5] software. Annotators were asked to input suitable pre-defined annotations and note any special cases that might play a role in the behavioural state of the subjects. Any state that was not specifically marked was considered *neutral*.

In our experiments the annotations of behavioural states were considered as ground truth, as we feel that people tasked with annotation were familiar enough with their subjects so that they could render as accurate picture of their behavioural state as is possible [8].

4. METHODOLOGY

Our methods assume that the person with PIMD has distinct NVS that correlate to his internal behavioural states. Each of the detected signals can have a meaning, but that is not guaranteed. The NVS can have no meaning or the same NVS can be used to convey multiple dissimilar meanings.

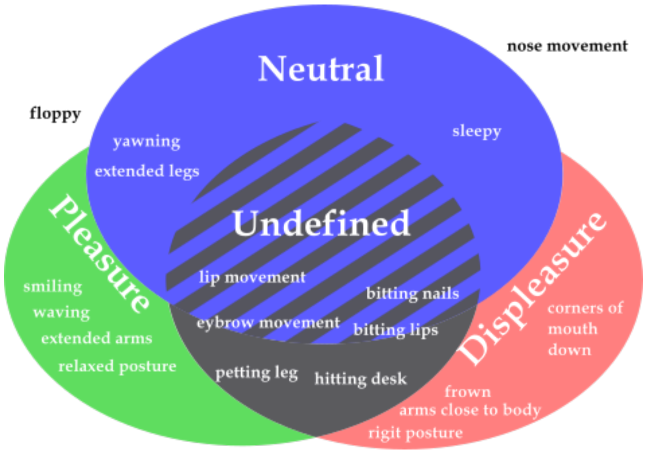

Figure 2: The visualisation of the NVS set interactions.

These signals do not necessary follow social conventions, for instance, lifting the corners of the mouth up can signify pain not pleasure as in normative individuals.

4.1 Classical Machine Learning

Deep architectures are not feasible in our case due to the small amount of available data. In our experiments we segmented the data into 3-second windows, owing to the fact that this was the window size used by annotators. Due to small number of examples leave one out approach was used and several training rounds were used to determine the accuracy of classification. Only present states were used in the classification.

Several methods were tested (nearest neighbors, linear SVM, RBF SVM, Gaussian process, decision tree, random forest, neural net, AdaBoost, naive Bayes, QDA), the decision trees providing the best results. The average classification accuracy for pleasure and displeasure is 63.8%. While the results do not seem bad at first glance, we can do better. We would like to make use of expert knowledge and perhaps even have access to the model and tweak it if the experts say that it does not make sense.

4.2 The Unique Non-Verbal Signals method

The Unique Non-Verbal Signals method encompasses the idea that there exists a NVS that will signify a specific behavioural state, but will never be used to signify any other behavioural state. This means that in order for us to robustly detect, for example, pleasure, we must remove all NVS that are associated with displeasure or neutral state. This leaves us with a set of NVS that uniquely represent the behavioural state of pleasure. Additionally, if experts annotated that a certain NVS corresponds to a behavioural state, we must take that into account. This approach is illustrated in Figure 2.

To decide the state we check if there are NVS specific to pleasure, either from the expert knowledge or from annotated examples (Listing 1). The term *window(Interval, NVS, _)* unifies for any 3-second window. Term *assessment(State, NVS)* will unify if experts noted that a NVS signifies a state.

```
decide_state(Interval, 'Pleasure') :-
    pleasure_marker(Pleasure),
    window(Interval, NVS, Annotation),
    member(NVS, Pleasure).

pleasure_marker(NVS) :-
    assessment('Pleasure', NVS).
pleasure_marker(NVS) :-
    window(Interval, NVS, _),
    window(Interval, 'Pleasure', _),
    not(displeasure_marker(NVS)),
    not(neutral_marker(NVS)).
```

Listing 1: Querying the behavioural state.

Failing that, *pleasure_marker* will check if there is a NVS in the annotations associated with pleasure and not with displeasure or neutral state.

4.3 The Valence method

The second method treats the significance of the NVS as an indicator of behavioural state on a continuous scale. We assume that each NVS has a certain correlation with valence. In our case valence is a number that is correlated with the three behavioural states *(displeasure, neutral, pleasure)*, a simplified case of mapping feelings to an arousal-valence plane. Valence is assumed to be a value in [-1, 1] interval, where displeasure is associated with negative and pleasure with positive numbers. If there is little or no correlation between pleasure and the expression, it should gravitate towards negative values, as shown in Listing 2. Inverse must be true for displeasure. *correlation_set(NVS, Behavoural_state, Num_correlations)* returns the number of all annotated intervals that contain a NVS at the same time as the behavioural state. The *intervals(Behavioural_state, Num_examples)* returns the number of all annotated intervals of a certain behavioural state.

```
valence(NVS, Valence) :-
    correlation_set(NVS, Pleasure, NVS_P),
    correlation_set(NVS, Displeasure, NVS_D),
    correlation_set(NVS, Neutral, NVS_N),
    intervals(Pleasure, P_Set),
    intervals(Displeasure, D_Set),
    intervals(Neutral, N_Set),
    Valence_direction is NVS_P/P_Set
                       - NVS_D/D_Set,
    Valence_strength is 1 + P_Set
                      + N_Set+D_Set,
    Valence is Valence_direction/Valence_strength.
```

Listing 2: The function that calculates the valence.

We determine the behavioural state based on the value of the sum of valence scores (Listing 3). The *calculate_valence* is a recursive function that sums the valence of a set of NVS, and returns 0 for an empty set.

The P_Cut and D_Cut variables determine the intervals of pleasure, displeasure or neutral behavioural state. We use constraint logic programming to determine the optimal values for these values based on the training set. At its core it is a minimisation problem where we try to find the thresholds for the intervals that produce the smallest classification error. The pseudo-code of the algorithm is presented in Listing 4. Here *count_errors(Bag, Errors)* is a function that returns

```
behaviour_state(NVS_Set, Decision, P_Cut, D_Cut) :-
    calculate_Valence(NVS_Set, Valence),
        (valence > P_Cut ->
            (Decision = Pleasure);
        (valence < D_Cut ->
            (Decision = Displeasure);
            (Decision = Neutral))).

calculate_valence([], 0).
calculate_valence([NVS | Rest], Valence) :-
    valence(NVS, V1),
    calculate_valence(Rest, V2),
    Valence is V1 + V2.
```

Listing 3: Determining the behavioural State.

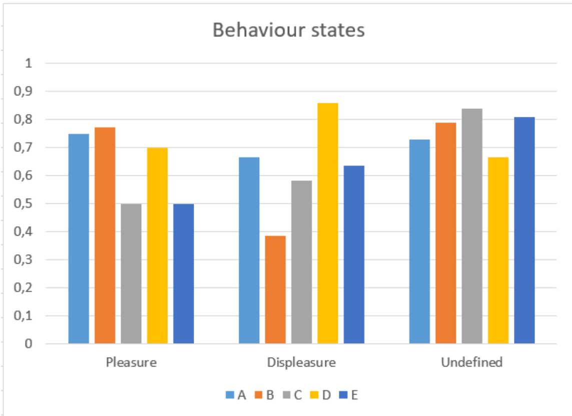

Figure 3: The accuracy from the decision tree classifier.

the number of missclassifications over the whole domain, and *min(Errors)* is a function that attempts to minimise the variable based on the constraints. It uses standard architecture for constraint logic programming on finite domains from the SWI-Prolog library, adapting it to the problem.

```
optimal_cut(P_cut, D_cut) :-
    [P_cut, D_cut] ins [inf..sup]
    min(Errors),
    findall(Correct,
            compare(Correct, P_cut, D_cut),
            Bag),
    count_errors(Bag, Errors).

compare(Correct, P, D) :-
    member(
    , All_observations)
    behaviour_state(NVS_Set, Decision, P, D),
    ground_Truth(NVS_Set, Truth),
    Correct = (Decision == Truth).
```

Listing 4: Calculating the minimal error.

5. RESULTS AND DISCUSSION

The benchmark we are trying to beat is based on standard machine learning algorithms from the python libraries. Out of the 10 algorithms tested, decision tree provided the highest accuracy (Figure 3).

The Unique Non-Verbal Signals method works surprisingly well with the limited data available. But it is expected to

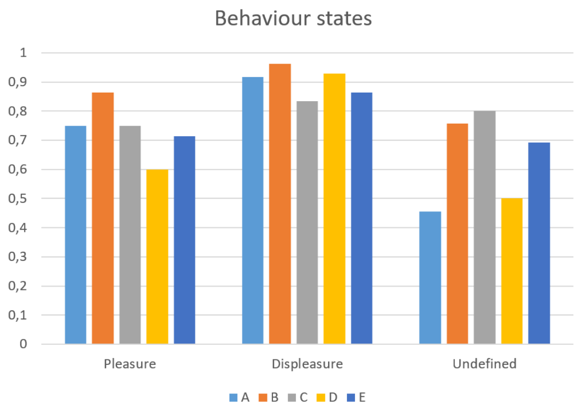

Figure 4: The Unique Non-Verbal Signals method classification accuracy.

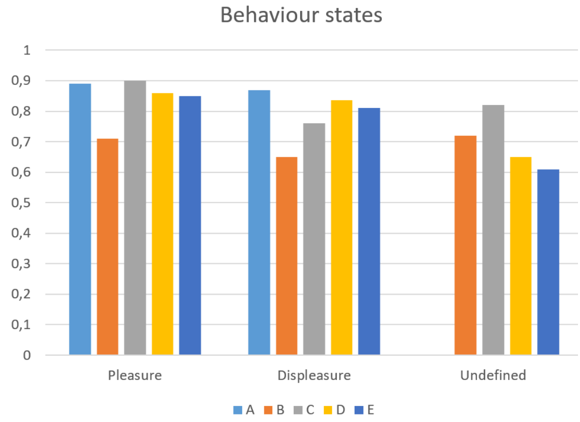

Figure 5: The Valence method classification accuracy.

become less viable with more data. The results in terms of classification accuracy are shown in Figure 4. The average classification accuracy for pleasure and displeasure is 81.8%. Due to uniqueness of the people with PIMD, a model is trained for each individual. The dataset for each individual was small, consisting of less than 10 annotated examples of each behavioural state. In order to evaluate our method, we trained the model on all the examples barring one for each state and compared it to the ground truth – based on annotations. The example here is a contiguous set of windows that annotate pleasure, so the data is not cross contaminated.

Using the same methodology, the Valence method performs worse than the somewhat naive Unique Non-Verbal Signals method, as seen in Figure 5. The average classification accuracy for pleasure and displeasure is 81.3%. Person A has very high miss-classification of neutral state, due to small sample size of this state. The Valence method seems to perform better for subjects with more annotations, perhaps indicating that it does not benefit as much from expert knowledge.

The two methods work on opposite spectrum, as Unique Non-Verbal Signals method with infinite data converges toward expert knowledge, while Valence method diverges from it.

6. CONCLUSIONS

In this paper we presented two ML methods specialised for learning behavioural states of people with PIMD. The advantage over the more common ML methods is the ability to incorporate prior knowledge in the from of assessments made by experts. The developed methods show promising results. The Unique Non-Verbal Signals method achieves 81.8% accuracy in classifying pleasure and displeasure and the Valence method achieves 81.3% on the same classes. However, more data must be collected and used to further validate our proposed methods. The next step is to use the environment of the person with PIMD to extract information on the actions that can be take in order to ameliorate the state our user finds himself in.

7. ACKNOWLEDGMENTS

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Izdelava govorne zbirke za sintezo slovenskega govora

Development of a Speech Corpus for Slovenian Text-to-Speech Synthesis

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POVZETEK

V članku opisujemo potek izgradnje govorne zbirke za potrebe sinteze slovenskega govora. Zbirka bo primerna tako za HMM-sintezo, kot tudi sodobnejšo WaveNet-sintezo, preprosto pa jo bo prilagoditi tudi na korpusno sintezo. Opisujemo postopke za izbiro povedi, izbiro govorcev, način snemanja govorne zbirke in njenega označevanja.

ABSTRACT

In this paper, we describe the process of building a speech corpus for Slovenian text-to-speech synthesis. The corpus will be suitable for both HMM synthesis and WaveNet synthesis, but it will also be easy to adapt to corpus-based synthesis. We describe the procedures for selecting text, speakers, and the process of recording and annotation a speech collection.

Ključne besede

Govorna zbirka, sinteza slovenskega govora.

Keywords

Speech Corpus, Text-to-Speech Synthesis for the Slovenian language.

1. UVOD

Za potrebe sinteze slovenskega govora v okviru projekta CityVOICE izdelujemo novo govorno zbirko z branim govorom. Takšen govor ustreza najpogostejšim oblikam rabe sintetizatorjev govora. Poleg tega je lažje izdelati njegovo transkripcijo, snemanje je bolj nadzorovano in predvidljivo. Pri spontanem govoru je govorno zbirko težko fonetično in prozodično uravnotežiti.

Najpomembnejši preostali dejavniki, ki smo jih upoštevali pri snovanju nove govorne zbirke za sintezo govora, so: izbira vsebine posnetkov, izbira govorcev, postopek snemanja in označevanje posnetkov.

Izbira velikosti govorne zbirke je posledica kompromisa med želenim številom variacij glasov oz. njihovim pokritjem na eni strani ter časom in stroški, vezanimi na razvoj, na drugi strani. Upoštevali smo tudi čas za kasnejše preiskovanje govorne zbirke in potreben prostor za njeno hranjenje.

Starejše obstoječe govorne zbirke so večinoma sestavljene iz posnetkov difonov, najpogostejših trifonov in nekaj besed. Obstoječa govorna zbirka eBralca [1] obsega 4.000 povedi v obsegu nekaj ur posnetega in označenega gradiva. Nova zbirka bo predvidoma obsegala do 50.000 povedi oz. do 100 ur posnetega gradiva. Za kvalitetno in naravno sintezo umetnega govora je zaželena čim obsežnejša in čim bolj raznolika govorna zbirka.

2. IZBIRA VSEBINE POSNETKOV

Umetno generirani govor mora zveneti naravno in biti prijeten za poslušanje. Pri izgradnji nove govorne zbirke smo na podlagi preteklih izkušenj [1,2] več pozornosti namenili:

- večji prozodični pestrosti posnetega besedila, ki pokriva najrazličnejše situacije rabe sintetizatorja govora, besedilo vsebuje tudi zelo kratke in zelo dolge povedi,
- »pokrivanju« različnih prozodičnih kontekstov, v katerih se najpogostejše besede običajno pojavljajo,
- izogibanju besedam, ki niso vsebovane v slovarjih izgovarjav, s katerimi razpolaga projektna skupina, saj je zanje pravilen fonetični prepis potrebno izvesti ročno,
- vključevanju pogostih leksikalnih terminov oz. pogostih besed, kot so denimo telefonske številke, ekonomska terminologija, različne valute, terminologija s področja računalništva in interneta, medicine, pogosta lastna imena, nekatera tuja imena in izrazi, glavni in vrstilni števniki, črkovanje ipd.,
- »pokrivanju« različnih situacij, ki nastopajo v dialogu (aplikacije dialoga in simultanega prevajanja; npr. raba v virtualnih asistentih),
- večji zastopanosti raznovrstnih povedi, predvsem vprašalnih in velelnih (pogostost teh povedi je večja, kot je v samem besedilnem korpusu, iz katerega smo zajemali besedilo za branje),
- zajemanju različnih zvrsti novic, različnih napovedi (npr. vremenske napovedi), podajanju informacij (npr. stanje na cestah, borzne informacije) in navodil (npr. napotki za vožnjo),
- izbiri ustreznega ženskega glasu – ta je nekoliko nižji in bolj aspiriran (povprečna osnovna frekvenca je nižja kot pri aktualnem ženskem glasu),
- zagotavljanju enakih snemalnih pogojev med posameznimi sejami snemanja,
- obsegu govornega korpusa, ki je precej večji od obstoječega [1].

Izbor vsebine posnetkov oz. branih besedil govorne zbirke za sintezo govora:

- ustvarila se je obsežna tekstovna zbirka besedil, ki je pokrivala različne zvrsti (dnevni časopisi, revije, leposlovje ipd.); uporabili smo tudi besedilni korpus Gigafida , ki vsebuje 1,2 milijarde besed v slovenskem jeziku,
- tokenizacija – iz zbirke besedil smo odstranili vse oznake, vezane na oblikovno podobo (glava besedila, tabele ipd.),
- okrajšave, števila ipd. smo pretvorili v polno besedno obliko (normalizacija besedil),
- besedila smo pretvorili v predvideni fonetični prepis (grafemsko-fonemska pretvorba); izvedli smo ga z modulom za

grafemsko-fonemsko pretvorbo, s katerim razpolagamo projektni partnerji.

- obseg zbirke smo optimirali glede na vnaprej pripravljene kriterije (metoda požrešnega iskanja); pri tem smo si prizadevali zagotoviti statistično ustrezno vzorčenje izbranega področja govorjenega jezika.

Izbira povedi ni potekala naključno, pač pa je bila skrbno načrtovana. Postopek izbire povedi je potekal v več korakih:

1. *Statistična obdelava besedil:*
   - Statistično obdelamo celoten besedni korpus in določimo pogostost pojavljanja posameznih glasov in glasovnih nizov v besedilu.
   - Vključimo vse stavke (povedne, velelne, vprašalne itd.) in izdelamo statistiko posameznih vrst povedi oz. stavkov.
2. *Izdelava spiska glasovnih nizov z oceno zaželenosti posameznega niza:*
   - V spisek vključimo nabor vseh teoretično možnih kombinacij difonov.
   - V spisek vključimo vse trifone, štirifone in (po potrebi) ostale zaželene (najpogostejše) polifone, na katere smo naleteli pri statistični obdelavi besedil.
   - Utež oz. ocena zaželenosti niza je odvisna od pogostosti njegovega pojavljanja v besedilu.
3. *Postopek izbire povedi:*
   - Ocenimo doprinos glasovnih nizov za vsako poved iz tekstovnega korpusa.
   - Doprinos povedi je enak vsoti vseh ocen zaželenosti nizov (iz spiska), ki se v povedi pojavijo.
   - Doprinos posamezne povedi normiramo z dolžino povedi (št. besed v povedi ali št. fonemov v povedi).
   - Določimo takšno utež, da bodo dolžine izbranih stavkov čim bolj ustrezale statistični porazdelitvi dolžin stavkov iz korpusa.
   - Izberemo poved z najvišjim normiranim doprinosom.
   - Iz spiska odstranimo vse glasovne nize, ki jih izbrana poved vsebuje.
   - Ponovno ocenimo vsako poved in izberemo najboljšo (glede na novi spisek, v katerem so izločeni tisti glasovni nizi, ki smo jih že pokrili) ter popravimo spisek.
   - Postopek ponavljamo, dokler ne izberemo želenega števila povedi.
4. *Ovrednotenje rezultatov:*
   - Vsakih 1000 povedi izdelamo statistiko difonov, trifonov, štirifonov in drugih polifonov, ki jih že pokrivamo (gre za glasovne nize, ki smo jih do takrat že izločili iz zgoraj omenjenega spiska).
5. *Dodatne izboljšave algoritma:*
   - Ker mora zbirka vsebovati vse možne kombinacije difonov, algoritem popravimo tako, da difone dodatno utežimo glede na ostale polifone. Na takšen način algoritem na začetku daje prednost povedim, ki pokrijejo čim več novih difonov. Predvidoma se vsi difoni pokrijejo že po ca. 100 stavkih.
   - Pri trifonih in štirifonih upoštevamo pri robnih glasovih tudi podatek o glasovni skupini, ki ji pripadajo (npr. štirifon "krak" ne bo doprinesel prav dosti novega v našo zbirko, če ta že vsebuje štirifon "krat"; zato oceno koristnosti takega štirifona popravimo navzdol). To lahko naredimo preprosto tako, da v spisek vnesemo dodatne nize skupaj z njihovimi frekvencami pojavljanja v korpusu (primer takega štirifona: "k"+"r"+"a"+"pripornik").
   - Algoritem z različnim uteževanjem izboljšamo tako, da končni nabor vsebuje različne povedi (povedne, vprašalne, velelne, enostavne, sestavljene, naštevanje itd.). Tako lahko isti korpus učinkovito uporabimo tudi za generiranje prozodičnih parametrov pri sintezi govora.

3. IZBIRA GOVORCEV

Pridobili smo posnetke preko 10 različnih govorcev. Te krajše posnetke (nekaj deset stavkov z dobrim pokritjem difonov) smo nato strojno označi in preizkusili na aktualnem sintetizatorju govora. Posnetke je poslušalo več poslušalcev, ki so podali svojo oceno glede naravnosti in razumljivosti govora, pa tudi glede subjektivne ocene, kateri glas se jim je zdel najprijetnejši za poslušanje. V praksi se izkaže, da so nekateri glasovi preprosto bolj primerni za izdelavo sintetizatorjev govora kot drugi. Pri tem je težko vnaprej napovedati, ali je nek glas primeren ali ne, pri tem ni splošno veljavnih pravil.

Pri izbiri govorca smo upoštevali tudi njegovo sposobnost sledenja napotkom, potrebne ponovitve med snemanjem, čas snemanja ipd. Posneli smo en moški in en ženski glas. Smotrno je, da sintetizator govora razpolaga s po dvema glasovoma za vsak spol.

Kandidate smo vnaprej seznani z namenom snemanja in možne uporabe tako pridobljenih glasov. Pred snemanjem so morali izbrani govorci podpisati pogodbo oz. privolilo, da dovolijo rabo posnetkov za potrebe sinteze govora.

4. POSTOPEK SNEMANJA

Snemanje govornega gradiva je potekalo ob prisotnosti izkušenega snemalnega operaterja z namenom, da se je preprečilo neustrezne izgovarjave besed in napake pri snemanju govora. Govorcu smo pred snemalnimi sejami podali ustrezna navodila in ga zaprositi, da povedi prebira razločno in enakomerno hitro. Med branjem besedila so imeli govorci nameščene elektrode laringografa, s katerimi smo spremljali nihanje njihovih glasilk zaradi lažjega kasnejšega označevanja osnovnih period govornega signala.

Govor smo snemali preko kvalitetnega mikrofona v digitalni obliki in sicer na namenski računalnik v studiu. Pred mikrofonom se je nahajal ustrezen filter (angl. »anti-pop filter«), ki je zadušil razne poke, tleske ipd. Potrebna je bila še ustrezna mešalna miza, zaslon in slušalke (preko katerih govorec prejema navodila in posluša povratni govor). Posnetke govora smo shranili v digitalni obliki na trajne računalniške pomnilniške medije. Frekvenca vzorčenja je 44,1 kHz, 24-bitno.

Samo snemanje celotne govorne zbirke je zaradi obsežnosti besedila, ki ga je bilo potrebno prebrati, trajalo več mesecev. Pri tem so morale nastavitve snemalne opreme ves čas ostati nespremenjene. Oseba, ki je snemanje nadzorovala, je preverila položaj govorca pred vsako snemalno sejo in jo primerjala s položaji v predhodnih sejah. Pred vsakim snemanjem je govorec poslušal svoje predhodne posnetke, s čimer se je skušal zagotoviti čim bolj enoten način govora med posameznimi snemalnimi sejami. Na začetku snemanja posamezne seje je govorec prebral nekaj vnaprej določenih fiksnih stavkov, ki so omogočali primerjavo glasnosti in višine govora med posameznimi snemalnimi sejami. Govorec ne sme biti preveč utrujen, zato je 10-minutno snemanje potekalo znotraj pol urnega intervala. Posamezna seja je trajala dve uri; znotraj tega časa smo lahko posneli 40 minut govornega materiala. Vsak govorec je opravil le eno dvourno sejo na dan.

5. OZNAČEVANJE POSNETKOV

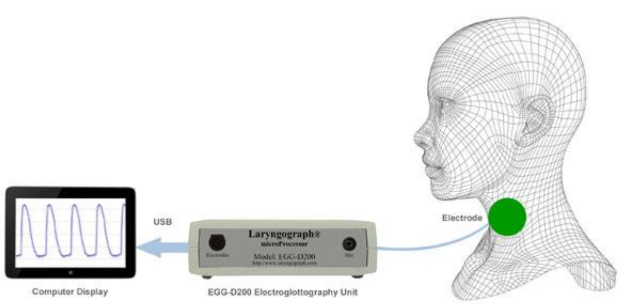
Uporabljamo tri nivoje anotacij oz. prepisov govorjenega besedila: grafemski prepis, fonetični prepis in prozodijske oznake. Ker je ročna segmentacija govora na fonetičnem nivoju naporna in dolgotrajna, smo pri tem uporabili vsaj delno avtomatizirane postopke, ki so bolj učinkoviti, če vnaprej poznamo grafemski prepis govorjenega gradiva. Avtomatskim metodam in postopkom je sledilo »ročno« popravljanje oznak, kar je ne glede na hiter razvoj tehnologije še vedno zelo zamudno. Osnovne periode govornega signala smo označili s posebnim algoritmom temelječim na izhodnem signalu larigografa.

OPIS LARINGOGRAFA

Laringograf (slika 1) je elektronska naprava za nadzor in analizo vibriranja glasilk. Obsega strojno opremo (elektrode, mikrofon, laringograf mikroprocesor priključen na računalnik) in programsko opremo (Speech Studio). Akustični signal (govor) je posnet preko mikrofona, signal elektrolaringografa pa preko dveh elektrod nameščenih preko oz. na obeh straneh glasilk. Mikrofon in elektrode so priključene na laringograf mikroprocesor, slednji pa je priključen na računalnik (slika 2).

Deluje tako, da se preko dveh elektrod, nameščenih na obeh straneh govorčevega vratu na nivoju ščitnice, spusti šibak električni tok. Z napravo nato merimo električno impedanco vratu. Ker se impedanca spreminja z nihanjem glasilk, dobimo signal, ki je dobro koreliran z osnovnim tonom izgovorjenih glasov. Časovni potek impedance je označen kot signal Lx. Lx signal se lahko nadalje obdela z namenom pridobitve informacije o času trajanju period nihanja vokalnega trakta. Dobra lastnost signala laringografa je, da je odporen na akustični šum prisoten v signalu mikrofona [3, 4].

Slika 1: Laringograf z elektrodama [5].



Slika 2: Uporaba laringografa [6].

ZAJEM PODATKOV LARINGOGRAFA

Zajem podatkov laringografa obega pravilno izbiro elektrod glede na fiziološke značilnosti govorca, njihovo pravilno namestitev in shranjevanje signala laringografa Lx.

Pravilna izbira velikosti in namestitev elektrod laringografa je zelo pomembna. Za vsakega uporabnika laringografa si je bilo potrebno vzeti dovolj časa in prilagoditi nameščene elektrode tako, da je bil signal čim močnejši. Signal laringografa in njegovo jakost pri tem opazujemo na zaslonu računalnika. Signal je najmočnejši takrat, ko sta elektrodi na nivoju glasilk. Takrat je namreč električno polje med elektrodama najbolj podvrženo vplivu samega stika med glasilkama. Pri osebah z velikim izrazitim grlom je bila namestitev elektrod preprostejša, saj smo lahko enostavno locirali obe strani ščitničinega hrustanca, dovolj velik kot elektrod pa je omogočal koncentracijo električnega polja okoli samih glasilk. Kadar grlo ni bilo tako izrazito, še posebej ko je bilo obloženo z večjimi količinami maščobnih blazinic, ga je bilo težje natančno locirati (položaj se med govorjenjem znatno spreminja). Posledično je bilo težje pridobiti »dober« in ustrezno močan signal laringografa Lx. Vendar pa za ugotavljanje osnovnih period k sreči zadostuje že relativno šibak signal. Detajli Lx signala pa so slabše razvidni oz. določljivi.

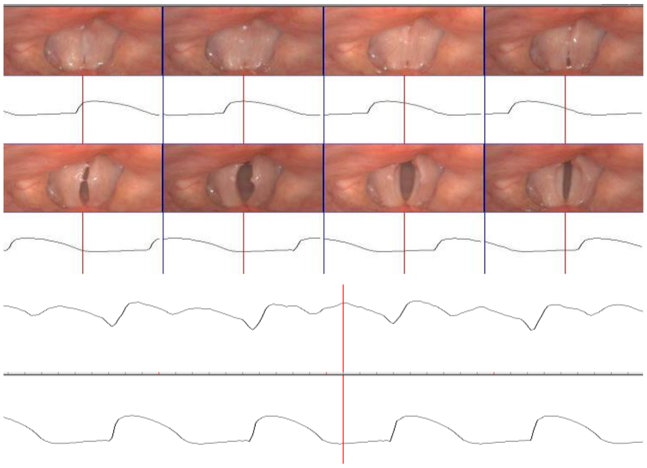
Pri ženski govorki (slika 3) smo preizkusili večje število elektrod. Kot primerne so se izkazale elektrode s premerom med 30 mm in 22 mm, medtem ko so se manjše elektrode (s premerom pod 16 mm) izkazale za neustrezne. Na koncu smo kot optimalni izbrali elektrodi s premerom 22 mm.

Slika 3: Govorka med snemanjem oz. branjem pripravljenega gradiva v tonskem studiu. V ozadju tonski tehnik, ki med snemanjem na zaslonu spremlja tako signal laringografa Lx kot tudi mikrofonski signal Sp.

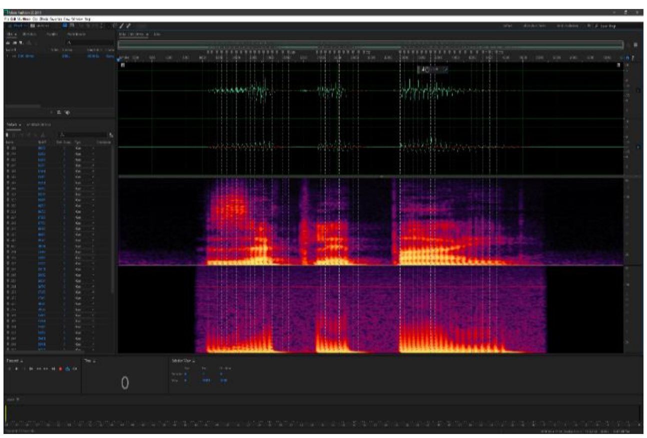
OBDELAVA PODATKOV LARINGOGRAFA

Obdelava podatkov laringografa obega označevanje osnovnih period govornega signala s pomočjo zajetega signala.

Slika 4 prikazuje osem zaporednih položajev glasilk med tvorjenjem zvenečega glasu moškega govorca. Začetno zapiranje glasilk se odraža v hitro naraščajoči krivulji Lx signala. To zapiranje povzroči akustični odziv Sp (mikrofon) signala. Pri Sp signalu tipično opazimo krajši zamik glede na Lx signal. Najvišja točka signala Lx predstavlja trenutek, ko preko elektrod laringografa steče maksimalen tok. To ustreza trenutku, ko sta glasilki v največjem kontaktu oz. najbolj skupaj. Ko sta glasilki najbolj narazen, je amplituda signala Lx najnižja. Širina konice signala pove, kako dolgo sta glasilki zaprti znotraj posameznega cikla vibriranja. Čas potreben za prehod iz ene točke signala Lx do enake točke na naslednji konici imenujemo perioda. Na takšen način lahko dobimo informacijo o osnovni frekvenci vibriranja glasilk (Fx). Informacijo o načinu odpiranja in zapiranja glasilk pa lahko dobimo iz naklona dviganja in spuščanja signala Lx. Prav tako lahko razberemo, kako dolgo sta bili glasilki zaprti.



Slika 4: Gibanje glasilk, moški glas, 120 Hz. Prikazana je serija osmih slik položaja glasilk, pridobljenih s stroboskopom, s pripadajočo oznako mesta na Lx signalu pod vsako sliko. Spodaj sta Sp (mikrofon) in Lx (laringograf) signala za šesto sliko. [5]



Slika 5: Primer govornega signala z označenimi osnovnimi periodami. Zgoraj je govorni signal posnet z mikrofonom, sledi signal laringografa Lx in spektralna prikaza obeh signalov. Navpične črte predstavljajo oznake period govornega signala.

Najprej smo preizkusili preprost algoritem za zaznavanje pulza in izračun časa trajanja med dvema impulzoma [7]. Začetek impulza predstavlja prvi vzorec, katerega amplituda je manjša od nič in hkrati manjša ali enaka amplitudi naslednjega vzorca. Konec impulza pa predstavlja zadnji vzorec, katerega amplituda je manjša kot nič in manjša ali enaka amplitudi predhodnega vzorca. Širina pulza je definirana kot časovna razlika med začetkom in koncem impulza. Vrh pulza predstavlja vzorec z največjo amplitudo med začetkom in koncem impulza (vrednost je vedno večja od nič). Trenutek pulza je določen kot prvi vzorec z amplitudo vrha pulza. Širina pulza je morala biti širša od od štirih vzorcev, vrh pulza pa je moral presegati neko arbitrarno določeno vrednost. Izračunal se je čas trajanja med dvema pulzoma, vrednost pa se je pretvorila v Hertze.

Potrebno je bilo izvesti še razločevanje med zvenečimi in nezvenečimi deli signalov. V nadaljevanju pa smo uvedli še omejitve signala Lx in sicer tako, da je Lx > 50 Hz za moški glas in Lx > 120 Hz za ženski glas. Znotraj posameznega zvenečega predela pa so morali biti vsaj trije pulzi. Takšen algoritem je že uporabna referenca za določevanje osnovne frekvence govornega signala.

Zanesljivost prvotno zasnovanega algoritma smo izboljšali tako, da smo ga dopolnili z avtokorelacijsko metodo začetne ocene osnovne frekvence. Prav tako smo predlagali dodatne dopolnitve pri prepoznavanju osnovnih period zahtevnejših fonemov, kot je to npr. fonem »r«. Z analizo koeficientov HNM smo povečali natančnost določevanja osnovne frekvence ter sredine okna. Ob tem je bilo potrebno detektirati situacije, ko je osnovni algoritem »odpovedal« in takšne situacije še posebej obravnavati in razrešiti. Z obsežnim testiranjem smo prišli do končnega algoritma, ki se je izkazal kot dovolj robusten in natančen za potrebe izgradnje govorne zbirke za sintezo govora v okviru projekta CityVOICE.

6. ZAKLJUČEK

Pri izdelavi govorne zbirke CityVOICE smo posebno pozornost namenili določanju optimalnih pogojev za snemanje govornih zbirk, določanju optimalnih fonetično in drugače uravnoteženih vsebin za snemanje govornih zbirk ter rešitvam za iskanje optimalnih govorcev.

Pri označevanju osnovni govornih period smo si pomagali s signalom laringografa. Algoritem za označevanje osnovnih period prebranega besedila, skupaj s dodatno spremljevalno kodo, je bil implementiran v programskem orodju Matlab. Prvotno zasnovani algoritem je bilo tekom preizkušanja potrebno dopolniti z obravnavo bolj zahtevnih fonemov, kot je to denimo fonem »r«, poleg tega je bilo potrebno razviti še detekcijo in obravnavo posebnih situacij, ko je osnovni algoritem »zgrešil« pravilno namestitev oznak period.

7. ZAHVALA

Operacijo CityVOICE sofinancirata Republika Slovenija in Evropska unija iz Evropskega sklada za regionalni razvoj, in sicer v okviru »Operativnega programa za izvajanje evropske kohezijske politike v obdobju 2014-2020«.

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Handling Real-World Problems within the COCO Platform

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ABSTRACT
Until recently, the problems employed for benchmarking optimization algorithms within the Comparing Continuous Optimizers (COCO) platform needed to have continuous variables and known optimal values. In addition, they had to be implemented within the platform (in the C language). These restrictions made COCO difficult to use for benchmarking algorithms on real-world problems. This paper describes the adaptations to the COCO platform that facilitate its use on real-world and other problems with integer or mixed-integer variables and unknown optimal values. Evaluation of solutions can now be done with external programs that are interfaced with COCO through socket communication.

Keywords
Real-world problems, algorithm benchmarking, the COCO platform

1. INTRODUCTION
Although Evolutionary Computation (EC) methods are often applied to real-world problems, they are almost exclusively benchmarked on artificial ones [7]. This is especially problematic in the field of Evolutionary Multi-Objective Optimization (EMO) where the most popular test problem suites like DTLZ [2] and WFG [5] have some unintended characteristics that stem from their construction and are not likely to be present in the real world. Consequently, we cannot expect algorithms that perform well on such test problems to also work well on real-world problems, which defies the very purpose of algorithm benchmarking [8].

To amend this issue, new test problems from the real world are being proposed. For example, the Mazda problem is a highly constrained problem with a large number of integer variables and two objectives [6]. It requires setting the thickness of several car parts so that their total weight is minimized and the number of parts with common thickness is maximized. The main challenge of this problem stems from its large search space dimension and the difficulty of finding feasible solutions due to the many constraints. Another example is the suite of three diverse design optimization problems that require Computational Fluid Dynamics (CFD) simulations for evaluating solutions [1]. These problems have a different number of objectives (two are single- and one is bi-objective) and can have varying search space dimension. Since the CFD simulations are time-consuming, the biggest challenge is to find good solutions to the problems in reasonable time.

Using such problems for algorithm benchmarking is nontrivial since nothing is provided but the problems themselves. A researcher who wants to use these problems in a benchmarking study still needs to take care of the algorithm performance assessment as well as run additional algorithms on the same problems to acquire data for comparisons.

An alternative is to propose real-world problems within a framework that takes care of the cumbersome aspects of algorithm benchmarking. The Comparing Continuous Optimizers (COCO) platform[1] was designed exactly for facilitating the algorithm benchmarking task [3]. It incorporates several suites of test problems, takes care of all the performance assessment and makes it easy to include data from previous experiments in the comparisons. The selection of its problem suites was recently extended to include mixed-integer problems [9] as well as real-world problems based on games [12]. This required some adaptations of the platform that are also expected to simplify future inclusions of real-world problem suites.

This paper presents the modifications that were needed for COCO to support problems with integer variables, problems with unknown optimal values and external evaluation of solutions, which were not previously explained in [9] and [12]. While discussing the details of these changes, we provide some information that can be useful when adding additional suites of (real-world) problems into COCO.

After a brief presentation of the COCO platform and its latest suites in Section 2, we explain the adaptations needed to support real-world problems within COCO in Section 3. The paper ends with concluding remarks in Section 4.

2. THE COCO PLATFORM
2.1 Overview
The aim of the COCO platform [3] is to simplify the benchmarking of numerical optimization algorithms and make the data from those experiments available to the scientific com-

[1] `https://github.com/numbbo/coco`

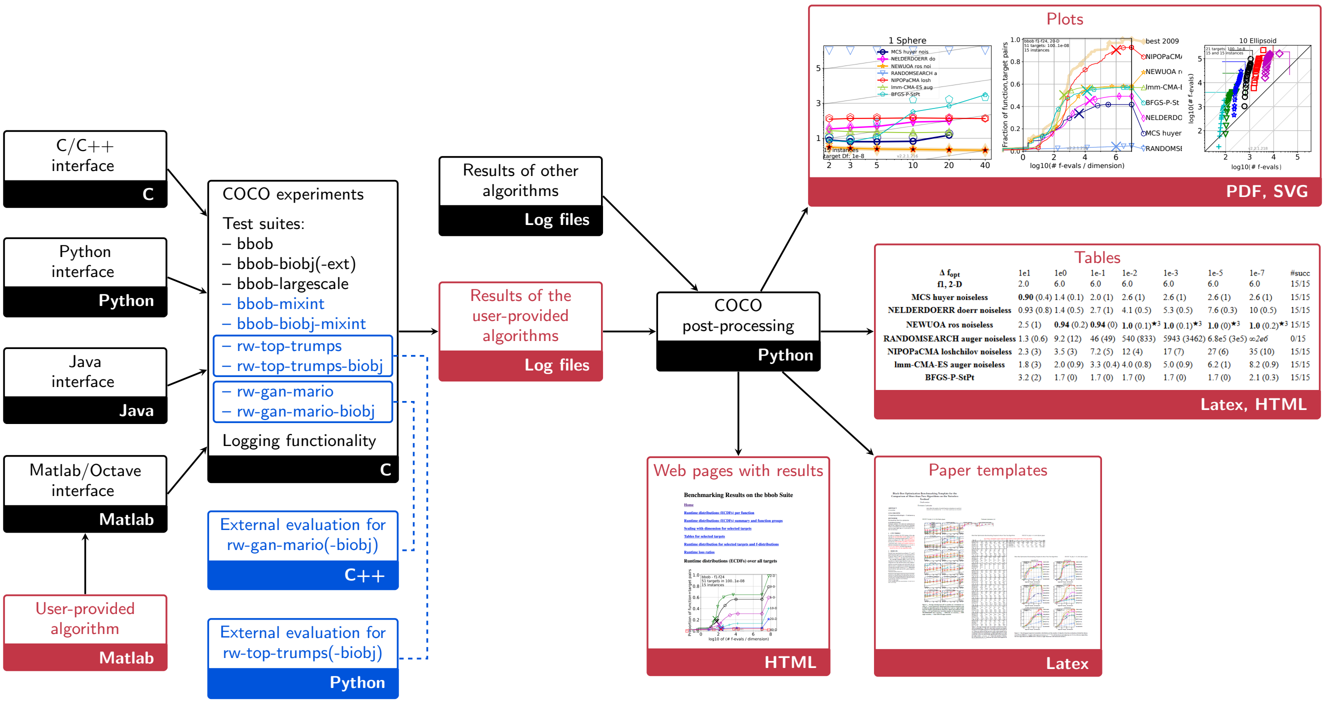

Figure 1: The COCO platform scheme. Its main components are presented in black, while the user-provided algorithm (shown here as implemented in Matlab) and its results are shown in red. Blue color is used to denote the recent additions.

munity. The platform consists of two main parts (see Figure 1). The first, called *COCO experiments*, is implemented in C. It is used for running an algorithm on the chosen test problem suite and recording its performance. The algorithm can be connected to the platform using one of the available interfaces in C/C++, Python, Java and Matlab/Octave. During the algorithm run, its results are logged into files whenever one of the performance targets is achieved.

The second part, called *COCO post-processing*, is implemented in Python. From the log files created by the experiments, it produces plots and tables with information on the performance of the algorithm as well as HTML pages to facilitate browsing through them and paper templates with the most relevant results already included. With COCO post-processing it is very easy to add the performance of other algorithms to the comparisons. Currently, results of more than 300 experiments are available. Most were collected on the `bbob` suite of 24 continuous single-objective problems without constraints or noise [4].

Until of late, all the problem suites in COCO were based on the `bbob` problems. For example, the `bbob-largescale` suite contains large-scale instantiations of the `bbob` problems [11], while the `bbob-biobj` and `bbob-biobj-ext` suites consist of bi-objective problems constructed by using the `bbob` functions as their separate objectives [10].

2.2 Recent Problem Suites

We have recently proposed a total of six new problem suites that are more real-world-like than those previously included in COCO [9, 12]. Table 1 shows summary information for some of their properties. All can be initialized with various search space dimensions and provide multiple instances that represent small perturbations of the problems. In all these suites the bi-objective problems were created by using two single-objective functions as the two objectives.

The `bbob-mixint` and `bbob-biobj-mixint` suites contain single- and bi-objective mixed-integer problems, respectively. They were constructed by discretizing the first 80% of the variables of the corresponding `bbob` and `bbob-biobj` problems. Since the discretization reduces the number of continuous variables, a large number of all variables need to be used in order to produce challenging problems. Therefore, the problem dimensions were set to be larger than those of the `bbob` problems, while the functions and instances remained the same.

The problems from the single- and bi-objective suites `rw-top-trumps` and `rw-top-trumps-biobj` are based on the Top Trumps card game. The goal (optimization problem) is to construct a deck for the game with desirable properties (objectives). The number of dimensions corresponds to the number of cards (22, 32, 42, 52) multiplied by the number of categories on a card (4), and the all-integer variable values are the values of the categories on the cards. Out of the five different objectives that measure a quality indicator of the deck, two can be computed directly and three require simulations of gameplay. The three bi-objective functions are constructed from the five single-objective ones in such a way that the two objectives are (at least partially) conflicting.

Table 1: Basic properties of the six recently proposed problem suites.

Suite name	`bbob-mixint`	`bbob-biobj-mixint`
# objectives	1	2
Dimensions	5, 10, 20, 40, 80, 160	5, 10, 20, 40, 80, 160
# functions	24	92
# instances	15	15

Suite name	`rw-top-trumps`	`rw-top-trumps-biobj`
# objectives	1	2
Dimensions	88, 128, 168, 208	88, 128, 168, 208
# functions	5	3
# instances	15	15

Suite name	`rw-gan-mario`	`rw-gan-mario-biobj`
# objectives	1	2
Dimensions	10, 20, 30, 40	10, 20, 30, 40
# functions	28	10
# instances	7	7

Lastly, the `rw-gan-mario` and `rw-gan-mario-biobj` suites contain single- and bi-objective problems of constructing levels for the well-known Super Mario Bros. platformer game to optimize the chosen objectives. The levels are generated by a Generative Adversarial Network (GAN), which learns a mapping from a continuous latent space with an arbitrary dimension to a valid level [13]. Properties of these generated levels (related to their difficulty and variety) are the optimization objectives. Out of the 28 single objectives, ten can be computed directly and the rest require simulations of gameplay. Again, the bi-objective functions were constructed by looking at the conflicts between objectives.

3. SUPPORTING PROPERTIES OF REAL-WORLD PROBLEMS

COCO was initially designed to work with the `bbob` problems that are continuous, have known optima and use the C code within COCO experiments to evaluate solutions. Here we explain in more detail the changes brought by the shift to real-world problems, which do not share these properties (see Figure 1).

3.1 Integer Variables

The Top Trumps and mixed-integer suites required supporting problems where either all or just some of the variables are integer. This entailed adding an additional parameter, which gives the number of integer variables to the internal problem class in COCO experiments as well as to the interfaces to all supported languages. Without any loss of generality we set that all the integer variables come before any continuous ones, which means that this single addition is enough to support problems with (some) integer variables (the parameter is naturally set to zero for continuous problems). The integer variables are internally still represented as real values with double precision. It is then up to the evaluation function to make sure they are correctly interpreted as integers.

In addition, the COCO loggers can be configured to output these variables as integers, which can save considerable space in case of a large number of integer variables (such as in the Top Trumps suites). This is done through the observer's `log_discrete_as_int` parameter (set to false by default).

3.2 Unknown Optimal Values

In COCO, an evaluation is logged whenever it surpasses a target value. When an algorithm is run on problems with known optimal values, the target values are defined as differences to the optimal function value (in the single-objective case) or to the optimal value of a multi-objective performance indicator (in the multi-objective case). In the usual benchmarking setting in COCO, the targets are chosen equidistantly in logarithmic scale. Therefore, it is very important that the optimal value is known (or is at least very well approximated). If the estimate of the optimal value is (too) optimistic, the smallest target values will never be reached. If, on the other hand, the estimate is (too) pessimistic, the algorithm will be able to reach all targets while still being arbitrarily far away from the optimal value.

The discretization of the `bbob` and `bbob-biobj` problems that produced mixed-integer problems was performed in such a way that the optimal values remained equal and are therefore known (see [9] for more details). This means that similarly to their corresponding continuous predecessors, the optima for the `bbob-mixint` problems are known, while for the `bbob-biobj-mixint` problems, the ideal and nadir points are known, but not the Pareto sets and fronts (except for the special case of the double sphere function). In contrast, most Top Trumps and Mario GAN problems have unknown optimal values already in their single-objective formulation, which is to be expected in the majority of real-world problems. Consequently, neither the Pareto sets and fronts nor the ideal and nadir points are known for the bi-objective game-based problems.

While the issue of unknown optimal indicator values for the `bbob-biobj` problems is amended by providing an estimate of indicator values using all nondominated solutions from several runs of a number of algorithms, this approach is not feasible for real-world problems.

In order to support real-world problems with unknown optimal values, we are using an infinite number of equally spaced absolute target values aligned at zero with a step of 10^{-5}. This assumes that the difference between best and worst objective values is not much smaller than 1. In this way, the logger records an evaluation each time the algorithm finds a function (or performance indicator) value that improves the best found one by at least 10^{-5}. Such a strategy makes sure that the convergence to the optimal value can be detected (up to the precision of 10^{-5}) regardless of its absolute value.

After the experiments, the targets of interest need to be chosen for the post-processing part. This requires some preliminary analysis of the results. Once the targets are chosen, they can remain the same for future experiments or change in order to account for better solutions found later on. This does not affect the ability to add previously computed results to the comparison as the post-processing is always run anew.

3.3 External Evaluations

While artificial problem suites can be implemented in C with some moderate effort, this is much harder to do for real-world problems (especially those that are not originally available in C). To address this issue, we added the possibility to evaluate solutions using an external evaluator that is not provided by COCO.

This is achieved by the means of *socket communication*, where the external evaluator acts as a server waiting to be queried and COCO as the client that continuously queries the server with proposed solutions. In such a case, the 'frame' of the suite that provides the general information about its problems still needs to be implemented in COCO, however, this is rather straightforward and has been automated with a script.

Evaluation of solutions using socket communication works as follows. COCO (the client) sends to the external evaluator (the server) a solution together with the information needed to identify the problem, that is, the function and instance identifier and the number of dimensions. If needed, other parameters can also be passed at the same time. When the external evaluator receives the query, it evaluates the given solution with the right problem and returns the objective and constraint values as a response to the query.

This is a quite flexible and efficient way to communicate with an external evaluator. It is much faster than writing to and reading from files. It is also very versatile—the external evaluator can really be external (not even run on the same computer as COCO), which might be important for some real-world problems that cannot be disclosed.

4. CONCLUSIONS

By adding to COCO the support for problems with integer variables, unknown optimal values and external evaluation of solutions, we have opened its use for benchmarking optimization algorithms on real-world problems. We hope that the mixed-integer and game-based problem suites described in this paper are just the start and other real-world problems, such as the Mazda problem and the CFD problems mentioned in the Introduction will follow soon.

The code with the functionality described in the paper can be found at `https://github.com/ttusar/coco/tree/gbea`.

5. ACKNOWLEDGMENTS

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Risk Stratification of Cardiac Patients by Utilizing Additional Unlabeled Examples

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ABSTRACT
In the paper we address the challenge of cardiac patient risk stratification using the additional unlabeled data. The motivation for using unlabeled data comes from the field of semi-supervised learning (SSL), which has shown that additional unlabeled data can improve accuracy of supervised learning models. In addition to traditional SSL, we propose three new approaches that are based on active learning (AL), fuzzy learning (FL), and supervised clustering (SC). We evaluate them on the UCI ML heart disease dataset and with four different classification models. The results show that our approaches increase the inductive performance compared to the learning algorithms trained exclusively on labeled data. The most favorable performance was achieved with the fuzzy learning approach that utilizes a reliability estimate for selection of the most beneficial additional examples.

Keywords
risk stratification, cardiovascular diseases, machine learning, knowledge transfer, semi-supervised learning, active learning, fuzzy learning, supervised clustering, unlabeled examples

1. INTRODUCTION
Cardiovascular diseases (CVDs) are the leading cause of morbidity and death worldwide, together with cancer and chronic respiratory diseases. To prevent them, people with increased risk need early identification and medical guidance. In the past two decades, researchers have invested a lot of effort to develop clinical decision support systems for risk assessment of CVDs, but only some are included in clinical guidelines [2].

In this paper we tackle the issue of developing a patient risk stratification model, which classifies patients into levels for having a serious cardiac event. To improve the predictive performance we utilize ideas from the field of semi-supervised learning, which have shown that utilization of additional unlabeled data can improve accuracy of supervised learning models. Applying unlabeled data has advantages, such as not relying on expertise to label examples, which saves time, effort and reduces cost [12].

To perform knowledge transfer from unlabeled examples to supervised learning, we apply our implementation of the following four approaches: traditional semi-supervised learning as the baseline (SSL), active learning (AL), fuzzy learning (FL), and supervised clustering (SC). In the latter three approaches we pay special attention on how to perform the *instance knowledge transfer* to properly *select the right examples for the training data.*

The paper is structured as follows. Related work is presented in Section 2. Our approaches are described in Section 3. The evaluation and results are given in Section 4. The last section concludes the paper and gives directions for future work.

2. RELATED WORK
The rapid development of predictive models for cardiac and cardiovascular disease diagnostics happened between years 2000 and 2013 [6]. In European guidelines, Systematic COronary Risk Evaluation (SCORE) estimates the ten-year risk for a fatal cardiovascular event, such as heart attack, stroke, aneurysm of the aorta, by stratifying patients into four risk groups: low, moderate, high, and very high. Different databases contain different risk level definitions. To facilitate an initial approach to the problem, we have chosen a simpler public Cleveland database with two levels of risk. The most commonly used machine learning (ML) algorithms for heart disease diagnosis are: Support Vector Machine (SVM), Naive Bayesian classifier (Naive Bayes), Artificial Neural Network (ANN) and Decision tree (DT). Parthiban et al. [10] used SVM with RBF kernel and Naive Bayesian classifier for diagnosis of heart disease in diabetic patients. The accuracy of their approach was 94.6% and 74%, respectively. Dangare et al. [3] propose using ANN with an extended feature set for heart diseases. They included information about obesity and smoking as the risk factors for coronary heart disease. Das et al. [4] used the ensemble approach of three ANN with a tangent sigmoid function, single hidden layer, and 14 neurons. The experimental results gained 89% classification accuracy for heart disease diagnosis.

Lately, knowledge transfer (transfer learning) has become popular in the field of machine learning [9, 7]. The reasons for transferring knowledge are often associated with a lack of learning data for the target problem or with the time it takes to learn a new model. Partially labeled training data have shown to improve performance in machine learning [8]. Such data are often also easier and cheaper to obtain. Knowledge transfer approaches are also found in different medical fields: pneumonia risk assessment with multi-task learning, lifelong inductive learning in the field of heart disease and sequential inductive a model for knowledge transfer in the field of coronary artery disease diagnosis [7]. A problem that can occur during the transfer of knowledge is the so-called *neg-*

ative transfer, which harms the learning success for the new domain [9].

3. UTILIZATION OF UNLABELED EXAMPLES

In this section we present four approaches for learning from partially labeled data using knowledge transfer. Each approach uses a learning algorithm to derive the knowledge from a small portion of labeled data. This knowledge is then used to classify unlabeled examples, which afterwards supplement the original training data set to increase the final prediction accuracy.

3.1 Semi-Supervised Learning

A well-known approach of SSL is called self-learning [12]. It first trains on labeled examples, then classifies the unlabeled examples and combines the latter with the initially labeled data. The extended dataset is used for further supervised learning. This method allows us to build on top of it and serves as a baseline in our experiments.

3.2 Active Learning

Active learning (AL) can similarly work with partially labeled data [11]. Its main goal is to find unlabeled examples that have the greatest potential to improve performance and present them to the teacher (oracle) who does the annotation process. The labeling of example is thus done iteratively rather than for all unlabeled dataset at once.

When selecting examples, we desire such that are labeled the most reliably. To estimate this reliability, we apply two metrics: (1) posterior class probability and (2) local modeling of prediction error with estimate CNK [1]. The posterior class probability for a given an example is provided by the learning algorithm. The reliability measure CNK estimates the reliability of the prediction by observing the local prediction error. In this work we adapt the original CNK estimate (designed for regression) for classification and compute it for each query example as:

$$CNK = \frac{\sum_i^k P_R(C_i)}{k}$$

where where C_i is an example from the local neighborhood $\{C_1, ..., C_k\}$ of our query example, and $P_R(C_i)$ is the posterior probability that the neighbor is classified into R, which is the class into which our query example is also classified. To summarize, CNK measures the average posterior probability for the classification into query example's class within its neighborhood. Such CNK estimate is defined on the interval $[0, 1]$, where 0 or 1 indicate unreliable or reliable classifications, respectively. In our experiments, we applied the size of the neighborhood $k = 5$, as used in the authors' original work.

The algorithm stops when any of the following three stopping criteria is reached. The first criterion defines the maximum number of iterations (N), which can be useful for large data sets. The second criterion stops the algorithm when there are no examples with reliable classifications. The third criterion is fulfilled when all the unlabeled examples have been utilized.

3.3 Fuzzy Learning

Our Fuzzy learning (FL) approach labels examples with probabilities for belonging to all possible classes. We further use these probabilities to assign class probabilities to unlabeled examples as weighted class probabilities of the nearest neighbors using the locally weighted regression (LWR). We observe each class separately and assign a fuzzy class probability to each unlabeled example. A fuzzy class probability is derived from the class probabilities of local neighbors, which are weighted with the distance to the observed example and then summed up.

The weighted probabilities are afterwards calibrated to scale up to 1, to ensure probabilistic interpretation. We use measures of reliability, such as posterior class probability and local modeling of prediction error (CNK, as already described), to select examples which we include into the training set across multiple iterations. Finally, the learning algorithm is trained on the combined training set.

The algorithm stops either when a maximum number of iterations is reached, it runs out of data, or when labeling is not reliable enough to extend the training set.

3.4 Supervised Clustering

Supervised clustering (SC) differs from classical clustering methods by considering class values during the clustering process [13]. Our approach looks for representative examples in the available data. We assign each example a class of the closest representative. All examples are then used to train the learning algorithm.

To find the representatives, we apply the iterative `SRIDHCR` algorithm [5]. The algorithm first constructs a random set of representatives, which represents the current solution. In each iteration, a single non-representative is added and another single representative is removed, generating two new candidate sets of representatives. Next, the algorithm evaluates each generated candidate set X using the fitness function $q(X)$:

$$q(X) = impurity(X) + \beta * \begin{cases} \sqrt{\frac{|K|-c}{N}} & |K| > c \\ 0 & |K| \leq c \end{cases}$$

which minimizes cluster impurity and punishes large number of clusters. The punishment is controlled with the input parameter β and takes effect if the number of clusters |K| is higher than the number of classes c. The candidate set, which improved the current best solution, is saved. In the next iteration, the procedure repeats itself until the algorithm cannot find a better set of representatives. The algorithm also utilizes a parameter S_{size}, which controls the number of candidate sets generated in each iteration. A higher value increases the probability of finding a better set of representatives because the algorithm performs more permutations.

Finally, we use the set of representatives from `SRIDHCR` to label the unlabeled data using the nearest neighbor approach. The final model is then trained on the combined data.

4. EVALUATION AND RESULTS

We evaluated our approaches on the Cleveland heart disease data from the UCI ML repository. The dataset has 297 patients of which 54% belong to low-risk (healthy) class and

46% to high-risk class. Two thirds of of patients are male with the average age of 54 years, and the remaining are female with the average age of about 56 years. We measured the performance using the Area Under a ROC Curve (AUC), which summarizes the overall performance of the model and reflects the discriminating ability to diagnose patients with and without the disease.

At the beginning of the evaluation process, we randomized the data. Next, the data was split using the 5-fold cross-validation into training and test sets. Since our experimental data set does not contain unlabeled examples, we split the training set into the labeled and unlabeled set (simulated, by hiding examples' classes). The ratio between the labeled and unlabeled set is controlled with an input parameter. In the experiments, we limited the AL and FL to 10 iterations and set their threshold to select examples with reliability at least 0.8. The SC generates 10 candidate sets for the representatives. The penalty (β) is set to 1.0 to prevent large numbers of representatives. The `SRIDHCR` algorithm performs restarts 30 times during the search process.

We used four different learning algorithms – Decision Tree (DT, using information gain and minimum number of 20 examples in leaves), K-Nearest Neighbors (KNN, with $k = 5$ and using Euclidean distance), Naive Bayesian classifier (NB) and Support Vector Machine (SVM, with linear kernel, regularization weight of 1 and termination criterion of 0.001). For each combination of approach and the learning algorithm we computed the *transductive* and *inductive* performance. The former reflects the quality of *transfer learning* by measuring labeling accuracy only of unlabeled examples prior their inclusion into the original learning data set. The inductive performance measures the final performance of the model that was built on the extended data set.

The transductive performance is shown in Table 1 and the inductive performance in Table 2. The first column displayes the percentage of labeled examples that were used in the experiments. Approaches AL and FL are displayed twice (with the use of posterior probability and with the use of the CNK estimate). The results of the transductive analysis show that on the average FL with CNK selection method obtains the highest AUC. Using 20% initially labeled examples, the obtained AUC is equal to 0.85 ± 0.03 and increases to 0.90 ± 0.05, with 80% of labeled examples. The AL approach shows low-averaged performance in combination with SVM, which in some cases learned to predict the opposite classes. The SC obtained the lowest transductive performance of 0.65 ± 0.14 on 20% and 0.75 ± 0.13 on 80% of labeled examples.

The inductive evaluation resembles the results of the transductive evaluation. The results of all approaches have decreased compared to transductive for about 0.05. FL obtained the best results followed by AL. The significant difference compared to the transductive results can be seen for SC. The predictive models obtain comparable performance, even though many misclassified examples were introduced. Using the 80% of initially labeled examples, the SC obtained AUC of 0.81 ± 0.05, which is equal to the other approaches.

5. CONCLUSIONS

We experimented with four different approaches for including unlabeled examples into risk stratification. The obtained results are comparable to the results in related works. The utilization of additional examples shows promising results, especially with the fuzzy learning approach that utilizes reliability estimate CNK.

In the future, we shall evaluate the methodology on databases with more complex risk levels. Secondly, we shall also analyze the performance of supervised learning algorithms and impact of their parameters. Thirdly, neural networks and deep learning are opening promising directions also in medical problems. Due to the limitation of resources, we did not include them in this work, but shall also include them in the work to follow.

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LABELS	METHOD	DT	KNN	NB	SVM	$\bar{x}$	p-value
20%	SSL	0.71 ± 0.05	0.80 ± 0.02	0.77 ± 0.06	0.79 ± 0.04	0.77 ± 0.04	-
	AL	$\underline{0.75 \pm 0.06}$	$\underline{0.87 \pm 0.03}$	0.79 ± 0.05	$\underline{0.42 \pm 0.42}$	$\underline{0.70 \pm 0.14}$	0.017
	AL (CNK)	$\underline{0.83 \pm 0.04}$	$\underline{0.82 \pm 0.03}$	$\underline{0.84 \pm 0.03}$	$\underline{0.68 \pm 0.20}$	$\underline{0.79 \pm 0.07}$	< 0.001
	FL	$\underline{0.81 \pm 0.05}$	0.81 ± 0.05	$\underline{0.81 \pm 0.05}$	0.81 ± 0.05	$\underline{0.81 \pm 0.05}$	< 0.001
	FL (CNK)	$\underline{0.85 \pm 0.03}$	$\underline{0.85 \pm 0.03}$	$\underline{0.85 \pm 0.03}$	$\underline{0.85 \pm 0.03}$	$\underline{0.85 \pm 0.03}$	< 0.001
	SC	0.64 ± 0.15	$\underline{0.64 \pm 0.13}$	$\underline{0.67 \pm 0.14}$	$\underline{0.66 \pm 0.13}$	$\underline{0.65 \pm 0.14}$	< 0.001
	$\bar{x}$	0.77 ± 0.06	0.80 ± 0.05	0.79 ± 0.06	0.70 ± 0.15	-	-
50%	SSL	0.75 ± 0.05	0.82 ± 0.02	0.79 ± 0.05	0.81 ± 0.02	0.79 ± 0.03	-
	AL	$\underline{0.82 \pm 0.06}$	$\underline{0.88 \pm 0.03}$	$\underline{0.84 \pm 0.05}$	0.66 ± 0.39	$\underline{0.80 \pm 0.13}$	< 0.001
	AL (CNK)	$\underline{0.87 \pm 0.03}$	$\underline{0.85 \pm 0.03}$	$\underline{0.87 \pm 0.03}$	0.74 ± 0.27	$\underline{0.83 \pm 0.09}$	< 0.001
	FL	$\underline{0.86 \pm 0.03}$	$\underline{0.86 \pm 0.03}$	$\underline{0.86 \pm 0.03}$	$\underline{0.86 \pm 0.03}$	$\underline{0.86 \pm 0.03}$	< 0.001
	FL (CNK)	$\underline{0.88 \pm 0.02}$	$\underline{0.88 \pm 0.02}$	$\underline{0.88 \pm 0.02}$	$\underline{0.88 \pm 0.02}$	$\underline{0.88 \pm 0.02}$	< 0.001
	SC	0.70 ± 0.13	$\underline{0.72 \pm 0.12}$	$\underline{0.73 \pm 0.12}$	$\underline{0.72 \pm 0.13}$	$\underline{0.72 \pm 0.13}$	< 0.001
	$\bar{x}$	0.81 ± 0.06	0.84 ± 0.04	0.83 ± 0.05	0.79 ± 0.14	-	-
80%	SSL	0.77 ± 0.06	0.81 ± 0.05	0.81 ± 0.07	0.82 ± 0.06	0.80 ± 0.06	-
	AL	$\underline{0.82 \pm 0.07}$	$\underline{0.90 \pm 0.04}$	$\underline{0.86 \pm 0.05}$	0.46 ± 0.46	$\underline{0.76 \pm 0.15}$	< 0.001
	AL (CNK)	$\underline{0.88 \pm 0.05}$	$\underline{0.87 \pm 0.05}$	$\underline{0.88 \pm 0.05}$	0.56 ± 0.43	$\underline{0.80 \pm 0.15}$	< 0.001
	FL	$\underline{0.87 \pm 0.06}$	$\underline{0.87 \pm 0.06}$	$\underline{0.87 \pm 0.06}$	$\underline{0.87 \pm 0.06}$	$\underline{0.87 \pm 0.06}$	< 0.001
	FL (CNK)	$\underline{0.90 \pm 0.05}$	$\underline{0.90 \pm 0.05}$	$\underline{0.90 \pm 0.05}$	$\underline{0.90 \pm 0.05}$	$\underline{0.90 \pm 0.05}$	< 0.001
	SC	0.75 ± 0.13	$\underline{0.76 \pm 0.11}$	$\underline{0.72 \pm 0.13}$	0.75 ± 0.16	$\underline{0.75 \pm 0.13}$	0.003
	$\bar{x}$	0.83 ± 0.07	0.85 ± 0.06	0.84 ± 0.07	0.73 ± 0.20	-	-

Table 1: Transductive AUC performance for different percentages of labeled examples, labeling approaches and four classifiers. Statistically significant differences to the baseline (SSL) approach are underlined.

LABELS	METHOD	DT	KNN	NB	SVM	$\bar{x}$	p-value
20%	BASE	0.72 ± 0.07	0.80 ± 0.05	0.78 ± 0.06	0.80 ± 0.06	0.77 ± 0.06	-
	SSL	0.72 ± 0.07	0.80 ± 0.05	0.79 ± 0.06	0.80 ± 0.06	0.77 ± 0.06	0.938
	AL	0.72 ± 0.08	0.83 ± 0.05	$\underline{0.76 \pm 0.06}$	$\underline{0.66 \pm 0.16}$	$\underline{0.74 \pm 0.09}$	0.032
	AL (CNK)	0.72 ± 0.08	0.81 ± 0.05	0.80 ± 0.05	0.80 ± 0.07	0.78 ± 0.06	0.066
	FL	$\underline{0.76 \pm 0.07}$	0.79 ± 0.05	0.77 ± 0.05	0.78 ± 0.06	0.78 ± 0.06	0.881
	FL (CNK)	$\underline{0.78 \pm 0.05}$	0.80 ± 0.04	0.79 ± 0.05	0.80 ± 0.06	$\underline{0.79 \pm 0.05}$	0.016
	SC	$\underline{0.65 \pm 0.15}$	0.67 ± 0.16	$\underline{0.77 \pm 0.08}$	$\underline{0.68 \pm 0.15}$	$\underline{0.69 \pm 0.14}$	< 0.001
	$\bar{x}$	0.72 ± 0.08	0.78 ± 0.06	0.78 ± 0.06	0.76 ± 0.09	-	-
50%	BASE	0.73 ± 0.07	0.80 ± 0.03	0.78 ± 0.06	0.81 ± 0.05	0.78 ± 0.05	-
	SSL	0.73 ± 0.07	0.81 ± 0.04	0.79 ± 0.05	$\underline{0.80 \pm 0.06}$	0.78 ± 0.06	0.394
	AL	0.74 ± 0.08	0.81 ± 0.04	0.79 ± 0.05	0.80 ± 0.05	0.79 ± 0.06	0.993
	AL (CNK)	$\underline{0.76 \pm 0.07}$	0.81 ± 0.05	0.80 ± 0.05	0.81 ± 0.05	0.79 ± 0.05	0.071
	FL	$\underline{0.79 \pm 0.05}$	$\underline{0.77 \pm 0.05}$	$\underline{0.81 \pm 0.05}$	0.82 ± 0.05	0.80 ± 0.05	0.087
	FL (CNK)	$\underline{0.82 \pm 0.04}$	$\underline{0.78 \pm 0.05}$	$\underline{0.81 \pm 0.05}$	0.81 ± 0.05	$\underline{0.81 \pm 0.05}$	0.002
	SC	0.71 ± 0.10	0.77 ± 0.08	0.80 ± 0.05	$\underline{0.75 \pm 0.12}$	0.76 ± 0.09	0.102
	$\bar{x}$	0.75 ± 0.07	0.79 ± 0.05	0.80 ± 0.05	0.80 ± 0.06	-	-
80%	BASE	0.77 ± 0.05	0.83 ± 0.04	0.81 ± 0.05	0.83 ± 0.06	0.81 ± 0.05	-
	SSL	0.77 ± 0.05	0.83 ± 0.04	0.82 ± 0.05	0.82 ± 0.05	0.81 ± 0.05	0.851
	AL	0.78 ± 0.04	0.83 ± 0.04	0.82 ± 0.05	0.82 ± 0.05	0.81 ± 0.05	0.334
	AL (CNK)	0.77 ± 0.04	0.83 ± 0.04	0.82 ± 0.05	0.83 ± 0.05	0.81 ± 0.05	0.680
	FL	$\underline{0.81 \pm 0.05}$	$\underline{0.78 \pm 0.07}$	$\underline{0.83 \pm 0.05}$	0.83 ± 0.06	0.81 ± 0.06	0.651
	FL (CNK)	$\underline{0.80 \pm 0.03}$	$\underline{0.78 \pm 0.05}$	$\underline{0.83 \pm 0.05}$	0.83 ± 0.05	0.81 ± 0.05	0.899
	SC	0.78 ± 0.05	0.83 ± 0.06	0.82 ± 0.06	0.82 ± 0.05	0.81 ± 0.05	0.818
	$\bar{x}$	0.78 ± 0.05	0.82 ± 0.05	0.82 ± 0.05	0.83 ± 0.05	-	-
100%	BASE	0.79 ± 0.04	0.82 ± 0.04	0.82 ± 0.05	0.83 ± 0.03	0.82 ± 0.04	-

Table 2: Inductive AUC performance for different percentages of labeled examples, labeling approaches and four classifiers. Statistically significant differences to the baseline (BASE - a model trained on initially labeled data) approach are underlined.

Fitness-Based Student Clustering Combining Clustering Algorithms and Dimensionality Reduction

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ABSTRACT

Health status and well-being of persons are significantly influenced by their physical fitness since, for example, low fitness is related to several health risks. Identification of unfit persons enables us to personalize advice or recommendations to improve their fitness. However, this identification is not straightforward or standardized. For this purpose, we propose a combination of dimensionality reduction methods and clustering algorithms on data from a test battery used in schools. Such an approach enables teachers, parents and policy makers to identify clusters of fit and unfit students, and better target actions for improving student fitness.

Keywords

Clustering algorithms, Dimensionality reduction, Student clustering

1. INTRODUCTION

Physical fitness has significant impact on health and well-being, since several health risk factors are related to low fitness (see examples in [4] and [2]). In order to reduce the risks, the physical fitness should be improved. This can be achieved, for example, in schools, where teachers, parents and policy makers can create and provide advice and recommendations. Although general advice and recommendations are possible, they are more efficient, when they are personalized and better-targeted. However, to achieve this, we firstly need to identify unfit students, which is not trivial.

Identification of fit and unfit students is not straightforward or standardized. There are some metrics, such as body mass index (BMI) [3] and the related Overweight and Obese Adolescents (OOA) categories [1], which enable identifying underweight, normal weight, overweight, and obese persons. However, these metrics are not directly related to the physical fitness and consequently cannot be effectively used to identify unfit students. To cluster students into fit and unfit, we propose to apply dimensionality reduction methods and clustering algorithms on data from widely used test battery. The identification of unfit students will enable decision makers to personalize actions for improving students' fitness.

The paper is further organized as follows. The procedure for identification of fit and unfit students is presented in Section 2. Section 3 describes the experiments in terms of the used dataset and the obtained results. Finally, Section 4 concludes the paper with ideas for future work.

2. IDENTIFICATION OF FIT AND UNFIT STUDENTS

The goal of the developed procedure is the identification of fit and unfit students. Since there are different risks between underweight, normal weight and overweight students, we focus only on one of these categories, namely overweight students. Note that this category also includes obese persons.

The developed procedure takes into account a set of physical fitness measurements, known as SLOfit test battery[1], which are performed yearly in Slovenian schools. The set of measurements is shown in Table 1. These attributes are given as raw data or as percentiles, where the attribute's percentile, i.e., the attribute's quantile, is the rank of the student based on this attribute within the set of students of the same sex and age. In addition to the measurement data, the procedure can also take into account a set of additional attributes that are shown in Table 2. Note that Fitness index (FI) is the quantile rank of the sum of the quantile ranks of the fitness measurements.

Table 1: Measurements of the test battery.

Measurement	Short name
Thickness triceps skinfold	TTSF
Reaction time during arm plate tapping	TAPT
Distance during standing broad jump	DSBJ
Time pass polygon backwards on all fours	TOCB
Number sit-ups in 60 s	NSU
Distance fingertips-toes, bending forward	DSR
Time bent arm position, hanging from bar	TBAH
Time run 60 m	T60m
Time run 600 m	T600m

The proposed procedure searches for fit and unfit students as follows. The input data consist of the measurement attributes and (a subset of) additional attributes. These data are clustered into groups of students. However, the true clusters are not given thus the quality of clustering cannot be easily assessed. As a solution, we apply dimensionality reduction to obtain two-dimensional representation of data, which is then visually assessed in terms of meaningfulness of the obtained clusters. The meaningfulness of the clusters is assessed based on two clusters' properties:

[1] http://en.slofit.org/measurements/test-battery

Table 2: Additional attributes.

Attribute	Short name
Sex	SEX
Height (raw or percentile)	H
Weight (raw or percentile)	W
Grade	GRD
Age	AGE
Fitness index	FI
OOA categories	OOA
Body Mass Index	BMI

1. We aim at obtaining at least two clusters that are separable in the reduced-dimensional space.

2. The obtained clusters should not be correlated to discrete attributes, i.e., SEX, GRD, AGE, and OOA. Such correlation is not wanted due to the fact that the easiest way to cluster or reduce dimensions is to focus on attributes that are already separable, e.g., discrete attributes. However, such a clustering/dimensionality reduction is meaningless for decision making, e.g., it makes no sense to find clusters of males and females since these clusters are already known.

In our procedure, we apply the following clustering algorithms: KMeans, Affinity Propagation, Mean Shift, and Birch. In addition, we use the following dimensionality reduction methods: Factor analysis (FA), Principal component analysis (PCA), Singular value decomposition (SVD), Independent component analysis (ICA), Isometric mapping (ISOMAP), and Uniform manifold approximation and projection (UMAP). The developed procedure works as follows. For each combination of clustering algorithms and dimensionality reduction methods we apply the following steps.

Step 1: A subset of data is randomly selected to make clustering and dimensionality reduction feasible (due to the fact that some methods are computationally intensive).
Step 2: This subset is clustered and the model for data clustering is obtained.
Step 3: Dimensionality reduction method is applied on the subset and the model for dimensionality reduction is obtained.
Step 4: The entire dataset is clustered with the clustering model.
Step 5: The model for dimensionality reduction is applied on the entire dataset.
Step 6: The entire dataset is presented in the reduced-dimensional space. Clusters are marked with different colors.
Step 7: This representation is visually assessed in terms of meaningfulness of the obtained clusters.

3. EXPERIMENTS AND RESULTS

The proposed procedure was evaluated on two relevant sets of students from the SLOfit dataset: a) High school students (ages 15–19), and b) Elementary school students (up to age of 11). In addition, only data from the most recent year was used, i.e., 2018. The attributes are shown in Tables 1–2. Note that the data of high school students included GRD, but not AGE, while data of elementary school students included AGE, but not GRD. The following sections present the analysis of the data, which was performed in two steps.

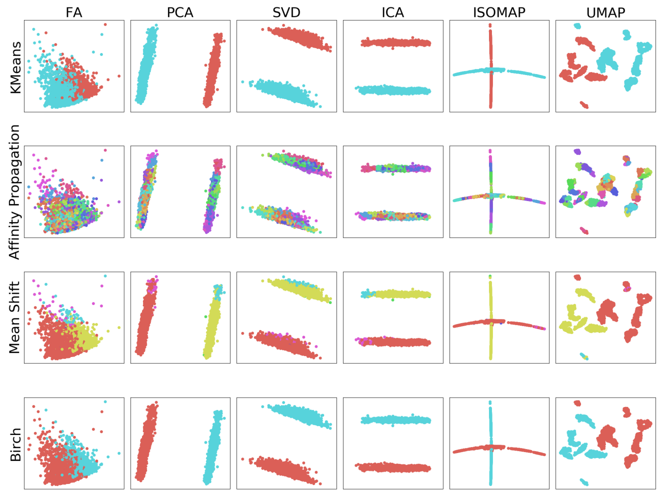

Figure 1: Dimensionality reduction and clustering on nonpercentile data from high school students. Reduced dimensions are presented with position in the new space, while clusters are shown with different colors.

3.1 Initial Analysis

The initial analysis was performed on all the attributes and with all the clustering algorithms and dimensionality reduction methods. The results are presented in Figure 1. This figure shows that several dimensionality reduction methods found two (separable) clusters, i.e., PCA, SVD, and ICA. In addition, KMeans and Birch identified those two clusters. However, the highest correlation with these clusters are obtained by SEX (see Figure 2). In addition, Figure 3 confirms that the two clusters obtained with reduced dimensions represent two sexes. Such clusters are obvious and thus not interesting for the decision makers.

Additional tests were performed on subsets of attributes and the results showed that only some subsets produced interesting clusters. Therefore, we decided to systematically assess various subsets of attributes. Since the measurements (see Table 1) are (probably) the most suitable for determining the physical fitness, we evaluated only the subsets of additional attributes (see Table 2), while measurements were always considered.

The results also indicated that some clustering algorithms and dimensionality reduction methods were redundant or uninformative. For example, Mean Shift and Affinity Propagation found more clusters than needed, while KMeans and Birch discovered the best (but the same) clusters (see Figure 1). Therefore, KMeans and Birch are redundant and we prefer KMeans among them due to its simplicity. In addition, dimensionality reduction methods can be divided into two groups: a) components/factor based (FA, PCA, SVD, and ICA), and b) projection based (ISOMAP and UMAP). The former, for example, aim at maximizing the variance

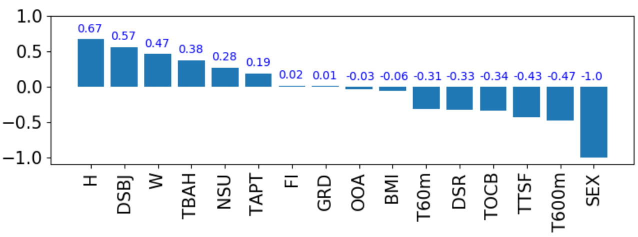

Figure 2: Correlation of clusters found by KMeans with the attributes on nonpercentile data from high school students.

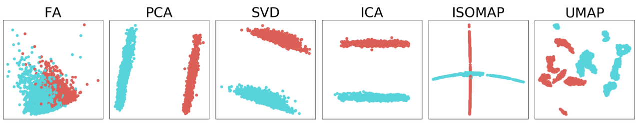

Figure 3: Relation between data in reduced dimensions and the SEX attribute on nonpercentile data from high school students, where SEX is shown with different colors.

in the dataset (PCA), while the latter try to maintain the distances between the data. Therefore, one representative of each group should be used, i.e., PCA as the most widely used from the first set, and UMAP (that is faster than ISOMAP) from the second set.

3.2 Systematic Analysis

Based on the results from the initial analysis, we decided to systematically evaluate all subsets of additional attributes (see Table 2) using only KMeans for clustering, and PCA and UMAP for reducing dimensions. Note that measurements' data (see Table 1) were always taken into account. In this way, the number of tested subsets of attributes was $2^7 = 128$ (due to 7 additional attributes). Each subset of attributes was evaluated four times: 1) percentile attributes of elementary school data, 2) nonpercentile attributes of elementary school data, 3) percentile attributes of high school data, and 4) nonpercentile attributes of high school data. This resulted in $4 \times 128 = 512$ tested subsets.

To additionally simplify clustering and find meaningful clusters, we grouped subsets of attributes with respect to their results and cluster the data with respect to clusters obtained with UMAP. More precisely, the procedure was as follows:

Step 1: Reducing dimensionality with UMAP.
Step 2: Clustering students for all subsets of attributes. Each subset represents one instance. Many instances cluster students similarly, therefore instances should be grouped in order to find only representative instances, i.e., one instance for each group of instances (Step 3).
Step 3: Grouping similar instances with respect to clusters of discrete attributes, i.e., OOA, SEX, and GRD/AGE, based on visual inspection. For example, grouping together instances with two clusters which represent two SEX-es, or instances with four clusters which represent four GRD-es.
Step 4: Clustering students for each group found in Step 3. The input for this clustering are the cluster ids of instances

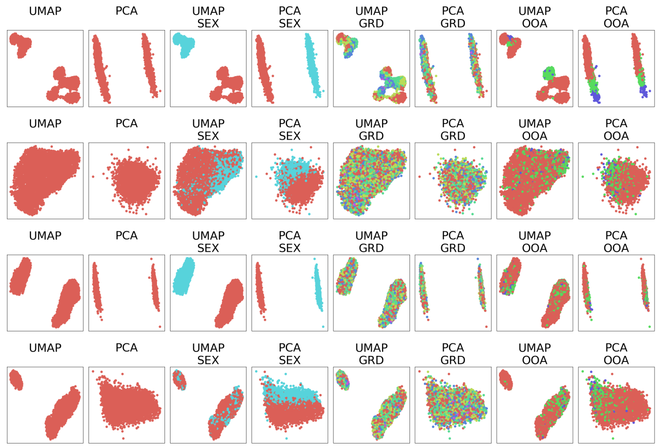

Figure 4: Examples of clusters found by PCA and UMAP on nonpercentile data from high school students. Columns 3–8 show the data with respect to discrete attributes, where attribute values are represented with different colors. Rows show the clusters with respect to four set of attributes that were used by dimensionality reduction methods. First row: all attributes, clusters represent SEX; Second row: measurements only, no clusters found; Third row: measurements and SEX, clusters represent SEX; Fourth row: measurements and FI, no connection between clusters and discrete attributes. According to definition of meaningful clusters given in Section 2, only the fourth row shows good clusters.

within the group, where these cluster ids were found in Step 2. The instances within the group might not produce similar clusters of students, therefore, such non-homogenous groups should be split (Step 5).
Step 5: Visual inspection of the obtained clusters for each group. If the found clusters are not consistent among the instances, the group is split and Step 3 is repeated. For example, if the group contains instances with two clusters and only half of these instances are correctly clustered into two clusters (i.e., consistent with clustering for the whole group), the correctly clustered instances represent a good subgroup and Step 6 should be applied. On the other hand, the incorrectly clustered instances are not a good subgroup and Step 3 has to be repeated.
Step 6: Finding representative instances of each group found in Step 5. For example, if attributes (e.g., SEX, GRD, W, H) of first instance are subset of the attributes of the second instance, the first instance (with a lower number of attributes) is more representative and should be used for further analysis.

This procedure enabled us to reduce the number of instances, i.e., subsets of attributes, that need to be analyzed, since it found the most representative subsets of attributes only.

The representative clusters are described in Table 3 in terms of additional attributes that were used (in addition to measurements), attribute type (raw or percentiles), the number of obtained clusters and the attribute with the highest cor-

Table 3: Properties of representative subsets of attributes obtained by combining dimensionality reduction methods and clustering algorithms.

Students	Additional attributes	Attribute type	Number of clusters	Attribute with highest correlation
high school	OOA	raw	2	OOA
high school	GRD, H, BMI	raw	2	GRD
high school	SEX	raw	2	SEX
high school	FI	raw	2	FI
high school	OOA, BMI	percentile	2	OOA
high school	SEX	percentile	2	SEX
high school	FI, GRD, W	percentile	2	FI
elementary school	AGE, H, W, FI, BMI, OOA	raw	2	OOA
elementary school	AGE, H, W, FI, BMI	raw	2	AGE
elementary school	SEX, AGE, W, FI, OOA	raw	3	SEX
elementary school	AGE, W, BMI, OOA	raw	3	OOA
elementary school	SEX, H, FI, BMI, OOA	raw	4	OOA
elementary school	AGE, W, FI	raw	5	AGE
elementary school	SEX, AGE, H, BMI, OOA	raw	6	SEX
elementary school	SEX, AGE, H, W, BMI, OOA	raw	7	SEX
elementary school	SEX, AGE, W, OOA	raw	8	SEX
elementary school	SEX, AGE, BMI, OOA	raw	10	SEX
elementary school	SEX, BMI, OOA	percentile	2	SEX

relation with clusters. Examples of obtained clusters are shown in Figure 4.

The results in Table 3 show that the majority of the obtained clusters is correlated with discrete attributes such as OOA, GRD/AGE, and SEX. The only exceptions are the two subsets of attributes whose clusters are correlated with FI. These subsets are also the most interesting ones, since the goal was to cluster the students based on their fitness into fit and unfit groups. These interesting clusters can be also seen in Figure 4 in fourth row. This figure confirms that the obtained clusters are not correlated with discrete attributes, i.e., SEX, GRD, and OOA.

Although we were able to find interesting clusters, i.e., those that are not correlated with discrete attributes, these clusters were obtained by using only specific subsets of attributes and only for high school data (see Table 3). In addition, no interesting clusters were obtained from elementary school data. It should be also noted that out of 512 possible attribute subsets, only two subsets were interesting, i.e., produced at least two clusters that were not correlated with discrete attributes.

4. CONCLUSION

This paper presented an approach for identification of fit and unfit students. This approach analyzes data from test battery used in schools by combining dimensionality reduction methods and clustering algorithms. By visually inspecting the results of data analysis, it enables us to find combinations of attributes that produce meaningful clusters of fit and unfit students. The identification of unfit students supports teachers, parents and policy makers in better targeting actions for improving fitness of those students.

In our future work, we will aim at developing a method for automatic assessment of obtained clusters, which will be used instead of visual assessment. To this end, an analytical approach for assessing the quality of clusters will be developed. This approach will also aim at determining to which extent the obtained clusters represent fit and unfit students. This task is especially challenging since we do not have the true values.

5. ACKNOWLEDGMENTS

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Counting Bites with a Smart Watch

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ABSTRACT
The work described in this paper is a part of the WellCo project, which is developing a virtual coach for healthy lifestyle. An important aspect of a healthy lifestyle is nutrition, and knowing as much as possible about the users' current nutrition can contribute to better coaching. We therefore set out to count the number of times the users take food to their mouths (bites) using smartwatch sensors. This enables identifying the meals as well as estimating the caloric intake and the speed of eating. We compare three approaches: two that rely on classical machine learning and hidden Markov models, and one that uses deep learning. The F-scores of the approaches range from 0.63 to 0.91, and the percentages of miscounted bites from 6.9 % to 10.7 %, with a different approach scoring best on each metric.

Keywords
Nutrition, monitoring, bite counting, wearables, smart watch, machine learning, hidden Markov models, deep neural networks

1. INTRODUCTION
The WellCo project is developing a virtual coach for seniors, which will provide advice on healthy lifestyle and wellbeing. To provide quality coaching and maximise the chances of achieving behaviour change, the advice should be fully personalised – not only adapted to the user's needs and wishes, but also to their current situation. To do so, the WellCo system uses smartphone and smart-watch sensors to monitor the users. One of the areas of coaching and therefore monitoring is nutrition. We want to know both what the users eat, as well as when and how they do it. The first part is addressed by questionnaires described elsewhere [1], while this paper deals with detecting eating and counting the number of times food is taken to the mouth (bites).

To count bites, the accelerometer and gyroscope in the smartwatch are used. These two sensors detect movement of the hand when the user is eating, and with the help of machine learning, these can be translated into individual bites. Section 2 briefly presents some related work on sensor-based nutrition monitoring, both using inertial sensors in wearables, as well as other approaches. In Section 3, we present the public dataset that was used to train and evaluate our methods. In Section 4, we describe three approaches to bite recognition and counting, starting with the simplest and ending with one using two (modestly) deep neural networks. Section 5 presents the experimental evaluation of the methods. Section 6 concludes the paper with a discussion of the integration of the described methods in the WellCo system, as well as some directions for future work.

2. RELATED WORK
The traditional tools for nutrition monitoring are questionnaires. However, these often prove inaccurate, especially regarding the quantity of food consumed – in one case it was underreported by up to 30 % for normal-weight subjects and 50 % for obese adults and children [2]. Therefore automated monitoring solutions are becoming increasingly important. By analysing photos of meals, one can determine the type and amount of food [3]. Using wearable sensors, it is possible to recognise the time, quantity and to some degree the type of food consumed in each bite. With development of smart watches and other (watch-like) wristbands, gesture recognition has been explored for this purpose [4][5]. With such devices, it is possible to recognise eating gestures, count bites and estimate the caloric intake. On-ear microphone or throat microphone can be used to detect chewing sounds [6][7], and swallows can be counted using a neck-worn sensor [8]. Out of these approaches, those relying on wrist-worn devices are the least intrusive and were thus selected for the WellCo system.

3. DATASET
We used the publicly availably Food Intake Cycle (FIC) dataset (https://mug.ee.auth.gr/intake-cycle-detection/) in the research described in this paper. It contains triaxial signals from accelerometers and gyroscopes in wrist devices with the sampling frequency of 100 Hz. 21 meal sessions by 12 unique subjects were recorded in the restaurant of the university using two commercial devices: Microsoft Band 2 for 10 out of the 21 meals, and Sony Smartwatch 2 for the remaining meals (both were worn on the dominant hand). In addition, the start and end moments of each food intake cycle (bite) as well as of each micromovement was labelled throughout the dataset.

4. BITE RECOGNITION METHODS
The most straightforward approach to bite recognition is to adopt the method usually used for activity recognition: split the stream of sensor data into windows and recognise the activity in each window using a machine-learning model. These activities – when they are a part of the bite cycle – are termed micromovements in this paper. This method on its own is not sufficiently accurate, so in Section 4.1, we describe an extension that applies smoothing and other postprocessing. In Section 4.2, we describe the most commonly used approach for bite recognition, which uses two HMMs – one for bites and one for non-bites [9]. Micromovement sequences are fed into both and classified based on which HMM they fit better. In Section 4.3, we describe a conceptually similar approach that replaces the classical machine-learning model for micromovement recognition with one neural network and the HMMs with another [10].

4.1 Micromovement Recognition with Smoothing

4.1.1 *Classical Micromovement Recognition*

The first step of this approach was to recognise micromovements related to the bite cycle – No movement, Pick, Upwards, Mouth, Downwards and Other. The Other label was used for non-eating activities, such as gesticulating. We used a 0.2-s sliding window (0.1 s overlapping) to compute features. Time-domain features that proved themselves in our previous work [11][12] were used. These features were designed for accelerometer data, and most of them were calculated only on the acceleration (and derived) data streams. However, the features that were also meaningful for gyroscope data were calculated from those data streams as well. After the features were computed, a feature selection using the methodology from our previous work was performed to filter out the redundant and uninformative ones.

In the above-mentioned previous work, features were calculated on acceleration data filtered with low-pass and band-pass filters. In the present work, we also filtered accelerometer data with a low-pass filter, however, we used "relative acceleration" instead of the band-pass filter. This was proposed by the authors of the FIC dataset. We computed relative acceleration by subtracting the first element of each window from all values in the window of length *n*.

$$a_{\mathrm{rel}}(i) = a(i) - a(1);\ i = 1, 2, \ldots, n$$

The random forest algorithm was used to build the micromovement recognition model. We built two versions – the first using all six micromovements as possible class values, and the other using all the micromovements except Other. We opted for the latter in further steps of our approach since the recognition of Other proved very difficult and made the model highly inaccurate.

4.1.2 *Smoothing and Other Postprocessing*

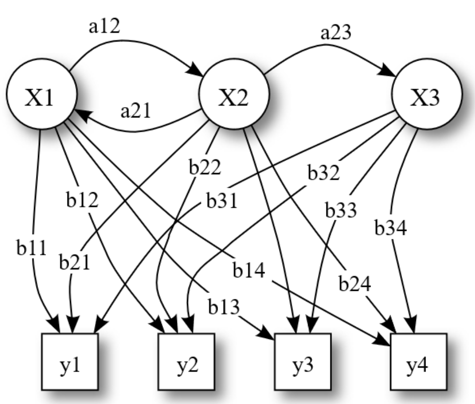

Figure 1: Example hidden Markov model
(licensed under Creative Commons Attribution 3.0 Unported license by Tdunning).

The second step of our approach was to smooth the recognised micromovements with a hidden Markov model (HMM). An HMM is defined by the following:

- Hidden states, which are labelled as X1 … X3 in the example in Figure 1, and correspond to true micromovements in our approach. They are called hidden because one cannot observe them directly – like true micromovements are hidden, otherwise our task would be trivial.
- Possible observations or emissions, which are labelled as y1 … y4 in Figure 1. These correspond to the micromovements as recognised by the first step of our approach.
- Emission probabilities – each emission *j* has a probability of occurring in each hidden state *i*, which is labelled as b*ij* in Figure 1. These probabilities correspond to the probabilities of recognising a micromovement *i* as micromovement *j* by the first step of our approach.
- Transition probabilities – these are the probabilities of transitioning between each pair of hidden states (micromovement in our case) *i* and *j*, which are labelled as a*ij* in Figure 1.

We built an HMM to describe the training portion of the FIC dataset, with the emission probabilities set based on the results of the micromovement recognition, and the transition probabilities extracted from the dataset. On the test portion of the dataset, we used the Viterbi algorithm to compute the most probable sequence of hidden states corresponding to the observed emissions. This means that we computed the most probable sequence of true micromovements based on the recognised micromovements, or, in other words, that we smoothed the recognised micromovements.

The smoothed micromovements were still not all correct, particularly where the true micromovement was Other, since our micromovement-recognition model was not trained to recognise that. We therefore trained a dedicated model to recognise the Other micromovement. It worked on the outputs of the micromovement-recognition model. One instance for this model was a continuous segment in which the same micromovement was recognised by the micromovement-recognition model. The features were the probability of each class output by micromovement-recognition model averaged over the segment, the standard deviations of these probabilities, and the length of the segment. This Other-recognition model was tuned so that it had precision above 90 % (while the recall was only 28.1 %) – we wanted to correct only the micromovements for which we were very confident they are Other, since the final step of the approach was capable of dealing with many of the remaining mistakes.

The final step looked at each quartet of consecutive segments, and penalised them based on how much they deviated from the ideal bite quartet of micromovement segments Pick, Upwards, Mouth and Downwards. Each segment *s* in the quartet was penalised if its length was atypical:

$$penalty(s) = -\frac{\left|\mathrm{length}(s) - \overline{length}\right|}{\delta_{\mathrm{length}}}$$

Penalty of –2 was added to the quartet if one of the expected segments was missing or if an incorrect segment was inserted. More than one mistake of this type was not tolerated. In the end, each quartet with the penalty above the experimentally set threshold of –5.4 was considered a bite. An example of true and smoothed micromovements, and penalty, is shown in Figure 2.

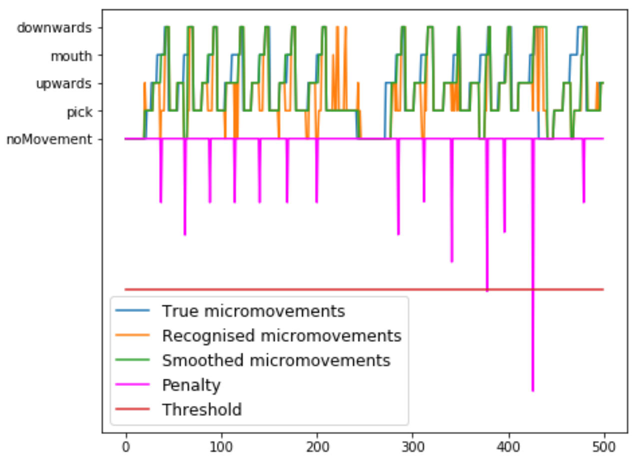

Figure 2: Bite recognition with micromovement recognition and smoothing.

4.2 Bite vs. Non-Bite HMM

The first step of this approach consisted of micromovement recognition as described in Section 4.1.1. The sequence of micromovements served as the input to the second step, which was implemented with two HMMs.

To build the HMMs for bite recognition, we randomly selected 1,000 bite and 1,000 non-bite instances from the FIC dataset. Each instance was 4 s long, which was the average length of a bite in the dataset. For an instance to be considered a bite, it needed to have an 80 % overlap with the ideal bite quartet of micromovement segments Pick, Upwards, Mouth and Downwards. For an instance to be considered a non-bite, it needed to have less than 60 % overlap with any such complete bite. The bite and non-bite datasets were then used to train (adjust parameters of) the two HMMs using the Baum-Welch algorithm. The number of hidden states in the models was experimentally set to 10.

After the models were built, we could pass over an input sequence of micromovements with a 4 s sliding window. We used the Forward-backward algorithm to estimate the probability that the content of the window was generated by the bite and non-bite model. We then subtracted the score returned for the non-bite model from the score returned for the bite model (the scores expressed log probabilities). The difference was proportional to the probability that the window contained a bite.

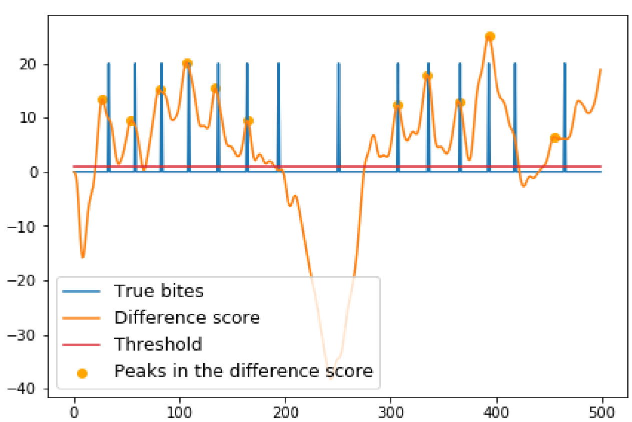

Figure 3: Bite recognition with bite vs. non-bite HMM.

The difference score was unfortunately not adequate to detect bites directly. Therefore, we first applied a Butterworth low-pass filter in a longer window to smooth it (5^{th} order with a cut-off frequency of 1 Hz). Afterwards, we detected peaks in the score – each peak corresponds to one bite. For a peak to be detected, the score had to be larger than its neighbours, it had to be higher than an experimentally set threshold of 1, and it had to at least 2.5 s from the previous peak. An example of true bites, the difference score and recognised bites is shown in Figure 3.

4.3 Deep Neural Network

4.3.1 CNN Micromovement Recognition

This step corresponds to the micromovement recognition from Section 4.1.1, except that a convolutional neural network was used instead of the random forest algorithm. A 0.2 s sliding window with a step of 0.1 s was used again. The input data were transformed using a median filter and a high-pass filter with the cut-off frequency of 1 Hz. The data were then normalized so that each data stream had the mean of 0 and standard deviation of 1.

The neural network consisted of two convolutional layers, each of them followed by a max pooling layer. The first convolutional layer used 64 filters, while the second used 128 filters, with both having the filter size set to 6. They were followed by a dropout and a fully-connected layer, after which the probability distribution of the five micromovements was retrieved with a softmax activation function. Categorical cross entropy was used as the loss function when training the model.

4.3.2 LSTM Bite Recognition

This step corresponds to the bite recognition from Section 4.2, except that a long short-term memory (LSTM) neural network was used instead of HMMs. A 3.6 s sliding window was used, which was the median length of a bite in the dataset, with a step of 0.1 s. The sequence of micromovement probability distributions from the first step of the approach was fed into two LSTM layers with 64 units each, again followed by a dropout and a fully-connected layer. The network output was a value gated using a sigmoid activation function. Binary cross entropy was used as the loss function when training the model.

To correctly recognise individual bites, we applied an experimentally set threshold of 0.87 to the output from the LSTM network. For each set of probabilities above the threshold, we found the maximum value, which denotes the bite moment. Then we disregarded all bites detected less than 2 s after the previous one. An example of the network's output with the true and recognised bites is shown in Figure 4.

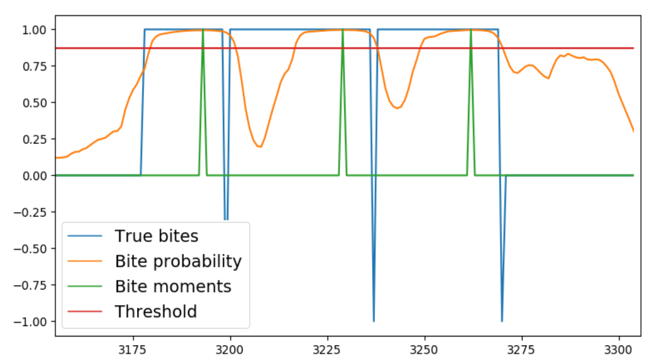

Figure 4: Bite counting with deep neural network.

5. EXPERIMENTAL EVALUATION

To evaluate the smartwatch-based nutrition monitoring, we again used the FIC dataset described in Section 3. The evaluation of the micromovement recognition used the was straightforward, using the leave-one-meal-out approach. This means that the feature selection and training of the model were performed on the data of all meals but one, and tested on the data of the remaining meal. The procedure was repeated for all the meals and the results averaged.

The evaluation of bite recognition was somewhat more involved. It was first evaluated in terms of precision and recall: precision is the fraction of instances recognised as bites that were in fact bites, while recall is the fraction of bite instances that were recognised as such. The first recognised bite inside each true bite interval was considered a true positive, and any other recognised bites inside that interval were considered false positives. Any true bite interval without recognised bites was considered a false negative. Bite recognition or bite counting was also evaluated in terms of the percentage by which it miscounted the number of bites in a meal. The three approaches described in Section 4 were compared to a baseline approach that considered every segment with the Mouth micromovement a bite. The results are shown in Table 1.

	Microm. only	**Microm. + smoothing**	**Bite vs. non-bite HMM**	**DNN**
Microm. accuracy	78.8 %	78.8 %	78.8 %	80.0 %
Bite vs. non-bite precision	0.44	0.77	0.62	0.91
Bite vs. non-bite recall	0.93	0.73	0.64	0.93
Bite vs. non-bite F-measure	0.59	0.75	0.63	0.91
Bite count relative error	110.7 %	6.9 %	8.7 %	10.7 %

Table 1: Accuracy of micromovement and bite vs. non-bite recognition.

6. CONCLUSION

In this paper we presented three approaches for bite (or food intake) counting using sensors in a smart watch. Each of them consisted of two main steps: the recognition of bite-related micromovements and the recognition of the actual bites based on that. Classical and CNN-based micromovement recognition proved comparable. The approach for bite detection based on HMM smoothing proved best in terms of the number of miscounted bites, while the DNN-based approach proved best in terms of precision and recall (and comparable to the state of the art). The contribution of the paper is the novel approach based on HMM smoothing, and its comparison with the two other main approaches known from the literature.

Since the success of the approach based on HMM smoothing was heavily dependent on its parameter settings, we decided to integrate the DNN-based method in the WellCo system. Our main task for the future is to merge the recognised bites into meals, and associate each meal with an estimate of the amount of food eaten, since this is what the WellCo virtual coach needs.

7. ACKNOWLEDGMENTS

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Austrian-Slovenian Intelligent Tourist-Information Center Platform

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ABSTRACT

We present the AS-IT-IC platform – Austrian-Slovenian intelligent tourist-information platform that enables live communication between tourist workers and tourists through a simple chat widget embedded on the existing tourism website, and includes TOUR-BOT, a virtual tourist assistant, for cases when no tourist worker is available. TOUR-BOT can communicate in natural language in English, German and Slovene. The AS-IT-IC platform enables trip planning by providing: attraction search in natural language, trip manipulation using natural language and traditional interaction through buttons, and optimal route calculation between selected trip points. Additionally, the AS-IT-IC platform enables attraction data management for tourist workers and data update suggestions by anonymous users.

Keywords

tourist-information system, virtual assistants, conversational platform

1. INTRODUCTION

Currently, the common way to obtain relevant information [5, 2] about cultural and natural heritage sights and plan a trip is through user-unfriendly web search and hard-to-find websites, usually managed at the government or local-authority levels. After finding relevant information, the trip is planned using route finder such as Google Maps[1] or more advanced tour planners such as e-Turist[2] [1] or TripHobo[3].

However, a new solution for tourists visiting Slovenia and Austria is emerging. Within the AS-IT-IC project [7], accepted in the cross-border Cooperation Programme Interreg V-A Slovenia-Austria in the programme period 2014-2020, a novel information communication technologies (ICT) system was implemented that enables several features for empowering the tourist:

1. Live-chat with the tourist information providers (tourist service providers, tourist offices, municipalities, and citizens).
2. Tour planing and tourism information search in natural language conversation with the virtual assistant.
3. Attraction information suggestion.

The designed ICT tools were integrated into the AS-IT-IC Platform and are accessible from the project homepage[4] through the tourist information provider access point[5] and the tourist access point[6].

The rest of the paper is structured as follows. In Section 2 an example of the platform usage is provided. In Section 3 the platform architecture and platform components are described and Section 4 concludes the paper.

2. USE CASE

To demonstrate the AS-IT-IC platform idea, consider the following example. Imagine Mary, a tourist worker who wants to enable live-chat feature on her website `https://visit-hidden-slovenia.com`. After registering on the AS-IT-IC platform, copy-pasting only a few lines of HTML and Javascript code into her website template and doing some color and text customization if so desired, she has a tourist live-chat widget embedded into her website. When John, a tourist, comes looking for information on her website, he clicks on the live-chat widget button to start a conversation. First, a virtual assistant greets him to kick-start the dialogue. John then searches for particular categories in the limited area such as: "horseriding near Bovec ", "wine cellars in Nova Gorica", "adrenaline sports near Soča river", "accommodation in GoriÅąka Brda" etc. John picks some of the results and includes them into his itinerary.

During the interaction, the tourist can communicate with logged-in humans or with a virtual assistant, the later most useful when no human is on-line, e.g., at night. In our example, John invites Mary into the conversation and they chat about the transit options and other questions the tourist may have. While chatting, the tourist worker has full overview of the conversation the tourist had with the virtual assistant and the currently chosen itinerary. This helps Mary provide relevant answers quickly. In the case that Mary does not know the answer, she can simply invite another tourist worker into the conversation in order to collaborate in providing all the information the tourist needs.

[1] `https://www.google.si/maps`
[2] `http://e-turist.si`
[3] `https://www.triphobo.com`
[4] `https://as-it-ic.ijs.si`
[5] `https://asitic.docker-e9.ijs.si`
[6] `https://asitic-chat-api-frontend.docker-e9.ijs.si/asitic-app.html`

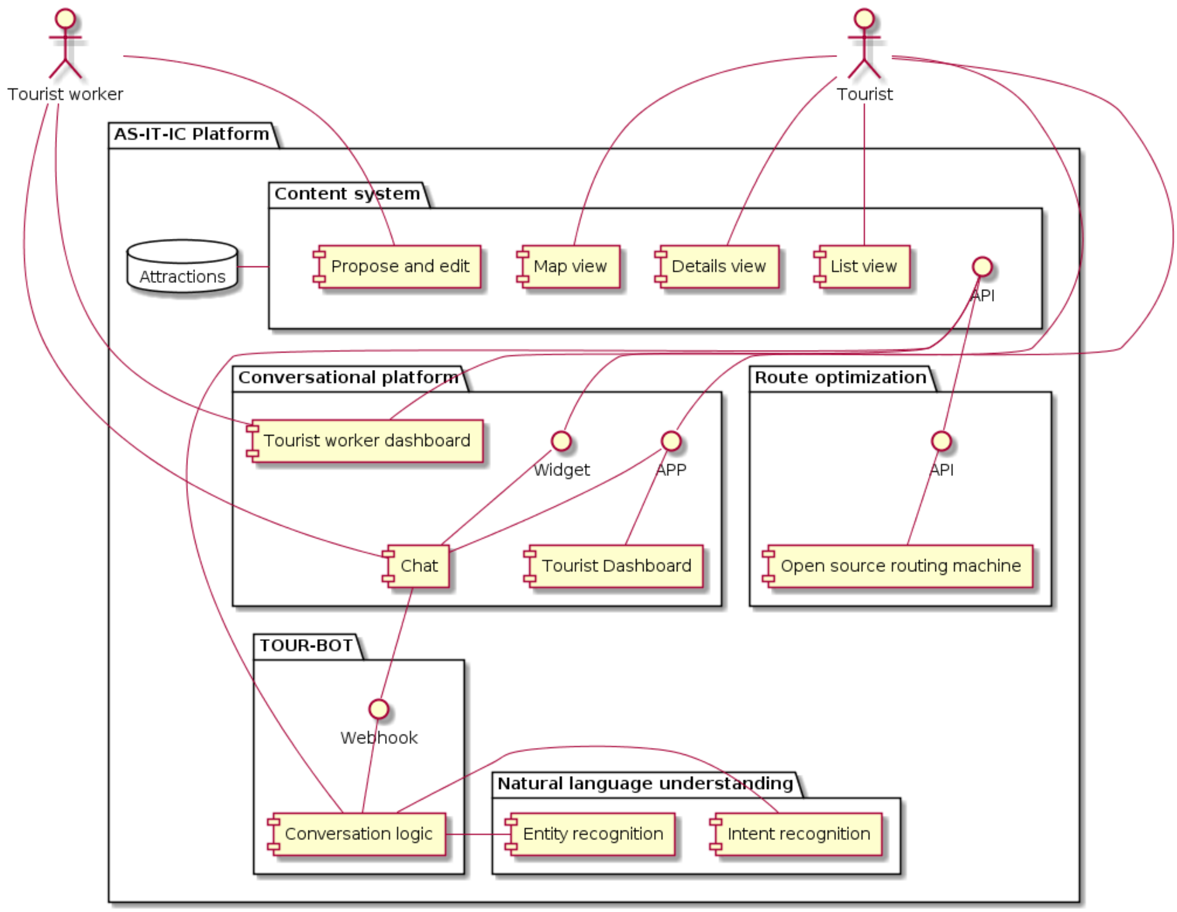

Figure 1: AS-IT-IC platform architecture overview.

3. ARCHITECTURE

The AS-IT-IC platform (Fig. 1) comprises several modules that enable the features mentioned in Sections 1 and 2. The main modules are:

1. *Conversational platform* that enables real-time communication between users and lays out the communication infrastructure.
2. *TOUR-BOT*, a virtual assistant that is able to hold a conversation with tourists by understanding the natural text entered by the user, responding to button clicks within the context, and performing actions with regards to third party systems.
3. *Natural language understanding*, a module that transforms unstructured text into structured information by recognizing entities and intent of the received text.
4. *Content system* enables to create, read, update and delete operations regarding the points-of-interest (POI) available on the AS-IT-IC platform. Additionally, it deals with the information presentation of specific POI or a group of POIs.
5. *Route optimization*, a service for finding optimal route between a set of points.

3.1 Conversation Platform

The conversation platform is based upon the popular open-source software Rocket.Chat[7], which provides a full-featured modern chat application by: enabling virtual assistant integration through webhooks, enabling the home page customization, allowing for the user interface localization, providing responsive interface for desktop and mobile screen sizes, enabling iframe integration through message posting. There are three entry points to the conversational platform:

1. Rocket.Chat app itself; meant for access by the tourist workers.
2. AS-IT-IC app: a full screen application with AS-IT-IC-specific menu and the embedded Rocket.Chat app; meant for access by frequent tourist users.
3. AS-IT-IC widget: a floating widget, which can be embedded into an existing website. It includes AS-IT-IC-specific menu and embedded Rocket.Chat app; meant for access by an anonymous tourist user visiting a tourism website.

Since two types of users are expected for the AS-IT-IC platform, the conversation platform has to enable different home-

[7] `https://rocket.chat`

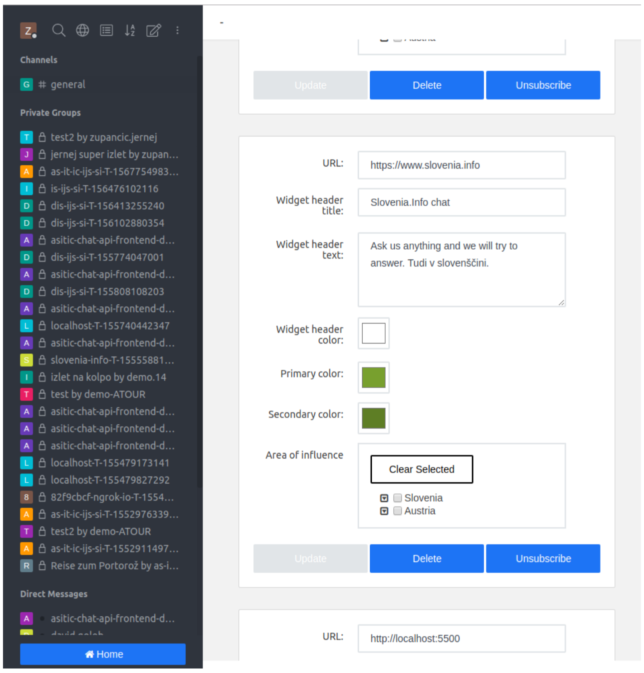

Figure 2: Tourist worker dashboard view.

page views, which are based on the user roles. To the tourist user, only the information regarding the planned trips is shown. This way, every planned trip is easily accessible from the home page. For the tourist workers, the configuration options for the AS-IT-IC widget deployed on the tourist workers' website are available (Fig. 2). This enables the tourist worker to customize the widget's appearance and converse with tourists from one central location.

3.2 Virtual Tourist Assistant

Our virtual tourist assistant "TOUR-BOT" can provide information to a tourist when no tourist worker is available or when the tourist prefers a robotic assistant (Fig. 3). TOUR-BOT has access to the conversation and the conversation context, which holds structured information about the current conversation. It responds to the users' button clicks and text inputs in natural language. In order to process the natural language it utilizes the "Natural language understanding" service, which analyzes the text and returns structured information about the text, consisting of:

1. Text intent – what does the user want to do; an example: the intent of "I want to go to Planica" is `obtain direction`), and
2. Recognized entities – what points-of-interest are mentioned in the text; an example: the entity in "I want to go to Planica" is `Planica`).

TOUR-BOT stores the conversation dialog flow rules, which enables it to hold a meaningful conversation that spans several tourist – TOUR-BOT interactions. For instance, when the tourist states "I want to go to Planica", TOUR-BOT asks "How will you visit those places" and offers different modes of

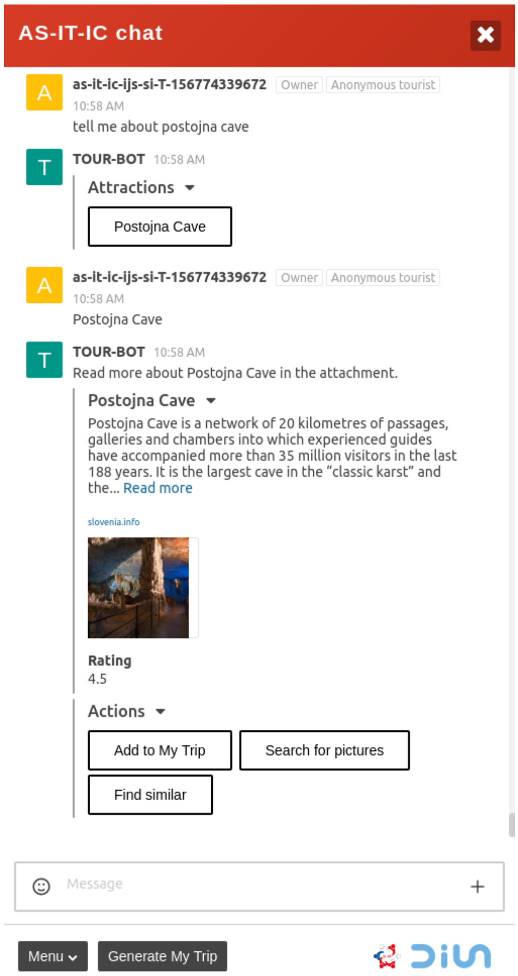

Figure 3: Tourist to TOUR-BOT chat example.

transport. After the tourist provides feedback, proper links to Google Maps[8] or Openroute service[9] are generated and displayed. The following intents are currently supported by TOUR-BOT:

1. General POI search. Examples: "Tell me about Postojna cave", "horseriding near Soča river", "accommodation near Ljubljana castle".
2. Path to attraction request. An example: "I want to go to Ljubljana castle".
3. Similar search request. An example: after reading about the Ljubljana castle – "anything similar nearby".
4. Trip manipulation actions: add a POI to the trip, clear the trip, generate route for the trip. Examples: after reading about the Ljubljana castle – "add this to my trip", "clear my trip", "generate route" etc.
5. Small talk intents: greeting, critique, about, help, praise and others. Examples: "hi", "who are you", "you are bad", "help me", "you are great" etc.

[8] `https://www.google.com/maps`
[9] `https://openrouteservice.org`

3.3 Natural Language Understanding

The natural language understanding service comprises two parts: entity recognition and intent recognition. Entity recognition is available for entities that were obtained from tourism websites and other sources. See [8] for more information. In summary, 20,999 entities are available in the system, of which 8,734 are attractions and others are mostly geographical entities. The entity recognition is based on the probability that an entity is present in the text. The probability is estimated on word distances between the entity words and the text input words. Entity recognition is further explained in [6].

Intent recognition is a text classification task. Based on the text representation, a machine learning model is built to best classify the text in the training examples. While different processing and classification pipelines were tested, the best performing pipeline is the following: First, the input text is tokenized[10]. Second, the stopwords are removed from the text. Third, word vector (using FastText embeddings [3] and the pymagnitude package [4]) for each remaining token is queried. Mean vector is computed and used as the text embedding representation. Support vector machine from the scikit-learn project[11] is then used to obtain the machine learning model. Using this pipeline we were able to achieve F1 score of about 0.8 on our tourist queries dataset that comprised about 100 queries.

3.4 Content System

The content system stores all the POI data [8] used across the AS-IT-IC platform. It enables tourist workers to create, view, update and delete specific POI information. Additionally, it enables crowd-sourcing the data-gathering by allowing anonymous users to provide suggestions for updating POI information. The suggested update is publicly visible only when the user with sufficient rights (e.g., tourist worker) approves the suggestion. The content system is further responsible for detailed POI presentation and the overview presentation of all POIs within the system, either in the form of a map or an interactive list[12].

3.5 Route Optimization

Route optimization enables finding quickest route for visiting a set of chosen points, while taking into account the preferred mode of transport and the road infrastructure within some region. We utilized the Open Source Routing Machine[13] (OSRM) for data preparation for the regions of Slovenia and Austria. Further, the OSRM `trip` endpoint was used to solve the Traveling Salesman Problem, which is solved "using a greedy heuristic (farthest-insertion algorithm) for 10 or more waypoints and using brute force for less than 10 waypoints"[14].

4. CONCLUSIONS

In this paper we presented an intelligent tourist-information platform for Austria and Slovenia as part of the AS-IT-IC project. The platform enables live communication between tourist workers and tourists. Additionally, tourists can converse with TOUR-BOT, a virtual assistant, in natural language in Slovene, German or English in order to search for relevant attractions and plan a trip. Using the AS-IT-IC platform, a tourist can easily plan a visit to a specific region, while tourist workers can establish direct communication with the tourists and obtain live feedback on their interests. In summary, the AS-IT-IC tourist platform enables several novel user-friendly functions for tourists and tourist workers.

[10]`https://repo.ijs.si/DIS-AGENTS/reldi-tokeniser`
[11]`https://scikit-learn.org`
[12]`https://eturist.docker-e9.ijs.si`
[13]`http://project-osrm.org`
[14]`http://project-osrm.org/docs/v5.22.0/api/#trip-service`

5. ACKNOWLEDGMENTS

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Razvoj postopka diarizacije govorcev z algoritmi strojnega učenja

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POVZETEK

Pomemben del konteksta uporabnikov mobilnih telefonov so njihove žive socialne interakcije. Zaznamo jih lahko s pomočjo mikrofona, pri čemer lahko zaznamo prisotnost človeškega govora, ugotavljamo število govorcev in določamo, kdaj je govoril kateri od govorcev, čemur pravimo diarizacija. V članku sta predstavljena detektor govora in širši postopek diarizacije govorcev, za katera smo uporabili že obstoječa orodja in jih prilagodili za široko uporabnost na posnetkih z mobilnih telefonov. Za zaznavo govora smo uporabili logistično regresijo, ki je računsko nezahteven algoritem, hkrati pa je imel visoko točnost, skoraj 90 %, v različnih akustičnih okoljih. Za razvoj ostalih korakov diarizacije smo uporabili že obstoječe zbirke podatkov, posneli pa smo tudi majhno lastno zbirko. Za snemanje smo uporabili telefone različnih proizvajalcev in na ta način preverili robustnost našega postopka v primerjavi z že razvitimi metodami zaznavanja govora in diarizacije govorcev. V kontroliranih pogojih je postopek deloval primerljivo z že obstoječimi, na posnetkih iz vsakdanjega delovnega okolja pa je dosegel izrazito boljše rezultate.

1. UVOD

V okviru projekta na temo stresa na delovnem mestu (angl. Stress At Work project, StrAW) [3] želimo analizirati in opisati odnose med izkušnjami psihosocialnega stresa v delovnem okolju, vsakdanjimi aktivnostmi in dogodki na delu in fiziološkimi signali [16] ter vedenjskimi vzorci, ki jih lahko zaznamo avtomatsko s pomočjo tehnologije. Eden od pomembnih virov podatkov, ki jih lahko uporabimo v ta namen so senzorski podatki in spremljanje interakcije z mobilnim telefonom. S temi podatki je mogoče prepoznati pomemben del uporabnikovega konteksta, kot so socialne interakcije in pogovori. Tega problema smo se lotili v pričujočem delu in že objavljeni diplomski nalogi [11].

V prispevku je predstavljen postopek za diarizacijo govorcev. To je proces označevanja posnetka z informacijo o tem, kateremu govorcu pripadajo določeni segmenti v posnetku. V splošnem zajema tri glavne korake: zaznavanje človeškega govora, iskanje mej med deli posnetka, med katerimi so govorili različni govorci, ter združevanje teh segmentov glede na identiteto govorca. Ker smo želeli večji nadzor nad delovanjem postopka v različnih akustičnih pogojih, smo se prvi komponenti, detekciji govora, posvetili ločeno od ostalih.

Za zaznavanje govora se najpogosteje uporablja pristop z mešanicami Gaussovih porazdelitev (angl. Gaussian mixture models, GMM) [17], za optimizacijo telefonskih klicev preko internetnega protokola pa je standardiziran pristop z uporabo statističnega modeliranja [2]. V zadnjem času se za ta namen pogosto uporabljajo tudi nevronske mreže (npr. [10]).

Diarizacija govorcev se v literaturi (dober pregled je v [1]) največkrat izvaja na posnetkih novic in sestankov, pri čemer imajo uporabljeni posnetki ugodne akustične značilnosti. Pri tem nekateri pristopi izkoristijo snemanje z več mikrofoni in s pomočjo različnih zvočnih tokov izboljšajo točnost določanja govorcev.

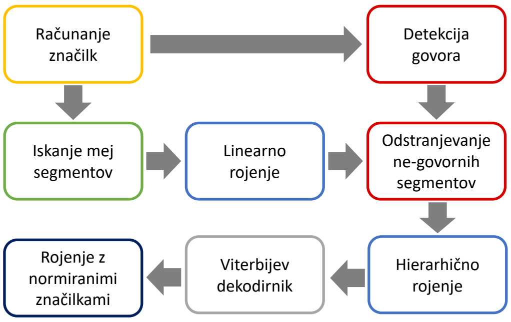
Cilj našega dela je bil prilagoditev postopka za uporabo na posnetkih iz vsakdanjega življenja, pri katerih bi za snemanje uporabili mikrofon mobilnega telefona.

2. METODE

2.1 Postopek diarizacije govorcev

Za zaznavanje govora (angl. voice activity detection, VAD) so uporabne tako značilke v časovni (na primer najvišje in najnižje vrednosti signala) kot v frekvenčni domeni (na primer ploščatost spektra). Poleg teh se za opis človeškega glasu uporabljajo tudi specializirane značilke, kot so kepstralni koeficienti melodičnega spektra (angl. mel-frequency cepstral coefficients, MFCC) in zaznavni kepstralni koeficienti linearne napovedi z relativno spektralno transformacijo (angl. RASTA perceptual linear prediction coefficients, RASTA PLP-CC) [8]. Obe vrsti značilk delujeta v kepstralni domeni, v katero pridemo z inverzno Fourierevo transformacijo logaritma spektra signala, obenem pa z različnimi transformacijami poskušajo posnemati odziv človeškega sluha na zvok.

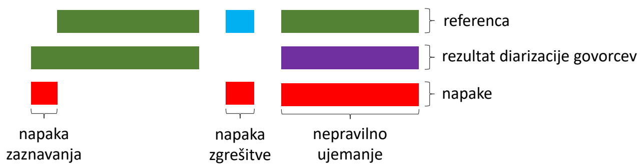
V našem postopku diarizacije govorcev, prikazanem na sliki 1, smo najprej izračunali značilke, ki smo jih uporabili v ostalih komponentah diarizacije govorcev. Izračunu značilk je sledilo iskanje mej med segmenti govorcev. Združevanje segmentov istega govorca se v procesu diarizacije ponovi večkrat na različne načine (modro obrobljeni koraki na sliki 1). Najprej smo z linearnim rojenjem (angl. linear clustering) združili le zaporedne segmente, ki pripadajo istemu govorcu. Nato smo na podlagi detektorja govora, ki je bil predstavljen v prejšnjem koraku, odstranili ne-govorne segmente in s hierarhičnim rojenjem že združili večino, tudi nezaporednih, segmentov istega govorca. Viterbijev dekodirnik dodatno izboljša začetno segmentacijo s pomočjo prikritih modelov Markova. Zadnji korak pa je bilo hierarhično rojenje z normiranimi značilkami, ki združi še roje istih govorcev, ki so bili do tega koraka ločeni zaradi različnega akustičnega ozadja.



Slika 1: Koraki v postopku diarizacije govorcev.

2.2 Vrednotenje rezultatov

Zaznavanje govora smo vrednotili s pomočjo ustaljenih mer: točnosti (angl. accuracy) in priklica (angl. recall). Poleg teh dveh mer pa smo za vrednotenje diarizacije uporabljali tudi mero napake med ujemanjem referenčnih in samodejno pridobljenih in označenih segmentov, krajše mero DER (angl. diarization error rate). Izračunamo jo kot delež napačno klasificiranih delov posnetka, kjer so možne tri različne napake (slika 2): napaka zaznavanja (ne-govor označen kot govor), napaka zgrešitve (govor označen kot ne-govor) in nepravilno ujemanje (klasificiran napačen govorec). Od običajne točnosti se razlikuje po tem, da delež izračunamo le glede na dele posnetka, v katerih je bil dejansko prisoten govor.



Slika 2: Pri vrednotenju diarizacije upoštevamo tri različne vrste napak. Njihov časovni delež v delih posnetka, v katerih je prisoten govor, je mera DER.

3. REZULTATI

3.1 Orodja

Orodje „openSMILE" [9] omogoča izračun vseh vrst akustičnih značilk, omenjenih v prejšnjem podpoglavju. V našem delu smo za njihov izračun uporabili okna z dolžino 25 ms in korakom 10 ms. Omeniti velja, da „openSMILE" ponuja tudi že prednaučeno povratno nevronsko mrežo z dolgim kratkoročnim spominom (angl. long short-term memory recurrent neural network, LSTM-RNN) za detekcijo človeškega glasu. Izhod te nevronske mreže smo pri našem detektorju govora uporabili kot značilko in kot referenco pri primerjavi točnosti drugih algoritmov za zaznavanje govora.

Glavni del diarizacije smo opravili z orodjem „LIUM SpkDiarization" [14]. Poleg prilagoditve parametrov tega orodja pa smo zamenjali prvo komponento zaznavanje govora, ki smo jo implementirali s pomočjo orodja za strojno učenje „Weka" [6].

3.2 Podatkovne zbirke

Pri razvoju postopka diarizacije govorcev smo uporabljali tri podatkovne zbirke: eno za učenje in validacijo zaznavanja govora, drugo za nastavljanje hiperparametrov ostalih komponent diarizacije in tretjo za končno testiranje postopka in primerjavo z drugimi metodami.

Kot učno množico za prvi korak zaznavanja govora smo uporabili „VAD-toolkit" [12]. Gre za pogovore dveh korejskih govorcev, posnetih s telefonom Samsung Galaxy S8 v štirih različnih okoljih z različnim hrupom v ozadju: v sobi, v parku, na avtobusni postaji in na gradbišču. Posnetki so označeni z deli govora in ne-govora (binarne oznake), pri čemer govor vsebuje približno tretjina celotnega trajanja posnetkov.

Za razvoj ostalih komponent diarizacije smo uporabljali podatkovno množico „AMI Corpus" [5], ki vsebuje označene posnetke sestankov v angleškem jeziku. Izbrali smo tri posnetke, v katerih je sodelovalo od 3 do 5 govorcev s trajanjem od 19 min do 66 min. Da bi posnemali različne akustične pogoje, smo jim umetno dodali šum s pomočjo orodja „Audio Degradation Toolbox" [13]. Dodali smo jim posnetek z ulice z razmerjem med signalom in šumom 15 dB in posnetek iz gostilne z razmerjem 20 dB.

Kot testno množico za ovrednotenje celotnega postopka diarizacije in primerjavo z drugimi obstoječimi orodji smo uporabili drugo podmnožico zbirke „AMI Corpus", dodatnih 12 posnetkov. Poleg tega smo posneli še tri lastne posnetke sestankov oziroma pogovora, za kar smo uporabili štiri različne pametne telefone: Huawei P Smart, Motorola Moto X, Samsung Galaxy S6 in Nokia 6.

3.3 Zaznavanje govora

Za zaznavanje govora smo najprej izbrali najbolj primeren algoritem strojnega učenja. Algoritme, ki smo jih preizkusili, prikazuje tabela 1 in so natančneje opisani v [6]. Z vidika točnosti se je najbolje izkazala logistična regresija. Kljub temu, da imajo nekatere druge metode za govor boljši priklic, smo v nadaljevanju izbrali ravno to metodo, saj je tudi relativno računsko nezahtevna.

Tabela 1: Primerjava uspešnosti različnih algoritmov za detekcijo govora pri uporabi vseh izračunanih značilk. Prikazani so priklic za razreda govora (priklic_g) in ne-govora (priklic_ng) ter skupna točnost.

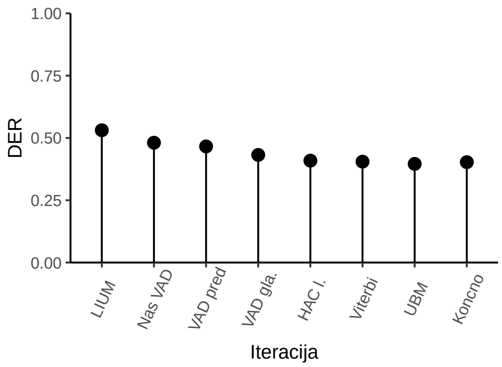
Algoritem	priklic_g	priklic_ng	točnost
Logistična regresija	93,7	97,1	96,1
SVM	94,4	96,8	96,1
Večplastni perceptron	95,6	95,5	95,5
Naključni gozd	93,8	95,4	94,8
AdaBoost	93,0	94,4	94,1
KNN	87,1	93,6	91,4
J48	90,0	91,1	90,7
Naivni Bayes	60,8	93,6	84,1

V naslednjem koraku smo izbrali najboljše značilke, saj smo sprva uporabljali vse smiselne, ki jih lahko izračunamo z orodjem „openSMILE“. V ta namen smo uporabili več metod: izboljšan postopek Relief (angl. ReliefF), izbor na podlagi korelacij (angl. correlation feature selection, CFS) in metodo z ovojnico (angl. wrapper) [6]. S tem smo nabor značilk zmanjšali s 104 na 54 značilk. Ohranili smo najvišjo, najnižjo in absolutno najvišjo vrednost oknjenega signala, ploščatost spektra, 13 značilk MFCC, 18 RASTA PLP-CC koeficientov in njihove koeficiente delta regresije ter izhod povratne nevronske mreže. Pri tem je točnost logistične regresije ostala enaka, priklic govora pa se je nekoliko izboljšal.

Kot omenjeno, smo izhod nevronske mreže pri našem detektorju govora uporabili kot značilko. Izkazalo se je, da je to v našem postopku najpomembnejša značilka, vendar vključitev ostalih poveča točnost s 86,6 % na 96,1 %.

3.4 Diarizacija govorcev

Komponente diarizacije govorcev smo spreminjali iterativno. Začeli smo z osnovnim postopkom LIUM, zamenjali detektor govora za opisanega v podpoglavju 3.3, nato pa spreminjali še hiperparametre. Slika 3 prikazuje, kako se je spreminjala napaka DER z zaporednimi spremembami postopka diarizacije.



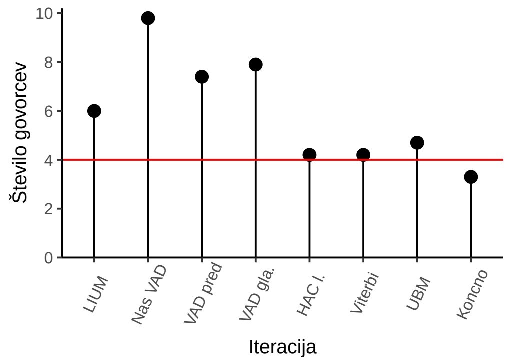
Slika 3: Spreminjanje napake DER skozi iterativne izboljšave postopka diarizacije. Največja, petodstotna, sprememba (označena z „Nas VAD“) je posledica zamenjave privzetega detektorja govora za lastnega.

V splošnem smo izbrali spremembe, ki so postopek izboljšale, tako da so zmanjšale mero DER. Največjo izboljšavo smo dosegli z zamenjavo detektorja govora („Nas VAD“), dodatno smo izboljšali delovanje postopka z odstranjevanjem negovornih segmentov v zgodnejšem koraku („VAD pred“) in nastavitvijo parametrov glajenja rezultatov detektorja govora („VAD gla.“).

Drugi korak (iteracija, označena s „HAC l“.), ki se je izkazal za pomembnega, je bila sprememba parametra v hierarhičnem rojenju (angl. hierarchical agglomerative clustering, HAC). Rojenje smo naredili bolj agresivno, s tem pa zmanjšali končno število rojev oziroma govorcev. Učinek te spremembe je še bolj izrazito opazen na sliki 4, kjer se je število govorcev močno približalo pravemu.

Nato smo prilagodili parametre Viterbijevega dekodirnika, namen katerega je, da izboljša začetno segmentacijo.

V zadnjih dveh korakih, označenih z „UBM“ in „Koncno“, smo spremenili še uporabo prednaučenega splošnega modela



Slika 4: Število zaznanih govorcev se je spreminjalo z vsako iteracijo postopka diarizacije.

govora (angl. universal background model, UBM). Ta model se uporablja za naknadni postopek rojenja, vendar bi ga bilo treba prilagoditi na uporabljeni podatkovni množici. Namesto tega smo komponento nadomestili s preprostejšim hierarhičnim rojenjem, na račun povečanja splošnosti pa se je z zadnjo spremembo nekoliko poslabšala napaka DER (slika 3) in napaka ocene števila govorcev (slika 4).

3.5 Primerjava rezultatov

Končno različico postopka, ki smo ga razvili, smo primerjali z nespremenjeno metodo LIUM ter drugo, v literaturi pogosto uporabljeno metodo diarizacije ALIZE [4].

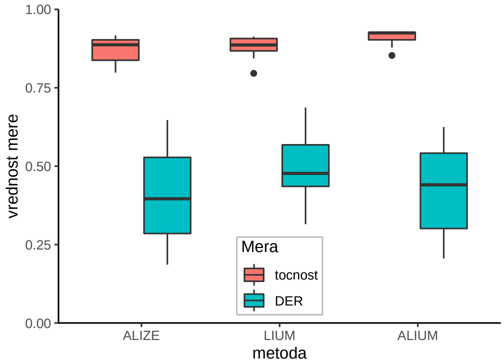
Slika 5 prikazuje točnost detektorja govora in napako DER našega postopka diarizacije (označenega z „ALIUM“) v primerjavi z drugima dvema postopkoma iz literature na posnetkih iz „AMI Corpus“. S spremembami, opisanimi v prejšnjem poglavju, smo izboljšali točnost zaznavanja govora: kot izračunano z analizo variance, se metode razlikujejo statistično pomembno ($\chi^2(2) = 32{,}8$, $p < 0{,}001$). Pri tem se je točnost izboljšala predvsem zaradi priklica razreda govora, medtem ko je priklic razreda ne-govora dejansko slabši kot pri postopku ALIZE. Po drugi strani se metode razlikujejo tudi v napaki DER ($\chi^2(2) = 14{,}8$, $p < 0{,}001$), vendar je bil glede na to mero najboljši postopek ALIZE.

Iste tri metode smo primerjali tudi na treh lastnih posnetkih. V tem primeru se je naš postopek obnesel mnogo bolje tudi z vidika napake DER, saj je napaka v povprečju znašala DER = 0,341, medtem ko je bila pri nespremenjenem postopku LIUM DER = 0,828 in ALIZE DER = 0,794.

Delovanje metode diarizacije smo primerjali tudi preko posnetkov z različnih mobilnih telefonov. Točnost zaznave govora se je med posnetki z različnih telefonov razlikovala za 1 %, napaka DER pa za največ 3,5 %.

4. ZAKLJUČKI

Naš postopek diarizacije govorcev, še posebej pa korak zaznavanja govora, deluje zanesljivo na raznovrstnih posnetkih. Že obstoječe metode v dobro kontroliranih pogojih in sodeč po nekaterih merah sicer dajejo nekoliko boljše rezultate, vendar kaže, da je v našem delu prilagojen postopek širše uporaben. To se je pokazalo v doslednih rezultatih na različnih zbirkah podatkov, in mnogo boljšimi rezultati na zbirki, posneti z mobilnimi telefoni različnih proizvajalcev.



Slika 5: Točnost detektorja govora, opisanega v podpoglavju 3.3, in napaka DER pri diarizaciji s postopkom, opisanim v podpoglavju 3.4 in označenim z „ALIUM". Ti dve meri smo primerjali z originalnim LIUM postopkom ter postopkom ALIZE na dvanajstih posnetkih „AMI Corpus".

Druga pomembna prednost razvitega postopka je njena nizka računska zahtevnost. Logistična regresija je preprost algoritem, zaradi česar je detekcijo govora mogoče izvajati v realnem času na sodobnih mobilnih napravah z operacijskim sistemom Android. Večino računske zahtevnosti tako prinesejo nadaljnji koraki diarizacije: čas računanja je linearno naraščal z dolžino posnetka, čas izvedbe celotnega postopka pa je bil na prenosnem računalniku v povprečju 20-krat krajši od trajanja posnetka.

Na posnetkih iz „AMI Corpus" se je metoda ALIZE brez prilagoditev glede na napako DER izkazala bolje od naše (slika 3). Ti posnetki imajo v primerjavi s posnetki s telefonov iz vsakdanjega življenja ugodno razmerje med signalom in šumom in tudi večjo glasnost. Naš postopek bi tako morda lahko izboljšali s predobdelavo posnetkov, predvsem z normiranjem glasnosti in odstranjevanjem šuma. Druga izboljšava, ki je bila v literaturi že preizkušena [7], je iskanje mej med segmenti govorcev od začetka do konca posnetka in nato še v nasprotni smeri.

Za implementacijo postopka za samodejno zaznavo pogovorov s pomočjo pametnih telefonov pa bomo v prihodnje pozornost poleg točnosti namenili tudi porabi energije. Kljub računski preprostosti detektorja govora je namreč že samo snemanje z mikrofonom veliko breme za baterijo. Govor je mogoče zaznati tudi brez neprestanega snemanja, na primer z uporabo adaptivnega vzorčenja [15].

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Measurement of Bradykinesia for the Detection of Parkinson's Disease

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ABSTRACT
Non-motor and motor symptoms that are linked with Parkinson's disease are often clinically assessed by neurologists using the Unified Parkinson's Disease Rating Scale (UPDRS). UPDRS scores are described as qualitative and are dependent on neurologist's experience. Consequently, clinical scores may differ among neurologists. We develop an application for measuring bradykinesia in the UPDRS finger tapping task, with which patients are recorded with a depth camera and by analyzing videos, given a more objective rating. In the first stage, we detect touches and thumb's and pointer's fingertips. Following, we calculate distances between the fingertips. From distances we then extract finger tapping features. We record a group of people with Parkinson's disease and a control group. Furthermore, we define a model that best separates instances with different UPDRS scores. Considering the small number of training data, the model successfully separates the instances, however, we need to obtain more data for classification.

Keywords
bradykinesia, finger tapping, Unified Parkinson's Disease Rating Scale

1. INTRODUCTION
Parkinson's disease is a progressive neurodegenerative chronic disease, where early diagnosis is of utmost importance for inhibition of further progression of the disease and the onset of more serious symptoms that do not effect only quality of life [5]. Due to the lack of a diagnostic test, Parkinson's disease is often misdiagnosed or overlooked because of common symptoms with other diseases. Bradykinesia, which is one of the motor symptoms of Parkinson's disease, refers to the slowness of movement, decrease in amplitude and speed during performing repetitive movements of body segments [4].

For assessment neurologists usually use the Unified Parkinson's Disease Rating Scale (UPDRS) [6], that consists of four parts. The first part deals with self-evaluation of non-motor experiences of daily living, second with self-evaluation of motor experiences of daily living. The third part deals with motor examination and the fourth part assesses complications in treatment.

We develop an application for assessing finger tapping, which is one of the motor tasks examined in the UPDRS, with a more objective rating. Finger tapping task consists of 10 taps, where the patient is instructed to tap their index and thumb fingers 10 times as quickly and as big as possible. In the first stage we detect touches and thumb's and pointer's fingertips, then calculate distances between the tips. From the distances, we define features that represent UPDRS characteristics such as amplitude decrements, slowness, interruptions, hesitations and halts. Individual tasks in UPDRS are rated with a score, ranging from 0 to 4. Both the left and the right hand is rated, separately. Requirements for each score of the finger tapping task are as follows:

0: Normal: No problems.

1: Slight: Any of the following: a) the regular rhythm is broken with one or two interruptions or hesitations of the tapping movement; b) slight slowing; c) the amplitude decrements near the end of the 10 taps.

2: Mild: Any of the following: a) 3 to 5 interruptions during tapping; b) mild slowing; c) the amplitude decrements midway in the 10-tap sequence.

3: Moderate: Any of the following: a) more than 5 interruptions during tapping or at least one longer arrest (freeze) in ongoing movement; b) moderate slowing; c) the amplitude decrements starting after the 1st tap.

4: Severe: Cannot or can only barely perform the task because of slowing, interruptions or decrements.

Many studies use accelerometers and gyroscopes attached to the fingertips [8, 9, 3, 2], however they may have an impact on the patient's performance of the finger tapping task. A depth camera, similar to ours, was used in [7] where multiple motor tasks were examined. 3Gear software development kit was used to detect fingertips and touches, for which a license is currently unobtainable.

2. APPLICATION IMPLEMENTATION
Our application includes a simple user interface, logic for recording and analyzing recorded videos, and a database for storing and reviewing results. Recording is done with an ASUS Xtion PRO LIVE depth camera. The resolution of the depth image is set at a maximum of 640×480 pixels

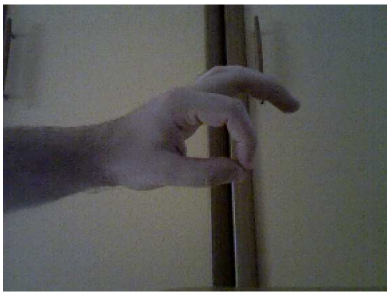

Figure 1: Example of a hand perpendicular to the camera's direction of recording.

at 30 frames per second. The following rules were set for recording for better results:

- There must be only one hand in the scene,
- the hand should be positioned as perpendicular as possible to the camera's direction of recording as visible in figure 1,
- the hand must be at least 0.6 meters away from the camera due to the range of the camera and must not be too far,
- other fingers should not be curled into a fist,
- recording should take place in a room not too exposed to sunlight,
- fingertips must be tapped 10 times as fast as possible and as big as possible.

2.1 Fingertip and Touch Detection

In the first stage, the hand needs to be separated from the background. Since patients are recorded in a way that the hand is the closest object, the closest pixels in a defined area can be taken. We also crop the image to exclude a portion of the arm we have no interest in.

Firstly, to detect fingertips we blur the image, using a median filter. Next, we remove excessive fingers using Canny edge detector. The hand is not always completely perpendicular to the direction of recording, so thresholds of Canny edge detector are not set too high, otherwise needed parts of the hand could be deleted. After deletion, we apply a morphological operation of closing to fill any holes that formed.

Occasionally excessive fingers do not get deleted with Canny edge detector. We use an algorithm that reduces an image to a 1-pixel wide skeleton. We iterate through the skeleton pixels and check for an adequate difference in depth of neighbouring pixels. Pixels further away get deleted along with the branch of the skeleton they were on. Two closest tips of branches are accepted as index and thumb fingertips, where the higher positioned tip is the index fingertip.

After deletion, we apply a morphological operation of dilation on the skeleton and then extract contours from the image. The largest contour represents the whole hand, in

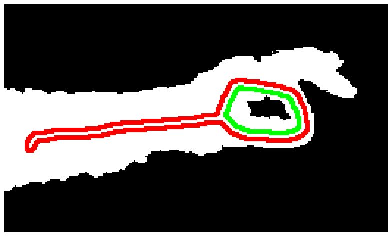

Figure 2: Example of obtained contours in case of a touch.

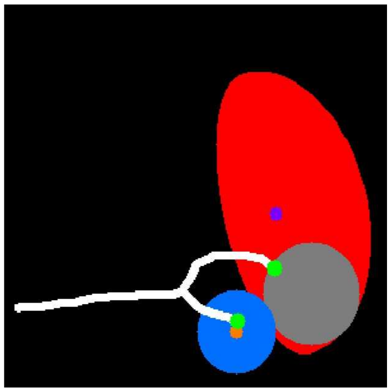

Figure 3: Typical regions of interest and the skeleton of a hand. Green circles represent the fingertips, the orange circle is the median of the fingertips of the thumb, and the purple circle is the median of the fingertips of the index fingers. The blue circle represents the first region, the gray region the second region, and the red image represents the third region composed of two parts.

case of a touch, a smaller contour on the inside of the fingers, as illustrated in figure 2, is formed, with which a touch is detected.

2.2 Correcting Misdetections

The closest points do not always represent the tips of the thumb and index fingers. To correct fingertip detection errors, we calculate the median of index and thumb fingertips every 20 images where a touch has not been detected. This way we reduce the impact of smaller hand movements and amplitude decrements. Based on the distance between the medians of fingertips, we define 3 regions of interest. The first one is a circle with it's center in the median of the thumb's fingertips. The second one is located in the middle of the distance offset from the hand. The last one is composed of an angled ellipse and semi-ellipse, so it captures the index finger movement better. Regions are displayed in figure 3. Most of misdetections occur when there is an excessive branch originating near the joint of the index finger where it's tip is closer than the index's fingertip. By making the 3rd region's ellipse narrower, we can avoid those misdetections. Tips of branches are accepted as fingertips based on if the tip is in the regions and the distance to the centres of regions. We choose the tip closest to the centre of the first region as the thumb fingertip and the tip closest to the centre of the second region as the index fingertip. Besides,

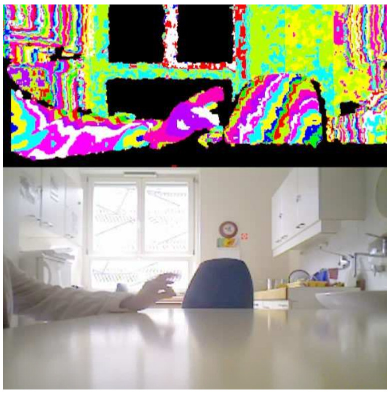

Figure 4: Errors in measuring depth. The depth image is represented with colored bands (top image).

we calculate the median length of index and thumb fingers. Branches where the tip is located on must be approximately the right length, for it to be considered a thumb or index finger. Next, we calculate z-score for every tip of a branch for x and y coordinates calculated as $z = (x - \overline{x})/\sigma$, where x is the coordinate, $\overline{x}$ is the mean of the coordinates and σ is the standard deviation of the coordinates. If absolute z-scores of both coordinates of a tip are under 3 and are the lowest of all other tips' absolute z-scores, we accept the tip as a fingertip, otherwise we mark the image's fingertips as undetected. Touches are detected if more than one contour is found in an image. The occurrence of a second contour does not always mean a touch occurred, so correction is necessary. Based on the size and position of all second contours we set a minimal size requirement and restrict the location of the contour's centre.

2.3 UPDRS Score Calculation and Results

To calculate the UPDRS score, we recorded a group of people with Parkinson's disease at a neurological clinic at the University Medical Centre Ljubljana. Patients were instructed to tap their thumb and index finger 10 times as fast as possible and as big as possible, i.e. 10 cycles of opening and closing. Each patient was given a clinical evaluation of the left and the right hand by a neurologist. We recorded 16 people. With recordings of left and right hands we got a total of 32 recordings. Out of the 32 recordings, all touches and fingertips were correctly detected in 12 recordings. Due to the limited space at the clinic, we had to move the camera between recordings of left and right hands, which caused problems. Depth measurement was also adversely affected by sunlight. The biggest reason for misdetections was the poor adherence to rules described in the beginning of Sec. 2. In some recordings, hands were not placed sufficiently perpendicular to the direction of recording, causing problems in detecting touches or fingertips or both. In other recordings, patients curled the rest of their fingers into a fist. Some patients tapped with their finger pads instead of their fingertips. Tapping with pads can easily turn into tapping with your thumb pad and the joint. Since we rely on the contours for detecting touches, such tapping, low resolution, camera distance, and other influences can cause errors in measuring depth and make it harder to find a contour. An example of such errors is shown in Fig. 4.

The UPDRS score consists of the slowness of finger movement, amplitude decrements, number of interruptions, hesitations and halts. For the purpose of identifying the listed properties, we extracted the following attributes from distances between the fingertips:

- mean, standard deviation and slope of amplitudes (pAmp, sdAmp, sAmp),
- differences in percentage between the mean of all amplitudes except the last and the last amplitude, between the mean of the first and second half of amplitudes, and between the first and the mean of all other amplitudes (Damp1, Damp2, Damp3),
- mean, standard deviation, and slope of the mean opening, closing, and full-cycle velocities (mVopen, sdVopen, sVopen, mpVclose, sdVclose, sVclose, mVcyc, sdVcyc, sVcyc),
- mean, standard deviation and slope of maximum opening and closing velocities (mMVopen, sdMVopen, sMVopen, mMVclose, sdMVclose, sMVclose),
- mean, standard deviation and slope of percentage of time of a cycle to maximum opening velocity (mTMVopen, sdTMVopen, sTMVopen),
- mean, standard deviation and slope of cycle duration (mLen, sdLen, sLen),
- mean, standard deviation and slope of touch duration (mTou, sdTou, sTou),
- mean, standard deviation and slope of mean acceleration (mA, sdA, sA),
- number of interrupts (Inter),
- hesitation index (Hesit),
- number of halts (Halt).

Amplitudes were calculated as the maximum distance between fingertips in a cycle. We calculatde decrements as described in the UPDRS with Damp1, Damp2, Damp3 and by using linear regression. We divide speed into mean opening, closing velocity and the velocity of the entire cycle. Opening velocity is defined by absolute differences of distances from the beginning of opening to the amplitude in the cycle divided by the travel time, similarly, closing velocity with absolute differences of distances from the amplitude to the end of closing, and velocity of the entire cycle from the beginning of opening to the end of closing. In addition to the average velocity, speed is also expressed with means of cycle and touch duration, maximum opening and closing velocities, and average accelerations in cycles. We obtain changes with linear regression. Halts are longer arrests in movement. We detect halts if the difference between the cycle duration and the approximation, calculated by Theil–Sen estimator, is above a certain threshold as calculated in [7]. Hesitations occur at the start of an opening or closing. We detect hesitations with an index, calculated by summing up the absolute differences between the percentage of time of a cycle to the maximum opening velocity and the approximation, calculated by Theil–Sen estimator, similarly as done in [8]. In a

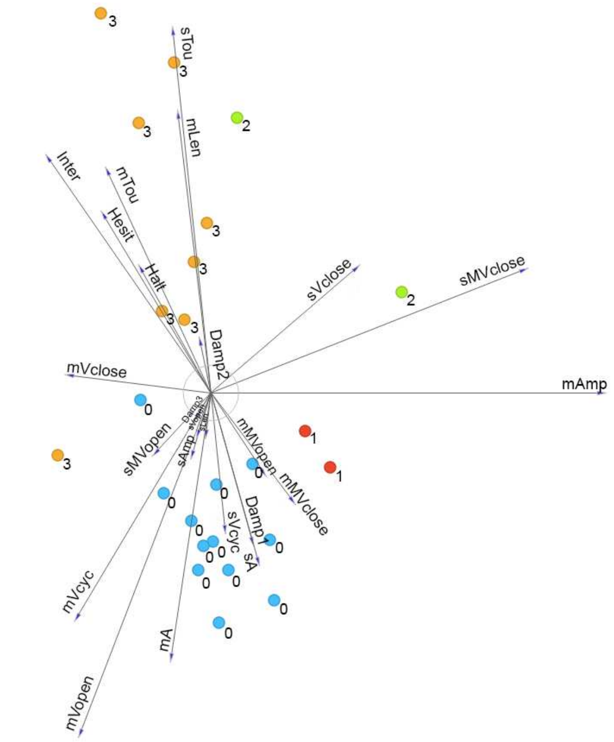

Figure 5: Optimized linear projection in Freeviz. The instances are colored according to the UPDRS scores that are displayed next to the instances.

case of no hesitations the index will be close to 0. Interruptions are changes in regular rhythm and occur during opening or closing. A healthy person will perform one smooth opening and closing, while a person with Parkinson's disease will need multiple shorter openings or closings. We detect interruptions if velocity changes it's sign more than once as done in [7]. We visualize results in Freeviz, which is a part of an open-source program Orange [1]. By optimizing the linear projection shown in figure 5, we get a model that best separates instances with different UPDRS scores. The usefulness of attributes is also shown with arrows. The shorter the arrow, less useful the attribute is. As seen, Damp2, sVopen, sLen are the least useful. The model groups instances with scores 0, 1, 3 rather successfully, however more recordings are required to define a classifier.

3. CONCLUSIONS

We developed an application for measuring bradykinesia in the finger tapping task. Our aim is to evaluate the patients with Parkinson's disease objectively, independent of a clinical doctor. Using a depth camera we detected touches and fingertips and calculated distances between the fingertips. The distances obtained by a depth camera helped us to compensate for very diverse hand poses, which we were unable to analyze using a standard camera; the patients are usually not able to follow strict experimental setting rules due to their disease. From the distances, we have extracted several attributes and built a model that best separates instances with different UPDRS scores. Due to the small amount of recordings, we could not construct a classifier. The biggest problems with detection of touches and fingertips are caused by improper tapping, clenching the other fingers into a fist and over-tilting the hand. We were limited by the small amount of collected data. Further work will involve more data and the use of hand keypoint detection systems such as OpenPose to improve fingertip and touch detection. With the classifier defined, the application could be used in clinics to evaluate patients more objectively. Analysis of other motor tests described in UPDRS would be essential, since finger tapping is only one of many tests in UPDRS.

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CmoPy: Constrained Multiobjective Optimization in Python

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ABSTRACT

Python is one of the most frequently used programming languages for solving multiobjective optimization problems (MOPs). Although there exist Python packages covering a wide range of multiobjective optimization tools, there is still a lack of implemented constraint handling techniques (CHTs). This paper introduces a new package for Constrained Multiobjective Optimization in Python (*CmoPy*). It describes the package implementation, the included CHTs and benchmark problems, and shows examples of using the package. With five state-of-the art CHTs and 22 benchmark constrained MOPs, *CmoPy* is currently the most comprehensive Python package for constrained mutliobjective optimization.

Keywords

Python, constrained multiobjective optimization, multiobjective evolutionary algorithms, constraint handling techniques, NSGA-II algorithm

1. INTRODUCTION

Real-world optimization problems regularly involve both multiple objectives and constraints. Such problems are called *constrained multiobjective optimization problems* (CMOPs). A CMOP can be formulated as

$$\begin{aligned} \text{minimize} \quad & f_m(x), \quad m = 1, \ldots, M \\ \text{subject to} \quad & g_n(x) \leq 0, \quad n = 1, \ldots, N \end{aligned}$$

where $x = (x_1, \ldots, x_D)^{\mathrm{T}}$ is a *decision vector* (solution), $f_m : S \rightarrow \mathbb{R}$ are *objective functions*, $g_n : S \rightarrow \mathbb{R}$ *constraint functions*, $S \subseteq \mathbb{R}^D$ is a *decision space* of dimension D, and M and N are the numbers of objectives and constraints, respectively. Additionally, $f_m(x)$ is an *objective value*, $g_n(x)$ a *constraint value*, $\phi_n(x) = \max(g_n(x), 0)$ *constraint violation* and $\phi(x) = \sum_n \phi_n(x)$ the *overall constraint violation*. A solution satisfying all the constraints is a *feasible solution* and otherwise an *infeasible solution*.

A feasible solution $x^{(1)}$ is said to *dominate* a feasible solution $x^{(2)}$ if and only if $f_m(x^{(1)}) \leq f_m(x^{(2)})$ for all $m \in \{1, \ldots, M\}$ and $f_m(x^{(1)}) < f_m(x^{(2)})$ for at least one index m. A feasible solution x^* is a *Pareto-optimal solution*, if there are no feasible solutions from S dominating x^*. The set of all Pareto-optimal solutions from S is called a *Pareto-optimal set* and its image in the objective space a *Pareto front*. The goal of multiobjective optimization is to find an approximation of the Pareto front that represents trade-offs between the objectives.

Python is one of the most frequently used programming languages for solving multiobjective optimization problems. Due to its simplicity, versatility and accessibility of numerous open source optimization tools, it is suitable for academic research as well as for real-world applications. In the Python Package Index—the biggest repository of Python software—there are currently six packages dealing with (nonlinear) multiobjective optimization problems: *DEAP* [7], *inspyred* [9], *jMetalPy* [1], *PaGMO 2.0* [2], *Platypus* [10] and *pymoo* [3]. All these packages implement the most common evolutionary algorithms for multiobjective optimization, such as Nondominated Sorting Genetic Algorithm II (NSGA-II) [5], Multiobjective Optimization Evolutionary Algorithm Based on Decomposition (MOEA/D) [18] and others.

However, constraint handling techniques (CHTs) are not explicitly addressed in these packages. In *jMetalPy*, *PaGMO 2.0* and *Platypus*, only the constrained-domination principle (CDP) [5] is implemented to deal with constraints. In *pymoo* and *inspyred*, constraints are not considered at all, while *DEAP* implements a CHT based on a penalty function. For this reason, there is still a great need for a more comprehensive package covering the area of constrained multiobjective optimization.

In this paper, we present a new package for constrained multiobjective optimization named *CmoPy*, which stands for Constrained Multiobjective Optimization in Python. The package is designed as a potential functionality in the *SciPy* Python tool [12]. It implements five state-of-the-art CHTs and an ensemble method capable of including multiple CHTs to handle constraints. In addition, several widely used CMOPs are included for benchmarking purposes.

The rest of this paper is organized as follows. Section 2 describes the implementation of *CmoPy*. Section 3 is dedicated to the CHTs implemented in the package, while the included CMOPs are covered in Section 4. In Section 5, some examples of using the package are shown. Finally, Section 6 summarizes the *CmoPy* presentation and provides ideas for future work.

2. PACKAGE IMPLEMENTATION

The main function in *CmoPy* is `nsga_ii`. When called, this function executes the NSGA-II algorithm to solve the given CMOP. The `nsga_ii` function resembles the original NSGA-II [5] in all segments except for minor modifications in the survivor selection phase, where the population is selected for the new generation, to allow for the inclusion of additional CHTs (see [17] for details on these modifications and Section 3 for a summary of CHTs implemented in *CmoPy*). The input and output parameters of the `nsga_ii` function are described below.

The input parameters of the `nsga_ii` function:

- `problem (Problem)`: A custom object including four parameters:
  - `fun (callable)`: A Python callable (function) consisting of objective and constraint functions. Must be of the form `f(x, *args)` where `x` is the argument in the form of a 1-D `ndarray` and `args` is a tuple of all additional fixed parameters needed to fully specify the objective and/or constraint functions. The output must be a 1-D `ndarray` of objective and constraint values. Note that only inequality constraints of the form $g(x) \leq 0$ are accepted. Equality and other forms of constraints need to be reformulated as inequality constraints.
  - `bounds (list of tuple)`: Bounds of the form `(min, max)` that define the lower and upper bounds for the arguments of `fun`.
  - `no_cons (int, optional)`: The number of constraints. Default is 0.
  - `args (tuple, optional)`: Any additional parameters needed to completely specify the objective and/or constraint functions. Default is `None`.
- `max_iter (int, optional)`: The maximum number of generations to be executed by the optimizer. Default is 250.
- `pop_size (int, optional)`: Number of solutions in the population. Default is 100.
- `max_fun (int, optional)`: The maximum number of function evaluations. Default is 25,000.
- `mut_prob (float, optional)`: The probability for a solution to be mutated. Default is $1/D$.
- `cross_prob (float, optional)`: The probability for parents to be altered by crossover. Default is 0.9.
- `mut_eta (int, optional)`: The distribution index for the polynomial mutation. Default is 20.
- `cross_eta (int, optional)`: The distribution index for the simulated binary crossover. Default is 20.
- `seed (int, optional)`: This parameter controls the seeds of the stochastic processes applied during the algorithm run. If no value is specified, a random seed is used.
- `init (str or ndarray, optional)`: The type of the population initialization. It can be `"lhs"` for the latin hypercube sampling, `"rand"` for random population initialization, or a `ndarray` of predefined solutions. In the last case, the parameter `pop_size` is equal to the number of rows in the array. Default is `"lhs"`.
- `cht (tuple of str, optional)`: The required constraint handling technique. It can be `"nds"` for nondominated sorting, `"cdp"` for constrained-domination principle, `"dpf"` for dynamic penalty function, `"str"` for stochastic ranking, `"mcr"` for multiple constraint ranking, or a tuple of any set of these methods. In the latter case, the ensemble of specified CHTs is used. The default value is `"nds"` if there are no constraints and `"cdp"` otherwise.

The output parameter is a custom object named `Result`. It is a multiobjective extension of the object `OptimizeResult` used to represent results in the optimization module of *SciPy* [12]. The object `Result` includes the following parameters:

- `x (ndarray)`: Solutions from the final population.
- `x_all (ndarray)`: All nondominated feasible solutions found during the entire optimization run.
- `success (bool)`: Whether or not the optimizer exited successfully.
- `status (int)`: The optimizer termination status.
- `message (str)`: The description of the termination cause.
- `fun (ndarray)`: The objective and constraint values of solutions from the final population.
- `fun_all (ndarray)`: The objective and constraint values of all nondominated feasible solutions found during the entire run.
- `nfev (int)`: The number of the `fun` function evaluations.
- `nit (int)`: The number of generations executed by the optimizer.
- `maxcv (float)`: The maximum overall constraint violation.

The implementation of *CmoPy* follows the guidelines for contributing to *SciPy*. The only dependency apart from *SciPy* needed to use the package is *NumPy* [14].

3. CONSTRAINT HANDLING TECHNIQUES

In *CmoPy*, there are five widely used CHTs and an ensemble method combining any desired set of single techniques:

- Nondominated sorting [5]: This method selects the new generation of solutions according to the dominance relation, not considering constraint violations at all. This method is used as the default CHT for unconstrained problems.
- Constrained-domination principle [5]: This CHT can be seen as an extension of the nondominated sorting, where feasible solutions dominate infeasible ones, and infeasible solutions are ranked according to the overall constraint violation. This method is used as the default CHT for constrained problems.

- Dynamic penalty function [6]: This method augments the fitness of a solution by adding a penalty that is proportional to the overall constraint violation. The penalty pressure is increased in each generation.

- Stochastic ranking [15]: This CHT uses a bubble-sort-like process to rank solutions in the population. Two feasible solutions are always compared based on their fitness. On the other hand, if at least one of the solutions is infeasible, then a random decision is made on whether the two solutions are compared based on their fitness or constraint violation.

- Multiple constraint ranking [8]: In this approach, the solutions are ranked based on their fitness and constraint violation. If there are no feasible solutions, only the rank generated from constraint violation is considered, otherwise a combination of both ranks is taken into account.

- Ensemble of CHTs [17]: This approach combines multiple single CHTs into an ensemble-based ranking. The solutions are ranked based on a quality measure which is averaged over all techniques in the ensemble.

4. INCLUDED BENCHMARK PROBLEMS

The *CmoPy* package contains 22 CMOPs that are frequently used for benchmarking purposes (see, for example, [4, 16]). Table 1 summarizes these problems considering three basic characteristics: the dimension of the decision space, the number of objectives and the number of constraints.

Table 1: Characteristics of the CMOPs included in *CmoPy*: dimension of the decision space D, number of objectives M and number of constraints N.

CMOP	D	M	N
Belegundu [4]	2	2	2
Binh 1 [4]	2	2	2
Binh 2 [4]	2	3	2
C1-DTLZ1 [11]	$M+4$	≥ 2	1
C1-DTLZ3 [11]	$M+9$	≥ 2	1
C2-DTLZ2 [11]	$M+9$	≥ 2	1
C3-DTLZ1 [11]	$M+4$	≥ 2	M
C3-DTLZ4 [11]	$M+4$	≥ 2	M
Car-side impact [11]	3	10	7
DTLZ8 [4]	30	3	3
DTLZ9 [4]	30	3	2
Jimenez [4]	2	2	4
Kita [4]	2	2	3
Obayashi [4]	2	2	1
Osyczka 1 [4]	2	2	2
Osyczka 2 [4]	6	2	6
Srinivas [4]	2	2	2
Tamaki [4]	3	3	1
Tanaka [4]	2	2	2
Vibrating platform [13]	2	5	5
Viennet [4]	2	3	2
Water resource planning [11]	5	7	3

5. EXAMPLES OF USING THE PACKAGE

This section illustrates the use of *CmoPy* on the well-known Srinivas [4] problem. It also shows an example of adding a new CMOP to the package.

We first need to install *CmoPy*. This can be achieved by running the following commands:

```
$ git clone https://gitlab.com/cmopy/cmopy.git
$ cd cmopy
$ python setup.py
```

In the following example, the NSGA-II algorithm is run to solve the Srinivas problem. The population size is set to 80 solutions (`pop_size=80`), while the number of generations is kept at the default value of 250. In addition, CDP is used for handling constraints as a default option.

```
>>> from cmopy.optimize import nsga_ii
>>> from cmopy.problems import srinivas, Problem
>>> nsga_ii(srinivas, pop_size=80)
```

To add new CMOPs to *CmoPy*, we need to implement the `problem` object introduced in Section 2. In addition to the `callable` object (`test_fun`) consisting of the objective and constraint functions, we need to specify the bounds (`bounds`) and the number of constraints (`no_cons`). The following example shows the implementation of the Tanaka problem [4].

```
>>> import numpy as np
>>> def test_fun(x):
...     x1, x2 = x
...     g1 = 1 - x1 ** 2 - x2 ** 2 + \
...          0.1 * np.cos(16 * np.arctan(x1 / x2))
...     g2 = (x1 - 0.5) ** 2 + \
...          (x2 - 0.5) ** 2 - 0.5
...     return np.array([x1, x2, g1, g2])
>>> bounds = [(0, np.pi)] * 2
>>> no_cons = 2
>>> test_cmop = Problem(test_fun, bounds, no_cons)
```

At this point, we can run the NSGA-II algorithm to solve the implemented problem. Here, we use the dynamic penalty function to handle constraints (`cht="dpf"`).

```
>>> nsga_ii(test_cmop, cht="dpf")
```

If we want to run an ensemble combining multiple CHTs, we need to specify all the desired techniques in a tuple. The `nsga_ii` function automatically detects that an ensemble method is required. In the following example, the optimizer uses an ensemble combining the constrained-domination principle and the dynamic penalty function to handle constraints (`cht=("cdp", "dpf")`).

```
>>> nsga_ii(test_cmop, cht=("cdp", "dpf"))
```

Figure 1 shows the Pareto front approximations for the Srinivas problem (left) and the Tanaka problem (right) obtained after running the above commands.

6. CONCLUSIONS

We introduced *CmoPy*, a Python package designed for constrained multiobjective optimization. Unlike other Python packages for multiobjective optimization, it contains a comprehensive set of CHTs. While other packages usually implement one simple method to deal with constraints, in *CmoPy* there are five state-off-the-art CHTs and an ensemble-based

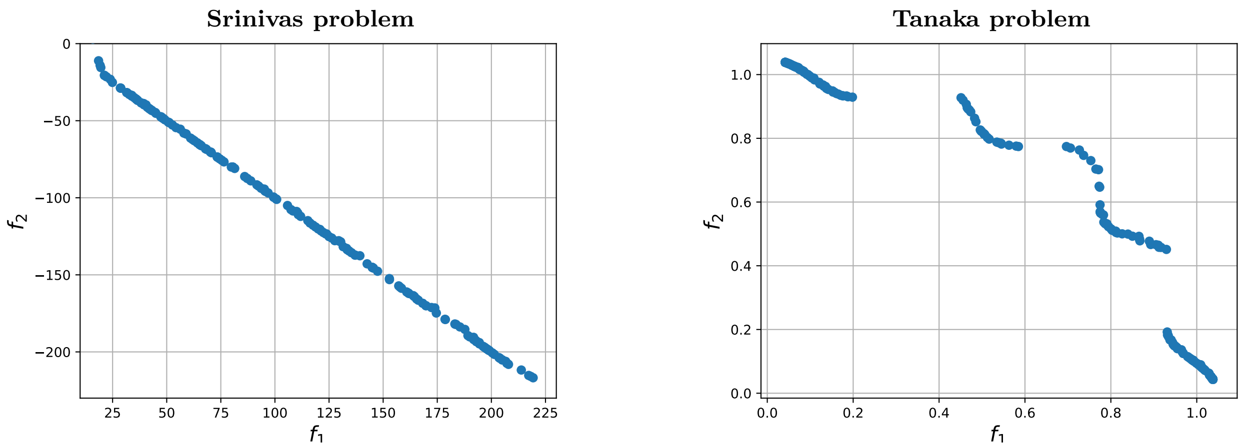

Figure 1: Pareto front approximations generated by *CmoPy* for the Srinivas problem (left) and the Tanaka problem (right). The former was solved by handling constraints with CDP, while the latter by applying an ensemble of CHTs.

method combining multiple single techniques. Moreover, an extensive set of benchmark CMOPs with various characteristics is also included in *CmoPy*.

In the future, we plan to extend the package functionality by adding other multiobjective optimizers, for example, MOEA/D, and integrating the methods for visualizing the results and algorithm performance.

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Designing an Intelligent Cognitive Assistant for Behavior Change in Mental Health

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ABSTRACT
The paper describes intelligent cognitive assistant technologies and how they can be used efficiently for behavior change in mental health, namely stress, anxiety and depression. It then reviews the state of the art of such cases, focusing on three different assistants and their experimental results. It raises some critical issues with the state of the art and the field itself, namely the lack of standardized evaluation and that current technologies do not take advantage of artificial intelligence and behavior sciences advances. The paper proposes its own comprehensive cognitive architecture for such an assistant, relying on the integration of behavior change theories and cohesive user modeling (together referred to as the theory of mind) into a cognitive architecture. In addition to linguistic input, the architecture includes biophysiological input for affect recognition purposes. Reinforcement learning and the use of the principle of multiple knowledge are proposed as the main drivers for strategy adaptation in relation to helping users. The paper attempts to fill the gaps in the works related to this field, which are mostly closed source, believing that an overview of the field, its issues and a proposed design will enrich the current academic landscape.

Keywords
Behavior change, cognitive architecture, intelligent cognitive assistant, mental health, user modeling and profiling.

1. INTRODUCTION
Intelligent cognitive assistants (ICAs) have been described as the next revolution in human-computer coexistence, particularly because of the idea of conversing with people in natural language [1]. The technology has relatively ancient roots in the history of artificial intelligence (AI), consisting of famous examples such as Weizenbaum's simulation of a Rogerian psychotherapist called ELIZA [2]. However, the technology has only recently laid the foundations for broad adoption in the form of ICAs such as Alexa and Siri as well as more domain-specific agents, and has been thus on the rise in terms of financing and research [1]. ICAs, which can be deployed as virtual agents or robots, are being made to: understand context; be adaptive and flexible; learn and develop; be autonomous; be communicative, collaborative and social; be interactive and personalized; be anticipatory and predictive; perceive; act; have internal goals and motivation; interpret; and reason. To achieve this in ICAs, they are embedded with a cognitive architecture (CogA), a "hypothesis about the fixed structures that provide a mind, whether in natural or artificial systems, and how they work together – in conjunction with knowledge and skills embodied within the architecture – to yield intelligent behavior in a diversity of complex environments" [3].

ICAs have recently shown great potential as persuasive technology in the domain of behavior change (BC). BC is a phenomenon that is considered to be a temporary or permanent effect on an individual in terms of their behavior, attitude and other mental states as compared to their past [4]. Persuasive technology can be defined as technology designed for attempting to "change attitudes or behaviors or both (without using coercion or deception)" [4, p. 20]. Persuasive technologies are already heavily used in the areas of health and wellness, where AI tracks people's behavior as well as physiological and mental states to motivate them to make better dietary decisions and exercise more along with offering people psychotherapeutic help in natural language [5]. To achieve this, user modelling and profiling (UMP) is extremely important in order to understand users' intentions, needs and states in relation to their psychographics, which can then be used for personalized and thus more effective BC through carefully selected outputs [6].

Of particular importance for persuasive technologies is the area of psychotherapeutic help. Stress, anxiety and depression (SAD) are prevalent and rising problems, with research revealing that more and more people are suffering from at least one of these mental issues, with figures in some groups reaching 71% for stress, 12 % for anxiety disorder and 48% for depression [7]. Slovenia, already struggling with the second highest suicide rate in Europe [8], also suffers from a serious shortage of officially recognized and certified mental health professionals as well as from a lack of regulation [9]. This opens the door to ICAs, as they are not only generally free to use (making help available to socioeconomically disadvantaged people) and available 24/7 (so people do not have to wait for their next therapy session), people tend to be more comfortable disclosing their feelings to an ICA than to a person [10], ICAs are available in remote locations, ICAs reduce burden on the healthcare system and its practitioners, and overall reduce barriers to mental healthcare access [11]. Such ICAs do not serve to replace professionals, but to complement them.

This introduction is followed by an overview of the state of the art. Afterwards, our design process and related work of constructing a psychotherapeutic ICA (PICA) are presented. Our work is in the phases of planning, analysis and design of the Systems development life cycle [12]. The paper focuses mostly on the computational (what the system does and why) and algorithmic level (how the system does what it does) of Marr's 3-level design hierarchy for AI systems [13]. Since papers on designs and their hurdles for PICAs are almost non-existent (as opposed to other kinds of ICAs), this work should find a useful place in the growing ICA research bibliography.

2. STATE-OF-THE-ART OVERVIEW

The chapter focuses on ICAs for BC in psychotherapy and mental health, namely for SAD. Various mechanisms of these systems are highlighted for the purposes of this work.

PICAs seem unique among ICAs, especially compared to Q&A ICAs. Users reveal personal information more freely, which makes PICAs more successful in their goals [14]. PICAs and their respective users also form a more longitudinal relationship. The interactions are not a one-off, where it is difficult to understand the users and act immediately with efficient strategies. This makes PICAs able to learn from historical interactions and improve in offering personalized psychotherapeutic help. However, since the use of ICAs as persuasive technology for BC is a recent endeavor, the pool of existing PICAs is small. The selection process of PICAs for this overview was based on the condition that they had been researched in an ecological environment (interacting with end users) with empirical experiments (e.g., randomized controlled trial). The metric is therefore being successful in relieving symptoms of SAD (a very indirect metric for determining which PICA performs best and why). PICAs cannot be compared in the same way as Q&A ICAs, where there are answers that need to be mapped to some collection of questions. PICAs must therefore be measured by their direct impact on the users [15], which makes them much more personalized in their acting, causing evaluation to be subjective and indirect. Our last selection metric was for PICAs to be text-based.

One of the most recent successful PICAs is Woebot [14]. Its overarching methodology is a "decision tree with suggested responses that accepts natural language inputs with discrete sections of natural language processing techniques embedded at specific points in the tree to determine routing to subsequent conversational nodes" [14, p. 3]. It gathers data on users' moods, goals, expectations and similar to build a user model and dispatch an intervention in the form of educational content, personalized messages, contextual strategies and scripted advice. In a randomized controlled trial, Woebot delivered better treatments to people than the government-approved self-help material, where the PICA relieved depression symptoms by app. 20% on average (Figure 1).

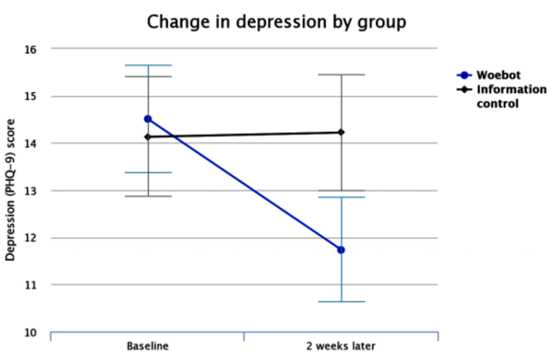

Figure 1 [14, p. 6]: Change in depression, control ('Information control') vs. test ('Woebot') group.

Another PICA is by Yorita, Egerton, Oakman, Chan and Kubota [16]. The PICA is built on the Belief-Desire-Intention (BDI) CogA (Figure 2). It comprises of three core models: "a conversation model for acquiring state information about the individual, measuring their stress level, a Sense of Coherence (SOC) model for evaluating the individuals state of stress, and Peer Support model, which uses the SOC to select a suitable peer support type and action it" [16, p. 3762], meaning it selects a suitable strategy based on the user model. 'Stress level' refers to scores from stress questionnaires, while 'state of stress' refers to three dimensions related stress that users actively try to improve: comprehensibility, manageability, meaningfulness.

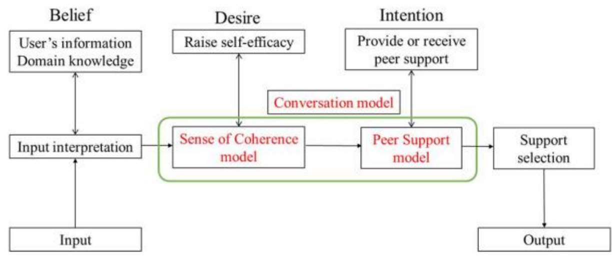

Figure 2 [16, p. 3762]: BDI CogA.

The experiment in the research found that the PICA had constructed more and more accurate models of its users, who managed stress better with each day of usage.

A PICA called Tess "reduce[s] self-identified symptoms of depression and anxiety" [17, p. 1]. It is crucially based on a wide emotion ontology, which it uses to determine and match users' emotions from their inputs. It uses stateful conversational models with scripted conversations, consisting of a natural language understanding module, dialogue state manager and natural language response generator. Improving strategies include asking for feedback as well as using user journaling data Tess gathers. Using Tess for psychotherapeutic interventions for mental health research showed that it significantly reduces anxiety and depression symptoms – roughly 16% for group 1 and 15% for group 2 (Figure 3).

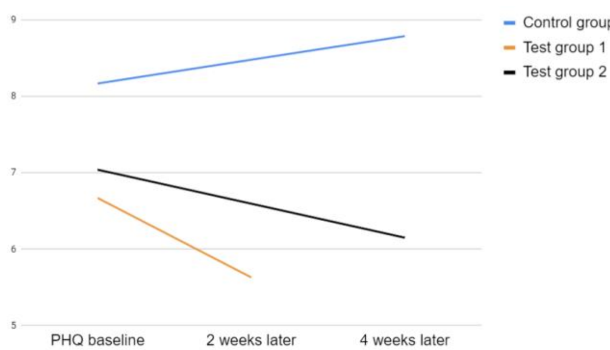

Figure 3 [17, p. 6]: Change in depression level (y-axis). Test group 1 used Tess for 2 weeks; 2 used it for 4 weeks. Control group used the government-suggested eBook on depression.

The PICAs described represent fully-formed agents with many mechanisms combined in a complete architecture. Most happen to be proprietary (closed source) and not available for technical scrutiny; there are no research papers that would describe them in detail, which holds true for most PICAs available online. Examining their architectures and implementation is therefore difficult, as noted by other researchers as well [18]. The overviewed work points at the PICAs being extremely goal-oriented and one-dimensional due to a lack of a contemporary UMP-based approach, a more coherent or theory-based CogA as well as a lack of inclusion if BC theories [5]. What follows is a description of a possible design and its hurdles towards a more effective PICA based on a coherent CogA, comprehensible UMP module and embedded BC domain knowledge.

3. THE PROPOSED DESIGN

This chapter describes the processes, related to the design of our PICA. First, an overview of contemporary methods of various fields used in ICAs is presented. Then, the necessity of embedded BC knowledge in relation to a comprehensive user model as well as a cohesive CogA for an effective PICA is argued through presenting the design and future implementation ideas.

For natural language understanding, dialogue-based applications are relevant for ICAs, where state-of-the-art applications use algorithms such as word2vec, Latent Semantic Analysis and deep learning methods [19]. Regarding UMP, there is a fairly accepted set of user characteristics that generally make artificial systems perform better when modelled: knowledge, beliefs, background, interests, preferences, goals, plans, tasks, needs, demographic information, emotional state, and context [20]. For CogAs, functional (as opposed to structural) architectures like BDI (and its various modifications) seem to be recommended [20].

Endowing a PICA with expert knowledge on BC has to be based on behavioral sciences advances in regards to human decision-making and similar phenomena [21], which has been recently combined with digital technologies, AI and big data. Many societal efforts are being put into creating persuasive technologies that would help, motivate, guide and affect people into bettering themselves and the world around them. One of the most powerful and effective contemporary BC concepts is the ‘nudge theory’[1]. Nudge is “any aspect of the choice architecture that alters people’s behavior in a predictable way without forbidding any options or significantly changing their economic incentive” [21, p. 6]. We believe that incorporating nudges and similar BC techniques into our PICA is essential for its effective behavior.

To effectively dispatch nudges and other strategies, our PICA (Figure 4) will build and continually update a user model. It is not clear which data on users is the most optimal for mental health BC, but we intend to implement a dialogically delivered questionnaire [22] on the Big Five personality traits (B5) as a fundamental element on the longitudinal (or global) user aspect [23]. This will largely inform PICA’s BC strategies as B5 is an extremely successful psychological construct in determining what kind of influence is effective on a person as well as many other inferences [24]. In the less longitudinal aspects, determining SAD will be fundamental. This will again be achieved through dialogically delivered Depression Anxiety Stress Scales 21 questionnaire [25] to determine specific mental health symptoms. SAD scores will be refined on a regular basis, as reinforcement learning will be used to adapt PICA’s behavior according to the changes in the SAD model [26]. The re-strategizing timeframe will have to be determined experimentally for optimal strategy adaptation. Continuous sentiment analysis (relying on Slovene sentiment lexicon JOB 1.0 if in Slovene [27]) will be used for a relatively short-term (albeit more inaccurate) inference on the user’s emotional state [28]. Other user dimensions will comprise of as much of the previously listed accepted characteristics as is possible, feasible and sensible. Adding biophysiological measurements (e.g., heart rate, sweating rate and skin temperature) from smart bands is being considered as well. This may be used for automatic monitoring of SAD [29–32]. For example, at the beginning, the SAD answers can used to label the biophysiological measurements. Once enough data is labeled, the labeled biophysiological measurements can be used to learn personalized machine learning (ML) models for predicting SAD. The SAD predictions can be later utilized by the SAD model. This eases the user’s burden since once the ML models for predicting the SAD are learned, the user will answer SAD questionnaires less frequently. The learning and the management of the personalized ML models will be handled by the Affect recognition module. Our PICA’s strategy selection will be based on the principle of multiple knowledge [33] – which says that when high quality different viewpoints are sensibly filtered, adapted and combined, the result will be superior to the individual methods – and the predictive coding theory of cognition (PCT) [34]. There will be multiple competing strategies that will contend, adapt and enact according to multiple criteria from the interpreted linguistic input, user model and BC domain knowledge. A strategy (one response or a more long-term strategy) will be selected when a certain confidence threshold will be reached. If the threshold is not reached, necessary information on the user will be dialogically extracted until the probability that a certain strategy will be effective is reached. This approximately mimics PCT, but a strict formalization is needed in the future and further elaboration is currently out of scope for this paper.

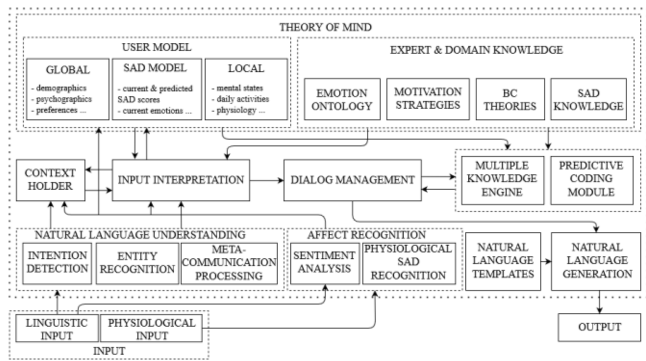

Figure 4: A tentative CogA for the described PICA.

4. CONCLUSIONS AND FUTURE WORK

This paper serves primarily the purpose of outlining the steps of planning, analysis and design of our PICA. This serves a variety of purposes: to highlight numerous problems in researching PICAs (the problems of existing PICAs being mostly proprietary and closed source, which means that there is a lack of research on PICAs that would illuminate technical details; a lack of standardized evaluation measures for PICAs), to contribute to a flourishing field of PICAs with a design paper, and to explicate our own unique ideas into a more coherent framework.

Our future work will require to define clear evaluation measures for PICAs. The lack of the latter points to a greater lack of a comprehensive overview on which CogAs are best suited for specific domains. This is all the more evident as there is little to no research on what user (or expert) data is needed for efficient PICAs. Our future work will continue with the Systems development life cycle steps (especially implementation; some work has already begun [35]) as well as with the third level of Marr’s 3-level design hierarchy – physical (the realization of the first two levels) – after more thorough completion of the analysis and design steps pending feedback of the current work when published. The implementation will go hand in hand with experiments, which will inform the design of the CogA. The experiment by Fitzgerald et al [14] (see Woebot in chapter 2) will be replicated for comparison purposes.

[1] Richard Thaler, its author, received the Nobel Prize for it.

We believe that the highlighted research areas and technologies show promise and potential in both effectiveness (use case) as well as openness to new explorations and progress, which makes our research not only sensible, but also necessary.

5. ACKNOWLEDGMENTS

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Classifying Power Quality Disturbances in Noisy Conditions using Machine Learning

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ABSTRACT

When ensuring high-quality power supply of the power grid it is of the upmost importance to correctly detect and classify any power quality (PQ) disturbance. Selecting the most relevant features is very important in the process of training a genera machine learning model. Therefore, we analyze the power signals and extract information from them, and then select the most significant features. Additionally, an effective classification model is required. In this study we apply grid search throughout the features sets on one side, and the classification algorithms on the side. This way, we determine the most effective combination of an algorithm and feature set for classification of power quality disturbances.

Keywords

Power quality, feature extraction, classification, machine learning.

1. INTRODUCTION

As nowadays the power grid undergoes many disturbances, it has become more of a challenge to not only detect these disturbances, but also to correctly identify them (as harmonics, transients, voltage dips, etc.). Awareness regarding a disruption within a signal could be used to minimize the undesired effects which poor power quality could inflict. The information gathered during detection and classification of power grid malfunctions could be utilized as insight in solving them. Additionally, the reliability of a power distribution network is key in preventing complaints by customers, which is why there is an increased focus on detection of disturbances in the grid.

In the recent years, with the development of the novel machine learning and feature extraction techniques, the power quality disturbances domain have also benefitted by introducing various approaches based on machine learning.

With regard to the feature extraction methods used to formulate the data frame before applying an algorithm, there are several digital signal processing techniques. S-transform is one of the most commonly used feature extraction approaches [1]. Other popular feature extraction tools are short-time Fourier transform (STFT), fast working Fourier transform (FT), Neural Networks, Wavelet Transform (WT) and Discrete Wavelet Transform [2][3][4][5]. WT analyses give frequency and time information accurately by convolving the dilated and translated wavelet with the input signal. This property makes the WT approach suitable for detecting various deviations in voltage and current waveform, caused by different PQ disturbances.

Proposed methods for classifications of PQ disturbances include rule-based approaches, as the one presented in [1], time series analysis [5], artificial neural networks (ANNs) [6] and machine learning techniques as Support Vector Machines, Decision Trees and Random Forrest [7][8].

A similar study to ours, explained in [9], shows results upon applying machine learning algorithms to PQ signals, where no phase shifts occur. Additionally, only 11 classes are being processed. The trained models achieve at the highest an accuracy of 98.38% in pure signals, by using combinations of features based on discrete wavelet transform. Our data has the included difficulty of phase shifts in 21 different class and a subset of data where the presence of noise is not labeled by exact value. Another approach is shown in [4], where neural network perform the classification of signals based on features extracted with discrete wavelet transform. The results obtained in this paper give accuracies displayed by class, which range from 76% to 100%. Overall, the approach can perform with equal quality as the energy difference patterns remain same in noisy environments, but the obtained model from the research can detect a total of 11 different types of disturbances, whereas we have 21 classes investigated.

Upon combining different feature extraction methods with machine learning approaches unique investigations of the problem are provided. We utilize the results of feature extraction and feature selection design to create descriptive feature groups and to use the obtained groups for training various models. The feature extraction process carries significant weight in addressing the type of disturbance inhibiting the power signal. A correctly determined set of features can be crucial for the accuracy of a model, as on a weak set of features even the best approach would provide extinguishable results. Moreover, a compressed feature set can influence the required processing time.

The processing of the signals and the feature extraction and selection method are addressed in section II, the approach methods are discussed in section III, the results are presented in section IV and we conclude this research in section V.

2. DATA AND FEATURE EXTRACTION

Our dataset is comprised of samples from 21 different type of PQ disturbances, as given in Table I, generated in accordance with the mathematical definitions given in [9]. We used those samples as PQ signals accompanied with 20 dB, 30 dB, 40 dB and 50 dB white Gaussian noise. Every signal we examined contained 10 cycles, for fundamental frequency of 50 Hz and sampling frequency of 3.2 kHz. Accordingly, a signal instance in our dataset contained 640 data samples linked in a time series. Note that there were 21000 training and 21000 test signal instances.

Table 1: PQ Classes

PQ Disturbance	Classes
Pure	C1
Sag	C2
Swell	C3
Interruption	C4
Transient/Impulsive/Spike	C5
Oscillatory transient	C6
Harmonics	C7
Harmonics + Sag	C8
Harmonics + Swell	C9
Flicker	C10
Flicker + Sag	C11
Flicker + Swell	C12
Sag + Oscillatory transient	C13
Swell + Oscillatory transient	C14
Notch	C15
Harmonics + Sag + Flicker	C16
Harmonics + Swell + Flicker	C17
Harmonics + Sag + Oscillatory transient	C18
Harmonics + Swell + Oscillatory transient	C19
Harmonics + Sag + Flicker + Oscillatory transient	C20
Harmonics + Swell + Flicker + Oscillatory transient	C21

Upon these signal instances we preformed automatic extraction of relevant features with the help of tsfresh (Time Series FeatuRe Extraction on basis of Scalable Hypothesis tests) [10]. The tsfresh library is used to accelerate the process of extracting features by combining 63 time series characterization methods, which resulted in 794 time series features. Related work that use tsfresh for feature extraction is proposed in [12].

The obtained features can be applied for classification. We used the complete set of extracted features that tsfresh provides, to train our models. However, as the number of obtained features was significant, it was necessary to influence the computational efficiency of the models. To do so, we used a feature selection module designed to reduce the number of features by selecting the most relevant descriptors of the problem.

Firstly, we determined the mutual information between each extracted feature and the corresponding class. Considering the fact that the higher the value of the mutual information the more relevant the feature is to the class, we sorted the features in descending order based on this value. We selected the upmost 300 features. Next, we divided the features in groups of 50. For the first group, we calculated the Pearson correlation coefficient [11] for every pair of features. Upon encountering a pair with a correlation higher than 0.8, the feature with the lower mutual information to the class was removed. Once the whole group was iterated, the next group was appended to the remainder of the features and the process was repeated for all groups, until a final set of features was obtained.

These features were a mix of both time domain features and frequency domain features. We inputted the time domain and frequency domain features to our models separately, as well as a union between the sets upon training our models.

3. MACHINE LEARNING APPROACH

With the four feature-wise possible data frames (all initial features, remainder of features after the feature selection process only containing time domain features, only containing frequency domain features and a combination of the two) we trained our models with 1000 signals per class. The signals used for training and testing within one class had different phase shifts. Our test set also contained 1000 signals per class.

We trained our models with different signal sets, where each set was synthetized with 20 dB, 30 dB, 40 dB or 50 dB of white Gaussian noise. Also, a set of signals synthesized with 20-50 dB of noise was used. The latter is due to the noise variations occurring within a real signal. The following five algorithms were used for the experimental analysis.

- *K Nearest Neighbors (KNN)* is algorithm that analyzes a test sample in comparison to the whole of the train data. Through comparing the sample with the whole of the data frame, the closest neighbors which have the highest similarity with the sample are found. They determine the class in which the sample will be placed.
- *Decision Tree* is an algorithm which preforms data division by splitting the frame into several branches recursively, in a way that each split is determined by a value of one feature from the data frame. The branching ends when a class for the analyzed sample is reached.
- *Random Forest* is an ensemble algorithm of decision trees. Each tree performs on the values of a random feature vector sampled

independently and with the same distribution for all trees in the forest.

- *Gradient Boosting* produces a prediction model in a stage-wise fashion as an ensemble of weak prediction models, typically decision trees.
- *XGBoost* is an implementation of gradient boosted decision trees which are designed for speed and performance.

4. RESULTS

Through the results given in Tables 2-6, we can observe the behavior of our algorithms depending on the noise and the feature set selected. We concluded that using all the features tsfresh extracts to train our models provided the highest accuracy. After we extracted the features with the method described in Section 2 and trained our models with the extracted features, a significant decrease in the accuracy of the models occurs. Those remaining features we divided into two categories, time domain and frequency domain features, before we retrained our algorithms. The time domain features in the worst-case scenario provided insignificant decrease in the accuracy of the classifiers, whereas the accuracy obtained through the frequency domain features caused a severe drop in accuracy.

When analyzing the algorithms themselves it shows that on overall the XGBoost algorithm performed best.

Table 2: Comparison of algorithms accuracy with 20 dB noise.

20 dB white Gaussian noise				
Classifier	Extracted Features	Selected Features	Time Domain Features	Frequency Domain Features
Nearest Neighbors	**0.99**	0.43	0.46	0.31
Decision Tree	0.29	0.6	0.54	0.37
Random Forrest	0.43	0.42	0.53	0.26
Gradient Boosting	0.99	0.75	0.75	0.53
XGBoost	0.98	**0.78**	**0.77**	**0.54**

Table 3: Comparison of algorithms accuracy with 30 dB noise.

30 dB white Gaussian noise				
Classifier	Extracted Features	Selected Features	Time Domain Features	Frequency Domain Features
Nearest Neighbors	**0.99**	0.46	0.52	0.34
Decision Tree	0.17	0.68	0.63	0.43
Random Forrest	0.48	0.52	0.6	0.25
Gradient Boosting	0.98	0.85	0.85	0.55
XGBoost	0.98	**0.88**	**0.87**	**0.57**

Table 4: Comparison of algorithms accuracy with 40 dB noise.

40 dB white Gaussian noise				
Classifier	Extracted Features	Selected Features	Time Domain Features	Frequency Domain Features
Nearest Neighbors	**0.99**	0.54	0.59	0.43
Decision Tree	0.29	0.68	0.65	0.5
Random Forrest	0.43	0.57	0.6	0.39
Gradient Boosting	**0.99**	0.87	0.87	0.63
XGBoost	**0.99**	**0.9**	**0.89**	**0.65**

Table 5: Comparison of algorithms accuracy with 50 dB noise.

50 dB white Gaussian noise				
Classifier	Extracted Features	Selected Features	Time Domain Features	Frequency Domain Features
Nearest Neighbors	**0.99**	0.57	0.63	0.45
Decision Tree	0.29	0.63	0.65	0.52
Random Forrest	0.51	0.58	0.69	0.44
Gradient Boosting	0.98	0.87	0.87	0.64
XGBoost	**0.99**	**0.9**	**0.89**	**0.7**

Table 6: Comparison of algorithms accuracy with 20-50 dB noise.

20~50 dB white Gaussian noise				
Classifier	Extracted Features	Selected Features	Time Domain Features	Frequency Domain Features
Nearest Neighbors	0.98	0.51	0.57	0.4
Decision Tree	0.42	0.64	0.6	0.43
Random Forrest	0.45	0.54	0.59	0.3
Gradient Boosting	**0.99**	0.85	0.84	**0.6**
XGBoost	**0.99**	**0.88**	**0.87**	**0.6**

5. CONCLUSION

With this paper we addressed the effectiveness of observing the PQ signals as time series and using features obtained with tsfresh in classification of PQ disturbances. The testing was conducted with numerous classification models, each time on 21 classes and accompanied with different noise levels.

The results show that features extracted with tsfresh can be used for correctly classifying PQ disturbances. However, a deeper understanding in choosing subsections of those features is needed, and also additional testing.

Our future endeavors will be creating a more optimal feature set, which might consist of a combination of our current features and features obtained from Wavelet Transform. Additionally, we will investigate the possibility of improvements using deep learning methods.

6. ACKNOWLEDGMENTS

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EMZ – Elektronsko in mobilno zdravstvo

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POVZETEK
Področje elektronskega in mobilnega zdravja ali e-zdravje postaja v zadnjih letih ključno za spopadanje z izzivi v zdravstvu, staranjem prebivalstva in zagotavljanje ustrezne ter celovite zdravstvene oskrbe. V okviru programa Pametne specializacije S4 EkoSMART in projekta EMZ smo želeli vzpostaviti okolje IKT, ki bi služilo informatizaciji področja zdravja in državljanom ponudilo nove platforme, storitve ter produkte, kar bi jim omogočalo celovitejšo oskrbo in hitrejši dostop do zdravstvenih storitev. S tem pa bi pripomogli k izboljšanju zdravstvene oskrbe in hitrejši obravnavi bolnikov v Sloveniji. V tem prispevku opravimo pregled izvedenih razvojnih aktivnosti in razvitih prototipov v okviru projekta EMZ.

ABSTRACT
The field of electronic and mobile health or eHealth has gained in importance in recent years to meet the challenges of healthcare, the aging of the population, and the provision of adequate and comprehensive health care. As part of the Smart Specialization S4 EkoSMART program and the EMZ project, we wanted to create an ICT ecosystem that would improve the health field and offer citizens new platforms, services, and products that would enable them to provide more comprehensive care and faster access to health services. In this paper, we review the development activities performed, and the prototypes developed within the EMZ project.

Ključne besede
EMZ, e-zdravje, jezikovne tehnologije

1. UVOD
V pričujočem preglednem prispevku podamo pregled opravljenih razvojnih in raziskovalnih aktivnosti na projektu EMZ – Elektronsko in mobilno zdravstvo, ki je eden izmed petih projektov krovnega programa EkoSMART [1] (2016-2019). To je program Slovenske strategije pametne specializacije (S4) za področje Pametna mesta in skupnosti. V projektu EMZ je sodelovalo 15 partnerjev. Glavni namen projekta je bil vzpostavitev okolja IKT za podporo področju zdravja in znotraj tega razvoj prototipov naprednih rešitev za klinično in domačo zdravstveno oskrbo.

Aktivnosti znotraj projekta EMZ lahko v grobem razdelimo na štiri podpodročja:

(i) definiranje Nacionalne strategije EMZ;
(ii) razvoj komunikacijske EMZ platforme;
(iii) razvoj IKT prototipov storitev ali produktov za področje zdravja;
(iv) verige vrednosti.

Definiranje Nacionalne strategije EMZ ni mišljeno kot izdelava programskega sistema, ampak je namenjeno odločevalcem (državnemu zboru, ministrstvu) kot priročnik za digitalizacijo in informatizacijo zdravstva. Komunikacijska EMZ platforma je namenjena splošni populaciji in njena glavna značilnost je enostavnost uporabe, saj omogoča komunikacijo v naravnem jeziku in ponuja intuitiven uporabniški vmesnik. Poleg tega integrira različne storitve, ki so bile razvite v okviru projekta EMZ drugih projektov in omogoča posredovanje informacij o razvitih produktih ter prototipih. Glavni del aktivnosti znotraj projekta EMZ pa je bil posvečen razvoju IKT prototipov za področje zdravja. Spričo velikosti ter večanja populacije starejših in kroničnih bolnikov in njihovih specifičnosti potreb je bil namen posameznih partnerjev izdelati sisteme, ki izboljšujejo varstvo in varnost široke skupine ljudi: starejših, kroničnih bolnikov, ki občasno ali stalno potrebujejo zdravniško oskrbo, ljudi s posebnimi potrebami in tudi zdravih oseb z namenom preventive. Verige vrednosti pa predvidevajo povezovanje različnih deležnikov in sodelovanje pri razvoju prototipov za različna področja, ki zahtevajo natančno specificirano obravnavo.

Doseganje teh ciljev (podpodročij) smo želeli v okviru EMZ doseči z uporabo modernih IKT tehnologij in pristopov. Razviti sistemi bodo stremeli k nadgradnji kakovosti današnje obravnave in oskrbe omenjenih skupin s pomočjo elektronskih in mobilnih naprav in pripadajočih programskih rešitev, zlasti umetne inteligence v oblaku ali lokalno, npr. na mobilni napravi ali s prilagojenimi senzorji in nosljivimi pripomočki. Namen EMZ je tudi, da ob tem nastajajo celovite verige vrednosti, ki bodo uspešno vstopile v nišne prostore na mednarodnih trgih.

V tem preglednem prispevku predstavimo opravljene razvojno-raziskovalne aktivnosti na različnih področjih, ki jih pokriva projekt ter navedemo nekaj prototipov rešitev, ki so jih partnerji razvili. Razviti prototipi spadajo v eno od skupin storitev/produktov/izdelkov, ki so vsebinsko razdeljene v različna področja

2. SPLOŠNO O EMZ
Projekt EMZ se je izvajal v okviru programa EkoSMART (S4 – Pametna mesta in skupnosti) in ga je koordiniral Odsek za inteligentne sisteme, Institut »Jozef Stefan«. EMZ je pretežno razvojno-raziskovalne narave in glavni rezultati aktivnosti na projektu so namenjeni razvoju prototipov novih produktov, aplikacij in storitev, ki bi lahko bili po preverbi ustreznosti prenešeni na trg preko zainteresiranih partnerjev, na pa tudi neposredno tržnim sistemom. EMZ je razdeljen na več delovnih paketov, kjer so aktivnosti v prvih štirih zasnovane tako, da pokrivajo ločena področja EMZ in so relativno neodvisna ena od druge. Del pa je zasnovan povezovalno, saj je usmerjen k razvoju povezovalne platforme. Pregled delovnih paketov je podan spodaj:

- **DP1: Informacijske tehnologije za podporo celostni oskrbi / bolnice**. Delovni paket se osredotoča na informacijske tehnologije, ki so namenjene celostni oskrbi.
- **DP2: Podpora na domu za zdrave, starejše in za kronične bolnike / doma**. Fokus aktivnosti je na izboljšanju obstoječih in razvoju novih prototipov, ki so

namenjeni podpori na domu za starejše, kronične bolnike in zdrave.

- **DP3: Mobilno spremljanje vitalnih in okoljskih podatkov / mobilno**. Delovni paket predvideva razvoj rešitev, ki so povezane z mobilnim spremljanjem vitalnih in okoljskih parametrov.
- **DP4: Računalniška podpora, podatki, kreiranje novih znanj /algoritmi**. Aktivnosti se osredotočajo na uporabo naprednih algoritmov za analizo podatkov, procesiranju podatkov iz naprav, podpori storitev za uporabnike, analizi slik in kreiranju novih znanj.
- **DP5: IKT platforma**. Obsega razvoj povezovalne platforme, ki omogoča povezljivost naprav ter senzorje, skupni zajem ter hranjenje meritev.

Partnerji po delovnih paketih stremimo k razvoju lastnih prototipov, ki bi lahko bili tržno zanimivi. Pri tem pa se osredotočamo na povezljivih sistemov, kar bi lahko po zaključku projekta omogočalo integracijo v skupno integracijsko platformo pametnega mesta, ki se razvija v okviru programa EkoSMART.

3. RAZVOJNE AKTIVNOSTI

Ta razdelek podrobneje prestavi opravljene aktivnosti na štirih glavnih podpodročjih projekta EMZ (glej Uvod). Najprej predstavimo predvideno vsebino nacionalne strategije EMZ, sledi opis komunikacijske platforme EMZ, nato predstavimo glavne prototipe storitev/produktov/izdelkov, ki so vsebinsko razdeljene v različna področja: rehabilitacijska orodja, pametne naprave za spremljanje oseb, naprave za spremljanje življenjskih funkcij, pametne naprave ter storitve EMZ in platforme ter spletne aplikacije. V zaključku razdelka pa navedemo opravljene aktivnosti povezane z vzpostavitvijo verig vrednosti.

3.1 Nacionalna strategija EMZ

Osnovna teza vizije EMZ v Sloveniji je, da je digitalizacija zdravstva še v začetnih fazah. Sistematična tranzicija na informacijske tehnologije bi lahko pohitrila obravnavo bolnikov, izboljšala kvaliteto storitev in zmanjšala stroške. Ker pa je bila sedanja uporaba tehnologij IKT v Sloveniji problematična, saj je pogosto povzročala dodatne zamude in birokratizacijo, je potrebno presekati s takim neproduktivnim pristopom. Hkrati je v Sloveniji veliko nekompatibilnih sistemov, v UKC kar 7. Prav tako še vedno ni vzpostavljene infrastrukture za učinkovito vpeljavo telemedicine na domu. S tem bi lahko zmanjšali čakalne dobe, povečali zmožnost obravnave bolnikov in obenem zmanjšali pritisk na zdravstveno osebje in celoten zdravstveni sistem. Napovedi strokovnjakov so (v svetovnem okviru), da se bo premik dogodil v roku desetletja. V okviru definiranja nacionalne strategije EMZ bomo pripravili Belo knjigo EMZ. Predlog bo predstavljen tako Ministrstvu za zdravje kot na posvetu v Državnem svetu v roku nekaj mesecev.

3.2 Komunikacijska platforma EMZ

Komunikacijska EMZ platforma je namenjena splošni populaciji. Njena glavna značilnost je enostavnost uporabe, saj omogoča komunikacijo v naravnem jeziku in ponuja intuitiven uporabniški vmesnik. Platforma je bila razvita z namenom povezovanja in integracije različnih produktov in storitev, ki so bili razviti v okviru projekta EMZ in širše. Platforma temelji na odprtokodni rešitvi Rocket.Chat [8] in omogoča uporabnikom komunikacijo v naravnem jeziku in s tem posredovanje informacij iz različnih domen.

Platforma ima tri glavne funkcionalnosti: (i) posredovanje odgovorov na vprašanja uporabnikov, ali pa posredovanje povezav do informacij, ki jih uporabnik potrebuje; (ii) pridobivanje informacij ali podatkov iz zunanjih spletnih servisov; (iii) iskanje po zbirkah podatkov vključenih institucij, tako da za iskanje v bazi podatkov najprej opravi stavčno analizo uporabniškega zahtevka in nad določene termine aplicira lematizacijo, pridobljene koncepte nato uporabi za identifikacijo ustreznih storitev ali terminov. Platforma pridobiva odgovore iz množice pogovornih svetovalcev, ki obravnavajo različne domene in so integrirani v platformo. V nadaljevanju na kratko predstavimo potek pridobivanja odgovorov in način delovanja svetovalnih agentov.

Uporabnik postavi vprašanje, ki ga sistem procesira. Na začetku se opravi enostavno zaznavanje namena. Če se tematika vprašanja nanaša na področja, ki jih obravnavajo svetovalni agenti in ne na bazo prototipov in domen (množica podatkovnih zbirk), glavni agent platforme posreduje celoten niz besedila svetovalcem, ki so integrirani v platformo. V trenutni različici so to Izbirčnež, asistent za čakalne vrste, EkoSMART asistent in občinski asistenti. Slednji nato izvedejo naprednejše procesiranje teksta: stavčno analizo, lematizacijo, zaznavanje namena in luščenje ključnih podatkov. Nato se v bazi znanja poišče najboljši odgovor, ki se posreduje nazaj platformi. V primeru, da vprašanje zadeva tematiko prototipov in domen, agent odgovor razbere neposredno iz baze podatkov. Pred tem glavni agent platforme izvede luščenje iskalnih konceptov in z njimi opravi iskanje v podatkovni bazi. Podatkovna zbirka domen in prototipov se redno posodablja. V nadaljevanju zberemo vse odgovore v tabelarično podatkovno strukturo. Odgovori se filtrirajo in izberejo samo tisti, za katere glavni agent oceni, da so smiselni. Na koncu se jih prikaže v pogovornem oknu platforme. Uporabnik lahko v oknu izbere najustreznejši odgovor. S klikom na gumb lahko nadaljuje pogovor s svetovalcem, ki je posredoval izbrani odgovor. Ko uporabnik to stori, drugi svetovalci ne odgovarjajo.

3.3 Prototipi EMZ

V nadaljevanju predstavimo nekaj izbranih prototipov izmed več kot 21, ki so bili razviti v okviru projekta EMZ. Najprej opravimo pregled prototipov, ki so bili razviti s strani partnerjev in nato še izpostavimo tri prototipe, ki so bili razviti na IJS.

3.3.1 Partnerji

V okviru projekta EMZ je bilo s strani partnerjev razvitih več prototipov, ki so v višjih fazah razvoja in so tržno zanimivi. V nadaljevanju podamo 6 primerov takšnih prototipov in jih na kratko opišemo.

Izvajal se je razvoj nove zapestnice za detekcijo padcev in beleženje aktivnosti starostnikov. Aktivnosti so vključevale razvoj strojne opreme za prototipno napravo, ki omogoča testno zbiranje podatkov, ki bodo uporabljeni za naprednejše algoritme. Izdelana je bila priključna shema ter načrt za izvedbo tiskanega vezja ter za polaganje elementov. Izdelano je bilo prototipno vezje ter programska oprema, ki omogoča testiranje izbranih komponent. Glavne funkcionalnosti naprave so spremljanje aktivnosti uporabnikov preko pospeškomera, zaznavanje lokacije uporabnika, gumb za klic v sili in glasovni klic ob izrednih dogodkih (padec).

Za področje rehabilitacije se je razvil prototip 10Cubes namenjen terapiji bolnikov (Parkinsonova bolezen, možganska kap ipd.). Gre za programsko opremo, kjer je 10 raznobarvnih kock naključno razporejenih po navideznem travnatem prostoru, uporabnik pa jih mora ena po ena zložiti v odprto skrinjo. Celotno okolje je bilo razvito v okolju Unity3D, informacijo o gibanju roke in prstov (kinematiko) pa se zajema s komercialno 3D kamero LeapMotion. Razviti so bili napredni moduli za analizo gibanja roke in prstov.

Vsak členek, dlan in zapestje imajo vpet koordinatni sistem, le-tega pa se poveže v kinematično verigo. Z matričnim računom se tako izračuna položaj vsakega segmenta v 3D prostoru.

Naslednji prototip je bluetooth naprava (značka, zapestnica) za lokalizacijo bolnikov ali drugih oseb v prostoru. Sistem je izveden s fiksnim senzorjem na ploščici Raspberry PI in napravami, ki oddajajo signal. Senzor zazna napravo v prostoru, jo identificira, analizira signal in ga shrani v bazo podatkov.

V okviru projekta je potekal nadaljnji razvoj mobilnega EKG z visoko ločljivostjo zapisa. Nadgradnje so potekale v smeri izboljšanja zaznavanja in beleženja ekstremno majhnih biopotencialov. V ta namen so se modificirale vhodne naprave in tako uspešno neinvazivno in pasivno beležilo električno aktivnost ploda v maternici. Aktivnosti so se fokusirale tudi v odpravljanje motenj, ki jih povzroča »elektrosmog« in s tem se izboljša samo ločljivost naprave. Izvedene so bile integracije z različnimi platformami in sistemi partnerjev: vmesniki do Think!EHR [4] (zdravstvena platforma podjetja Marand, ki temelji na EHR zapisih), komunikacijski protokol za prenos podatkov v platformo, prikaz EKG poročil in meritev v zdravstvenem informacijskem sistemu (BIRPIS32 [7]).

Potekal je razvoj prototipa pametne ščetke. Osnovna ideja je opremiti zobno ščetko s senzorji, ki naj omogočajo detekcijo gibanja (pospeškomeri) in merjenje pritiska ščetke na zobe. Zbrane podatke se prenese v oblak, kjer se podatki analizirajo in pridobijo ustrezne informacije. Razviti ter povezani so bili ustrezni mehanski deli, pospeškometer in pretvornik signalov iz merilnih lističev za merjenje pritiska. Senzorske signale ob uporabi ščetke (pospeški in sila) sprejema Arduino in jih preko protokola BLE (Bluetooth low energy) prenaša na mobilne naprave. Implementiran je bil tudi prototip resne igre za vzdrževanje zobne higiene, ki je povezan s prototipom ščetke in izvedene gibe ščetke preslika v akcije v igri.

Razvil se je laboratorijski prototip lahke IoT platforme, ki temelji na odprtih M2M in IoT standardih in omogoča komunikacijo z napravami in senzorji prek vseh ključnih komunikacijskih protokolov, vključno z BT, WiFi, CoAP, MQTT, 6LowPAN, ZigBee, ZWawe. Poleg celotnega sklada protokolov platforma omogoča tudi zajem in procesiranje podatkov za potrebe detekcije kompleksnih dogodkov in realizacije lokalne inteligence (npr. na nivoju stavbe ali oskrbovanega stanovanja).

3.3.2 IJS

V tej sekciji predstavimo tri prototipe storitev in izdelkov, ki so bile razvite na Odseku za Inteligentne sisteme.

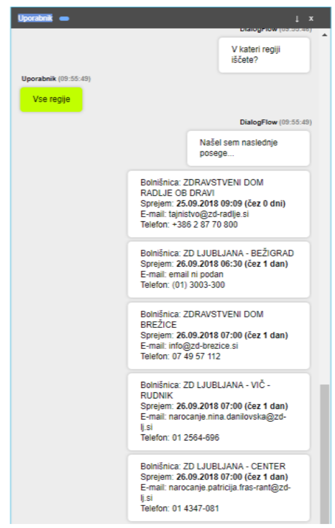
Nadaljevanje razvoja in nadgradnje prototipa programske opreme za androidne pametne ure, ki samostojno zaznava padce in ima 15 funkcij. Aplikacija skrbi za varnost uporabnika s stalnim nadzorom ter procesiranjem signalov iz senzorjev in obveščanjem v primeru izrednih dogodkov kot so padci. Razvoj je vključeval nadgradnjo aplikacije za pametno uro, vključitev algoritmov strojnega učenja za učinkovito zaznavanje padcev, optimizacija delovanja z namenom varčevanja z baterijo. Vključeno je bilo posredovanje meritev in dogodkov v spletni servis, ki podatke analizira in omogoča pregleden prikaz nadzornikom sistema. Dodana je možnost geo-lociranja in nastavljanja preko spleta ali sms sporočil. Glavni del sistema je aplikacija, ki spremlja aktivnosti uporabnika. V primeru padca se sproži avtomatski klic na pomoč. Če se na klicani strani nihče ne odzove, ura ponovno kliče vse številke, ki so vnesene v seznam skrbnikov.

V okviru EMZ smo razvili več aplikacij in storitev, ki temeljijo na jezikovnih tehnologijah in procesiranju naravnega jezika z namenom komunikacije z uporabniki in posredovanja informacij. V nadaljevanju predstavimo dve. Prva tovrstna storitev je aplikacija za posredovanje informacij o čakalnih dobah za posamezne zdravstvene storitve.

Splošna arhitektura predlaganega sistema je sestavljena iz štirih glavnih komponent:

- spletnega vmesnika za zajem uporabniških poizvedb,
- pogovornega agenta znotraj sistema DialogFlow [2] za procesiranje jezika,
- zalednega mehanizma, ki procesira zahtevke iz DialogFlow agenta,
- univerzalnega vmesnika za dostop do podatkovnih zbirk.

Spletni vmesnik je implementiran v obliki pogovornega okna (angl. chat), kjer se vprašanja in odgovori izmenično prikazujejo (glej sliko 1). Odgovori sistema se prikažejo na desni strani in so osenčeni s sivo barvo. Vnosi uporabnika pa se prikažejo na levi strani in so osenčeni s svetlo zeleno barvo. Vmesniku so dodani tudi izbirni gumbi, kar olajša uporabniku interakcijo, saj mu ni potrebno pisati in lahko izbere želeno opcijo.



Slika 1: Prikaz rezultatov poizvedovanja za zobozdravstveni pregled.

Procesiranje tekstovnih zahtev uporabnika poteka preko storitve DialogFlow za prepoznavanja namena (angl. intent recognition), ki klasificira zahtevke v različne kategorije. Na primer, uporabnik lahko povpraša po določeni zdravstveni storitvi ali pa poda nujnost napotnice. Svetovalec najprej poskuša razbrati iz vnosov uporabnika, za kateri zdravstveni poseg se zanima. To je realizirano s kombiniranjem algoritma za indeksiranje izrazov in klasifikacijo ključnih konceptov. V DialogFlow agentu najprej definiramo različne namene (angl. intents), ki naj bi jih prepoznaval, nato posredujemo množico učnih primerov (povedi), ki so reprezentativni za posamezne namene. Agent nato z uporabo različnih pristopov strojnega učenja zgradi model, ki klasificira nov zahtevek uporabnika. Storitev DialogFlow omogoča tudi gradnjo modela, ki izlušči vrednosti predhodno definiranih parametrov iz teksta. Na primer, iz stavka: »Želim se naročiti pri zobozdravniku« bi sistem izluščil vrednost *zobozdravniku* kot iskani poseg. Gradnja modela poteka na podoben način. Storitvi posredujemo označene učne podatke na katerih nato sistem zgradi ustrezen model.

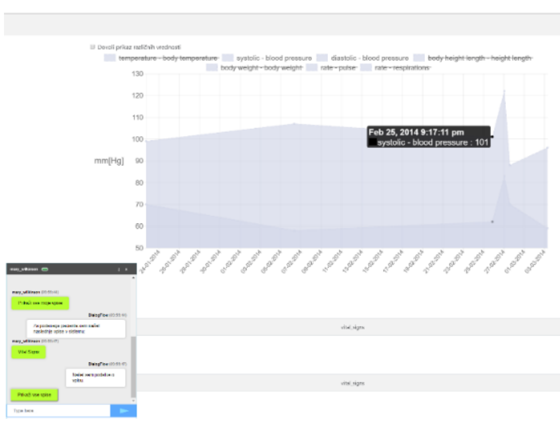
Agent vedno poskuša identificirati natančno storitev, ki naj bi zanimala uporabnika. V primeru, ko agent ni prepričan o posegu, uporabniku vrne množico elementov, za katere je določil najvišjo verjetnost ujemanja. Ko sistem od uporabnika pridobi vse predvidene informacije, opravi zaledni sistem odločitev glede načina pridobitve želene informacije. V predstavljeni rešitvi se podatki pridobijo iz zunanjega vira (spletnega servisa). Zahtevo se nato pošlje do ustreznega vmesnika, ki je sposoben komunicirati z zunanjim virom. Ta pretvori JSON podatke v zahtevek, ki ga zunanja podatkovna zbirka, aplikacija ali platforma razume. Običajno se generira REST zahtevek. V primeru te aplikacije se pošlje zahtevek na API NIJZ [3].

Naslednja spletna storitev, kjer smo aplicirali metode jezikovnih tehnologij, je asistent za poizvedovanje po Think!EHR platformi. Pri implementaciji aplikacije smo ponovno uporabili generičnega svetovalca, kot je bil uporabljen v prejšnji aplikaciji, ki pa smo ga prilagodili glede na specifike domene.

Uporabnik se mora v aplikacijo najprej prijaviti, da se določi vloga: zdravnik ali pacient. Glede na določeno vlogo svetovalec nato posreduje različne tipe in obseg podatkov iz Think!EHR platforme. Zdravnik lahko pregleduje vse osebne podatke in meritve svojih pacientov. Uspešno prijavljena oseba (pacient) lahko pregleduje vse svoje zapise, ki so shranjeni v platformi Think!EHR. Asistent nato uporabniku posreduje celoten seznam zahtevanih podatkov, ki so zabeleženi za določeno osebo. Uporabnik nato s klikom na gumb izbere posamezno meritev.

Procesiranje tekstovnih zahtevkov je realizirano na enak način kot v prej predstavljeni rešitvi. Samo pridobivanje podatkov pa je realizirano preko REST vmesnika ehrscape platforme [5]. Gre za različico Think!EHR platforme, do katere je mogoče dostopati preko spleta. Določene podatke smo lahko pridobili preko osnovnih API klicev, za kompleksnejše poizvedbe pa smo uporabili AQL jezik, ki omogoča poizvedovanje po EHR zapisih.

Za pregledovanje meritev smo spletnemu vmesniku dodali grafični prikaz, ki se prikaže v ozadju pogovornega svetovalca (glej sliko 2). Ta omogoča prikaz poljubnih podatkov v meritvah na preglednejši način.



Slika 2: Grafični prikaz posamezne vrste meritev za vlogo pacient

3.4 Verige vrednosti

Verige vrednosti znotraj EMZ predvidevajo povezovanje različnih deležnikov in sodelovanje pri razvoju prototipov za različna področja, ki zahtevajo natančno specificirano obravnavo. Dva primera tovrstne vzpostavitve verig vrednosti sta klinična obravnava bolnikov s kroničnimi boleznimi. Partnerji iz UKCLJ so definirali specifične klinične poti in intervence, ki so se nato integrirale v spletno platformo eOskrba (spletna platforma projektnega partnerja FRI). Druga oblika sodelovanja in primer vzpostavljene verige vrednosti je skupni razvoj treh partnerjev pri integracija mobilnega EKG s platformo Think!EHR in zdravstvenim informacijskim sistemom. V ta namen so partnerji najprej definirali nov EHR arhetip za beleženje EKG meritev. Merilnik nato pošilja posamezne sklope meritev, v dogovorjenem formatu, v platformo Think!EHR. Zdravstveni portal pa iz platforme pridobiva podatke o meritvah za posameznega pacienta in zdravnikom omogoča pregleden prikaz v realnem času.

Za Slovenijo smo vzpostavili interesno skupino za področje EMZ, ki združuje preko 300 podjetij in institucij, ki delujejo ali pa so izkazala interes po sodelovanju na področju EMZ. Smiselna povezovanja preko interdisciplinarnih področij in verige vrednosti za področje zdravja smo podrobneje predstavili v Beli knjigi EMZ [6].

4. ZAKLJUČEK

V pričujočem prispevku smo opravili pregled projekta EMZ – Elektronsko in mobilno zdravstvo, ki se je izvajal v okviru programa Pametne specializacije S4 EkoSMART. Predstavili smo splošne koncepte in samo strukturo projekta ter fokusna področja na katere so se partnerji osredotočili.

Komunikacijska EMZ platforma omogoča komunikacijo v naravnem jeziku in ponuja intuitiven uporabniški vmesnik. Namenjena je splošni populaciji in njena glavna značilnost je enostavnost uporabe, kar bi lahko omogočilo tudi starejšim in manj veščim uporabe internetnih storitev dostop in uporabo tovrstnih naprednih storitev. Zajema pa tudi vrsto drugih zdravstvenih storitev in asistentov, recimo ASPO kot aplikacijo za odkrivanje spolnih infekcij ali 200 občinskih agentov, ki odgovarjajo na vprašanja o občinah. Glavne razvojne aktivnosti v projektu so bile usmerjene v razvoj prototipov IKT za področje zdravja. S strani partnerjev je bilo razvitih 21 različnih prototipov, ki naslavljajo posamezna področja. V prispevku predstavimo 9 primerov razvitih prototipov, ki kažejo večji tržni potencial ali uporabno vrednosti. Predstavljeni prototipi so iz različnih domen in rešujejo različne problematike starejših ali bolnikov.

Doseženi rezultati projekta bodo predstavljeni v Beli knjigi EMZ, ki bo predstavljena na posvetu v državnem svetu in predana odločevalcem na ministrstvih in v vladi.

5. ZAHVALA

Raziskave in razvoj so nastale v okviru programa EkoSMART in so delno sofinancirane s strani Ministrstva za izobraževanje, znanost in šport in Evropske unije iz Evropskega sklada za regionalni razvoj (ESRR).

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Five Attempts at Cross-Dataset Speech Emotion Recognition

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ABSTRACT

In this paper, we tried to recognize emotions from speech when we have a very small dataset available. Because recording and annotating new data is a costly task, our goal is to use publicly available datasets in addition to our own to improve the recognition accuracy. To do this, we implemented five different methods able to extract knowledge from the publicly available dataset and use it in our target dataset. Two of these methods are based on transfer learning, one is a multi-task learning method, and the last two use advanced feature normalization methods to bring the feature domains from the two datasets closer together. We show that in certain combinations of train-test set, some of our methods outperform the baseline classifier by a maximum of 9 percentage points. In some cases, however, the baseline method proved to provide best results.

Keywords

speech emotion recognition, transfer learning, multi-task learning, cross-dataset

1. INTRODUCTION

In the last two decades a lot of research has been put into the automatic recognition of emotional states. The main reason for this is the rapid development of affective user interfaces. If we are able to recognize the user's emotions, we can develop dynamic applications that can adapt to the user's feelings at any given time. Here, our task could be to measure the stress of the calling users and include them in a priority list accordingly.

In our research, we focused on measuring the emotional state of a person based on their speech. More precisely, we did not analyse what the person is saying, but how they express themself. Since this type of emotion recognition does not analyse the content of the person's speech and does not require any of their other personal data, it can be used if we have some limitations regarding the use of personal data.

The main obstacle to determining a person's emotional state for machine learning is the lack of data. Bringing people into a certain emotional state is a challenging and, when it comes to negative emotions, unethical task. Furthermore, recording people expressing their genuine feelings, without their knowledge, violates the right to privacy, and these datasets, if ever acquired, are not publicly available. Therefore, most of the datasets we get are from actors who do their best to perform certain emotions.

Many papers present high accuracy scores when training and testing a model with the same dataset [9, 6, 10] but, what happens if we do not have data for our specific problem? What happens if we use recording devices of different quality, or if our target subjects are older people and not young or middle-aged actors, or if our setting differs in some other way? In our research, we assumed that we have a small amount of representative data of our problem, and we wanted to additionally exploit publicly available datasets. The most similar related work is a contribution by Latif et al. from INTERSPEECH 2018 [8]. Although it claims to achieve state-of-the-art results, when trained on a source dataset and tested on a target its accuracy does not even exceed the majority classifier. When a small amount of data from the target dataset was used, a modest improvement was observed, but the paper only distinguishes between two emotions. It thus seems that the issue we are tackling in this paper is poorly explored in the literature.

The most common way to use information from a source dataset to improve the classifier of a target dataset is to use transfer learning. We have chosen two different methods for transfer learning. The first method was recreated from the paper mentioned previously, while the other method uses Fully Connected Neural Networks to transfer some of network parameters between datasets. Additionally, we tried multi-task learning as well as two different types of feature normalization, which we applied on the data in order to bring the feature domains between the two datasets closer together.

In Section 2 we present the datasets we use. In Section 3 we present the five methods we used for cross-dataset emotion recognition. In Section 4 we present our evaluation methods and the achieved results. Finally in Section 5, we conclude and present our future work.

2. DATASETS

To detect emotions from speech, we used four publicly available datasets: EmoDB [1], EMOVO [3], IEMOCAP [2] and SAVEE [7]. The datasets were recorded in three different languages: IEMOCAP and SAVEE datasets were recorded in English, while EMOVO and EmoDB were recorded in Italian and German. A common problem when combining multiple datasets is that most of the datasets use different sets of emotions. To deal with this problem, we used only instances presenting four basic types of emotions, which are present in all the datasets: neutral, anger, joy and sadness. The number of instances for each emotion per dataset is presented in Table 1.

Table 1: Number of instances per emotion

Dataset	Neutral	Anger	Joy	Sadness
EmoDB	79	127	71	62
EMOVO	84	84	84	84
IEMOCAP	392	500	94	467
SAVEE	120	60	60	60

3. METHODS

The best established way to build a model able to recognize emotions from speech is by extracting global features from the speech and then building a classifier on top of these features. To extract features, we used a publicly available toolkit - OpenSmile [4], which offers a wide range of possible sets of features. We decided to use the 'emobase2010' feature set. This set is composed of overall 1582 features. As the machine learning algorithm we selected Random Forest with 1000 trees and maximal depth of 10. This combination outperformed several alternatives, including Deep Learning on raw audio. An additional advantage of the OpenSmile features and Random Forest over Deep Learning is that features can easily be extracted on the phone, so that raw audio is never sent outside the user's device. We developed or implemented five methods for transfer learning, which we describe in sections 3.1-3.5.

3.1 Deep Belief Network

In speech emotion recognition, there has not been much related work whose main focus is to transfer knowledge from the source dataset to the target dataset. The most dedicated attempt is the already mentioned one by Latif et al. [8], in which they used Deep Belief Network (DBN). To evaluate their method, they used another work that used autoencoders to transfer knowledge from the source dataset to the target dataset. They achieved better results than the autoencoders approach, and therefore we decided to recreate their method. In our DBN implementation, we used the same network parameters as described in their paper.

3.2 Fully Connected Deep Neural Network

Since the rise of transfer learning, the most commonly used method of transferring knowledge from one problem in another is by transferring network parameters. Therefore, in the second method we trained a Fully Connected Neural Network (FCNN) on the source dataset and transfered some of the network parameters to the target dataset. The FCNN architecture is composed of one input layer, one output layer, and three hidden layers. The input layer takes the same amount of input units as the number of features extracted from one utterance. The first hidden layer is composed of 1000 units, the second hidden layer is composed of 500 units and the third hidden layer is composed of 300 units. The output layer consists of only four units, one for each emotion. The activation function of all layers is 'tanh'. The only exception is the output layer, which uses 'softmax' activation function.

First, the FCNN was trained on the whole source dataset. After the training on the source dataset was finished, and all network parameters have been determined, we froze all parameters of the network, except those belonging to the output layer. We then fine-tuned the parameters of the final layer using a part of the instances from the target dataset.

3.3 Multi-task Learning

In the multi-task learning method, we used the same Random Forest classifier as the one described in the baseline method. However, instead of having the same target class for matching emotions from the source and the target dataset, we used two different target classes: one for the emotion from the source dataset, and another one for the same emotion from the target dataset. For example, angry utterances from the source and the target dataset would get the same target label 'Anger' in the baseline Random Forest Classifier. However, in the multi-task learning approach, angry utterances from the source dataset would get the target label 'Anger1', while angry utterances from the target dataset would get the target label 'Anger2'. The idea is that the classifier classifies specifically into classes of the target dataset, while the structure of the classifier still benefits from the source dataset (upper leaves of the tree in Random Forest). Because when training we used the whole source dataset and only a small portion from the target dataset, we ended up with unequal distribution of emotions. To deal with this problem, we oversampled examples from the target dataset until we got equal distributions in both datasets.

3.4 Normalization based on neutral speech

As shown in Table 1, the distribution of emotions is not equal across dataset and thus, a simple feature normalization and standardization method might not work across different datasets.

To implement a more advanced feature normalization method, we applied a normalization technique on the source and on the target data independently. In this normalization technique, we used neutral speech to bring the datasets to the same reference point. Ideally the neutral speech using our normalization technique should be near the coordinate space origin. To normalize and standardize our data, we applied the following formula to the feature values:

$$x_{i\_new} = \frac{x_i - \mu}{\sigma}$$

where μ is the average value from neutral speech in the training data, σ is the standard deviation in all training data and x_i is the i-th instance in the data.

To evaluate the performance of the model whose features were normalized based on the neutral emotion, we used the baseline Random Forest Classifier.

3.5 Normalization based on feature distribution

When analysing feature distributions between two datasets, we noticed that most of the features do not have the same distributions per emotion. For example, on the left side in Figure 1 we present the distribution of feature 'pcm_loudness_sma_amean' on neutral utterances in IEMOCAP, while on the right side, the distribution of the same feature is presented for neutral utterances in SAVEE. Since this could be confusing for our model, we tried to bring the two feature distributions as close as possible for each emotion.

To do this, we used the feature distribution from the training data in the target dataset as the baseline, and tried to bring the feature distribution from the whole source dataset as close as possible to the baseline distribution. Thus, for each emotion, we divided the feature distribution of the training data in the target dataset into 5 equal bins and saw how

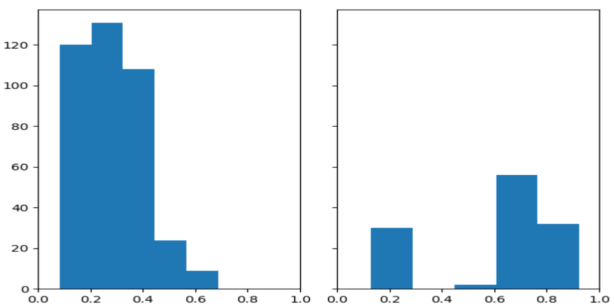

Figure 1: Distribution of values in neutral speech from feature pcm_loudness_sma_amean on the left side in IEMOCAP, on the right side for SAVEE

much of the data belongs to each bin. Thus, all instances in the target dataset whose $feature_i$ belong to the first bin of the $feature_i$ distribution, sould be given the value 0, all instances that belong to the second bin of the $feature_i$ distribution would be given the value 1, etc.
Let us assume that the percentage of the training data from the target dataset that was given the value 0 for $feature_i$ is x_0, the percentage of the training data that was given the value 1 is x_1, etc. To bring the distributions for $feature_i$ from the source and the target dataset closer together, we would assign the lowest x_0 percent of data from the source dataset a value of 0, etc. Thus, we got a similar distribution of the features in the source and the target dataset for each emotion separately.
To evaluate the performance of the model whose features were normalized based on their distribution, we used the baseline Random Forest Classifier.

4. EVALUATION AND RESULTS

Recording and annotating data is an expensive process. Because of this, for training our models we used at most one subject, while the rest of the subjects would be used for testing the performance of the model. To evaluate the performance of the model on the target dataset without a transfer-learning method, we used three different scenarios:

- In the first scenario, we uses the whole source dataset for training, and the whole target dataset for testing. This simulates the case when we do not have any of our target data, thus only training our model on a publicly available dataset.
- In the second scenario, we used one subject from our target dataset as the training set and the rest of the subjects as the testing set. To get a more objective evaluation of the performance of the model, each of the subjects was used as training data once, and the final result was calculated by averaging the accuracy of each train-test split. This scenario simulates the case where we only use our small dataset for training.
- In the third scenario we used the whole source dataset and one subject from the target dataset for training. The rest of the subjects from the target dataset were used for testing. Similarly as in the second scenario, each subject from the taget dataset was used as the training data once, making the final result an average of each train-test split. This scenario simulates the case where we combine our small dataset with some publicly available dataset.

Since only two of the four datasets we use are recorded in the same language, we decided to evaluate the models only on these two datasets. This way, we can compare same-language and different-language cross-dataset emotion recognition on the same target datasets. To present the complexity of the task, in Table 2 we used the Majority Classifier and Random Forest Classifier for each of the three possible scenarios. The results achieved using the first scenario are the poorest, not even achieving the majority classifier. The results achieved using the second and the third scenario outperform the majority classifier, but still the classifier from the third scenario gives overall poorer results compared to the classifier from the second scenario. This could mean that we do not gain any useful information from the source dataset.
We applied the transfer learning methods from Section 3 according to the third scenario. The results are presented in Table 3. To evaluate the success of the information transfer, we compared these results to the baseline Random Forest Classifier calculated using the second scenario. The results in Table 3 show us that most of the improvements are achieved by normalizing the feature spaces based on the feature distribution. However, the presented results are not optimistic, since in some cases the best results were achieved using the baseline classifier. So far, the best improvement we achieved was 9 percentage points, which we gained when training on EmoDB and testing on SAVEE while normalizing the features based on their distributions. This method outperformed both the DBN presented as most suitable for this type of problems in related work, as well as the commonly used FCNN transfer learning.
An interesting observation is that when our methods use EmoDB and EMOVO as train data and SAVEE as test data, they perform better compared to when the same-language IEMOCAP is used as train data. This happened with most of our methods, and could indicate that the way the recording took place (5 min conversations vs. short utterances), might be more important when choosing which source dataset to use, than the language.

5. CONCLUSIONS

In this paper, we tried to use the knowledge obtained from a source dataset in order to improve the classification accuracy of a target dataset. We found that although in different languages, EmoDB and EMOVO contain more useful information for detecting emotions from speech in SAVEE, compared to the same-language database IEMOCAP.
The baseline classifier could be outperformed by using some of the methods described here, with a maximum improvement of 9 percentage points. The best performance was achieved by normalizing the features, based on their distributions. The worst performance was achieved by a method from related work, which did not even outperform the majority classifier.
Although we implemented five different methods for cross-dataset speech emotion recognition, there are other possibilities. A potentially more effective, but substantially more

Table 2: **Results obtained from the majority classifier and baseline Random Forest Classifier for each scenario without transfer learning**

Train dataset	Test dataset	Majority	Scenario1	Scenario2	Scenario3
EmoDB	SAVEE	40%	29%	49%	57%
EMOVO	SAVEE	40%	41%	49%	51%
IEMOCAP	SAVEE	40%	27%	49%	41%
EmoDB	IEMOCAP	34%	34%	67%	62%
EMOVO	IEMOCAP	34%	52%	67%	67%
SAVEE	IEMOCAP	34%	33%	67%	65%

Table 3: Results obtained from the majority classifier and baseline Random Forest Classifier compared to the five transfer learning methods

Train dataset	Test dataset	Majority	Baseline RF	DBN	FCNN	Multi-task	Norm.1	Norm.2
EmoDB	SAVEE	40%	49%	20%	50%	56%	57%	58%
EMOVO	SAVEE	40%	49%	30%	58%	50%	51%	58%
IEMOCAP	SAVEE	40%	49%	20%	46%	42%	41%	47%
EmoDB	IEMOCAP	34%	67%	33%	60%	62%	62%	66%
EMOVO	IEMOCAP	34%	67%	30%	61%	67%	67%	67%
SAVEE	IEMOCAP	34%	67%	27%	56%	66%	65%	69%

complex approach may be by using Generative Adversarial Networks [5] to translate the features from one dataset to another. This is the main approach we consider for future work, assuming it can work on modestly sized dataset such as are available.

A cursory look at the literature suggests that emotion recognition from speech is not a very difficult problem, since many papers report good results and several datasets are publicly available. However, our study shows that practical applicability of these datasets is limited considering how poorly cross-dataset learning works. It is also possible that the typical methods for emotion recognition from speech would prove unsuitable for the wider range of emotion expressed in real life. Therefore, it is important to study emotion recognition without limiting to one homogeneous dataset.

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Toma Strle, Tine Kolenik, Olga Markič

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PREDGOVOR

Na letošnji konferenci Kognitivna znanost sodelujejo avtorice in avtorji z različnih disciplinarnih področij in predstavljajo tako empirične rezultate svojih raziskav kot tudi teoretska raziskovanja in razmisleke. Ena izmed osrednjih tem letošnje konference je "Umetna inteligenca in kognitivna znanost v 21. stoletju", avtorji pa se dotikajo tudi drugih področij kognitivne znanosti.

Upamo, da bo letošnja disciplinarno in metodološko bogata kognitivna konferenca odprla prostor za izmenjavo zanimivih misli in idej ter povezala znanstvenice in znanstvenike z različnih disciplinarnih področij, ki se ukvarjajo z vprašanji kognitivnih procesov.

Toma Strle
Tine Kolenik
Olga Markič

FOREWORD

At this year's Cognitive Science conference, the authors come from numerous disciplinary backgrounds and present their empirical as well as theoretical work. One of this year's main conference topics is "Artificial Intelligence and Cognitive Science in the 21st Century" but authors present research form other areas of cognitive science as well.

We hope that this year's cognitive conference – being extremely diverse in disciplines and methodologies – will become a welcoming space for exchanging intriguing ideas and thoughts as well as for bringing together scientists from all the different areas exploring the questions of cognitive processes.

Toma Strle
Tine Kolenik
Olga Markič

PROGRAMSKI ODBOR / PROGRAMME COMMITTEE

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Perception of linguistic and emotional prosody in Parkinson's disease - evidence from Slovene.

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ABSTRACT
The present study investigated the perception of emotional and linguistic prosodic functions in speakers of Slovene language affected by Parkinson's disease. Eight participants with a diagnosis of Idiopathic Parkinson's disease (PD group) and eight elderly healthy controls (HC), matched for age and years of education, were tested using an identification and a discrimination task for emotional and linguistic prosody. The stimuli for linguistic prosody consisted of sentences uttered as a question or as a statement. The stimuli for emotional prosody consisted of sentences uttered in six different emotional tones: anger, disgust, fear, happiness, sadness and pleasant surprise. Compared to healthy control the overall performance of the PD group was lower in three out of four tasks: linguistic identification, linguistic discrimination, and emotional discrimination. Moreover, the PD group identified less accurately negative emotions, more specifically anger and sadness.

Keywords
Parkinson's disease, receptive prosody, emotional prosody, linguistic prosody

1. INTRODUCTION
Prosody, the rhythm and melody of speech, plays many important functions in human communication. Through the variation of acoustic cues of pitch, loudness, and intensity speakers can convey linguistic (e.g. stress, sentence mode), as well as extra linguistic information (e.g. attitudes, emotions, irony and sarcasm) [1]. In neurolinguistics literature, two main functions of prosody are distinguished: linguistic and emotional [1]. Linguistic prosody encodes linguistic distinctions (e.g. phrase boundaries) [2]. Emotional prosody encodes information about the emotional state of the speaker or the emotional emphasis of the uttered content [3]. The processing of prosodic features of speech seems to rely on different neurocognitive mechanisms than the processing of other linguistic domains (e.g. syntax or semantics) [1]. A comprehensive model of the brain structures involved in emotional and linguistic prosodic processing is still missing [1]. Evidence from lesion [4] and neuroimaging [5] studies suggest that the basal ganglia, a subcortical structure with numerous connections to cortical areas, might play a role in how we process (express and perceive) linguistic and emotional prosody.

Parkinson's disease (PD) is a neurodegenerative disorder, characterized by the loss of dopaminergic cells in one of the nuclei of the basal ganglia. PD has been associated with expressive prosodic impairments and PD speech described as monotonous, lacking loudness and inappropriate in speech rate [6]. More recently, evidence for the receptive prosodic ability in PD has also been found [7-12]. Many studies investigating the perception of emotional prosody in PD reported a deficit in the recognition for specific emotions: sadness [11,12], anger [9], fear [9], and disgust [7,9,11]. Lower recognition rates in the perception of emotions in PD seem to converge on negative emotions [13]. Other studies [14-16] however, found no evidence for an impaired perception of emotional prosody in PD. Investigations of the recognition of linguistic prosody in PD report a preserved ability to recognize prosodic meanings of smaller units, such as words (e.g. PROject – noun, projECT – verb) and an impaired perception of prosodic meanings that require integration of prosodic information on longer units, such as for spoken sentences (e.g. the rising intonation indicating a question) [17]. The above described receptive prosodic difficulties in PD have been found independent of dementia or depression, but strongly correlated with executive functions and working memory capacity [8]. Among studies on prosodic disorders in patients with brain conditions, only few investigated the perception of both types of prosodies in the same group of patients. Moreover, contributions from Slavic languages are missing.

The aim of the current study was to investigate the perceptive ability of emotional and linguistic prosody on sentence level for speakers of Slovene language affected by PD, similarly to studies for Germanic (e.g. English; [10]) and Romance languages (e.g. Italian; [7]). For the investigation of linguistic prosody, we tested the identification and discrimination of questions and statements. For emotional prosody, we tested the identification and discrimination of utterances expressing six different emotional categories: anger, disgust, fear, happiness, sadness, and pleasant surprise. A prosody recognition paradigm consisting of a combination of an identification and a discrimination task was administered to the participants. Along the lines of Pell [10], we expected PD participants to perform less accurately in the linguistic and emotional identification tasks, but no impairment was expected in the discrimination task for linguistic and emotional prosody. Moreover, we expected the PD group to perform worse in the identification of negative emotions and the reduced recognition to be emotion specific.

2. MATERIALS AND METHODS

2.1 Participants

Eight individuals diagnosed with idiopathic PD (seven males and one female) and eight healthy controls (four males and four females), whose first language is Slovene, were included in the study. Participants of the PD group were recruited from the University Medical Center of Ljubljana, Department of Neurology. The participants for the HC group were recruited from the Retirement Home of Bežigrad, Ljubljana. Exclusion criteria for both groups included: dementia, hearing problems, language disorders, and depression. The neuropsychological assessment of participants included the administration of the Mini Mental State Examination (MMSE) [18]. The demographic data, together with the statistical comparison between groups using independent samples t-test, is presented in Table 1. The PD and HC groups did not differ significantly with respect to age t(14) = -1.071, p = .370 (PD = 77.38 ± 9.1; HC = 71.88 ± 11.3), years of education t(14) = -1.007, p = .175 (PD = 14.75 ± 4.6; HC = 12.75 ± 3.1), and MMSE scores t(14) = 2.016, p =.063 (PD = 28.13 ± 0.6; HC = 28.88 ± 0.8). Moreover, the comparison of the distribution of males and females between groups did not result as significant (p = .282, df = 1, Fischer's exact test).

Table 1: Demographic, neuropyschological, and neurological information for PD and HC (mean ± SD) together with the statistical comparison for age, years of education, and MMSE scores.

Variable	PD group Mean ± SD	HC group Mean ± SD	t-Test P value
Age (years)	77.38 ± 9.1	71.88 ± 11.3	> 0.05
Education (years)	14.75 ± 4.6	12.75 ± 3.1	> 0.05
MMSE (/30)	28.13 ± 0.6	28.88 ± 0.8	> 0.05

2.2 Materials

A new inventory of audio stimuli, uttered by an actress, was built for the purpose of this study. In order to ensure that the identification and discrimination would be based on prosodic cues and not on the content, pseudo-words (constructed from existing Slovenian syllables) were used in sentences (e.g. "*Prohast katoh groji zdrog")*. Ten raters first validated all stimuli. Included in the narrow selection were only those that scored high on the recognition test (at least 70%).

2.2.1 Stimuli-identification tasks

For the linguistic prosody identification task we used 20 utterances, 10 were statements and 10 questions. For the emotional prosody condition 42 utterances were used uttered in 6 distinct emotional tones: anger, sadness, disgust, fear, happiness and pleasant surprise (42 utterances: 7 utterances × 6 emotional categories).

2.2.2 Stimuli-discrimination tasks

The stimuli in the discrimination tasks consisted of pairs of prosodically same or different utterances. The content of two paired utterances was kept equal. For the linguistic prosody discrimination task 16 pairs of utterances were used, 8 uttered with the same and 8 with different intonation. For the emotional prosody discrimination task 20 pairs of utterances were used, 10 uttered with the same emotional tone and 10 with different.

2.3 Experimental tasks and procedure

For both experimental conditions (linguistic and emotional) we administered an off-line forced choice identification task followed by the corresponding off-line forced choice discrimination task. In the identification task single stimuli were presented in each trial (linguistic prosody condition: 20 trials; emotional prosody condition: 42 trials) and participants were asked to recognize and choose the correct label for stimuli belonging to distinct linguistic (question, statement) or emotional (anger, disgust, fear, happiness, sadness, pleasant surprise) categories. In the discrimination task, participants were presented with pairs of stimuli in each trial (linguistic prosody condition: 16 trials, emotional prosody condition: 20 trials) and were asked to judge whether they are the same or different in regard to prosody. To familiarize the participants with the tasks and speaker's voice, practice trials were presented before every task (not included in the analysis). Participants listened to the stimuli through headphones connected to a touch screen laptop on which they would give their responses.

2.4 Data analysis

Group differences between PD and HC in tasks were analyzed by comparing the proportions of correct responses (raw scores) to stimuli using the Chi-square test. Participant's responses (correct, incorrect) were in all comparisons treated as the dependent variable. The independent variables were: the two groups (PD and HC), the two different tasks (identification, discrimination), and the stimuli type in the identification tasks. The stimuli type for linguistic prosody were questions and statements. The stimuli type for emotional prosody were the six different emotional categories (anger, disgust, fear, happiness, sadness, and pleasant surprise), which were also grouped as positive (happiness and pleasant surprise) and negative emotions (anger, disgust, fear, and sadness).

3. RESULTS

Mean percentages of corrent answers of the PD and HC groups for linguistic and emotional identification and discrimination tasks are reported in Table 2.

Table 2: Mean percentages PD's and HC's correct responses in the identification and discrimination task for both conditions (linguistic and emotional prosody).

	Group	
Task	**HC**	**PD**
1. Identification		
Linguistic	94%	87%
Emotional	50%	43%
2. Discrimination		
Linguistic	93%	79%
Emotional	89%	80%

3.1 Linguistic prosody

Identification task: a significant difference between the participant's overall response to the stimuli was found $\chi 2(1, N = 320) = 5.297$, $p < .05$, with PD being less likely to respond correctly (87%) compared to HC (94%) (see Table 2). No statistically significant differences in the response to questions $\chi2(1, N = 168) = 2.210$, $p = .137$ or statements $\chi2(1, N = 168) = 3.059$, $p = .080$ was found between groups. Discrimination task: a statistically significant difference $\chi2(1, N = 240) = 10.440$, $p < .01$ was observed between the groups in the overall proportion of correct responses, with PD performing worse (79%) compared to HC (93%) (see Table 2).

3.2 Emotional prosody

Identification task: no statistically significant difference between PD and HC was observed in their overall responses to the stimuli $\chi2(1, N = 672) = 3.449$, $p = .063$ (see Table 2). However, a comparison between PD's and HC's performance in response to negative emotions revealed a statistically significant difference $\chi2(1, N = 448) = 6.531$, $p < .05$, with PD (47%) scoring lower than HC (59%). No statistically significant difference was found between groups for positive emotions $\chi2(1, N = 224) = .183$, $p = .669$. Moreover, a comparison between PD's and HC's performance in response to specific emotions revealed a statistically significant difference for stimuli belonging to two emotional categories: anger $\chi2(1, N = 112) = 4.432$, $p < .05$ (PD 71%; HC; 87%), and sadness $\chi2(1, N = 112) = 10.351$, $p < .01$, (PD 37%; HC 68%). The mean percentage of PD and HC correct responses across different emotional categories is presented in Figure 1**.** Discrimination task: a statistically significant difference $\chi2(1, N = 320) = 4.073$, $p < .05$ was also observed in the overall correct responses between groups in the emotional prosody discrimination task, with PD performing worse (80%) compared to HC (89%) (see Table 2).

Figure 1: Mean percentage of PD and HC correct responses across the different emotional categories in the emotional identification task.

4. DISCUSSION

The present study sought to investigate the recognition of linguistic and emotional prosody in PD by providing evidence from Slovene language. Overall, compared to HC, the performance of the PD group was significantly lower in three out of four tasks: linguistic identification task, linguistic discrimination task, and emotional discrimination task. These findings did not confirm our first hypothesis, since we expected the PD group to perform significantly worse in the identification tasks only. Our findings are in contrast with Pell [10], where no low performance of PD in the emotional and linguistic discrimination task was found, but are in line with Ariatti, Benuzzi and Nichelli [7], who reported a low performance of PD in the discrimination tasks for both types of prosody. Moreover, Pell and Leonard [11] also reported a marginally significant worse performance of PD compared to HC in the discrimination of emotional prosody. Our PD group scored significantly lower than HC in the linguistic identification task, which tested the participants' ability to identify utterances as sentences or as questions based on intonation only, similarly to Ariatti et al. [7]. No statistically significant difference between PD and HC emerged in the overall scores in the emotional identification task. However, a further analysis comparing group performances in negative and positive emotions revealed a significant difference for negative emotions. The impoverished performance of PD was evident for the emotional categories of sadness and anger. These findings confirmed our predictions on PD's performance to be lower for negative emotions compared to positive ones and for it to be emotion specific. Our findings on low recognition rates for negative emotions (anger, disgust, fear, and sadness) and for the emotional categories of sadness and anger are in line with several other studies [9,11,12]. Overall, the results of our study supported the notion that PD affects receptive prosodic ability. Our study was the first attempt to investigate how Slovene speaking individuals diagnosed with PD perceive prosody conveying emotional and linguistic information on sentence level.

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Mindfulness in preschool children – outline of the study

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ABSTRACT

Practicing mindfulness with preschool and school-aged children affects their general well-being, diminishes mood swings, and improves their ability to focus which all contribute to effective learning. We present a research design for a study that is going to be carried out in the forthcoming months in selected kindergartens. The methodology is partially exploratory and partially following the methodology of the authors of Toy wrap Toy wait test.

We will try to establish whether preschool children become more focused on events around them and on their inner feelings while practicing mindfulness. We will test their ability to replace the dominant with subdominant reaction, which is one of the main components of self-regulation. On the basis of teachers' written answers, and questionnaires: a) Toy wrap Toy wait test and b) Children's Behavior Questionnaire, we will try to establish whether there is any difference between the children who practice mindfulness and those who do not, regarding their self-regulation.

Keywords

mindfulness, preschool children, kindergarten, Toy wrap Toy wait test, Children's Behavior Questionnaire

1. INTRODUCTION

Mindfulness has been known for thousands of years as a part of a meditative practice that, due to its specific way of focusing attention, allows it to focus on the present moment, thus calming the mind and reducing tension [1]. It can be used as a technique for psychotherapeutic purposes as it integrates content from cognitive, behavioral, experiential, and psychodynamic theories [2]. Practicing mindfulness in children affects their overall well-being and behavior, improves mood swings, helps with learning disabilities, fear of failure, and enhances executive function [3, 4].

1.1. Self-regulation

Self-regulation is a critical component of a child's readiness for school since it facilitates a child's acceptance by peers, social and academic success, higher self-confidence, professional achievements and better health [5]. Self-regulation is defined as the process by which people incorporate behavior change into their everyday lives, and it involves: self-monitoring, goal setting, reflective thinking, decision making, planning, plan enactment, self-evaluation and management of emotions arising as a result of behavior change. [6]. Self-regulation in childhood can be defined as a construct that represents the development of children's abilities to follow the everyday norms and practices that are embraced by their parents [7]. Self-regulation has been found to predict positive life outcomes, including good physical health (e.g., healthy body weight), higher levels of education and income, and better psychological well-being (e.g., lower risk for depression and substance abuse) [8]. Majority of the studies we had access to, focused on understanding children's maturation of executive functions —working memory (e.g. remembering a set of directions to complete a learning task), focused attention, and behavior inhibition (e.g. waiting for a turn to speak instead of talking out in class) and how these are linked to their development of emotional and/or behavior control during the preschool and early school years [9, 10].

To our knowledge, research on mindfulness in schools regarding the influence of mindfulness on self-regulation, is still in its infancy. Studies of mindfulness impact on behavior, academic performance, and physical health in children can best be described as 'promising' and 'worth trying'. There are data that show mindfulness training in pre-adolescence could support self-regulation development [11]. This is why we have decided to do the exploratory study where we are going to evaluate self-regulation in pre-school children who practice mindfulness compared to the control group.

1.2. Test Toy wrap Toy wait

Level of self-regulation represents the option to substitute your dominant response over subdominant one; to be able to avoid acting irrational and instead acting rational. A test named Toy wrap Toy wait [5, 11] establishes and compares the level of self-regulation in the intervention and control group.

The test named Toy wrap Toy wait is carried out in a way that the teacher tells the child that s/he has a surprise for him or her but first s/he has to wrap it. S/he sits the child down so that s/he is turned away from her/him by the angle of ninety degrees. The teacher starts to wrap the gift so that the crunching of the paper can be heard. After one minute the teacher shows the wrapped gift to the child and that is when the second part of the test begins. Researchers marks the latency of "peeping": seconds that pass before the child peeps and looks at the object the teacher is wrapping. When the teacher puts the wrapped gift in front of the child, s/he tells him/her to wait before s/he touches the gift and meanwhile s/he pretends that s/he has another task to do; s/he is tidying the paper from the previous task. Researchers marks the latency of touching the gift: how many seconds pass before the child touches the gift [12]. In this test the "peeping" and touching the gift represents the dominant versus subdominant response. In our case the dominant response is to "peep" straight away and the subdominant response is not to "peep" at all. The same reasoning is applied to touching the gift. Dominant response is to touch the gift straight away and the subdominant response is not touching it at all. Longer latency means better subdominant reaction and better self-regulation. The test does not need to be recorded. The teachers are able to carry out the test and researchers can measure the latency of "peeping" and touching.

1.3. Children's Behavior Questionnaire

Children's Behavior Questionnaire is used for children aged from three to seven years. The questionnaire can be filled out by the parents. The questionnaire is a shorter version of the longer Children's Behavior Questionnaire [13] and its use was approved by the author. In the questionnaire three different subscales are used: liveliness (example: "is slow and unhurried in deciding what to do next"), negative emotion ("gets quite frustrated when prevented from doing something s/he wants to do") and effortful control ("notices it when parents are wearing new clothing"). Parents mark their child's behavior in the five-level Likert's scale, from extremely untrue to extremely true of their child.

2. METHODS

We will observe whether preschool children are capable of substituting their dominant reaction with the subdominant and whether they can react differently in their home environment by practicing mindfulness. In this study a dominant response will represent the response which is immediate, non-thinkable or irrational. On the other hand, subdominant response is a rational response, response that demands people to think first, before they act or respond. Our hypothesis is that with practicing mindfulness children will exhibit more subdominant responses than the control group measured by the test Toy wrap Toy wait and Children's Behavior Questionnaire.

The study is going to take place in two kindergartens in Municipality of Radovljica, Slovenia who have agreed to participate in the study. One group will contain 24 five to six-year-old preschool children in Kindergarten in Radovljica and the other one will contain same number, same age group preschool children in Kindergarten Lesce. Parents' approvals were collected prior to commencing the study.

The exercises of mindfulness practice will be carried out after lunch when children have time to rest. One department will practice mindfulness five times per week from five to fifteen minutes, eight weeks in a row while the control group will spend their time resting.

Teachers from individual kindergarten department will participate in the research. They will practice with children an eight-week mindfulness program. During the research they will be supported by the e-learning project of mindfulness: Shift Mindful, dare to be human. Mindfulness program for children will contain structured mindfulness practice based on different sources: mindfulness fairy tales, mindfulness activity games, mindfulness tasks, such as focus on their breathing, focus on gratitude or different feelings; experience love, anger, sadness, happiness etc. Teachers in the control group will follow the regular curriculum and will read a story to children when they rest or let them play quietly.

The research will be composed of three parts. The first part of the research will present a test named Toy wrap Toy wait [5] which will establish and compare the level of self-regulation in the intervention and control group. The second part of the research will present the shorter version of Children's Behavior Questionnaire [13] for children aged from three to seven years which will be filled out by the parents. Parents will get the Questionnaire in hand and they will fill it out before and at the end of the research. With the Questionnaire we will get the report on children's behavior at home, with special focus on concerning subscales; liveliness, negative emotion and effortful control. Our intention is to verify possible changes happening in behavior of children in their home environment while practicing mindfulness. The third part of the research will present the teachers' answers who will carry out the exercises of mindfulness. We will ask them three questions concerning the mindfulness practice with children. We will be interested on their opinion on mindfulness in general, what do they think about practicing mindfulness with preschool children and whether they noticed any change in children. The questionnaire will contain written questions and answers send via email.

Table 1: Tests used in the experiment

Test	Time	Short description
Toy wrap Toy wait	5 minutes	Wrapping the gift by the teacher in front of the child and measuring the time when peeping and touching from the child starts
Children's Behavior Questionnaire	15 minutes	Parents have to mark their child's behavior in the five-level Likert's scale, from extremely untrue to extremely true of their child
Questionnaire for the teacher	10 minutes	Written answers about experience in practicing mindfulness and its effect on children

3. DISCUSSION

3.1. Ethical concerns

The practice of mindfulness and meditation is a conscious exercise that builds attention control and inhibitory skills [10]. Recent pilot research on practicing mindfulness has shown a positive effect on the general well-being, behavior, improving mood swings, and help with learning problems, fear of failure and strengthening executive functions [14-16]. Teaching children mindfulness is expected to enhance their regulatory competences and give them a new experience. The technique is itself non-invasive, voluntary, and can be seen as part of child play. The tests used are playful so children are not stressed by doing them. Since we already introduced the research to the teachers in the kindergarten where the research will take place, they already expressed their interest since they lack the techniques which could help them concentrate and focus themselves.

3.2. Limitations

One has to be aware that incorporating more integrative therapies or techniques in preschool and school programs could be motivated by some economic / consumer interest. However, mindfulness is a technique which requires little financial input. Another problem is that the structure of teaching mindfulness can vary substantially from teacher to teacher, which is why we have decided to offer the teachers a uniform course on mindfulness. Another major drawback to our study is the lack of time. Practicing mindfulness techniques takes more time to exert any larger and/or measurable effects. Practicing mindfulness is most valuable when an individual can internalize or in-personalize the practice in her or his daily routine which can be done by practicing mindfulness on daily basis, for a longer time period. The sample in our study could be too small, since it will be composed of two groups of preschool children, whose parents will agree to participate in the two selected kindergartens in the Municipality of Radovljica. In our study we will not include children's personality and socio-economical and emotional (family) background, which are all important components in accepting mindfulness practice in daily routine.

4. CONCLUSIONS

To introduce practicing mindfulness into kindergartens and primary schools as a part of the curriculum or as a part of a learning program could bring some positive effects on children which are crucial for each individual who starts the path of public and private educational establishment. One of the positive effects could be a higher level of self-regulation. Hopefully with our study we will be able to show some effect on preschool children who will practice mindfulness with the help of their kindergarten teachers.

5. ACKNOWLEDGMENTS

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Consequences of relationships with robots in our everyday lives

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ABSTRACT

We live in an era where robotics and artificial intelligence are rapidly developing, resulting in first humanoid robots. A novelty like this could have a great impact on the society. It is therefore important to consider what potential positive and negative consequences the introduction of humanoid robots into society might pose. At first, this article briefly presents a pilot study on attitudes of the elderly towards robots in our everyday lives. We will also consider a similar research. We used both to present general attitudes towards robots. We will then continue with further investigation on how and why the robots influence humans – we will point out some of the human and the robot characteristics that are involved in their relationships and discuss why some consequences, regarding characteristics, are good or bad for human beings.

Keywords

artificial intelligence, robotics, robots, humanoid robots, ethical issues

1. INTRODUCTION

Every novelty in science, that will soon penetrate/infiltrate our everyday lives, should be carefully considered, because we must be prepared for the consequences – the good and the bad, and how they could possibly influence the society and individuals. In this article we will talk about robots that are entering our day-to-day lives in many different ways; from the industry, and the army to our homes. We will start with my pilot study and a similar research. They will serve as a starting point for further discussion, where we will identify relevant characteristics of humans and robots, and how those influence their relationship.

2. PILOT STUDY

The main aim of the study was to investigate what the elderly think about the usage of robots and how robots make them feel. Hypothesis is that the elderly are not as open, to novelties, such as robots in our everyday lives, as young people are. Coincidentally, participants in both groups differed in level of education and because of that there is another hypothesis; highly educated participants will be more open minded for novelties and will consider them more critically than the ones with lower education.

2.1 Participants

There were two groups of participants. Both consisting of four women. In the first group, the participants were 80 years old or more, and in the second group the age span was from 70 to 80 years old.

Because of a fortunate coincidence, participants in the first group were highly educated – they have all completed university-level education. Participants in second group have not. This information was used to form the second hypothesis, presented a few lines above.

2.2 Method

Before we started the interview, I asked all the participants about their usage of computers and cellphones. This information showed whether they were familiar with some forms of technology.

All participants in the first group had their own phones, but not a computer although they did use computers in the later years of their careers. They admitted that it made some work easier, but not all of it. For example, it was really helpful when you needed a calculator, but not useful in making compromises with clients or selling the products. Today they are using computers for writing e-mails and looking up information on the world-wide net. Only one of them is avoiding computers and prefers newspaper and books. On the bases of their education and the use of computers and phones I think they will be open but critical to new technology.

In the second group, there were four elderly ladies from a smaller town. They didn't have such high education as the participants in the first group. They were a cook, two maids in the local hotel and a cashier at the local market. They have lived in their home town for all their lives and they never travelled. During their careers, they were not in contact with computers. Today, they have their own cellphones, but not any computers. However, they all have TVs, for which they said are a good source of information for them. They said they don't have any need to learn how to use a computer or a smart phone. As we can see, the second group is quite different from the first one. My hypothesis is that they won't be as open for new technology, as the participants in the first group.

After this introduction we proceeded with the interview, based on some videos from the portal "Youtube" [1,2]. Questions were prepared beforehand. Questions were as following: "How do you feel about robots helping you in your work place? Would you trust them with your duties? Do you think we should welcome industry robots in our work places if the human workers won't lose their jobs because of it?", "Pepper is a social robot; you can talk to her, play cognitive games with her, she can make you feel less lonely. Would you accept this kind of robot in your home?", "If you'd live in a home for the elderly would you prefer a robot or a human helper and caregiver?", "We can use robots for human rehabilitation. Would you be open to trying it or would you prefer a human physiotherapist?", "Do all these robots we have seen in videos make you feel good and safe, or are you having any doubts and why so? What do you like about these robots and what makes you feel uncomfortable? Do you think they would be more successful in social interactions because they would constantly be in a good mood and would be made to satisfy humans?"

2.3 Results

In the first part of the first video [1] we can see an industrial robot. General manager said that they thought the robots were good for their company because they didn't need rest and they represent a lower expense than a human yearly salary. Besides, human employees had accepted them, as well. In the first group, participants agreed that it made sense to employ robots in the industry, if it will be taken care of the human workers left without jobs. Through discussion we came to an idea of a universal salary for all people, but came to a problem that owners of such companies would not give up on "easy money" easily. And as consequence, the rich would become even richer and the poor even poorer. To a question, if they would have a robot helper at their work place, they answered differently. But what was common to all of the answers was that they would miss the human factor. Hence, they would have a robot for things like math, but not for something where human factor is important. They also expressed doubt about robots' lack of plasticity and ability to adapt to situations. Participants in the second group agreed that robotization would relieve human employees. Robots are also faster and more precise than humans. In the second group, we also came to a problem of universal salary. To the second question, they all answered negatively and argued the same way as the participants in the first group – robots lack human factor.

Second part of the first video [1] was showing a robot named Pepper and her interaction with her owners. I wanted to know if they would have such a robot in their home. All participants in the first group expressed doubt about having a robot as a friend or a companion. It would feel odd to have a robot friend, again because of their lack of "human-ness". The answers in the second group were not as I had expected. Three of the participants were widows and they all answered that they would like to have such a companion, but at the same time, they expressed doubt about how they would use it, because they didn't know anything about robots.

Third part of the video [1] shows a robot which is used as outer skeleton for patients in the process of rehabilitation after a stroke or some other accident. Robot is connected to the patient through electrodes on muscles and it helps the patient walk. After therapy, the odds of walking again get higher. Participants in both groups said that it was a really useful robot. Regarding this robot we also talked about robot-surgeons; would they prefer a human or a robot surgeon? They said that a robot could be more precise, but they were doubtful about its ability to decide fast if something would go wrong.

In the next video [2] we saw a robot similar to Pepper. It was working as a companion and an animator for exercise in a home for the elderly. Participants in the first group weren't that eager about a robot employee in a home for the elderly. In the second group, they said it would be fun to have additional staff that would be robots.

The last set of questions was about general impressions of robots in our everyday lives. Participants in the first group were sceptic about the universality of robots and missing the human touch, which they found very important in human communication. Participants the in second group came to a similar conclusion. Though, as they said, they didn't have enough knowledge and understanding to judge this.

2.4 Discussion

This pilot study had two groups with four participants each. This means the sample is very small and unrepresentative. This is why the results cannot be used for the whole population of the elderly. Though this study was useful for the purpose of making a starting point for further investigation.

Participants in the first group all had a university education. while the participants in the second group did not. My hypothesis was that the level of education will influence how participants comprehend the robots and its use. Study showed what I had expected; participants in the first group were more open to the usage of the robots. What people think of usage of robots also depends on the culture and where they live. Robots are well accepted in Japan, but in Europe there are still some doubts about it. What could also influence the results is the fact that all participants live alone in their own homes, and not in homes for the elderly. I think people in homes for the elderly often feel neglected by their family and have a bigger need to have someone close to them, even if it is a robot. Because I didn't have access to database, my sample was not random, but I used participants I or my mentor knew.

The aim of this pilot study was not to generalize the results but more to get a grip about the attitudes of the elderly towards robots and their presence in our everyday lives.

3. SIMILAR RESEARCH

Dautenhahn with colleagues [3, p. 1] made a similar research as the one presented before. They were investigating attitude towards potential robot companions. Their main aim was to figure out, how people perceive robots and how they feel about their presence in our everyday lives.

In their research there were 28 participants. Their research questions were: "Are people accepting of the idea of robot companions in the home?", "What are people's perceptions of a future robot companion?", "What specific tasks do people want a robot companion to perform?", "What appearance should a robot companion have?", " What are peoples' attitudes towards a socially interactive robot in terms of robot behaviour and character traits?", "What aspects of social robot-interaction do people find the most and least acceptable?". [3, p. 2].

They used two types of questionnaires: the Cogniron Introductory Questionnaire, used for providing demographic details and the Cogniron Final Questionnaire used for investigating people's attitudes and perceptions towards robots. First questionnaire enquired about participants' personal details (age, gender, occupation), level of familiarity with robots, prior experience with robots (at work, as toys, in movies/books, in TV shows, in museums or in schools), and level of technical knowledge of robots were rated according to a 5-point Likert scale. And the second consisted of questions like "What is robot companion?", "What tasks would you like a future robot to be able to carry out?", "How controllable, predictive and considerate should a future robot be?", "How human-like should the robot appear, behave and communicate?", etc. [3, p. 2-3].

Results showed that 82% of subjects liked or liked very much the concept of computing technology in the home compared to just under 40% for a robot companion. When asked what role they thought a future 'robot companion in the home should have', the majority of participants wanted the robot as an assistant (79%), a machine/appliance (71%) followed by a servant (46%). Younger participants even said they would have robot as a friend and companion. Majority would like future robots to carry out household job as vacuuming. Only 10% would trust a robot with babysitting. Most participants expressed that they would want the behaviour of a robot companion to be highly predictable. Participants' responses about human-like appearance, behaviour and mode of communication for a robot companion were somewhat mixed. 71% of subjects would want a robot companion to communicate in a very human-like or human-like manner. However, human-like behaviour and appearance were less desirable. 36% thought that the robot should behave either very human-like or human like, and 29% stated that a robot in the home should appear human-like or very-human like. [3, p. 3-4].

Suma sumarum; Most subjects saw the potential role of a robot companion in the home as being an assistant, machine or servant. Few were open to the idea of having a robot as a friend. Robot companions should also be predictable, controllable, considerate and polite. Their communication should be human-like, though their appearance and behavior are not necessarily human-like. [3, p. 4]

The current study was exploratory in nature and has revealed many findings that could be relevant for future research ideas and robot companion designs. However, a potential drawback of the study could be the self-selected university sample that was recruited to participate. Future studies should attempt to recruit a more representative population sample. Also, the cultural background of subjects, which was not accessed in the present study, is likely to have a significant impact on people's perception of robots. Moreover, none of the participants were older than 55 years, which means that
the views of an elderly population are likely to be under represented in this study. [3, p. 4]

To conclude, the current study explored people's perceptions and attitudes towards the idea of a robot companion in the home. Interesting and positive results have emerged, indicating that a large proportion of people are favourable to the idea of a robot companion. Results have highlighted the specific roles and tasks that people would prefer a robot companion to perform in addition to the desired behavioural and appearance characteristics. The finding that people frequently cited that they would like a future robot to perform the role of a servant is maybe similar to the human 'butler' role [3, p. 5-6].

4. COMPARISON OF BOTH RESEARCH

Both researches had a similar goal: create a picture of human attitude towards robots and their presence in our everyday lives.

In both researches participants found robots to be acceptable for carrying out household jobs. At the same time, they all rejected the idea of robot as a friend.

Regarding both researches I think people don't accept robots as substitutes for human beings, although they are already taking our jobs in the industry, help in our homes, hospitals, hotels, etc.

5. HUMANS AND ROBOTS

Both researches gave us an insight on attitude of humans toward robots. Now we can continue discussing about our relationship with robots as our partners, friends or lovers and how could this relationship affect humans and society. Relationship depends on characteristics of both groups.

Human characteristics that influence our relationship with robots are: emotions and the ability to anthropomorphize, which is the ability to see non-living things as living. Itis a psychological characteristic that we got through evolution. In this process human ascribe human characteristic to non-human objects or subjects. Emotions are, like the ability to anthropomorphize, a part of human cognition. We got them during evolution and they are helping us regulate our living in day-to-day lives. The consequence of both is that a human being bonds emotionally with a robot very quickly. This could be ethically problematic because such a relationship is only one-sided. This is why friendships or partnerships with robots could be ethically problematic.

There are also robot characteristics that influence the relationship: mobility, autonomy, way of communication. I will present a few experiments on how autonomy and mobility of the robot influence human perception of them. Regarding human psychology and robots' construction and mechanics we can get to another ethical problem: loss of tolerance towards another human being.

5.1 Autonomy and mobility experiments

Scheutz [5, p. 208] was doing a research on how autonomy and mobility influence human perception of robots. Autonomy is considered as the ability to carry out a task without human intervention. And there can be different levels of autonomy. We can give orders to a robot such as "Move 3m ahead" or "Find the evidence for stratification in this rock". It is obvious that the robot that can carry out the second order, has a higher level of autonomy. Levels differ among them, depending on the ability of comprehension, analytics, communication, decision making … [5, p. 208]. Scheutz made three different experiments.

5.1.1 Dynamic Autonomy

In this task, a human subject worked together with a robot to accomplish a team goal within a given time limit. While both the human and the robot had tasks to perform, neither robot nor human could accomplish the team goal alone. In one of the task conditions (the "autonomy condition"), the robot was allowed to act autonomously when time was running out in an effort to complete the team goal. As part of this effort, it was able to refuse human commands that would have interfered with its plans. In the other condition (the "no autonomy condition"), the robot would never show any initiative on its own and would only carry out human commands. Human subjects were tested in both conditions (without knowing anything about the conditions) and then asked to rate various properties of the robot. Overall, subjects rated the "autonomous robot" as more helpful and capable, and believed that it made its own decisions and acted like a team member. There was also evidence that they found the autonomous robot to be more cooperative, easier to interact with, and less annoying than the nonautonomous robot. Surprisingly, there was no difference in the subjects' assessment of the degree to which the robot disobeyed commands (even though it clearly disobeyed commands in almost all subject runs in the autonomy condition while it never disobeyed any commands in the no-autonomy condition). We concluded that subjects preferred the autonomous robot as a team partner. [5, p. 209]

The problematic point of this relationship between human and a robot is, that it is one-sided. Robots are not capable of forming emotional bonds or feeling emotions. At this moment, they are only capable of recognizing human emotion and act accordingly- depends on how they are programmed. In my opinion, genuine features of partnerships or friendships are reciprocity of emotions and respect and belonging. This makes a human happy and fulfilled. Today, robots are not as sophisticated and developed to be able to feel the emotions or be capable of forming an emotional bond with its owner. Because of that, the relationship with a robot cannot be as good as the relationship with a living being. If humans, instead of a robot, buy a dog, this relationship will fulfill reciprocity.

5.1.2 Affect Facilitation

Here, instead of making autonomous decisions, the robot always carried out human orders. However, in one condition (the "affect condition") it was allowed to express urgency in its voice or respond to sensed human stress with stress of its own (again expressed in its voice), compared to the "no-affect condition," where the robot's voice was never modulated. Each subject was exposed to only one condition and comparison was made among subject groups. The results showed that allowing the robot to express affect and respond to human affect with affect expressions of its own—in circumstances where humans would likely do the same and where affective modulations of the voice thus make intuitive sense to humans—can significantly improve team performance, based on objective performance measures. Moreover, subjects in the "affect condition" changed their views regarding robot autonomy and robot emotions from their pre-experimental position based on their experience with the robot in the experiment. While they were neutral before the experiment as to whether robots should be allowed to act autonomously and whether robots should have emotions of their own, they were slightly in favor of both capabilities after the experiments. This is different from subjects in the no-affect group who did not change their positions as a result of the experiment. We concluded that appropriate affect expression by the robot in a joint human–robot task can lead to a better acceptability of robot autonomy and other human-like features, like emotions in robots. [5, p. 209-210]

5.1.3 Social Inhibition and Facilitation

While the previous two studies attempted to determine human perceptions and agreement with robot autonomy indirectly through human participation in a human–robot team task (where the types of interactions with the robot were critical for achieving the goal, and thus for the subjects' views of the robot's capabilities), the third study attempted to determine the human-likeness of the robot directly. Specifically, the study investigated people's perceptions of social presence in robots during a sequence of different interactions, where the robot functioned as a survey taker as well as an observer of human task performance. Our experimental results showed that robots can have effects on humans and human performance that are otherwise only observed with humans. Interestingly, there was a gender difference in subjects' perception of the robot, with only males showing "social inhibition effects" caused by the presence of the robot while they were performing a math task. Post-experimental surveys confirmed that male subjects viewed the robot as more human-like than did the female subjects. [5, p. 210-211]

The results showed human attitude toward autonomous robots. People prefer autonomous robots, when they have to finish the task together. Humans prefer characteristics that shows human-like autonomy. It is important to acknowledge, that this might not be the case in a situation outside the laboratory. Let us now check the situation outside the laboratory.

5.1.4 Robots, mines and soldiers

Now we will talk about a robot that is used for detonating the mines. It goes over the dangerous mine field and when it steps on it, the mine blows up/explodes. The robot was made by Mark Tilden who was present in an experiment. Every time the robot found a mine, it was left with less and less limbs. When it only had one left, it was still pulling itself forward. Then, Tilden stopped the experiment saying he could not stand the pathos of watching the burned and crippled machine drag itself forward. This test is in his opinion inhumane. [5, p. 211]

Whether or not "inhumane" was an appropriate attribution, the fact remains that the only explanation for not wanting to watch a mindless, lifeless machine, purposefully developed for blowing up mines, destroy itself, is that the human projected some agency onto the robot, ascribing to it some inner life, and possibly even feelings. [5, p. 211]

We can conclude that the more sophisticated the robots get, the bigger will be the danger for humans to form one-way emotional bond with such robots. One-way emotional bonds are potentially dangerous because we could be doing things we otherwise wouldn't. For example: if we would trust robots too much, it could get us to buy some articles we don't need, just because it said so. And it could say so, if it were programmed this way. [5, p. 216] I also think one-way emotional bonds are harmful for people who bond this way. Relationships we have should be reciprocal, because this gives the fullness and depth to the relationship.

People who are selling robots should inform their clients that robots don't have emotions and cannot form emotional bonds. This way, they can instill knowledge about non-reciprocal relationships.

Robots are made to make our lives easier and better, which doesn't mean there cannot be some bad consequences. This is why it is very important to think about all possible outcomes of having a robot in our home. And because of the possible negative consequences we should also prepare some safeguards. These safeguards could be laws or guides on how robots can be made, and obligatory informing of clients that robots don't have emotions and cannot bond this way. Which still doesn't prevent us from bonding to robots. [5, p. 217-218]

To conclude, Scheutz approached the problem with doubt in such robots and with a lot of criticism. I think his way of thinking makes sense because society is not informed enough and not everyone is educated on the topic, or they don't even think about negative consequences. Usually people and society are so fascinated by the achievements of science, they forget to think about the bad consequences. We should somehow prevent that.

5.2 Partnership with robots

At some point, the robots could also become partners and lovers. I think partnership is one of the most important relationships we have in our lives. Partner (husband/wife) is someone you supposedly spend the rest of your life with. We choose our partners in many different ways, by different criteria: regarding looks, personality traits, goals, way of communication … What is also important in partnership is reciprocity of respect and emotions. Because of what we have said until now, we can easily claim that a robot would not make a good partner. Downside of having a robot for a partner is also that they are not equal to us; we chose them, they are made the way we want them to be, we don't have to compromise with them, because they always agree with us, etc. Because of how robots function and how they influence humans and our perception of human beings and relationships, partnership with robots could bring us more bad consequences than good. I think the only good outcome would be that the person wouldn't be alone. Otherwise it would change our perception on how relationships work: it is possible that humans would lose patience towards another human being, their potential partner, because they would be used to not compromising. Also, other humans don't think the same way as we do, and have different goals and taste in different things in our lives. Robots would support the fact that we don't have to work for a relationship.

We could make criteria on who is justified to have a robot as a partner, but how would it look? Will the justified be someone who got dumped by his or her first girlfriend/boyfriend? Someone who got divorced for the second time? Or someone who is working 12 hours a day and doesn't have time for social interaction? There are many different questions which could help us define these criteria, but how will we choose the best one? This could be a topic for a whole another article, so I will end it here.

I argue that having a robot partner or a lover is not good.

First, it can clearly be argued that a peaceful, even loving interaction among humans is a moral good in itself. Second, we should probably distrust the motives of those who wish to introduce technology in a way that tends to substitute for interaction between humans. Third, for a social mammal such as a human, companionship and social interaction are of crucial psychological importance. Ultimately, it may perhaps be that we can scientifically analyze all of these psychological needs. It may also be possible one day to build technology that completely fulfills these needs. However, as things stand, we cannot be sure that our caring technologies are capable of meeting all the relevant psychological needs. [3, p. 238]

6. CONCLUSION

Robots are a part of our cultural and technological evolution. It is only a matter of time before they will infiltrate our society completely. I think the right time to prepare ourselves for that moment is now. I think all the scientists that are included in producing a robot should think about how such robots will influence the society. I also think the philosophers should help them think and rethink all the possible outcomes and consequences and how we could prepare for them or even prevent them.

Humans and robots are two different categories, and each have different characteristics which influence one another. We have to consider all of them, when we think about how the relationship among them will work.

In this article, I first presented my pilot study. The main aim of the study was to get a grip on how the elderly feel about robots in our everyday lives. Results confirmed my first hypothesis. Regarding second hypothesis, I was wrong in suggesting that better educated participants would be more open to having a robot in their home. After presenting my pilot study, I also presented a few other studies considering human relationship with robots.

I finished this article with the thought of why robots are not good for us as partners.

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Redukcionizem, samorazumevanje in učinki zankanja v kognitivni znanosti

Reductionism, Self-Understanding, and Looping Effects in Cognitive Science

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IZVLEČEK

V pričujočem prispevku raziščem odnos med nevroznanstvenimi pojmovanji človekove duševnosti, njihovo predstavitvijo v javnosti in načini, na katere se vpletajo v samorazumevanje ter konkretni vsakdan posameznikov v sodobni družbi. Po kratki omembi teoretske delitve na znanstveno in manifestno podobo človeka ponudim pregled izbranih empiričnih raziskav s področja širjenja nevroznanstvenih idej v medijih in njihove integracije v vsakdanjem (samo)razumevanju posameznikov. S pomočjo koncepta zankanja človeških vrst pokažem na kompleksnost odnosa med opisovanjem duševnih pojavov v nevroznanosti in tega, kako se ti pojavi kažejo v sodobnem življenjskem svetu. Izpostavim, da se v vsakdanje pojmovanje duševnosti ne vključijo nujno tisti nevroznanstveni koncepti, ki so najbolje podprti z raziskavami, ampak tisti, ki jih je mogoče integrirati z obstoječimi družbeno-kulturnimi motivacijami in okvirji prepričanj.

Ključne besede

Kognitivna znanost, nevroredukcionizem, samorazumevanje, učinki zankanja

ABSTRACT

In this contribution, I explore the relationship between neuroscientific conceptions of the human mind and mental phenomena, their presentation in the public sphere, and the ways in which they become involved in the self-understanding and day-to-day lives of individuals in contemporary society. After briefly touching on the theoretical distinction between the (neuro)scientific and the manifest image of the human being, I offer an overview of selected empirical research on the dissemination of neuroscientific conceptions of the mind in the media and their integration into the everyday self-understanding of individuals. With the help of the concept of the looping effect of human kinds, I point to the complexity of the relationship between describing mental phenomena in neuroscience and how these phenomena are manifested in the modern lifeworld. I emphasize that everyday conceptions of the mind do not necessarily include those neuroscientific concepts that are best supported by research, but those that can be best integrated with existent socio-cultural frameworks of beliefs and motivations.

Keywords

Cognitive science, neuroreductionism, self-understanding, looping effects

1. Uvod

Razvoj nevroznanosti v zadnjih treh desetletjih je ob znanstvenih odkritjih in tehnološkem napredku pripeljal tudi do porasta prisotnosti nevroznanstvenih idej v javnem prostoru. Če je bil leta 1990 vodilni razlog za razglasitev *desetletja možganov* (ang. *decade of the brain*), kot je George Bush v sodelovanju z znanstvenimi ustanovami poimenoval devetdeseta leta prejšnjega stoletja, »povečati zavedanje javnosti o koristih, ki si jih lahko obeta od raziskovanja možganov«[1], se danes zdi, da je javnost dodobra ozaveščena. Skupaj z razširitvijo dometa nevroznanstvenih raziskav na polje raziskovanja čustev ter socialnega in kulturnega sveta postajajo nevroznanstvene informacije relevantne na mnogih področjih človekovega delovanja, ki ležijo onkraj prvotnih aplikacij v znanosti in zdravstvu. Nevroznanstvena pojmovanja duševnosti in duševnih pojavov ter govor o možganih (ang. *brain talk*) [1] so se iz laboratorijev in klinik razširili tako v medije [2] in vsakdanjo pogovorno rabo [3] kot tudi v prostore šol, ministrstev in gospodarskih zbornic [4].

V promocijskih materialih ob zagonu evropskega nevroznanstvenega *Projekta človeški možgani* (ang. *The Human Brain Project*) najdemo trditev, da bi, če projektu uspe zastavljeni cilj – tj. uspešno simulirati možgane – to »globoko vplivalo na naša najbolj temeljna prepričanja – še posebej na naše razumevanje sebstva, svobodne volje in osebne odgovornosti, načina, na katerega sami sebe razumemo kot osebe, ki so osebno odgovorne za svoja dejanja«[2]. Do katere mere se je z vzponom nevroznanosti naše samorazumevanje – in razumevanje tega, kaj pomeni biti človek – res spremenilo pod vplivom širjenja nevroznanstvenih pojmovanj duševnosti? Po številnih teoretskim obravnavah je to vprašanje v zadnjih letih tudi nekaj empiričnih raziskav širjenja nevroznanstvenih informacij v medijih ter njihovega vključevanja v življenjske svetove različnih članov družbe.

V tem prispevku se bom pomočjo pregleda izbranega nabora empiričnih študij vprašala, na kakšne načine se v sodobnem svetu nevroznanstvene informacije prepletajo z vsakdanjim razumevanjem človekove duševnosti in skušala tako empirično

[1] Pridobljeno s http://www.loc.gov/loc/brain/proclaim.html (september 2019), lastni prevod.

[2] Pridobljeno s http://www.humanbrainproject.eu/ethics.html (december 2014), lastni prevod.

osvetliti staro filozofsko vprašanje o povezavi med znanstveno in manifestno podobo človeka.

2. Manifestna in (nevro)znanstvena podoba človeka

Razkol med pojmovanjem duševnosti v vsakdanjem življenju in znanstvenimi razlagami duševnih pojavov seveda ni le stvar sodobne kognitivne znanosti. Na perečo vrzel med t. i. življenjskim svetom vsakdanjega izkustva in svetom, kot ga prikazujejo znanstvene discipline, je že v prvi polovici prejšnjega stoletja opozarjal Edmund Husserl [5], najbolj izrecno pa je na razkorak med življenjskim in znanstvenim gledišččem znotraj razumevanja duševnosti pokazal ameriški filozof Wilfrid Sellars v svojem razlikovanju med t. i. manifestno in znanstveno podobo človeka v svetu [6]. *Manifestna podoba* predstavlja pojmovni okvir, znotraj katerega ljudje dojemamo sebe in druge kot osebe, ki živijo in delujejo v vsakdanjem človeškem svetu pomenov, norm, namer in osebne odgovornosti. V nasprotju s tem *znanstvena podoba* človeka obravnava kot kompleksen fizični sistem – v primeru nevroredukcionističnih pogledov, s katerim se bom ukvarjala v pričujočem prispevku, kot »nič več kot skupek živčnih celic« [7: str. 2, lastni prevod].

Kljub zaupanju v ontološko primarnost znanstvene podobe je Sellars razkorak med obema podobama prepoznal kot temeljni filozofski problem sodobnega časa. Ker se koncepti, potrebni za vsakdanje razumevanje sebe in drugih kot oseb, neizogibno izgubijo, kadar zvedemo duševnost na objektivistične znanstvene razlage, je vztrajal, da je manifestna podoba nujno potrebna za razumevanje normativnih in pomenskih vidikov človekovega življenja. Po Sellarsu zato celovito razumevanje človeka v svetu zahteva zedinjen pogled (t. i. »stereoskopski vid«), ki zmore obenem zaobjeti tako znanstveno kot manifestno podobo.

V zadnjih desetletjih je skupaj s porastom prisotnosti nevroznanstvenih idej v javnosti naraslo tudi število analiz, ki kažejo, da se (nevro)znanstvena podoba človeka vse bolj vpleta v pojmovni okvir našega vsakdanjega razumevanja lastne duševnosti in duševnosti drugih. Danes številni teoretiki opozarjajo, da se kot posledica razvoja ter popularizacije nevroznanosti in povečanega vpliva nevrotehnologije in psihofarmakologije vsakdanje razumevanje duševnosti v sodobni (predvsem zahodni) družbi vedno tesneje tke okrog konstruktov, kakršni so »nevrokemično sebstvo« (ang. *neurochemical self*) [8], »možganski subjekt« (ang. *cerebral subject*) [9] in »možganstvo« (ang. *brainhood*) [3].

Redukcija duševnih pojavov na njihove nevrobiološke korelate, ki izkustvo obravnava kot epifenomen brez vzročne vloge v delovanju duševnosti, socialni svet pa kot neodvisni nabor zunanjih dražljajev, ima lahko pomembne posledice za človeško samorazumevanje in različne vidike urejanja družbe [4]. Petdeset let po tem, ko je Sellars izpostavil razkorak med znanstveno in manifestno podobo, se tako zdi njegov klic po zedinjenem pogledu še posebej relevanten. Po drugi strani pa sodobna vprašanja o povezavi med nevroznanostjo, družbo in samorazumevanjem posameznikov v družbi ponujajo edinstveno priložnost za empirično osvetlitev njegove in drugih filozofskih razprav o razkoraku med obema pogledoma.

3. Nevroznanstvene razlage duševnosti v medijih

Ob bliskovitem razvoju tehnologije za slikanje možganov s funkcijsko magnetno resonanco so nevroznanstvene raziskave človeških možganov s prvotnega fokusa na senzorimotorične in kognitivne procese kmalu posegle na področje pojavov, ki tradicionalno spadajo v domeno družboslovja in humanistike [10]. Danes med predmeti nevroznanstvenih raziskav neredko najdemo fenomene, ki so najbolj intimno zvezani z našim samorazumevanjem in razumevanjem vprašanja, kaj pomeni biti človek: od ljubezni, umetnosti in religije do politike in prava. Kot so v pregledu britanskih časopisnih člankov, izdanih med letoma 2000 in 2010, pokazali O'Connor, Rees in Joffe [2], je pričetek stoletja prinesel dramatičen porast poročanja o nevroznanstvenih raziskavah v medijih. Čeprav uporaba znanstvenih konceptov za podkrepitev vsakdanjih trditev o duševnosti ni novost [11], se zdi, da so z novimi nevroslikovnimi metodami podkrepljene nevroznanstvene razlage duševnosti še posebej prepričljive. V zgodnjih raziskavah vpliva prisotnosti nevroznanstvenih informacij v besedilu so bralci argumente v splošnem presojali kot bolj kredibilne, kadar so jih spremljali (za samo vsebino argumenta nerelevantni) nevroznanstveno izrazje in slike [12, 13]. Ta retorična moč nevroznanosti se s pridom izrablja v medijih, v katerih informacije o možganih (še posebej nevroslikovni material) pogosto služijo kot podkrepitev v člankih podanih razlag – tudi, kadar trditvam ne pridajo nobene dejanske razlagalne vrednosti.

V medijski analizi iz leta 2005 so Racine, Bar-Ilan in Illes [14] prepoznali tri glavne načine, na katere je nevroznanost pogosto izrabljena kot retorično orodje: uporabo nevroznanstvenih informacij za utemeljevanje resničnosti ali objektivnosti raziskovanega pojava (*nevrorealizem*), interpretiranje možganov kot bistva osebe, pri čemer pojem »možgani« navadno zamenja koncepte, kot so »duševnost«, »jaz« ali »sebstvo« (*nevroesencializem*), ter uporabo nevroznanstvenih študij za promocijo in podporo političnih ali osebnih ciljev (*nevropolitika*). Kasnejše analize [2] so dodatno identificirale še naraščajoči trend prikaza možganov kot vira za samoizboljšavo in optimizacijo »možganskih« oz. psiholoških funkcij, pa tudi trend posluževanja nevroznanstvenih informacij za poudarjanje nevrobioloških variacij med različnimi demografskimi ali diagnostičnimi skupinami (npr. med spoloma in spolnimi usmerjenostmi, med kriminalno in nekriminalno ali klinično in neklinično populacijo). Slednja strategija, ki (povezana z zgoraj omenjenima nevrorealizmom in nevroesencializmom) skuša s sklicevanjem na nevrobiološke razlike med skupinami razložiti razlike v njihovih vedenjskih in psiholoških značilnostih, najpogosteje temelji na (navadno implicitni) biologizaciji družbenih kategorij in je tako pogosto izrabljena, da na novo interpretira družbeno oblikovane pojave kot posledico »naravnega reda« [15].

4. Nevroznanstvene ideje v samorazumevanju posameznikov

Trendi prikazovanja nevroznanosti v medijih pa ne odražajo nujno načinov, na katere se nevroznanstvene informacije vpletajo v dejanski vsakdan njihovega občinstva. V redkih raziskavah s področja uporabe nevroznanstvenih informacij v kontekstu razumevanja duševnosti pri dejanskih posameznikih se je pokazalo, da je zanimanje splošne javnosti za nevroznanstvene podatke najverjetneje skromnejše, kot bi to predvideli na podlagi »nevromanije« v medijih [16]. Medtem ko posamezniki koncept možganov pogosto dojemajo kot relevantnega v kontekstu abstraktnih razprav, v konkretnem vsakdanu povprečnega člana družbe navadno ne zavzema posebej pomembne vloge za samorazumevanje in razumevanje duševnosti [17].

V primerjavi z omejenim prevzemanjem nevroznanstvenih idej v splošni javnosti nosijo nevroznanstveni pojmi opazno večji pomen v skupnostih, v katerih se jih lahko uporabi kot orodje za samorazumevanje in socialno prezentacijo. Vpletanje nevrobioloških konceptov in nevroredukcionističnih pogledov v razlago svojega stanja in gradnjo osebne identitete je še posebej pogosto v klinični populaciji posameznikov s psihiatrično diagnozo. V skladu z zgoraj navedenimi trendi medijske uporabe nevrorealizma in nevroesencializma nevroznanstvene – predvsem nevroslikovni material – informacije pogosto služijo kot prepričljivo orodje za samointerpretacijo: s svojim potencialom za reifikacijo duševne bolezni v fizičnem substratu možganov za mnoge posameznike predstavljajo »dokaz za biološki obstoj [njihove] duševne bolezni« [18, str. 18]. Kot kaže nabor raziskav s pacienti z razpoloženjskimi motnjami, pa se posamezniki tega »dokaza« poslužujejo za različne vrste (samo)interpretacije. Medtem ko za nekatere predstavlja orodje za opolnomočenje, manjšanje stigme, legitimizacijo njihovega stanja ali prelaganje sebi pripisane osebne odgovornosti zanj, lahko isti nevroznanstveni koncepti, ideje in/ali razlage pri drugem posamezniku ali v drugem kontekstu vodijo do nasprotnih učinkov, npr. v resignacijo spričo svoje diagnoze, povečanje stigme ali zvišanje sebi pripisane osebne odgovornosti za svoje stanje [18–22]. Tako se zdi, da za klinično populacijo nevroznanstvene informacije ne *določajo* samointerpretacije, temveč služijo kot potencialni *material* zanjo – material, ki glede na dani kontekst omogoča različne, včasih celo nasprotujoče si načine narativnega uokvirjanja diagnoze v širši kontekst pacientovega življenja in osebne identitete.

5. Učinki zankanja človeških vrst

Spremembe v razumevanju duševnosti – bodisi v konkretnih življenjskih svetovih posameznikov bodisi na nivoju medijskih reprezentacij – se ne dogajajo v vakuumu. Kot izpostavljata Nikolas Rose and Joelle Abi-Rached [4], vprašanje, kaj pomeni biti človek, ni le predmet filozofskih razprav, temveč nosi pomembne praktične posledice. Pojmovanje duševnosti in duševnih pojavov v družbi igra ključno vlogo pri tem, kako kot družba načrtujemo, vodimo in urejamo svoje izobraževalne, pravne in kazenske sisteme, svoje socialne in gospodarske politike, zdravstvo in psihiatrijo, pa tudi svoje estetske in etične okvirje – po drugi strani pa vsi ti sistemi in okvirji »upravljajo« in »vodijo« nas same.

Pomembno je poudariti tudi, da oblikovanje pojmovanj duševnosti ni le enosmeren proces iz nevroznanstvenega laboratorija v družbo. Medtem ko rezultati nevroznanstvenih raziskav informirajo družbeno in osebno razumevanje duševnosti, je nevroznanost (in širše kognitivna znanost) kot socialna aktivnost tudi sama umeščena v svoje družbeno in politično okolje, družbeno pojmovanje duševnih pojavov pa se – še posebej v primeru preučevanja človeških možganov in duševnosti – vpleta v raziskovalni proces od izbire raziskovalnega vprašanja, udeležencev in metod za pridobivanje ter analizo podatkov do interpretacije pridobljenih rezultatov.

Zaradi posledic, ki jih imajo nevroznanstvene ideje na vsakodnevno pojmovanje duševnosti v družbi, lahko širjenje rezultatov raziskav v javnem prostor posredno vzvratno vpliva na proces raziskovanja v nevroznanosti, kjer z izbiro uporabljene metodologije nevroznanost *sooblikuje* – in ne »le« preučuje – prav tiste pojave, ki jih skuša razložiti [19].

Filozof Ian Hacking proces dvosmernega vzajemnega sovplivanja med opisovanjem in klasifikacijo duševnih pojavov v znanosti ter njihovim obstojem v družbi in življenjskem svetu posameznikov zajame v konceptu *učinka zankanja človeških vrst* [23]. Med človeške vrste uvršča pojave, ki so – za razliko od t. i. *naravnih vrst* – po definiciji umeščeni v določeno družbeno in konceptualno okolje. Zaradi te umeščenosti človeške vrste, med katere spadajo mnogi psihološki konstrukti [24], *interagirajo* z opisi in klasifikacijami, ki so jim pripisani. Točneje, opisovanje in klasificiranje človeških vrst lahko vpliva na način, na katerega se te vrste manifestirajo v vsakdanu.

Razširitev določenega pojmovanja duševnega pojava (npr. pojmovanja duševne bolezni, kakršna je depresija, kot »bolezni možganov« raje kot »bolezni osebe« [25]) v znanosti in medijih vpliva na to, kako se ta pojav razume in obravnava v družbi. Posameznikom, za katere je pojav relevanten (v tem primeru ljudem, ki trpijo za depresijo), so kot posledica spremenjenega razumevanja na voljo vsaj delno drugačne intervencije in možnosti delovanja (npr. spodbuda k psihofarmakološkem zdravljenju raje kot k integrativni psihoterapiji) ter drugačen pojmovni okvir za samorazumevanje in konstrukcijo osebne identitete. To vodi do sprememb v njihovem doživljanju in dejanskem vedenju – sprememb, ki dalje vplivajo na pojmovanje danega pojava v družbi (vključno z načinom, na katerega se znanstveno raziskuje). Tako znanstvena pojmovanja duševnih pojavov, kot je depresija, pomembno sooblikujejo način, na katerega razumemo, doživljamo in živimo depresijo v kontekstu vsakdanjega življenja – istočasno pa način, na katerega se depresija živi in manifestira v vsakdanu, podpira naše znanstveno pojmovanje tega pojava.

Za razliko od analiz, ki svarijo pred enoznačnim določanjem vsakodnevnega pojmovanja duševnosti z nevroznanstvenimi (in bolj specifično nevroredukcionističnimi) pogledi, se zdi koncept zankanja človeških vrst primernejši za razumevanje raznolikih in dinamičnih načinov prepletanja (nevro)znanstvene in manifestne podobe človeka v sodobni družbi. Kot opozarja antropologinja Emily Martin [20], v izgradnji konceptualnih okvirov za vsakdanje razumevanje duševnosti ne prevladajo nujno modeli, ki so najbolje podprti z rezultati nevroznanstvenih raziskav: ohranijo se tiste razlage, ki jih je možno najbolj smiselno integrirati v trenutno kulturno in družbeno-politično okolje. Na področju psihiatrije, na primer, med razlogi za privlačnost nevroredukctionističnih razlag – tudi takih, ki jim primanjkuje empirične podpore, kakršna je na primer monoaminska hipoteza depresije – najdemo vpliv interesov in finančnih investicij psihofarmacevtske industrije, pa tudi zmožnost nevrobiologije, da preusmeri pozornost s politično spornih družbenih in ekonomskih dejavnikov, ki doprinašajo k nastanku duševnih bolezni [26], po drugi strani pa nevroredukcionistične razlage s prenosom vzročnosti z delovanja *osebe* na delovanje *možganov* mnogim posameznikom s psihiatričnimi diagnozami omogočajo zmanjšanje občutka, da sami povzročajo svoje trpljenje. Uporaba nevroredukcionističnih konceptov je v medijih pogosto promovirana z odkrito aktivističnimi cilji, kot sta zmanjšanje stigme in spodbuda oblikovanja pozitivne identitete prizadetih skupnosti; najopaznejša primera najdemo pri »gibanju za nevrodiverziteto« v avtistični skupnosti [3, 22] ter pri otrocih z motnjo pozornosti in hiperaktivnosti [1].

Morda še pogosteje kot v spreminjanje vsakdanjega razumevanja duševnosti pa biologizacija človeških vrst vodi v utrjevanje že obstoječih prepričanj in stereotipov tako v medijskih reprezentacijah duševnosti kot tudi pri samorazumevanju posameznikov. Vidal and Ortega [22, str. 17] tako govorita o

»soobstoju ontologij« in »sobivanju konceptov sebstva«, s pomočjo katerih ljudje v svojem samorazumevanju in socialni prezentaciji pogosto prehajamo med mnogimi registri govora o duševnosti. Ni neobičajno, denimo, da se ista oseba interpretira s pomočjo sklicevanja na pojme, ki izhajajo iz različnih – celo nasprotujočih si – sklopov pojmovanj duševnosti. Medtem ko »brain talk« včasih zares implicira redukcijo duševnosti na »skupek nevronov« osrednjega predstavnika nevroredukcionizma Francisa Cricka [7], koncept možganov v medijih [27] in vsakdanji rabi [3, 11] pogosto služi kot metafora za širok razpon različnih pojmovanj ter teorij – od nevrokemičnih do psihoanalitičnih – o duševnih pojavih in sebstvu, pri čimer navadno ohrani psihološko globino, ki je bila pred vzponom nevroznanosti pripisana duševnosti.

6. Zaključek

Na podlagi pregleda izbranih empiričnih raziskav lahko sklenemo, da se dandanes (nevro)znanstvena podoba v vsakodnevno pojmovanje duševnosti vpleta na fleksibilne in raznolike načine. Kljub pričakovanjem, da bo nevroznanost vsak čas pripeljala do radikalne revolucije v pojmovanju duševnosti [28], se zdi, da nova nevroznanstvena spoznanja niso zmanjšala zaupanja v duševno in psihološko domeno, znotraj katere učinkujejo [4]. Integracija izbranih nevrobioloških konceptov v vsakodnevno razumevanje duševnosti je poleg prepričljivosti znanstvenih rezultatov odvisna od različnih motivacij za redukcionistični pogled – področja, na katerih se nevroredukcionistične ideje »zakoreninijo«, pa odražajo predvsem njihovo skladnost z že obstoječimi prepričanji o duševnosti in duševnih pojavih [3, 4, 16–20].

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Modelling natural selection to understand evolution of perceptual veridicality and its reaction to sensorimotor embodiment

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ABSTRACT
The relationship between mind and world has always been one of the focal interests of cognitive science. Perception has been identified as one of the main sources of knowledge about the world and therefore a prime research interest. Evolutionary scientists claim that natural selection optimizes perception so that it accurately mirrors the outside world. In opposition, the interface theory of perception proposes that perception is a non-veridical interface between an organism and the outside world, evolutionarily fitted to the organism's fitness and not the objective truth. It has been studied using genetic algorithms (GAs), which show that non-veridical perception offers more survival value to the modelled organism than veridical perception. However, the theory is based on cognitivist presuppositions about the mind, claiming that perception does not require action. We successfully replicated the GA model, then replaced cognitivist presuppositions with embodied-enactivist presuppositions, coupling action and perception by adding a sensorimotor loop. The sensorimotor loop bootstraps evolution, with organisms needing less information to perform better due to knowing how to perceive by taking appropriate actions. We also perform additional experiments to further corroborate our claims.

Keywords
Cognitivism, enactivism, evolution, genetic algorithms, interface theory of perception.

1. INTRODUCTION
Perceptions have evolved not to describe the objective world, but to help us survive. In a way, they are similar to a computer desktop, which shows its elements, like icons, as to make them easily manipulatable, but 'hides the truth' behind them, like the underlying electrical current. This is the main idea of the interface theory of perception (ITP) [1].

Hoffman et al. [1] claim that perceptions are not isomorphic – "a structure-preserving relation between the physical-causal make-up of the system and the formal structure of the computational model supposedly instantiated by the system" [2, p. 7] – to the objective world, but to the evolutionary fitness of the perceiving organism. ITP therefore follows a more general upheaval in cognitive science (predictive coding [3], enactive approaches [4]) that goes against the idea that perception generates "a fully spatial virtual-reality replica of the external world in an internal representation." [5, p. 375]. Hoffman et al. use, among other methods, genetic algorithms (GAs) to back up their theory [6]. Their model generates a population of artificial organisms that can perceive and act, and evolves them. After a number of generations, the organisms that survive and reproduce do not perceive the objective world isomorphically – rather, they perceive it according to their internal needs, isomorphic to their payoff function.

In our work, we replicate their GA model. Hoffman et al. make a claim that perceptual experience does not require motor movement [1, p. 1497]. We believe that is not true, following enactive approaches to sensorimotor cognition [7], and make our own GA model. In it, we replace cognitivist presuppositions on sensomotorics with embodied-enactivist ones by adding a sensorimotor loop. This also serves to offer further evidence for ITP's idea.

2. REPLICATION
Hoffman et al.'s cognitivist model (CM) is based on Mitchell's 'Robby, the Soda-Can-Collecting Robot' [8]. Robby is an agent that forages soda cans scattered on a grid (Figure 1). It can make a move in a Von Neumann neighborhood (non-diagonally adjacent cells), which it perceives, as well as try to pick up a soda can. It gets points if there is a soda can in the cell it stands on. It loses points if there is no soda can or if it bumps into a wall surrounding the grid. The GA model generates many such grids with many Robbies, who start out with very bad strategies for foraging. Through evolution, where Robbies with better strategies are selected for DNA crossover, Robbies in the final generation become masters of their craft. Their DNA is composed of situation-move pairs, where the situation part describes a possible configuration of soda cans in a Von Neumann neighborhood, and the move part describes which move to make when Robby is in that situation.

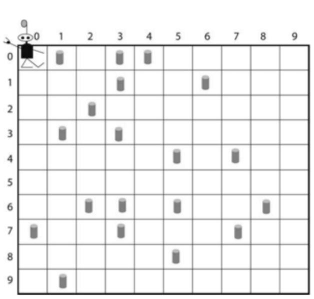

Figure 1: Robby and its world [from 6, p. 131].

Hoffman et al. modify Mitchell's model in a number of ways to be able to investigate ITP. They add a perceptual DNA (pDNA) to Robbies alongside their foraging DNA (fDNA) to evolve as well. The pDNA determines how Robbies see the cells in their Von Neumann neighborhood. They either see them colored in red or in green, depending on the number of soda cans in the perceived cell and their pDNA. As implied, Hoffman et al. also changed the number of possible soda cans in a cell from up to 1 to up to 10. The points Robbies get from picking up soda cans are modified as well – the payoff function is Gaussian, Robbies get (0,1,3,6,9,10,9,6,3,1,0) points for (0,1,2,3,4,5,6,7,8,9,10) cans, respectively (see Figure 2). Each gene in the pDNA represents one amount of soda cans, connecting it with one of the two colors.

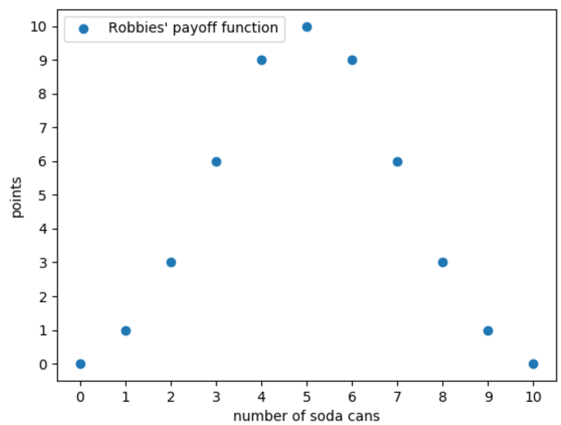

Figure 2: Robbies' Gaussian payoff function for foraging soda cans.

Robbies evolve similarly as in Mitchell's model – they start with bad strategies and end with good ones. What is of interest is how their pDNA evolves during this time – the question is whether the perception is isomorphic or non-isomorphic to the outside world. If the pDNA were to evolve to be isomorphic, it would look like the top genome in Figure 3, which makes colors organize to reflect the lower and the higher amounts of soda cans. If it were to evolve to be non-isomorphic, it would look like the bottom genome in Figure 3, reflecting Robbies' fitness function. It is the latter that does evolve, making Robbies not see the world isomorphic to the outside world, but in a way that helps them survive – the number of soda cans that brings them the most points are of one color, the number that brings them the least points are of another color.

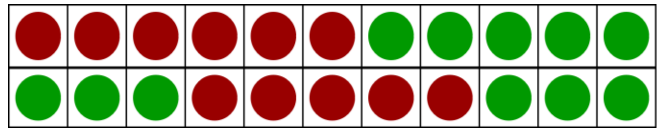

Figure 3: Isomorphic (top) and non-isomorphic (bottom) perceptual DNA.

3. EMBODIED-ENACTIVE MODEL

We look at ITP from an embodied-enactive perspective [7], especially since Hoffman et al. claim that perception is possible without action. Therefore, we add a sensorimotor loop to Robbies. Our model's (EAM) modifications are the following: previously able to see the Von Neumann neighborhood, now Robbies only see the cell they are in and the cell they are looking at. The latter implies another modification – Robbies first have to act to perceive. They have to turn towards a certain direction to see the cell in that direction. Robby therefore has the following 'loop of life':

1. Depending on where Robby is looking at, perceive the cell's color.
2. Make a move depending on what Robby sees in the direction it is looking at and the cell it is standing on.
3. Decide which cell to turn to, which will be perceived in step 1 of the process' reiteration.

The fDNA is modified to include turn-situation-move triplets, which are then evolved instead of only situation-move pairs as in

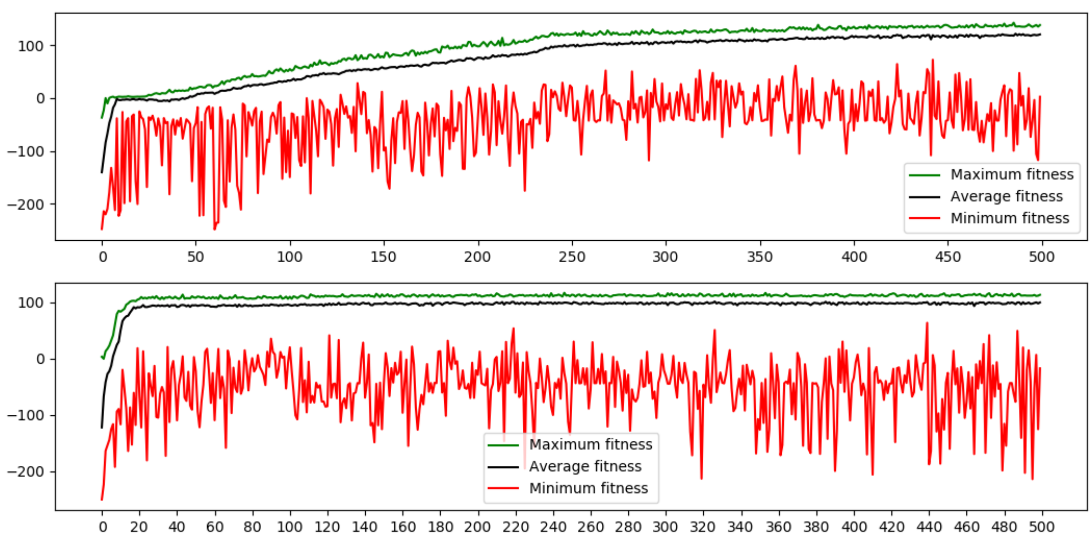

Figure 4: Robbies' foraging skills evolution in CM (top) and EAM (bottom).

CM. Figure 4 shows the results of how Robbies and their fitness (number of points on y-axis) evolve (time on x-axis) with CM on the top and EAM on the bottom. EAM's Robbies' pDNA evolves the same as in CM.

4. ADDITIONAL EXPERIMENTS

Four additional experiments were made with CM and EAM to further examine legitimacy of non-isomorphic perception prevailing over isomorphic perception. Robbies were implemented with pDNA coding the mapping from the external world to colors that was constant, unchanged neither by crossover nor by mutation. Four experiments were run:

1. CM was implemented with a fixed isomorphic perceptual strategy.
2. CM model was implemented with a fixed non-isomorphic perceptual strategy.
3. EAM was implemented with a fixed isomorphic perceptual strategy.
4. EAM was implemented with a fixed non-isomorphic perceptual strategy.

Figures 5, 6, 7 and 8 show graphs for CM with a fixed isomorphic perceptual strategy, CM with a fixed non-isomorphic perceptual strategy, EAM with a fixed isomorphic perceptual strategy and EAM with a fixed non-isomorphic perceptual strategy, respectively.

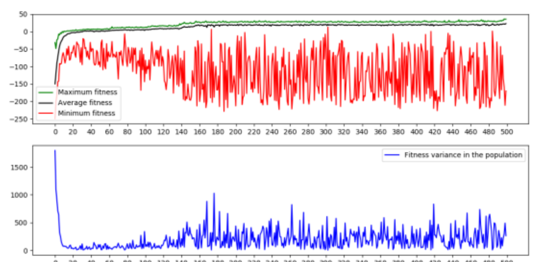

Figure 5: CM with a fixed isomorphic perceptual strategy. The top graph shows the fitness score over generations, the bottom graph shows fitness score variance over generations.

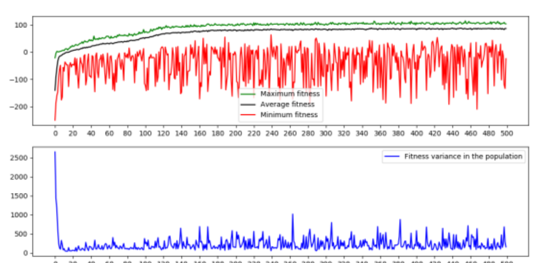

Figure 6: CM with a fixed non-isomorphic perceptual strategy. The top graph shows the fitness score over generations, the bottom graph shows fitness score variance over generations.

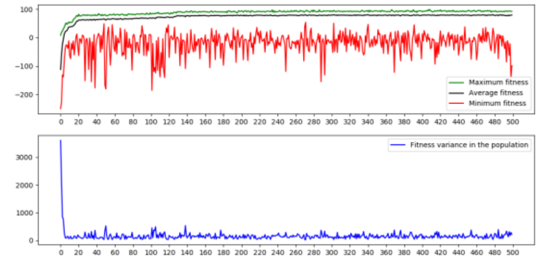

Figure 7: EAM with a fixed isomorphic perceptual strategy. The top graph shows the fitness score over generations, the bottom graph shows fitness score variance over generations.

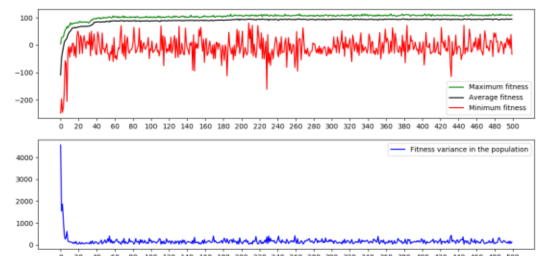

Figure 8: EAM with a fixed non-isomorphic perceptual strategy. The top graph shows the fitness score over generations, the bottom graph shows fitness score variance over generations.

Experiments mostly yielded nothing out of the usual. Both models with non-isomorphic perceptual strategies scored similarly between each other as well as to the original models without fixed, but evolving perceptual strategies. The slope of CM's two graphs compared to EAM's are again to be expected – the same happened in the models with evolving strategies. The same goes for variance. What is unexpected is that Robbies with isomorphic perceptual strategies in EAM score a lot higher than Robbies with the same perceptual strategy in CM. This might be again due to the varying variance and higher scoring individuals in EAM, where the sensorimotor loop works as an optimizer.

Further experiments therefore yielded results that were expected, and showed that the fitness-based, non-isomorphic perceptual strategy makes Robbies more successful in picking up soda cans and navigating the modelled world.

5. DISCUSSION AND CONCLUSIONS

CM and EAM both evolve perceptions that are not isomorphic to the objective world, but rather to the perceiving organism's needs. However, they diverge in how long it takes for Robbies to become master foragers. EAM implements active perception [9], which bootstraps evolution and optimizes the best foraging strategy discovery process. This means that actively choosing which (and less) information to take in beats more ('free') information which needs to be processed in CM. In our future work, we want to make Robbies more 'enactively' autonomous [10], meaning that there would be less designer-fixed agent architectures and more learning through non-deterministic dynamic interactions. We also want their fitness function more dependent on historical interactions [11]. Lastly, we want to conceptualize the role of such modelling in researching how presuppositions of different cognitive science paradigms influence our understanding of cognition [12].

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The state of the Integrated Information Theory, its boundary cases and the question of 'Phi-conscious' AI

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ABSTRACT

This work analyzes Giulio Tononi's Integrated Information Theory of consciousness, defined in 2016, the tools it offers to calculate the level of consciousness in any given system, produced in 2018, and compares the theory to other relevant recent theories of consciousness. It then discusses issues with the theory as well as the tools, namely that they are unreliable due to a variety of shortcuts that give different approximations, as current technology does not allow faithful computation of consciousness, i.e. a system's Phi. The testing confirms the problems with running time (*O*). Tononi's stand on AI is then problematized in relation to IIT. The authors' thoughts and treatise on a possibility of Phi-conscious AI is presented afterwards. AI systems are separated in three levels of hierarchy according to Marr and two types – knowledge representation-based and neural network systems according to Shoham. The authors hypothesize that combining both types brings AI closer to consciousness, which should hold true according to the multiple knowledge principle. Both systems are evaluated in relation to IIT's axioms and postulates. Evaluation shows that their combination conforms to more axioms and postulates than both types do separately, therefore confirming the hypothesis. However, AI is still not Phi-conscious as it does not encompass all of IIT's requirements.

Keywords

Artificial intelligence, consciousness, functionalism, Integrated Information Theory.

1. INTRODUCTION

Consciousness, this infinitely intimate state that we cannot escape and which encompasses our every thought, our every feeling and our every experience, is currently one of the most explored phenomena in science. It was explored with natural scientific methods more than 100 years ago by figures like the psychophysicists William James, Gustav Fechner, Hermann von Helmholtz and Wilhelm Wundt, but the research stopped as it was seen as a primitive, subjective and unscientific practice [1]. However, since the late 1990s, consciousness was again established as a phenomenon not only worth of exploring, but being able to be explored [2].

Theories of consciousness are abound, and there are many unique proposals, featuring orthogonal presuppositions, various ontological claims and sequestered methodologies for inquiry. Some of the most well received recent theories include the Global Workspace Theory [3], the Multiple Drafts Model [4], predictive coding approaches [5] and quantum theories of consciousness [6]. Among all, the Integrated Information Theory (IIT) of consciousness [7], proposed by the neuroscientist and psychiatrist Giulio Tononi, was described as the most formally sound, most computer science related and the most scientifically viable theory in this field yet [8].

IIT is based on a mathematical concept or quantity Φ, Phi, which can be calculated for any given system and represents *integrated information* (more in Section 3). IIT claims that integrated information is almost entirely correlated with the level of consciousness in the system Φ is calculated for. For example, the human brain has a very high Φ, which according to IIT, means that it is very highly conscious. But Φ can be calculated for any given system, so even atoms have some low number of Φ, or systems such as a light switch [9]. This conceptualization comes very close to the philosophical view of the mind called panpsychism, which proposes that consciousness or mind is a fundamental property of each and every part of any given system (from atoms to rocks to buildings to planets to the universe itself) [10]. This connection was also acknowledged by Tononi and Koch [11]. Another important aspect of IIT pertains to the hard problem of consciousness, which describes the explanatory gap between qualia or experience and physical states. IIT eschews the hard problem by presupposing consciousness as intrinsically real due to a system's cause-effect powers upon itself (see Section 3, Axiom 1). This axiomatic property of IIT circumvents the hard problem debate, which is why it will also not be addressed any further in this work as it is out of its scope. The wider framework of IIT is described in Section 3. However, since even photodiodes' Φ is above zero, the threshold for levels of semantically reasonable consciousness should be above zero in order to differentiate between what is commonly seen as conscious and unconscious. This should serve for easier discussions on consciousness in boundary cases such as artificial intelligence (AI).

In general, this paper is an upgrade of the paper by Gams [12], who presents an older version of IIT defined in 2014, offers a commentary on it and sets foundations for discussing AI in relation to IIT. The current work encompasses:

a. the state of the mentioned recent theories on consciousness in order to set them apart from IIT (Section 2),

b. an analysis of the state of IIT in its updated, newest form alongside with the recently developed tools available for measuring consciousness of any given system (Section 3), and

c. an analysis of the boundary cases for consciousness as described by Tononi [13] with the focus on AI and its possibilities for possessing consciousness (Section 4).

The paper ends with the authors' intentions for future work and some concluding thoughts.

2. STATE OF THE RECENT THEORIES OF CONSCIOUSNESS

This Section briefly presents the current state of the following theories on consciousness: the Global Workspace Theory [3], the Multiple Drafts Model [4], predictive coding approaches [5] and quantum theories of consciousness [6]. It also offers a short criticism of each and whether they encompass the possibility for AI to be conscious.

The Global Workspace Theory (GWT), which spawned many advanced off-shot theories such as the 'neuronal global workspace' theory [14], relies on the concept of global availability of conscious content. Conscious content is supposedly available to all cognitive processes (e.g., attention, decision-making), which are connected more to certain parts of the brain, while conscious content inhabits a global neuronal activity across the brain. Consciousness is therefore widely spread, while various processes and states compete for being brought into this conscious landscape. The theory can explain various neuronal phenomena as well as functional cognitive processes, but it is not clear on how the graduality (or binariness) of consciousness works and how to precisely measure it. If the organizational aspects of GWT were realized in computers, it would be sensible to say that computers would be conscious.

The Multiple Drafts Model is a cognitivist theory of consciousness and proposes that there is "no reality of conscious experience independent of the effects of various vehicles of content on subsequent action (and hence, of course, on memory)." [4, p. 132] The theory claims that there are numerous interpretations of the sensory data that comes in through our senses. Since these are processed in different parts of our brains at different times, the first of the multiple drafts that checks all the necessary boxes in the neural processing is the one that is acted upon, and that the experience accompanying it is illusory. However, critics claim that the theory does not hold the power to explain or predict neuropsychological research data. It also does not offer mathematical explanations. Regardless, Dennett believes that mental functions are functions in a mathematical sense, which means that they can be formalized in a machine, resulting in a conscious AI.

Predictive coding approaches [5] are probably the most recent approaches to understanding the mind. Predictive coding refers to the theory that the minds and brains are fundamentally prediction machines. The mind builds a hierarchical generative model of the world which it is always predicting. This radically changes the idea that the sensory input and information-processing of it is a feed-forward process, that sensory data travels from, e.g., the eye through the brain's multiple layers of processing, and in the end, causes a motor action. Instead, the brain predicts the next input to the eyes before the input appears. The theory is currently one of the most researched, if not the most researched theory in cognitive science [15]. Predictive coding is a highly mathematical theory, as it partly relies on computer science algorithms, meaning that it should be able to encode at least some aspects of what predictive coding has to say on consciousness in machines.

Quantum theories of consciousness mainly claim that classical mechanics cannot explain consciousness. It is quantum entanglement and superposition as well as other quantum phenomena that cause consciousness [6]. However, the quantum hypotheses mostly discuss how quantum phenomena may give rise to consciousness and not much about the consciousness itself. The main (and particularly enormous) problem is that they are nowhere near testable. Since the quantum theories rely on quantum phenomena in terms of consciousness existing, machines first need to possess these quantum phenomena. Then, according to the theory, they can be built to have consciousness.

This collection of various contemporary theories of consciousness tries to sketch the state of consciousness theories so that IIT is placed in context and that it can be evaluated against them. The next Section discusses the state of IIT.

3. STATE OF THE INTEGRATED INFORMATION THEORY

This Section more thoroughly introduces IIT and the recently released tools and methods for measuring Φ. This serves as a continuation and an upgrade of the description of IIT by Gams [12] as well as a foundation on which Section 4 analyzes AI in regards to Φ.

The IIT takes inspiration from various sources – panpsychism was already mentioned – but it starts from getting away from purely searching for neuronal and behavioral correlates of consciousness and experience. It asks the harder questions of why cerebral cortex gives rise to consciousness but not cerebellum, even though it has approximately 4 times more neurons than the cerebral cortex and of what is important for consciousness in terms of various boundary cases having it. The latter is especially important, and Tononi and Koch [11] list a number of such cases where they ask whether they are conscious or not: 1) patients and infants, 2) animals, and 3) machines (more on this in Section 4). IIT therefore does not want to only work with collected data on cases where consciousness is freely attributed – neurotypical adult humans – it wants to propose what consciousness and experience are and what kind of systems in regards to their interactional properties can have them. IIT does that, however, in a reverse order than what consciousness researcher usually do – it starts from experience by positing five axioms and deriving five postulates that describe systems for which the axioms are true. On top of that, IIT establishes a calculus for precise measurements of consciousness, which it connects to integrated information, symbolized by Φ, Phi.

The five axioms and postulates are:

1. Intrinsic experience:

Axiom: Consciousness is real, and it is real from its own perspective.

Postulate: System must have cause-effect power upon itself.

2. Composition:

Axiom: Consciousness is composed of phenomenological distinctions, which exist within it.

Postulate: System must be composed of elements that have cause-effect power upon the system.

3. Information:

Axiom: Consciousness and each experience is specific, differing from other possible experiences.

Postulate: System must possess cause-effect sets that differ from each other in their space of possibilities.

4. Integration:

Axiom: Consciousness is unified and experience is irreducible to a set of its phenomenological distinctions taken apart.

Postulate: System must specify its cause-effect structure as to be unified, irreducible to mere sum of its parts ($\Phi_{system} > \Phi_{sum\ of\ parts}$).

5. Exclusion:

Axiom: Consciousness and experiences are definite and are the way they are, nothing else.

Postulate: System must specify its cause-effect structure to be definite, always over a single set of elements and maximally irreducible ($\Phi_{system} > \Phi_{any\ given\ sub\text{-}system}$).

The remaining part of this Section focuses on the notion of integrated information, Φ, as this is the part of IIT that Tononi's team is paying attention to the most in the recent years in terms of updating and revising it, especially with new tools.

Among others, the notion of integrated information offers the answer to the question of why cerebral cortex generates consciousness, but not cerebellum, even though the later has four times more neurons than the first. It also explains how even photodiodes can have experience and therefore, albeit very low level of, consciousness.

The main idea behind Φ and why it measures consciousness is this: First, it measures information in a certain system. This information is denoted by how much information the system has about itself, which is defined as a number of possible states, past and future. Second, this measure of information is coupled with how this information is integrated. What is measured is how much the information depends on the interconnectedness of the system's parts. To demonstrate this measurement, the system is split (into an arbitrary number of sub-systems) and then information is measured again. The more information that is lost, meaning the more information that arose from this interconnectedness, the more integrated the system was. Integration is also the reason why Tononi argues that computers have very little consciousness – because even though they can have much information, it is not integrated. He argues that transistors (he deems the physical, implementational level the most important) do not lose much structure or information if split, as they can still give rise to the same system (more on this in the next Section).

However, measuring Φ, even if we generally know what we want to measure, is extremely difficult. The biggest problem is that Φ cannot be calculated with our current computational technologies even if the system is only as big as a few nodes. Φ can be approximated with various different shortcuts and heuristics, but the problem is that for the same system, the approximation wildly varies depending on the technique for the approximation used [16]. In 2018, Mayner et al. [17] produced PyPhi, a Python software library that allows one to study the cause-effect structure of a given system in relation to IIT and calculate Φ. However, even though it encompasses a number of heuristics to calculating Φ, the algorithm's running time is exponential in terms of number of nodes increasing. Currently, the algorithm's running time is $O(n53^n)$, where n denotes the number of nodes. Running simple CPU experiments, it takes 24 hours to calculate Φ using the major complex of systems approach on a seven-node system if run on 4 × 3.1GHz CPU cores (see Table 1). Other shortcuts produce different running times, but also different Phis.

Table 1: Test of running time of Φ calculations for three systems with a different number of nodes.

# of nodes in system	Running time
3	~8 seconds
5	~2.5 minutes
7	~24 hours

The running time and the problem of getting different Phis with different calculations is one of the biggest criticisms of IIT. It also seems that in its current version, V3, IIT does not provide falsifiable predictions, which is one of the most common criticisms of most theories of consciousness.

4. INTEGRATED INFORMATION THEORY AND ARTIFICIAL INTELLIGENCE

This Section speculates on conscious AI in relation to IIT, dubbed as Phi-conscious AI. The authors address some of Tononi's points on AI, argue that some of his points may not be correct regarding it, propose that AI on certain levels may be seen as conscious and evaluate different AI paradigms through IIT's axioms.

Tononi examines AI only from a physical level. He only considers what computers are physically made of and makes claims exclusively about transistors and their inability to reach high Φ due to not being integrated – if one splits transistors, they can still possess the same information value. Tononi even states that if "integrated information theory is correct, computers could behave exactly like you and me, and yet there would literally be nobody there" [18, para. 32]. This means that even if they were programmed to satisfy the axioms and have a sufficiently high Φ, according to Tononi, their physical, transistor-based implementation would preclude 'true' consciousness. AI that would behave perfectly humanly would be the philosophical zombie. However, Tononi takes a very narrow perspective on AI that may even be in contention with IIT itself, as IIT's axioms and postulates do not necessarily require the implementational level of a system to be the one that counts in term of consciousness. Marr [19] proposes a three-level hierarchy in regards to AI and cognition in general: 1) computational level (what the system does and why), 2) algorithmic level (how the system does what it does), 3) physical level (the realization of the first two levels). The first two levels may bear a much higher Φ. However, the computational level does presuppose some functionalist ideas, namely that mental states are as they are because of the function they perform.

To speculate on whether certain types of AI on the 1st and 2nd level of Marr's hierarchy are Phi-conscious, AI is separated in three categories. It is investigated whether IIT's axioms and postulates hold true for them. The AI categorization is based on Yoav Shoham's invited talk [20] at this year's International Joint Conferences on Artificial Intelligence (IJCAI), one of the biggest and oldest AI conferences in the world. Shoham categorizes AI in roughly two categories: knowledge representation (KR) based AI (commonly dubbed as ‘good old-fashioned AI’) and neural networks (NN). His hypothesis is that KR is good for certain problems, that NN is good for other problems and that by combining the two, AI will enter a new era of progress as KR+NN will work better than its parts (see Figure 1). Our hypothesis mirrors Shoham’s – we believe that KR may satisfy some IIT’s axioms and postulates, that NN may satisfy some other axioms and postulates, but that together they would have higher Φ than they would if treated separately and then summed up. This thinking is also based on the multiple knowledge principle [21], according to which our hypothesis should hold true.

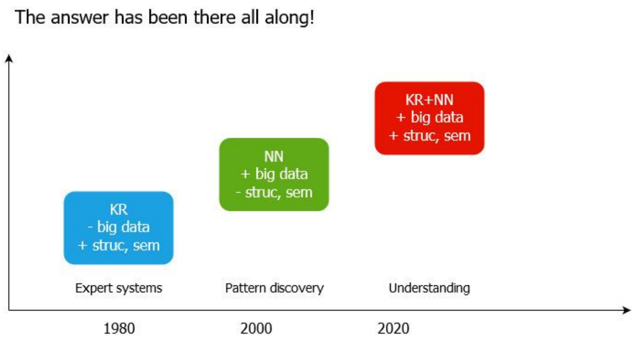

Figure 1: Shoham’s vision for AI (struc = structured, sem = semantics). Adapted from [20].

KR mostly encompasses expert systems. These are systems that have all their domain knowledge programmed into them with various rules, which are explainable and symbolic in nature. The process of knowledge acquisition is top-down, meaning that the designer presupposes everything they know.

NN encompass learning systems that usually look for patterns. Their knowledge is produced from lots of data (big data), bottom-up, they are subsymbolic and very robust.

The table below (Table 2) shows the analysis for KR, NN and KR+NN in relation to IIT’s axioms and postulates. KR+NN’s relation to IIT is determined by using logical disjunction (∨, (x)or) between KR and NN, as axioms and postulates have to hold true only for one to hold true for KR+NN.

The arguments in Table 2 claim that by combining KR and NN, AI gets closer to achieving consciousness according to IIT. What seems to be lacking in both is *exclusion*. AI therefore cannot be characterized as being Phi-conscious just yet, but our initial hypothesis is confirmed.

There is more to IIT’s problems regarding AI. One problem is that Tononi clearly states that his theory should be judged according to how it explains the empirical data about consciousness [11]. There is a problem with this in relation to AI – there is no empirical data about consciousness. Tononi presupposes consciousness and acts accordingly – that neurological data on the brain is in fact empirical data about consciousness, without calculating Φ to find out whether this is true. This inherently cripples meaningful research on AI consciousness, as one cannot do the same and presuppose it in, e.g., robots. You cannot, as Tononi tries to do with IIT, reverse engineer the process of scientific investigation and theorizing.

Table 2: Analysis of KR, NN and KR+NN in relation to IIT’s axioms and postulates.

AI type / **IIT**	**KR**	**NN**	**KR+NN (KR ∨ NN)**
Intrinsic experience	can have cause-effect power upon itself, as rule-based system may operate on feedback loops and recursions (the specified rules may change) that are being performed without input **TRUE**	layers may easily be interconnected or connect in a way (bi-directional layers, feedback loops on the same nodes …) for NN to have cause-effect power upon itself, especially in no-input NNs such as (generative NN, Kohonen NN …) **TRUE**	**TRUE**
Composition	has strong compositional property; computational rules may be linked between each other and have effect among each other **TRUE**	due to the self-organizational nature of NNs, modularity and therefore composition is not clear and entirely explainable; nodes do connect, but may not hold true for concepts; since it is very robust, parts may be removed without affecting the system itself **FALSE**	**TRUE**
Information	can possess many cause-effect sets, differing from each other (Tononi also states that machines have high information value) **TRUE**	a number of cause-effect sets is usually operationally the same in relation to their power in the system (which is why optimization by reducing NN size works) **FALSE**	**TRUE**
Integration	in KR, the sum of its parts by definitions cannot be more than the system itself, as expert systems are inherently modular, therefore violating ‘$\Phi_{system} > \Phi_{sum\ of\ parts}$’ **FALSE**	works as a unified and distributed system and completely irreducible to the sum of its parts as nodes necessarily organize between each other in an inseparable way; ‘$\Phi_{system} > \Phi_{sum\ of\ parts}$’ holds true **TRUE**	**TRUE**
Exclusion	cannot guarantee that a KR system is a maximally irreducible, especially due to its modularity, therefore violating ‘$\Phi_{system} > \Phi_{any\ given\ sub\text{-}system}$’ **FALSE**	Usually a NN can be reduced to an operationally equally effective subsystem that has the same integration and information values (which is why optimization by reducing NN size works), which implies that NN systems violate ‘$\Phi_{system} > \Phi_{any\ given\ sub\text{-}system}$’ **FALSE**	**FALSE**

5. CONCLUSIONS AND FUTURE WORK

This work presents the latest iteration of the Integrated Information theory proposed by Tononi, some tools the IIT researchers offer for calculating Φ, and the problems of both. Some other theories of consciousness are presented as well to put IIT in context, especially in regards to AI. The biggest contribution of this work is in trying to speculate on whether AI is, as dubbed by the authors, Phi-conscious or not. We speculate about consciousness on various types of AI, categorized by Shoham, and hypothesize that combining different types brings us closer to Phi-conscious AI, which we claim to confirm (Table 2).

Our future work includes more thorough analysis of different concrete KR and NN systems, but our foremost interest lies in working with KR+NN systems. This seems to be the future regardless of IIT, but we want to make KR-NN systems as close to Phi-conscious as possible and see what consequences will emerge. Other ideas for future work include using machine learning and state-of-the-art algorithms to deal with the algorithm running time better in terms of developing heuristics to shorten the calculating time, and consequently calculating Phi for systems such as recurrently connected Turing machines to find out whether it is higher than the sum of individual Turing machines due to dynamic interactions [21].

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Establishing illusionism

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ABSTRACT
In his recent paper on the meta-problem of consciousness, Chalmers claims that illusionism is one of the best reductionist theories available and that it is not incoherent even if it is implausible and empirically false. The paper argues against this. The first part introduces the reasoning leading to illusionism, i.e. it describes the initial conditions and relations among them for establishing it. The second part of the paper argues that strong illusionism is not set up in a satisfactory way and calls the flaw in establishing it the pre-illusion problem.

Keywords
Consciousness, illusionism, phenomenal properties, knowledge argument, first-person perspective.

1. INTRODUCTION
When we reflect on what it means to be conscious or what it means to undergo a certain qualitative experience we are faced with the following problem: the subjective aspect of the first-person experience is not compatible with physicalism. Traditionally, phenomenality is understood as a cluster of 'what it's like' properties that determine the phenomenal character of a mental state. There is a consensus among most philosophers that the phenomenal states threaten the truth of physicalism. The phenomenal cluster consists of phenomenal properties being, among other things, ineffable, irreducible, intrinsic, direct, subjective, private etc. So, the problem of relating such properties to something purely physical emerges naturally: How does conscious experience emerge from physical processes in the brain? The problem framed this way and called by Chalmers the hard problem poses a great threat to any physicalist strategy [1]. In the contemporary philosophy of mind, the discussion regarding the hard problem has been radicalized to the point that mainstreem traditional physicalism is losing its proponents. We see fewer philosophers who are ready to maintain a compatibilist position, that mental, phenomenal states are real and can be placed within the physicalist ontology. On one hand we have the realists about mental states, who maintain that the placement problem of mental states is indicative of their special nature, namely thier non-physical nature [1, 2, 7, 11]. Since we cannot fathom how can mental states, if real, be placed within the physical framework, this means that the mental states must somehow be something extra-physical. On the other hand we have philosophers, who realized that one cannot be a realist about mental states and at the same time hold that physicalism is true, and therefore their physicalist position is radicalised to the point that they deny the reality of mental states [4, 5, 9, 10].

One of these strategies is called illusionism. It does not try to solve the hard problem but to dissolve it by showing that something like phenomenality as described does not exist at all. And, if there is no phenomenality then there is no hard problem of consciousness. Chalmers sees it as the best reductionist approach to the explanation of consciousness [2]. According to his line of thinking, what we are left with is the so-called illusion problem: "Why does it seem that we have phenomenality when we really don't" [5]. There are several answers to the question of how the illusion of phenomenality[1] arises but they will be left aside [8, 9, 14]. The focus of the paper is on the reasoning leading to illusionism, more precisely, the evaluation of the contemplation process establishing the illusionist position. Firstly, the paper describes how strong illusionism is set up. Secondly, it argues that there is a flaw in setting it up called the pre-illusion problem.

2. SETTING-UP ILLUSIONISM
We introduce the illusionistic modifications to phenomenality as uncovered by Frankish through a simulation of the reasoning leading to illusionism [5]:

1. Phenomenality is/seems anomalous.

2. A commitment to an explanatory strategy that relies on existing theoretical resources without major revisions.[2]

∴ (3) Phenomenality does not exist.

The first premise is understood as "phenomenality is anomalous" by strong illusionism and as "phenomenality seems anomalous" by weak illusionism. Weak illusionism claims that the mere possibility that phenomenality is anomalous is already enough and ties it to certain suspected anomalous characteristics that phenomenal states possess, i.e. they are private, ineffable, immediately apprehended, intrinsic, direct. However, some authors think that strong illusionists are right in saying that weak illusionism either collapses into strong illusionism or it cannot do the job that it sets out to do [5]. The second premise emphasizes the importance of relying on existing theoretical resources, its mantra is "first exhaust, then propose" [4, 5]. According to this methodology, one should deal with a problem by, firstly, trying to exhaust all the existing theoretical resources, and, secondly, making radical theoretical revisions (the second step is made only in case of the failure of the first one). The exhaust/propose approach is somewhat straightforward as it is present even in the radical realist camp.[3]

[1] There are no instantiated phenomenal properties.

[2] Major theoretical revision would be some metaphysical modification of physicalism to accommodate phenomenal consciousness, e.g. panpsychism, where consciousness is a fundamental property of matter.

[3] Those who are already making radical theoretical revisions and are modifying the existing metaphysics in a nonphysical way

Nevertheless, according to strong illusionism, the fact that phenomenality (as standardly characterized) is anomalous and since physicalists (realists about phenomenal states)[4] have a problem explaining phenomenal consciousness, illusionism lends itself as a good radical explanation of phenomenality. To preserve physicalism, it must explain phenomenal states as illusory [3, 5].[5] One of the best course of action in dealing with anomalous phenomena is to declare them illusions, especially if one has good reasons to stay committed to the current explanatory framework provided by physical sciences. This way illusionists do not banish consciousness but modify it to fit the physicalist world. On their view, conscious states do not possess real phenomenality but merely, the so-called, quasi-phenomenality [5]. These quasi-phenomenal properties are functional properties of brain states. We get tricked by consciousness[6] as our introspective self-representation mischaracterizes the physical/functional properties as phenomenal. There really are no phenomenal properties instantiated in our mental states, we only wrongly think that the essential characteristic of consciousness is 'what it's like'. The research project for illusionism is, therefore, to explain and identify mechanisms that are responsible for phenomenal misattribution.

As far as the hard problem is concerned, its position is obvious and very straightforward: there is no such problem because there is no true phenomenality.[7] The next step is to explain why then we are prone to phenomenal judgements,[8] why we think that we are phenomenally conscious, and why the illusion of phenomenality is so powerful. There are already several theories that deal with the questions at hand: some identify the underlying firmware of our introspection as a candidate for the misattribution [8, 9, 14], some find the perpetrator in the flawed inferential mechanism [10], and some combine the misaligned introspective mechanism with philosophical prejudices [4] in order to account for the misattribution. Still, what we are concerned with in this paper is not an answer to the question of why the illusion of phenomenality arises but with identifying a mistake in the sheer concept of illusionism. Because the incoherence in conception can be a source for the incoherence in perception, what is called the meta-illusion problem [13], we will analyze the initial establishing conditions of illusionism.

3. INCOHERENCE OF ILLUSIONISM

Illusionism sees phenomenality in general to be incompatible with physicalism and, therefore, turns it into quasi-phenomenality that is supposed to align with physicalism. In what follows, we are not going to argue for such functional transformation of phenomenal properties but are going to show that illusionism is built on false initial assumptions. We will introduce the central thesis (T) of our argument first and then work backwards to construct it.

T*: To be justified in denying phenomenality, one must accept the claim that phenomenality exists.*

It is a puzzling situation for illusionism as the following question nicely shows: If there really are no such things as phenomenal states how do we know that they are incompatible with physicalist metaphysics? One of the essential characteristics of phenomenal consciousness is that we must have the first-person perspective 'what it's like' experiences to know that they have a phenomenal character. There is no other way to know what something is phenomenally like but to have a private subjective experience of it. And this is exactly the feature of phenomenality that threatens to reject physicalism once and for all. The famous Knowledge argument [11, 12] is one strong example of how to dismiss physicalism on the 'what it's like' ground. Phenomenal states have a devastating characteristic from the physicalist/illusionist point of view: they are by their nature the first-person perspective states. No amount of careful speculation and imagination can reveal what they are like. This characteristic is what makes them anomalous and it is what gives such a striking power to the hard problem of consciousness. We get to know what phenomenal states are by having 'what it's like' subjective experience of them, and illusionists are no exception. Yet, someone might say that our objection does not affect illusionism since they deny the existence of the phenomenal character of experiences, i.e. there is no 'quale' involved in no matter what mental states. It is clear why illusionists have to refuse it, but the question is how can they dismiss something, i.e. 'what it's like', without experiencing it? Given the nature of phenomenal states, they cannot. And does not then having the subjective qualitative experience mean that something like phenomenality must exist before it is denied? Given the nature of phenomenal states, it must. We call this the pre-illusion problem. Let us now recapitulate the story of how someone becomes an illusionist. First, she has something like phenomenal experience whose nature is, in the light of physicalism, anomalous, which generates the hard problem. Second, since she wants to keep the theoretical advantages of the physicalist explanatory repertoire, the only natural thing to do seems to reject the existence of phenomenality and to become the illusionist. But to deny phenomenality illusionists must have the first-person perspective experience of it, they must be subjectively acquainted with it. How else would they know that phenomenality is anomalous? Illusionists cannot say that phenomenal states are not revealed through phenomenal experience, or that they are not tied to the first-person perspective experience since the elimination of their supposed properties undermines the case for strong illusionism: if phenomenal states do not have these characteristics then they are not anomalous and the motivation for illusionism is lost. But what is in the first place that is anomalous? It seems that to conceptualize the anomalous nature of phenomenal experience one must first have it: we cannot conceptualize the phenomenal character of mental states in any other way, and this is exactly what makes phenomenality anomalous. Moreover, why would physicalists deny the existence of phenomenality if it did not have the problematic 'what it's like properties' that makes it anomalous? It turns out that

simply follow the described methodology: physicalism is exhausted so bring out some new, i.e. nonphysical, explanation of phenomenality.

[4] E.g. phenomenal concepts strategy

[5] The analogy drawn here is the one with paranormal powers, such as telekinesis. The phenomenon of telekinesis is anomalous to our scientific understanding of the world; thus, we can modify the naturalistic framework to accommodate telekinesis or we explain it away as an illusion.

[6] Consciousness can be understood in functionalist terms, e.g. access consciousness, where a mental state is not qualitatively present to the organism, but it is generally available to it.

[7] In other words, phenomenal consciousness does not need to be explained since it does not exist, i.e. there is no phenomenal consciousness instantiated in our world. This is the so-called meta-approach (denying or questioning the hard problem) to the explanation of consciousness within the physicalist framework.

[8] Chalmers calls them phenomenal reports [2].

strong illusionism is left with the catch-22 situation:[9] on the one hand it refuses the existence of phenomenal states, but on the other hand it accepts it to be justified in denying them. However, we are not justified to reject something that exists, therefore strong illusionism, as it is set up now, is not a well-founded theory.

4. CONCLUSION

We introduced the pre-illusion problem as a real threat to the truth of illusionism because it prevents it from being established in the first place. It shows that the argumentation leading to a creation of illusionism is flawed: to know that phenomenal properties are anomalous requires to be subjectively familiar with them, i.e. to experience their 'what it's like' from the first-person perspective, a condition that is not met by illusionism. The very anomalous nature of phenomenal properties, the one that is incompatible with physicalism, is not a reflective by-product of our metaphysical imagination but something that we experience. Illusionism can be seen as a good dialectical position; it recognizes the metaphysical allure of phenomenality and tries to save physicalism by turning the phenomenal nature of mental states into the functional one. Unfortunately, it seems that to get to know the anomalous nature of phenomenal properties we must undergo qualitative private experiences, which renders a denial of phenomenality by illusionists impossible. This means trouble, so the pre-illusion problem must be solved if they want their theory to be plausibly established at all.

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[9] Catch-22 is a situation from which an individual cannot escape because of contradictory rules.

Artificial intelligence and pain: a promising future

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ABSTRACT
Artificial intelligence and cognitive computing give hope or even promise that humans with augmented abilities will empower many unanswered questions and provide unprecedented opportunities in the quest for pain management. With improved connectivity, depth and breadth of comprehensive information, phenomena are easier to understand, and it is easier to implement an improved and ethically acceptable healthcare of suffering people. This ubiquitous and everyday phenomenon of artificial intelligence could be incapacitating, however, we believe the world would be happier and more creative with this exceptionally important though at present still unmanageable friend and co-worker.

Keywords
Artificial intelligence, Cognitive computing, Ethics, Medicine, Pain, Psychology.

1. INTRODUCTION
Computers continue to empower our life and everything important influencing our world. This is reasonable as far as human beings and technology cooperate in the transformation of global understanding of changeable momentary conditions. The era of cognitive systems that are helpful in deepening human knowledge and expertise is one of the greatest opportunities humankind ever thought or dreamed possible.

The digitalised future is forcing blinkered individuals to continuously complete their idealised "selves". Consciousness is partly based on the person's processing of information from external and internal worlds transferred to the mind (internal mental life) [1]. Individuals tend toward seeking and maintaining balance (homeostasis) within their internal environment, even when faced with external changes [2; 3]. Complex sensory discriminative, affective, evaluative and cognitive processes must detect deviations of values, which need accurate regulation. The most important information for individuals is connected with their health. The human mind is able to process limited amount of information and this amount does not essentially change with time [4]. The growing amount of subjective information, including subjectively most essential healthcare-related information, overflows any person's cognitive abilities. It is estimated that it would take a qualified person 150 hours each week to read every piece of content published in their field of interest. With the help of cognitive computing, this enormous and continuously growing pool of information could potentially be mastered [5].

In reality, contemporary circumstances overtake most insufficiently informed and too conservative people: artificial intelligence is seen as taking advantage of machine-learning techniques, such as artificial neural networks and its applications for diagnostics and healthcare management decisions [6]. Academic medical research has the opportunity to implement machine learning in health care. So far, health system information still seems manageable [7]. In the future, as predicted for 2020, the footprint of professionally collected data will double every 73 days [5]. Complete health information should be accepted and perceived as the most important for modern informed individuals. They should receive and understand information, i.e. cognitively process the incoming stimuli [8-10].

2. WHERE ARE WE?
The contemporary reality reflects an unfortunate and troubling trend: the aging population is, as expected, characterised by a growing number of individuals reporting highly subjective experiences that burden them [11; 12]. Slovenian endurance and patience have become proverbial, but chronic diseases – due to their multiorgan involvement and long-lasting progression – are repeatedly and prevalently incapacitating, which renders them subject to frequent complaints. The perceived inconsistency is associated with comprehensive peculiarity of pain [13-15].

3. PAIN
Current understanding of pain as a comprehensive multidimensional phenomenon goes beyond its important and generally accepted Merskey's, Melzack's and Wall's definitions [16-18]. Pain itself is a body's protective mechanism; a response could be partly defensive, but harmful stimuli are potentially dangerous and could seriously affects patients' normal lives [7]. This most ubiquitous somatosensation, multidimensional and multifunctional phenomenon, is undervalued, in spite of its importance and prevalence [11]. The unpleasant and burdened comprehensive process limits the functional status of pain-afflicted subjects and adversely influences their quality of life. Pain is also costly to society and increases healthcare costs. It has been discussed but real interventional plans have never been addressed. In general, societies, governments and funding agencies are insufficiently interested in providing money for enough research, teachers and professionals. If they were, they could be informed on the one hand by the published information and on the other hand by statistics. The management of pain requires more health care resources than the treatment of diabetes, heart diseases and cancer combined [19]. The comparison of health care costs of people who report pain, and those who do not report pain, discloses important distinctions between the two groups in terms of controlling health needs, demographic characteristics and socioeconomic status [20].

4. WHAT ABOUT PAIN?
For now, it is impossible to get away with the quest of pain. Helping people to live better with pain may be achievable. This conviction motivates "real" pain professionals that know and understand this multifaceted and unpleasant condition. Experience is either direct (own) or indirect (emphatic). The leading

inspiration and *condition sine qua non* (an indispensable condition) is the belief that pain is manageable. The accomplished fact has to be emphasised: diminution of the impact of pain stays, falls or persists on the enthusiasm, eagerness for knowledge and immense motivation of exceptional individuals and their exceptional co-workers.

5. PAIN MEDICINE AND ARTIFICIAL INTELLIGENCE

The incorporation of artificial intelligence and machine learning into the field of pain medicine is, from the clinical point of view, entirely a matter of the future, but at the same time a real-time availability. Clinical decision is one of the cornerstones of pain-puzzle and a computerised support system with cognitive computing could potentially be very useful in objectively impacting the field of health care.

The era of cognitive computerised health care, especially pain care, will bring together individualised professional research and transdisciplinary data from a diverse range of healthcare sources to redefine a path to personalized, transparent, integrated, transdisciplinary and high-quality care [21-23]. Artificial intelligence uses different data, classical unstructured and recent structured data. They fall into two major categories, i.e. machine learning techniques and natural language processing methods [24-26]. Machine learning techniques analyse structured data such as imaging, genetic and electrophysiological data. Natural language processing methods extract information from clinical notes, medical journals and books, proceedings, etc. and turn them into analysable and machine-readable structured data [27, 28]. Artificial intelligence techniques efficiently assist motivated pain professionals with raised awareness, who are motivated by clinical problems, their prediction and recognition, management, outcome prediction and prognosis evaluation.

Despite the increasingly rich artificial intelligence and the literature on healthcare, the published research mainly concentrates around a few disease types: diabetes, cancer, some nervous system diseases, cardiovascular disease and rarely pain [29-36]. In the foreseeable future, personalized healthcare and advanced personalized medicine will focus on the diagnosis, prognosis, and treatment of individuals. More sophisticated diagnostic and therapeutic health devices will be used to gather data and successfully manage the involved subjects.

6. WHERE ARE WE GOING?

In the foreseeable future sophisticated algorithms will "learn" features from a large volume of data and then use the obtained insights to assist clinical practice. The disciplines concerned with pain as unsolved problem are medicine, psychology, information and bio-technical disciplines. Some researchers hope that patterns of somatic activity might one day serve as a "link" to pain response, although exclusively biological data are far from being a comprehensive solution and comprehensive management of such a disturbed and changeable multidimensional phenomenon.

7. OUR INTENTION

Our great and extraordinary opportunity is the contribution of "pain psychologists" in the development of successful systemic human–computer interaction. We are building a network of intra–, inter–, cross–, multi– and transdisciplinary interactions with the help of contemporary technology that gives us the freedom to go everywhere and be at the same time part of the research group that is based on human–human interactions.

The goal of our transdisciplinary and "multidimensional" professional research group is to provide a set of data we have access to (our patients), and to indicate our decision-making path.

Aspects that should be inscribed as data are psychological, biological, sociological, etc. The currently available data on pain are anamnesis/history, psychological, algological and neurological examination, functional examination (e.g. psychophysical, electrophysiological, morphological examination), immunological examination, appropriate psychological tests, questionnaires and a battery of tests. These data are unstructured and structured.

Additionally, we will define a minimal set of data needed to select a successful diagnostic tool and explain the path to obtain diagnosis from the available data.

This should be the basis for next steps needed.

We have to get access to and the ability to handle ever larger data sets (bigger data sources) and an artificial intelligence system capable to run on our dataset. Then, with access to bigger data sets, we can start implementing an artificial intelligence system to become a valuable help to pain patients, their families, social networks and societies.

8. FINAL REMARKS

Last but not least (for us even most important): ethical issues [37-41]. The digital revolution is needed to address the broader ethical and societal concerns of new technologies. These high-priority areas need specific ethical guidance. Computerised health system is developing and subsequently, changing healthcare and people living inside or at the border zone of health and life.

We are absolutely convinced that living and working for people who suffer is worth it.

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BiOpenBank information systems and its integration into the analysis of genetic predispositions in psychiatric disorders

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ABSTRACT
In this paper, we describe BiOpenBank, an open source information system devoted to the management of small biobanks. We describe its implementation, technologies that were used in the process of its development and its compatibility with recent standards, regulations and good practices, which present the state of the art in the field of biobanking as well as on the wider field of data management. We demonstrate the integration of BiOpenBank in the process of the analysis of genetic predispositions in psychiatric disorders.

Keywords
Biobank, data management, BIMS, GDPR, psychiatric disorders.

1. INTRODUCTION
Psychiatry is a medical specialty that has yet to establish clinically applicable biomarkers. In order to be able to provide well defined samples of patients and controls that would enable faster search for reliable, specific and sensitive biomarkers, biobanks dedicated to biological psychiatry have to be carefully planned. A more standardized approach could provide solid background for single biomarker research as well as for developing more holistic approaches oriented towards systems medicine, as psychiatric disorders are complex disorders and need to be treated as such.

The term biobank refers to a collection of biological, namely human, animal or plant, samples. Biobanks must handle different processes, such as collection, processing, storage and distribution of biological samples. Each of these must be compliant with a vast amount of requirements [1,2]. For example, storage conditions of samples need to be appropriate to maintain their integrity, access permissions need to be established and controlled, and audit trails of all the changes in the biobank need to be recorded. These requirements are defined by different standards, regulations and good practices, such as ISO 20387:2018 Standard [3], General Data Protection Regulation (GDPR) [4], Minimum Information About Biobank Data Sharing (MIABIS) [5,6], FDA 21 CFR Part 11 [7], ISBER best practices [8] and others. Imposed requirements are however hard to fulfill when data management is performed manually, i.e. without a designated biobanking information management system (BIMS). Recently, several commercially available BIMS platforms have been introduced. These present customizable solutions which are tailored to each user's demands. Moreover, their out-of-the-box compliance with the recent regulations and standards addresses all or at least most of the data protection and integrity requirements dictated either by legislature, common sense and/or good practices. The main problem of these solutions, however, is their cost, which makes them inaccessible for small, non-commercial research laboratories. Different open source BIMS solutions have already been reported recently, such as Advanced Tissues Management Application (ATiM), Baobab [9] and OpenSpecimen [10]. Even though these solutions might seem promising, they are still not fully compliant with the most recent requirements that are constantly being updated [11].

Herein, we describe our initiative to develop a comprehensive open source biobanking solution, which would be accessible to all, would be compliant with the most recent standards and regulations, and would allow straightforward customization. The described solution is a direct result of several projects which financed the collaboration within a vast interdisciplinary group of students, mentors and researchers. These projects were focused to the implementation of a general purpose BIMS in the domains of Genotyping in Alzheimer disease, research work with model organisms (mice), genetic predispositions in suicide victims, HCC biomarkers and genotyping in erythrocytosis. The group has been working on the implementation of the system from the initial specifications to its programming and testing in a laboratory environment. We describe the integration of the proposed solution in the process of the analysis of genetic predispositions in psychiatric disorders.

2. BIOBANKING STANDARDS AND REGULATIONS
Standards and regulations define the requirements that make the BIMS compliant with legislature, increase the safety and efficacy of the biobank, ensure the biobank integrity, as well as allow easier exchange of the samples and their corresponding data between different laboratories and research groups. Here, we only

briefly overview some of these standards and regulations, namely standard ISO 20387:2018 [3], GDPR [4], MIABIS 2.0 [5,6], FDA 21 CFR Part 11 [7] and ISBER best practices [8].

The International Organisation for Standardization (ISO) introduced the standard General Requirements for Biobanking ISO 20387:2018 mainly to promote the confidence in biobanking [3]. The standard aims to facilitate cooperation, fosters exchange and assist the harmonization of data and good practices among biobanks, researchers and other parties.

Harmonization of biobanks and facilitation of data exchange is also addressed by MIABIS [5,6]. MIABIS promotes the harmonization of biobanks by following the same set of Standard Operating Procedures (SOPs) and the same medical ontologies. Moreover, it defines the main biobank components and their data models, such as *Biobank*, *Sample collection* and *Study*.

GDPR is not specifically focused on the regulation of personal data within biobanks. However, biobanks operating within the European Union must comply with its requirements when handling personal data. These data can be collected only after the consent of the natural person has been acquired. Moreover, each individual has a right of the removal of consent, a right of erasure and a right to be forgotten. This means, that in the worst case, all the data belonging to this individual need to be removed from the biobank.

Part 11 of the Title 21 of the Code of Federal Regulations (FDA 21 CFR Part 11) is focused on the regulation on electronic records and their integrity [7]. One of its main requirements is that all the changes within the system should be automatically logged within the system's audit trail, which cannot be modified by anyone. Moreover, the system should implement role-privileged limited access.

Last but not least, the BIMS should follow good practices, which are defined by ISBER (International Society for Biological and Environmental Repositories) best practices [8]. These include topics, which are to some extent already addressed by other regulations and common practices.

3. IMPLEMENTATION

Biobank and BIMS requirements defined by recent standards, regulations and good practices served as a set of initial specifications of our system. These were updated with the functional requirements of the target users (collaborating laboratories). Functional requirements included the sample coding and decoding using QR codes, straightforward modularization of the user interface (principal investigator leading the study can choose among the modules, which will be present within the study), and use of the system on an arbitrary computational platform, such as personal computer, mobile phone or tablet, without any installation.

BiOpenBank was implemented as a web application running on a designated served. The system was designed according to the Model-View-Controller software architecture pattern. Laravel PHP framework was used to enhance the development process, and Laradock was used to configure the system within the docker environment. Data model was implemented within the PostgreSQL database. The source code of the BiOpenBank implementation is available at https://gitlab.com/biopenbank/biopenbank.

4. INTEGRATION OF BIOPENBANK AND ANALYIS OF GENETIC PREDISPOSITIONS IN PSYCHIATRIC DISORDERS

In order to perform reliable and reproducible research we have to be able to produce good quality and accessibility of samples and data. The problem of irreproducibility is very persistent as more than half of the errors stem from inappropriate manipulation of the samples during collection, preparation and storage of specimen [12]. There is namely an estimation that out of all preclinical studies 53.3% have errors, which means they are not reproducible. Among the most frequent errors are the ones concerning biological reagents and reference materials (36.1%), study design (27.6%), data analysis and reporting (25.5%) and laboratory protocols (10.8%) [13]. These errors could be mitigated with appropriate standardization of methods and procedures.

The search for reliable biomarkers is particularly intriguing in psychiatry, as there is currently no established laboratory testing that would aid physicians in their determination of the diagnosis, treatment protocol or monitoring of the patients [14]. For several years genetic testing has been an important research topic that might bring some specific and sensitive biomarker which could be used in clinical setting. Our most important research areas are suicidal behavior and depression, where we are looking for genetic markers.

In order to be able to standardize our procedure of sampling, storing and manipulation of the samples and data acquired during different projects in the field of psychiatric genetics, we studied standards, protocols and other published literature on the topic.

Based on the obtained information we identified the data that has to be included in the BIMS. According to MIABIS we first defined the data regarding the study, which describes the purpose of the research and designates the data and samples we are storing. Further on we defined the data we are going to collect about the study subjects, the sample handling and storage, isolated specimen, and the analyses performed.

The second step in the development of BIMS was study and preparation of the SOPs, which were prepared correspondingly to legislation and describe relevant processes in detail. They were prepared in accordance to the National Cancer Institute's Biorepositories and Biospecimen Research Branch [15], and are covering the following topics:

1. Informed consent.
2. Equipment monitoring, maintenance and repair.
3. Control of supplies used for biospecimen collection.
4. Biospecimen identification and labeling.
5. Methods for biospecimen collection and processing.
6. Sample storage and retrieval.
7. Shipping and receiving of samples.
8. Laboratory tests performed in-house including QC testing.
9. Biospecimen data collection and management.

10. Biosafety.
11. Training.
12. Security.

5. CONCLUSIONS

Safe and orderly storage of data and samples represents an important point in contemporary research. Particularly for smaller laboratories it represents an important challenge as they usually lack the resources to be able to use commercially available BIMS, while on the other hand open source BIMS are too general to enable efficient biobanking. In order to be able to participate in international projects, multicenter projects or just to be able to publish the results in established journals, the laboratories have to be able to collect, store, and manage numerous samples and their corresponding data. Development of an in-house BIMS encouraged our group to standardize the sample and data collection, storage, maintenance, and generation of SOPs which all importantly contributed to greater transparency of our work. Moreover, it improved our collaboration with clinical environment where regulations associated with biobanking are very demanding. It is expected that biobanking is going to undergo important changes in the upcoming years, which is in favor of their users, as in clinical setting only highly reproducible biomarkers can add value to the evolving fields of personalized and translational medicine.

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Comment sentiment associations with linguistic features of educational video content

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ABSTRACT

As people spend an increasing amount of time on social media, researchers are motivated to study the newly emerging communities and the interpersonal relationships within them. This study examines one such relationship, namely between the audiences of educational videos and its presenters. A dataset of sentiment-labeled comments from TEDx and TED-Ed YouTube videos was extended to include linguistic features of video content. It was revealed that the features significantly varied between animations and presentations, and in the latter case, the speakers' genders. A correlation analysis showed that sentiment depended on a number of features, where the most notable observations included associations between negative sentiment and negative emotional content, and between positive sentiment and (first person singular) personal pronouns.

Keywords

TED Talk, YouTube, comments, LIWC, sentiment analysis

1. INTRODUCTION

As social media platforms like YouTube became so prevalent in our daily lives [1], offering opportunities for interaction with wide audiences, educators and scholars are often motivated to participate with their own content [2]. The interactions on these platforms, however, are not always civil, and are frequently characterized by unwanted behavior [3]. In order to foster better online communities, recent research has focused on understanding contentious individuals and studying the effects of various design and moderation measures [4, 5]. Research has also suggested that individuals sharing content online mind the potential reactions of their audience and, motivated by not being badly perceived, adapt their behavior accordingly [6]. Little research has, however, been done on the specifics of these behavioral measures, or their effectiveness in terms of influencing the audience. A study examining vloggers, for example, found that they use a distinctive viewer-oriented speaking style, often characterized by explicit or implicit encouragements of desired behaviors (e.g. commenting, subscribing) [7]. Building upon these observations, this study, using a quantitative approach, explores potential ways for content creators to influence their audiences' behavior. By applying methods and theory previously unused in such a setting it explores associations between the language used in educational videos and the sentiments expressed in the comments, opening opportunities for future inquiries into the dynamics between individuals and large online audiences.

1.1 Lexical inquiry and word count (LIWC)

For linguistic analysis, the Linguistic Inquiry and Word Count (LIWC) program was used [8]. LIWC is a text analysis software which, using a predefined dictionary, measures the frequency of words across a variety of categories relating to grammar and psychological processes, and rates the text's manifestations of four underlying psychological dimensions - analytical thinking, authenticity, clout (expression of social status) and emotional tone. In the last two decades LIWC has become the most popular tool for automated text analysis in socio-psychological studies, as it helped illuminate how a person's choice of words reflects their mental states (for a review, see [9]). One of the most notable revelations stemming from LIWC research was the importance of function words in human social dynamics. Personal pronouns were shown to be particularly revealing as they, by conveying information about attentional focus, let us know how people relate to themselves and others, disclosing details ranging from one's social status to their emotional states.

1.2 Sentiment analysis

The research field of sentiment analysis or opinion mining aims to capture the public's feelings about various entities, be it products, people or ideas [10]. Due to the availability of a wide variety of tools and data, a significant portion of the field deals with the analysis of texts gathered from social media. The sentiment in this study was assessed with the SentiStrength [11] tool, which, using a lexical approach, identifies sentiment-related tokens and scores social web texts on a dual positive and negative scale.

1.2.1 Comment sentiment on TED YouTube videos.

The current study builds upon a dataset compiled by Veletsianos et al. [12]. The authors collected English-speaking educational YouTube videos posted on TEDx Talks and TED-Ed channels and investigated how presenter gender, video format and comment threading effect the sentiment expressed in the comments. They observed that presentations with female presenters, relative to those with male, exhibited greater polarity in positive and negative sentiment, and that animated videos were more neutral than presentations. These differences not only held for comments directed toward the video, but replies to the comments as well. The study also examined the relationship between sentiment and video topic by analyzing description and title keywords, and found that some topics exhibit more positive (e.g. beauty) and others more negative (e.g. cancer) sentiment.

2. METHOD

A modified »YouTube TED Talk Comment Sentiment Data« dataset [13] was used. The dataset contained positive (1 to 5) and negative (-1 to -5) sentiment scores of comments from 665 videos, information about whether the video was an animation or a presentation, and in the latter case, the information about presenter's gender. In this study, the dataset was extended to include LIWC scores of video subtitles. The subtitles were assessed using the LIWC2015 dictionary, scoring each subtitle track across 93 linguistic categories. As not every subtitle track featured all of the categories, occurrences where the score of a category equaled zero were ignored in the analysis.

Videos that did not have English subtitles available were excluded from the dataset (n = 57), reducing the sample size of videos and comments by 8.6% and 6.7%, respectively. Additionally, the analysis only included first-level comments representing 50% of the sample. Because comments on YouTube come in two general forms, posted directly under the video or as a reply to another comment, this study followed the interpretation that replies are directed towards other comments rather than the video itself.

Table 1: Descriptive statistics of videos and comments

Format/ gender	**Videos *n***	**Comment *n***	**Comment *n* M**	**Comment *n* SD**
Female	66	38572	584.42	782.40
Male	130	89642	689.55	1575.45
Animation	412	197385	479.09	873.51
	608	325599	535.52	1056.97

While the removal of videos minimally affected the reported differences between video formats and presenters, the exclusion of replies significantly increased both positive and negative average sentiment. The general trend that videos with female presenters exhibited greater polarity and that animations were the most neutral, however, still remained.

Table 2: Sentiment differences of comments by format and gender

Format/ gender	**Positivity**		**Negativity**	
	M	**SD**	**M**	**SD**
Female Speaker	2.16	0.98	-1.72	1.06
Male Speaker	1.96	0.95	-1.63	0.98
Animation	1.60	0.78	-1.62	0.94

Each video then received two aggregated sentiment scores by separately averaging the positive and negative sentiment of all its comments.

Table 3: Differences of aggregated sentiment scores by format and gender

Format/ gender	**Positivity M**	**Negativity SD**	**Positivity M**	**Negativity SD**
Female	2.23	0.21	-1.71	0.26
Male	2.02	0.25	-1.61	0.31
Animation	1.63	0.18	-1.58	0.27

This further increased the average positivity and negativity, reflecting the otherwise statistically insignificant trend that sentiment averages decrease as the number of comments on a video increases.

3. RESULTS

The data was tested for differences in LIWC scores between video formats and presenter gender. The Wilcoxon rank sum test revealed that the video formats significantly ($p < 0.01$) differed in 70 and genders in 26 of the 93 LIWC2015 categories. Differences in summary variables and language metrics showed that animations were more analytical and used longer words and sentences, whereas the presentations had a greater word count and exhibited more clout, authenticity and emotional tone. Similar differences could be observed between the genders, where videos with male presenters exhibited greater analytical thinking and those with female presenters more authenticity. Numerous differences in categories relating to style and content were also observed, a selection of which is shown in Table 4.

Table 4: Word category prevalence by format and gender

	Animation	**–**	**Talk**
Female	anxiety, body	*negative emotion, sadness, female referents, feeling, health*	pronouns, 1^{st} person singular, regular verbs, conjunctions, negations, *affect, certainty*
–	prepositions, adjectives, comparatives, *death, anger, seeing, sexuality, ingesting, relativity, space, religion, friends, swearing*	3^{rd} person, *tentativeness, differentiation, assent, home*	1^{st} person plural, 2^{nd} person, auxiliary verbs, adverbs, interrogatives, *positive emotion, social processes, insight, discrepancies, hearing, time orientation, drives, motion, work*
Male	articles, quantifiers, numbers	*money*	*informal speech, leisure*

Note. Content categories are presented in italic

Across the five (sub)samples, correlating positive and negative aggregated sentiments with LIWC scores revealed 302 significant ($p < 0.05$) correlations, of which 83 were stronger than $|r| = 0.3$. Because the correlations covered a large majority of the LIWC2015 categories, only the categories exhibiting correlations above $|r| = 0.3$ in at least two sentiment-sample pairings are reported in Table 5. In the sample containing all videos, correlations with three out of four summary variables could be observed. Positive sentiment was positively associated with authenticity and inversely with analytic thinking, while emotional tone positively correlated with both positive and negative sentiment (note that negative sentiment was represented by a value between -1 and -5). The association between emotional tone and negative sentiment, however, remained in all samples. Significant correlations with language metrics could also be observed. The percentage of words longer than six letters exhibited a general inverse correlation with negative sentiment, and in the case of videos with female speakers, positive sentiment as well.

was related more to content whereas positive sentiment to style and grammar, especially (first person singular) personal pronouns.

Table 5: Correlations between aggregated sentiments and LIWC categories

		Positive sentiment					Negative sentiment				
		All videos	Presentations			Animated videos	All videos	Presentations			Animated videos
	LIWC categories		All	Male	Female			All	Male	Female	
Summary variables	**Analytic thinking**	-.62***	-.24***	-.08	-.33**	-.08	.06	-.19**	-.23**	-.24*	.08
	Authenticity	.28***	.31***	.16	.45***	-.12*	.04	.01	.05	.06	.11*
	Tone	.27***	-.06	-.05	.02	.09	.28***	.44***	.40***	.49***	.30***
Language metrics	**Words >6 letters**	-.40***	-.17*	-.05	-.42***	.05	-.14***	-.23**	-.22*	-.30*	-.24***
	Dictionary words	.56***	.37***	.29**	.36**	.00	-.13**	.06	.09	.14	-.14**
Style and grammar	**Function words**	.57***	.32***	.20*	.35**	-.05	-.00	.16*	.15	.35**	.07
	Total pronouns	.66***	.34***	.20*	.44***	.11*	-.05	.16*	.16	.34**	-.01
	Personal pronouns	.67***	.45***	.29***	.56***	.12*	-.07	.11	.13	.24	-.06
	1st person singular	.63***	.40***	.19*	.60***	.23*	-.09	-.01	.04	.04	-.04
	Articles	-.46***	-.28***	-.09	-.40***	-.10	.15***	-.04	-.13	.01	.18***
	Regular verbs	.55***	.16*	-.02	.36**	.00	-.00	.19**	.22*	.25*	.05
	Quantifiers	-.23***	-.31***	-.17	-.42***	-.03	.15***	.02	-.01	-.06	.17***
Content	**Affect words**	.34***	.18*	.11	.18	.24***	-.39***	-.17*	-.10	-.30*	-.47***
	Negative emotion	.10*	.21**	.16	.12	.14**	-.53***	-.44***	-.35***	-.61***	-.58***
	Anger	-.08	.029	.07	-.01	.08	-.28***	-.19*	-.17	-.35**	-.35***
	Sadness	.06	.20**	.15	.16	.15*	-.36***	-.42***	-.29**	-.66***	-.36***
	Biological processes	-.04	.16*	.14	-.01	.04	-.20***	-.33***	-.33***	-.27*	-.19***
	Health	-.03	.15*	.17	-.03	-.05	-.34***	-.36***	-.37***	-.31*	-.35***
	Past focus	.35***	.31***	.23**	.41***	.05	-.07	-.05	-.06	.05	-.03
	Death	-.25***	.01	.07	.11	-.08	-.19***	-.44***	-.53***	-.22	-.18**

Note. For visualization purposes, the significant correlations are colored with a grey-to-black gradient, representing their strength.
*p<0.05, **p<0.01, ***p<0.001

The presentation subsamples also exhibited correlations between positive sentiment and the percentage of words caught by the dictionary. Regarding style and grammar, positive sentiment was associated with function words, particularly (first person singular) personal pronouns. In the female presenter subsample, associations with positive sentiment were observed between regular verbs, quantifiers and articles, while negative sentiment positively correlated with the percentages of function words, pronouns and verbs. Contentwise, a majority of significant correlations was with negative sentiment, most of which were inverse and related to negative affective processes like anger and sadness, or concerns like health and death. Positive sentiment exhibited fewer and weaker content related associations, except in the case of presentations expressing a greater focus on the past.

4. DISCUSSION AND CONCLUSIONS

An important caveat before delving into interpretations is that the videos included in this study had different audiences. In fact, more than 90% of commenters only commented on one or two videos, as different topics and formats invite different profiles of people. While this does not change the overall experience for the comment reader, it should be noted that the results would likely differ with a constant or randomized audience.

Nevertheless, the analysis returned some interesting results. A general pattern was observed, showing that negative sentiment

The association with content is not that surprising as it can at least partially be attributed to video topic, as has been reported in the original study. Additionally, the emotion tokens SentiStrength and LIWC used for analysis overlap to some degree. This explanation also holds for the association with emotional tone, as it merely combines the words from emotion categories.

From a socio-psychological perspective the association between positive sentiment and style is more intriguing. While the importance of function words in human social dynamics is well documented, it has so far been limited to studies of smaller groups of people, like couples or teams [14]. This is the first time that a reaction of a larger audience has been associated with a speaker's pronoun use. What this observation means in terms of social psychology is less clear. It should be noted that sentiment, as it was assessed here, is a theoretically unsound construct and a particularly crude measure of emotion (for a critique, see [15]). It only measures emotion on a dual positive/negative scale, and does not differentiate between the nuances of human emotional experience and expression. For example, on a video discussing suicide, a comment personally attacking the speaker might receive the same sentiment score as one where the commenter shares their experience with depression. The motivations for these behaviors are vastly different, as are the readers' reactions. For this reason, one should be careful when interpreting sentiment and take into account the variety of factors contributing to its manifestation.

These limitations considered, the observed associations still encompass some psycholinguistic information about speaker-audience interaction, and call for a deeper inquiry into the topic.

A question that still remains is why the sentiments were differently associated with content and style in the first place. The observation may reveal information about the social aspects of emotion processing. If we only focus on the clearest examples, negative emotion and first person singular, a general explanation could be that the former evokes more sympathy whereas the latter, which entails more self-focus, evokes cheer.

Results also suggest a relationship between sentiment and language metrics, specifically the percentages of words longer than six letters and that of words caught by the dictionary. As the dictionary encompasses some 6000 words and stems in common use, this observation might indicate a relation to the simplicity or commonality of language used in the video. This could be interpreted in a way that people prefer simpler language, or that the use of more complex language encourages more sentiment-neutral conversation.

Lastly, the results shed light on the originally reported gender and format differences in sentiment. The groups varied in content and style, which might entail that some of the primarily observed discrepancies were due to the differences in topics the content makers chose, or the ways in which they were expressed. This considered, this explanation likely accounts only for a portion of the difference as there was still notable variation in correlation strengths between the samples, with the female subsample exhibiting the strongest correlations in most categories. For example, in the female subsample, but not the other two, positive sentiment exhibited an inverse correlation with articles and quantifiers. While this could still be due to the chosen topics, or some other confounding factor, another explanation for the phenomenon may lay in the fact that these words are mostly used in conjunction with concrete nouns, indicating a relation to concreteness or abstractness of a presentation. Why this relation would be only specific to female presenters, remains an open question.

Taken together, this study was mostly exploratory in nature, providing more avenues for research than solid findings. In order to thoroughly answer the questions emerged, future research should use more sound measures of behavior and mental states, as well as look into different communities and platforms where similar interpersonal interactions take place.

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Primerjava kognitivnih sposobnosti igralcev akcijskih videoiger in neigralcev videoiger

Comparison of cognitive skills between action video game players and non-gamers

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IZVLEČEK

V raziskavi na slovenskem vzorcu preverjamo povezavo med igranjem akcijskih videoiger (AVI) in sposobnostjo mentalne rotacije, sledenja več objektom in preklapljanja med nalogami. Rezultati so pokazali, da je igranje AVI pomemben napovednik sposobnosti mentalne rotacije in krajših reakcijskih časov pri nalogi preklapljanja. Čeprav so igralci AVI hitreje preklapljali med nalogami pri vseh pogojih, pa se skupini nista razlikovali v stroških preklapljanja, ki so glavni pokazatelj kognitivne fleksibilnosti. Povezava z obsegom pozornosti ni bila jasna, statistično pomembne razlike med igralci in neigralci so bile opazne po izključitvi enega izstopajočega udeleženca. Rezultati nakazujejo, da je igranje AVI pozitivno povezano z določenimi kognitivnimi sposobnostmi, vendar zahtevajo nadaljnje presečne in eksperimentalne študije, ki bi dale več informacij o vzrokih in mehanizmih izboljšanja sposobnosti.

Ključne besede

Akcijske videoigre, prostorska sposobnost, mentalna rotacija, obseg pozornosti, preklapljanje med nalogami

ABSTRACT

Our research examines the connection between playing action video games (AVG) and the ability to mentally rotate objects, track multiple objects, and switch between tasks. The results show that playing AVG is an important predictor of mental rotation ability and faster reaction times in task switching. Even though AVG players switched between tasks more quickly than non-gamers in all conditions, the groups did not differ in the switching cost, which is a major indicator of cognitive flexibility. The effect on attention span was not as clear; statistically significant differences between action gamers and non-gamers were noticeable after excluding one participant. The results indicate that playing AVG can have positive effects on certain cognitive functions, but require further cross-sectional and experimental studies to provide more information on the causes and mechanisms of cognitive abilities improvement.

Keywords

Action video games, spatial ability, mental rotation, attention span, task switching

1. UVOD

Videoigre so dandanes povsod med nami, napovedi pa kažejo, da bodo v prihodnosti vse bolj razširjene. Najbolj popularna zvrst je akcijska, ki je tudi najbolj zanimiva z vidika kognitivne psihologije. Raziskovanje, kako igranje lahko vpliva oziroma, ali je povezano s kognicijo, je v porastu, kljub temu pa v Sloveniji to še ni raziskano področje. Čeprav so bile AVI primarno izdelane za zabavo in prosti čas, vse večje število raziskav kaže, da ima igranje te zvrsti pozitiven učinek na širok spekter zaznavnih in kognitivnih sposobnosti. Dve nedavni metaanalizi [1, 6] kažeta, da se igranje AVI povezuje s prostorsko kognicijo, pozornostjo, vodeno od zgoraj navzdol, izvršilnimi funkcijami in verbalno kognicijo. Obstaja tudi empirična podpora za vzročne učinke na področju prostorske kognicije in pozornosti. Kljub temu povezave med igranjem in kognitivnimi sposobnostmi še niso dobro raziskane; vzorci v raziskavah so pogosto majhni, definicija akcijske zvrsti pa nenatančna, zaradi česar prihaja do neprimernega uvrščanja nekaterih igralcev v skupino akcijskih. Prav tako omenjeni metaanalizi poročata o različnih velikostih učinkov, zato so za zanesljivejše zaključke potrebne dodatne študije, ki bi se izognile omenjenim pomanjkljivostim.

V ta namen smo razvili spletno računalniško testiranje, ki je vsebovalo tri kognitivne teste. Osredotočili smo se na sposobnost mentalne rotacije, ki je del prostorskih sposobnosti, obseg pozornosti in sposobnost preklapljanja med nalogami, ki je del izvršilnih funkcij.

2. METODOLOGIJA

2.1. Udeleženci

Vzorčenje je bilo neslučajnostno, saj smo načrtno iskali igralce in neigralce videoiger. Sodelovalo je 452 posameznikov, vendar nekateri niso zaključili meritev ali niso ustrezali kriterijem. Končni vzorec je vključeval 163 udeležencev (starih 18–37 let), od tega 82 igralcev (70 moških, 12 žensk) in 81 neigralcev (37 moških, 44 žensk).

2.2. Pripomočki

2.2.1. Vprašalnik o igranju videoiger

Za razvrstitev v skupino igralcev in neigralcev smo uporabili vprašalnik o igranju videoiger.[1] Udeleženec je za dva časovna sklopa (v preteklem letu in pred preteklim letom) in vsako od sedmih kategorij videoiger izpolnil, kako dober je v tej kategoriji, pogostost igranja in katere videoigre je igral. Posameznik je bil uvrščen v skupino igralcev AVI, če je v zadnjih 12 mesecih igral AVI vsaj 6 ur na teden, pri čemer drugih zvrsti ni igral pogosto. Za uvrstitev v skupino neigralcev je moral poročati, da AVI v preteklem letu ni igral, prav tako ni smel imeti veliko izkušenj z igranjem drugih zvrsti.

2.2.2. Test mentalne rotacije (MRT)

Za preverjanje sposobnosti mentalne rotacije smo uporabili test mentalne rotacije (Mental Rotations Test – MRT [7]). Sestavljen je iz dveh delov, vsak del obsega 10 nalog. Vsaka naloga je sestavljena iz osnovnega objekta na levi in štirih alternativ na desni. Posameznik mora izmed štirih možnosti izbrati dve, ki sta enaki osnovnemu objektu. Edina razlika med osnovnim objektom in pravilnim odgovorom je v zornem kotu oz. rotaciji. Pravilna odgovora sta pri vsaki nalogi samo dva. Reševanje je časovno omejeno na 6 minut (3 minute za vsak del). Maksimalno možno število točk je 40. Dve točki dodelimo za oba pravilno izbrana odgovora, 1 točko, če je izbran le en pravilen odgovor, in 0 točk, če sta izbrana pravilen in nepravilen odgovor ali le nepravilni odgovori.

2.2.3. Test sledenja več objektom (MOT)

Test sledenja več objektom (Multiple Object Tracking – MOT [8]) smo uporabili kot mero obsega vidne pozornosti. Udeleženec mora vso pozornost usmeriti v naključno premikajočih se 16 rumenih krogov. Po dveh sekundah se določeno število krogov (1–5) obarva modro in tem mora slediti. Po štirih sekundah sledenja se vsi krogi obarvajo nazaj v prvotno rumeno barvo. Nato se le enega izmed 16 krogov izpostavi in udeleženec mora odgovoriti, ali je to dražljaj, kateremu je moral slediti (modro obarvan), ali ne. Test vsebuje 6 nalog za vajo, nato sledi 45 poskusov, razdeljenih v tri sklope (vsak sklop ima 15 poskusov).

2.2.4. Test preklapljanja Switcher

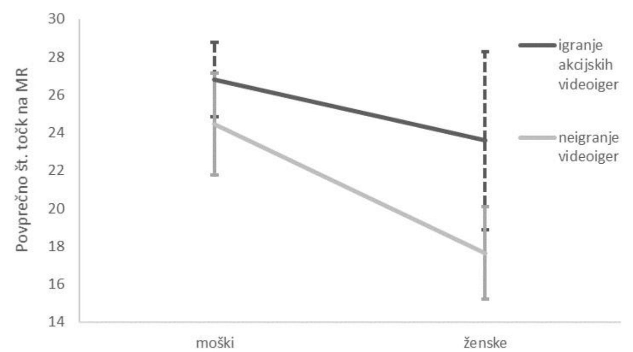
S testom preklapljanja (The PEBL Switcher Task [5]) smo merili kognitivno fleksibilnost oz. sposobnost fleksibilnega preklapljanja med nalogami z različnimi pravili. Na zaslonu je naključno razporejenih 10 dražljajev, ki se razlikujejo po barvi, obliki in črki. Na začetku vsakega preizkusa je en dražljaj obkrožen in na vrhu zaslona napisano pravilo, kateremu mora udeleženec slediti tako, da izbere naslednji ustrezni dražljaj. Tri pravila so »barva«, »oblika« in »črka«. Če je pravilo npr. »oblika«, mora udeleženec poiskati dražljaj, ki je enake oblike kot dražljaj, ki je takrat obkrožen. Test je razdeljen na tri stopnje preklapljanja; pri prvi se v enakem vrstnem redu izmenjujeta dve pravili, pri drugi se v enakem vrstnem redu izmenjujejo tri pravila, pri tretji pa se naključno izmenjujejo tri pravila. Vsaka stopnja preklapljanja vsebuje tri preizkuse z devetimi preklopi. Meril se je reakcijski čas in število napak.

2.3. Analiza podatkov

Pri testu mentalne rotacije smo podatke analizirali z dvosmerno ANOVO za neponovljene meritve, kot faktorja smo določili spol in (ne)igranje videoiger. Pri testu sledenja objektom smo rezultate analizirali z 2 (igralci/neigralci – neponovljene meritve) x 4 (dva, tri, štiri in pet objektov sledenja – ponovljene meritve) ANOVO. Opravka smo imeli z deleži od 0 do 1, vendar je bilo meritev več, vrednosti pa se niso gibale le okoli 0 ali 1 (z izjemo sledenja enemu objektu, ki je bil iz analize izločen), zato je bila uporaba ANOVE smiselna. Pri testu preklapljanja smo rezultate analizirali z 2 (igralci/neigralci – neponovljene meritve) x 3 (prva, druga, tretja stopnja preklapljanja – ponovljene meritve) ANOVO. Če je bila pri Mauchlyjevem testu stopnja nesferičnosti statistično pomembna, smo uporabili Huynh-Feldtov popravek prostostnih stopenj. Za preverjanje razlik v časih pri različnih stopnjah preklapljanja smo uporabili *t*-test za dva neodvisna vzorca, za preverjanje razlik v številu napak pa neparametrični test Mann-Whitney *U*, postopek Monte Carlo.

3. REZULTATI

Igralci (M = 26, SD = 8) so na testu mentalne rotacije v povprečju dosegli 5 točk višji rezultat od neigralcev (M = 21, SD = 9). Ta razlika je bila statistično značilna, $F(1, 158) = 6{,}86$, $p = {,}010$, η_p^2 = 0,04. Z rezultati mentalne rotacije je bil pomembno povezan spol, $F(1, 158) = 10{,}07$, $p = {,}002$, η_p^2 = 0,06, in sicer so moški dosegli višje rezultate (M = 26, SD = 8) kot ženske (M = 19, SD = 9). Interakcija med učinkom igranja AVI in spolom ni bila statistično značilna, $F(1, 158) = 1{,}30$, $p = {,}255$, $\eta_p^2 = 0{,}008$. To pomeni, da je učinek igranja AVI na sposobnost mentalne rotacije podoben pri moških in ženskah. Rezultate na testu ponazarja slika 1.



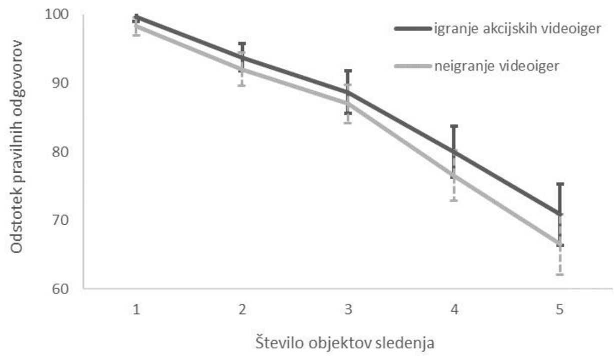
Slika 1: Povprečni dosežki s 95 % IZ na testu mentalne rotacije glede na spol in igranje videoiger

Pri testu sledenja objektom so imeli igralci v povprečju 85,1 % pravilnih odgovorov (SD = 7,5 %), neigralci pa 82,5 % (SD = 7,9 %). Razlika med skupinama igralcev in neigralcev ni bila statistično pomembna, $F(1, 126) = 3{,}37$, $p = {,}069$, $\eta_p^2 = 0{,}026$. Na rezultate je pomembno vplival učinek števila objektov sledenja, $F(2{,}63;\ 331{,}27) = 88{,}8$, $p < {,}001$, $\eta_p^2 = 0{,}413$. Več kot je bilo objektov, ki jim je moral posameznik slediti, nižji je bil povprečni delež pravilnih odgovorov. Interakcija med igranjem videoiger in številom sledenih objektov ni bila statistično pomembna, $F(2{,}63;\ 331{,}27) = 0{,}338$, $p = {,}771$, $\eta_p^2 = 0{,}003$.

En udeleženec iz skupine igralcev je zelo odstopal od povprečja svoje skupine (za –3,07 SD), zato smo ga izključili in analizo rezultatov ponovili. Pri tem je ANOVA pokazala statistično pomembno razliko med skupinama, $F(1, 125) = 4{,}80$, $p = {,}037$, η_p^2 = 0,037. Na rezultate je pomembno vplival učinek števila objektov sledenja, $F(2{,}60;\ 324{,}50) = 88{,}3$, $p < {,}001$, $\eta_p^2 = 0{,}414$. Interakcija med igranjem videoiger in številom sledenih objektov ni bila

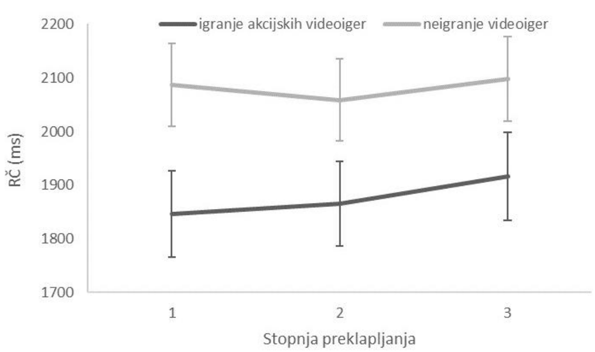
[1] Vprašalnik in kriteriji so bili prirejeni po https://osf.io/t72vp/.

statistično pomembna, $F(2,60; 324,50) = 0,395$, $p = ,728$, $\eta_p^2 = 0,003$ (glej sliko 2).



Slika 2: Povprečni odstotki pravilnih odgovorov igralcev in neigralcev s 95 % IZ pri 1–5 objektih sledenja

Iz slike 3 je razvidno, da so imeli igralci pri testu preklapljanja v vseh pogojih naloge krajše reakcijske čase od neigralcev. Razlika med skupinama je bila statistično pomembna, $F(1, 141) = 15,679$, $p < ,001$, $\eta_p^2 = 0,10$. Na hitrost reagiranja je pomembno vplivala tudi stopnja preklapljanja, $F(2, 282) = 3,230$, $p = ,042$, $\eta_p^2 = 0,022$. Reakcijski časi so v povprečju naraščali s stopnjami preklapljanja. Najboljši pokazatelj kognitivne fleksibilnosti pa je primerjava različnih stopenj preklapljanja, ki nam poda informacijo o stroških preklapljanja. Interakcija med igranjem videoiger in stopnjami preklapljanja ni bila statistično značilna, $F(2, 282) = 1,240$, $p = ,291$, $\eta_p^2 = 0,009$, kar pomeni, da je bil učinek igranja videoiger podoben pri vseh stopnjah preklapljanja. Igralci in neigralci se niso statistično pomembno razlikovali v stroških preklapljanja. Razlika v reševanju nalog s kompleksnejšimi preklopi in manj kompleksnimi preklopi je bila v obeh skupinah podobna. Pri primerjavi razlik v reakcijskih časih preklapljanja med tremi in dvema praviloma v konsistentnem zaporedju (2. in 1. stopnja preklapljanja) se igralci in neigralci niso pomembno razlikovali, $t(141) = 1,19$, $p = ,237$, enako je pokazala primerjava razlik v reakcijskih časih naključnega in konsistentnega preklapljanja med tremi pravili (3. in 2. stopnja preklapljanja), $t(142) = 0,298$, $p = ,766$.



Slika 3: Povprečni reakcijski časi igralcev in neigralcev s 95 % IZ pri treh različnih stopnjah preklapljanja

Kljub temu, da so bili igralci pri vseh pogojih testa preklapljanja hitrejši, pa pri tem niso naredili pomembno več napak (glej tabelo 1).

Tabela 1: Rezultati Mann-Whitneyjevega *U* testa razlik v povprečnem številu napak pri testu Switcher

	Igralci *M* (*SD*)	Neigralci *M* (*SD*)	*U*	*z*	*p*
1. stopnja preklapljanja	0,4 (1,0)	0,5 (1,3)	2584,5	–0,018	,984
2. stopnja preklapljanja	0,5 (1,1)	0,4 (0,9)	2586,0	–0,008	,997
3. stopnja preklapljanja	0,6 (1,1)	0,4 (0,9)	2536,5	–0,262	,787

4. RAZPRAVA

Tako igralci kot igralke AVI so izkazali boljše sposobnosti mentalne rotacije od neigralcev in neigralk. Velikost učinka je bila sicer majhna (in manjša od velikosti učinka spola), vendar statistično pomembna. Sklepamo lahko, da je igranje AVI povezano z višjimi prostorskimi sposobnostmi, natančneje mentalno rotacijo, kar je skladno s predhodnimi ugotovitvami raziskav, vendar pa sta dve nedavni metaanalizi [1, 6] pokazali večje velikosti učinka. Razlog za to bi lahko iskali v tem, da smo mi raziskovali specifično sposobnost mentalne rotacije, metaanalizi pa sta vključevali splošne prostorske sposobnosti, od katerih je mentalna rotacija le del. Uporabljena različica naloge mentalne rotacije je bila časovno omejena, kar bi lahko vplivalo na rezultate. Časovni pritisk je zagotovo dodaten stresni dejavnik pri reševanju nalog in ljudje se nanj različno odzovemo. Igranje AVI pogosto poteka pod časovnim pritiskom, prav tako pa raziskave kažejo, da se igranje povezuje s hitrostjo procesiranja in krajšimi reakcijskimi časi [2], kar bi lahko vplivalo na rezultate. Zanimivo bi bilo primerjati razlike med igralci in neigralci pri časovno omejenem in neomejenem testu mentalne rotacije.

Test sledenja več objektom je mera obsega pozornosti. Predhodne raziskave [3, 8] kažejo, da z višanjem števila objektov sledenja pada povprečni delež pravilnih odgovorov, kar se je pokazalo tudi na našem vzorcu. Razlike med igralci in neigralci pri tem testu niso bile tako očitne. Statistično pomembne razlike so se pokazale po izločitvi enega udeleženca. Kaže se torej trend, da imajo igralci širši obseg pozornosti, ne moremo pa zanesljivo zaključiti, ali je razlika med skupinama večja, kot bi jo pričakovali po naključju. Takšni rezultati niso popolnoma v skladu s predhodnimi izsledki, ki kažejo, da je pozornost najbolj dosledno povezana z igranjem AVI [1, 6]. Razlog bi lahko bil v velikosti vzorca, ki je bil pri nas večji kot pri večini drugih raziskav. Prav tako bi bil lahko kriv tudi sam test – čeprav so pri enakem testu raziskovalci [3] ugotovili največje razlike med igralci in neigralci pri sledenju štirim in petim objektom, bi bilo v prihodnje dobro vključiti tudi sledenje šestim in sedmim objektom in izključiti sledenje le enemu objektu, kjer je viden učinek stropa. Tekom reševanja testa sledenja objektom se je pri nekaterih udeležencih pojavila težava, da so se njihovi dražljaji premikali prehitro v odvisnosti od hitrosti osveževanja monitorja. Zaradi tega smo morali izločiti 11 igralcev. Predpostavljamo, da so le-ti imeli zelo dobre monitorje, ravno posamezniki z dobrimi boljšimi monitorji pa so verjetno pogosti in kompetentni igralci videoiger, zato je možno, da bi bili rezultati drugačni, če bi bili vključeni tudi ti igralci.

Rezultati testa Switcher so pokazali statistično pomembne razlike med skupinama igralcev in neigralcev v reakcijskih časih pri vseh treh stopnjah preklapljanja. Velikost učinka je bila srednja do visoka, igralci so bili hitrejši tako pri predvidljivem preklapljanju med dvema in tremi pravili kot tudi pri naključnem preklapljanju. Čeprav so vse naloge reševali hitreje, pa pri tem niso naredili pomembno več napak kot neigralci. Takšni rezultati so skladni s prejšnjimi ugotovitvami o reakcijskih časih igralcev AVI [2], ki kažejo, da so igralci hitrejši, natančnost pa je v obeh skupinah primerljiva. To pomeni, da igralci na račun hitrosti ne naredijo več napak, torej ne gre za kompromis med hitrostjo in natančnostjo (angl. *speed-accuracy trade-off*). Krajši reakcijski časi igralcev kažejo na bolj razvito vidno procesiranje, pozornost in hitrejše preklapljanje med pravili ter spremembo načina reševanja, ko naloga to zahteva. Pri testu Switcher je ključna primerjava reakcijskih časov med stopnjami preklapljanja, ki poda več informacij o stroških preklapljanja kot reakcijski časi pri posameznih stopnjah preklapljanja. Igralci in neigralci se niso razlikovali v stroških preklapljanja. Število pravil (dve ali tri pravila) in (ne)predvidljivost preklopov sta na obe skupini vplivala enako. To ni skladno z drugimi korelacijskimi študijami, ki ne glede na uporabljeno paradigmo kažejo, da imajo igralci nižje stroške preklapljanja [1, 6]. Naši rezultati so bolj skladni z zaključki Karla idr. [4], ki predvidevajo, da so igralci sicer hitrejši pri preklapljanju zaradi boljšega nadzora nad selektivno pozornostjo, pri čemer pa ne gre za bolj razvite izvršilne funkcije in večjo kognitivno fleksibilnost.

Predvidevamo, da bo v prihodnosti vse manj igralcev, ki igrajo izključno AVI, hkrati pa bodo meje med različnimi zvrstmi videoiger vse manj jasne. Razvijalci v igre vključujejo priljubljene lastnosti različnih žanrov, zato ima vse več videoiger tudi nekatere lastnosti akcijskih [1]. Iz teh razlogov bi se bilo v prihodnosti bolje osredotočiti na posamezne lastnosti in kognitivne funkcije, ki jih videoigre vključujejo, in ne na specifične zvrsti. Le-te so namreč slabši indikatorji kognitivnih procesov, ki jih zahteva igranje. Na podlagi karakteristik iger, katerih igranje se povezuje z višjimi sposobnostmi, bi lahko raziskovalci tudi lažje izdelali videoigro v namene razvijanja specifičnih sposobnosti.

Za konec bi izpostavili tudi, da skupina igralcev ne vključuje izključno posameznikov, ki videoigre igrajo cele dneve oz. ki svoj čas že nekoliko nezdravo posvečajo le igranju. Zaključki, da prekomerno igranje AVI pripomore k izboljšanju kognitivnih sposobnosti, so torej napačni, in sicer iz dveh razlogov. Prvič zato, ker je bil kriterij za vključitev igranje več kot 6 ur na teden. Pri tem ne dobimo podatka o tem, kako se povezava spreminja z naraščanjem števila ur igranja. In drugič zato, ker primerjava med rednimi igralci in neigralci ne daje zaključkov o tem, ali je igranje res vzrok bolj razvitih kognitivnih sposobnosti. Morda posamezniki, ki imajo boljše kognitivne sposobnosti, igrajo več AVI, ker se v njih dobro odrežejo. Za odkrivanje, ali so AVI vzrok izboljšanja, so potrebne skrbno načrtovane in nadzorovane eksperimentalne longitudinalne študije.

5. ZAKLJUČKI

V sodobnem času veliko ljudi namenja vse več časa igranju videoiger. Posledično se kaže potreba razumeti, kako takšno početje vpliva na človeško kognicijo. Prvi korak do odgovorov je primerjava med igralci AVI in neigralci. Problem raziskave je bil ugotoviti, ali se skupini med seboj razlikujeta v obsegu pozornosti in sposobnostih mentalne rotacije in preklapljanja med nalogami. Vse to so ključne sposobnosti, ki jih uporabljamo v vsakdanjem življenju in so potrebne za uspešnost na različnih področjih. Na slovenskem vzorcu se je pokazalo, da je igranje AVI povezano s sposobnostjo mentalne rotacije in hitrostjo procesiranja vidnih informacij, medtem ko povezava z obsegom pozornosti in preklapljanjem med nalogami ni bila tako jasna. Vsekakor se kaže trend, da imajo igralci tudi ti dve sposobnosti bolje razviti, vendar so učinki majhni. Nadaljnje raziskave bi lahko razčistile vprašanja in pomanjkljivosti pričujoče študije. Poznavanje značilnosti videoiger, ki vplivajo na določene kognitivne funkcije, je ključnega pomena ne samo zato, ker so videoigre tako razširjene po celem svetu, temveč tudi zaradi potencialne uporabe v učnem in zdravstvenem kontekstu.

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Regular and irregular forms: evidence from Parkinson's and Alzheimer's disease in Slovene-speaking individuals

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ABSTRACT
According to the Declarative/Procedural Model, declarative and procedural memory play a specific role in the production of irregular and regular forms (REG: *talk-ed*, IRR: *went*, respectively). In Parkinson's disease where procedural memory is impaired, and Alzheimer's disease, where declarative memory limitations are manifested, the production of (ir)regular forms has been widely investigated leading to contradictory results. The current study reports evidence from Slovene-speaking PD and AD patients, by examining the production of (ir)regular forms in the formation of number (singular vs. plural), tense (present, past, future) and grammatical aspect (perfective vs. imperfective). Participants performed worse than the control group, but no dissociation between regular and irregular forms was observed, suggesting that declarative and procedural memory are possibly involved in linguistic process, but they might not play a crucial role in the production of (ir)regular forms.

Keywords
Parkinson's disease, Alzheimer's disease, (ir)regular morphology, Declarative/Procedural Model.

1. INTRODUCTION
Alzheimer's disease (AD) is a neurodegenerative disease characterized by impairment in temporal lobe structures [1]. Dysfunction in declarative memory (semantic and episodic), rooted in temporal lobe structures, is manifested early on the disease. Procedural memory (rooted in basal ganglia) is considered to be relatively preserved [2]. Language abilities are affected during all stages of the disease with patients having difficulties in both production and comprehension of grammatical and semantic aspects of language. Fyndanis et al. [3] report impaired tense and grammatical aspect (perfective "*played*", imperfective "I was playing") production and comprehension in Greek-speaking mild-AD patients. Roumpea et al. [4] observed similar language performance in mild-AD patients. Concerning semantic aspects of language, Kim and Thompson [5] report noun and verb naming deficits in AD. Language impairment in individuals with AD results from declarative memory (mainly semantic memory) limitations [1] and working memory impairment [6].

Parkinson's disease (PD) is a neurodegenerative disorder characterized by loss of dopamine in the basal ganglia and degeneration of subcortical frontal structures. These areas sustain procedural memory which has been found to be impaired in PD [2]. Declarative memory (temporal lobe) is considered to be preserved [2]. Macoir et al. [7] mention that individuals with PD mainly display motor system dysfunction, but language deficits are also observed (e.g. difficulties in sentence comprehension and production), while semantic features (e.g. word recognizing) remain unimpaired. Basal ganglia impairment has been assumed to affect PD patients' language abilities. More specifically, PD patients' language limitations are attributed to degraded procedural memory which is responsible for the computation of rule-based linguistic procedures.

2. LINGUISTIC BACKGROUND AND BACKGROUND RESEARCH
2.1. Regular and Irregular morphology in Slovene
Slovene is a language with rich morphology and manifests both regular and irregular forms in multiple domains, such as number (singular vs. plural), tense (present tense) and grammatical aspect (perfective vs. imperfective). Grammatical aspect conveys information about how a situation took place in time. Perfective aspect (*I walked*) presents a non-durative situation, while imperfective presents (*I was walking*) a durative situation.

The regular formation of the above categories is either by suffixation or by prefixation [8]. Suffixation is a morphological operation where a morpheme (e.g. –ed) is attached to the end of a word (stem e.g. walk) [walk + ed → walked (English past tense)]. Prefixation is a morphological operation where a morpheme (e.g. un-) is attached to the front part of a word (stem e.g. lock) (un + lock → unlock). While present tense and number are regularly formed by suffixation (delati$_{inf}$ – delam$_{1sing}$ "to work – I work", miza$_{sing}$ – miz**e**$_{pl}$ "table – tables"), in the formation of *aspect*, the corresponding perfective form of an imperfective infinitive is usually formed by prefixation (risati$_{imperf}$ – **na**risati$_{perf}$ "to draw – to finish drawing"). However, irregular forms in the formation of tense, number and grammatical aspect are also observed, such as as "iti$_{inf}$ – grem$_{1sing}$ "to go – I go", človek$_{sing}$ – ljudje$_{pl}$ "human - humans" and metati$_{imperf}$ – vreči$_{perf}$ "to throw – to finish throwing", respectively.

2.2. Background research and predictions for PD and mAD

Concerning the processes of regular and irregular forms, one of the proposed models is the Declarative/Procedural Model (D/PM) by Ullman et al. [9]. According to D/PM, the declarative memory (temporal lobe structures) stores and processes lexical information and is responsible for the production of irregular forms (go → **went**), while procedural memory (basal ganglia) processes grammatical rules, thus it is responsible for the production of regular forms (*walk* → *walk**ed***).

The process of regular and irregular forms, as suggested by the D/PM, has been widely investigated with studies leading to mixed results. Ullman et al. [9] found irregular forms of English past tense (*I taught*) to be impaired in AD individuals, but better preserved in PD, while regular forms (*I played*) were better preserved in AD individuals compared to PD. The authors claimed that degeneration of declarative memory in AD and impaired procedural memory in PD might explain these results (D/PM). The same findings and rationale are reported for PD and AD patients in Cameli et al. [10].

However, there are several studies which failed to replicate the D/PM. Macoir et al. [7] found that French-speaking PD patients' performance did not differ for regular and irregular verbs in experimental conjugation tasks. The authors suggest that basal ganglia, where procedural memory is rooted, interfere with language processing but do not play a specific role in verb production as proposed by the D/PM. Similarly, Terzi et al. [11] and Penke and Wimmer [12] report that Greek-speaking and German-speaking PD individuals showed no dissociation between regular and irregular verbs. The authors claimed that there was no evidence for a selective deficit affecting the production of regular forms, suggesting that basal ganglia and procedural memory do not play a crucial role in the production of regular forms as proposed by the D/PM.

Motivated by the above contradictory results, in the present study we investigate the production of regular and irregular forms in Slovene language in the categories of number, tense and grammatical aspect. While the production of regular and irregular forms has been examined widely in other languages (e.g. English), to our knowledge there is no evidence from Slavic languages. This study is one of the first attempts to investigate the issue of nominal and verbal (ir)regularity in Slovene. Furthermore, we will examine whether the production of Slovene regular and irregular morphology is supported by the D/PM [9].

Concerning AD, we expect that declarative memory decline will lead participants to have difficulties in producing the irregular forms of all the under examination categories (number, tense and grammatical aspect). The irregular forms are supposed to be retrieved directly from the declarative memory as they are not subject to grammatical rules. On the other hand, procedural memory impairment in PD participants might lead them to perform better in producing irregular forms of number, tense and grammatical aspect compared to regular ones. This is expected based in the fact that in order to produce regular forms application of grammatical rules is needed. Procedural memory limitations might cause difficulties in applying grammatical rules to PD. Finally, differences among the categories of number, tense and grammatical aspect might arise due to the different morphological operations (suffixation or prefixation) used in their formation.

3. METHODOLOGY

3.1 Participants

Five individuals with no neurological impairments (4 females, 1 male), 5 no-dementia PD (all males) and 6 mild-AD (henceforth mAD, all females) all native-Slovene speakers participated in this study. PD and mAD participants were recruited at the Neurological clinic of Ljubljana, all diagnosed by a qualified neurologist, while the healthy participants were recruited from an Elderly Care House in Ljubljana "Dom starejših občanov Ljubljana-Bežigrad". Participants were matched when it comes to age and years of education. The Mini Mental State Examination (MMSE) was administered to all participants to collect more information about their cognitive profile. Table 1 provides detailed information on participants' demographics as well as their scores in the neuropsychological task.

Table 1: Participants' demographic and neuropsychological information. Standard deviations are given in parentheses. T-scores, p-values and Degrees of Freedom (df) from independent samples t-tests comparing the groups are also reported.

	PD	mAD	Control Group
Mean age	77.6	82.5	73.6
Education level	13.2 (1.7)	12.8 ()	12.8 (4.3)
MMSE	27.0 (1.8)	19.5 (3.0)	28.2 (1.3)
	Statistical Comparisons		
	PD vs. mAD	**PD vs. Control group**	**mAD vs. Control Group**
Mean age	t= .943, p= .370, df= 9	t= -.618, p= .554, df= 8	t= 1.833, p= .100, df= 9
Education level	t= -.619, p= .551, df= 9	t= .189, p= .855, df= 8	t= -.218, p= .832,df= 9
MMSE	t= -4.817, p< .01, df= 9	t= 1.177, p= .273, df= 8	t= -5.960 p< .01, df= 9

3.2 Stimuli and Experimental task

Our stimuli consist of 23 verbs [11 regulars, 12 irregulars and 6 nouns (3 regulars, 3 irregulars)]. A sentence-completion task was designed and it included 29 pairs of source sentences (SS) and target sentences (TS): 6 of them designed to test number, i.e. singular vs. plural (3 regulars, 3 irregulars), 14 tested present tense (6 regulars, 8 irregulars) and 9 tested aspect (5 regulars, 4 irregulars/ 5 perfective, 4 imperfective). The SS and the TS were presented simultaneously to the participants. The SS differed from the TS only to the point that it was necessary to trigger the production of the target verb or noun forms. The sentence in (1) is an example of producing regular tense.

(1) SS: Hoditi v šolo je pomembno. (To go to school is important)
TS: Maja zdaj hodi v prvi razred. (Now, Maja is now going to the first grade).

3.3 Procedure

Power Point was used to present the experimental materials to the participants. Each pair of sentences (SS and TS) was presented separately to the participants. At the beginning of the experimental procedure, participants were provided with instructions of how to complete the task. 3 pairs of sentences that were not included in the stimuli were used as examples in order to get participants familiar with the task. Participants' responses during the trial period were not taken into account in the analysis. Participants had to complete the right form of the missing noun or verb. The task was off-line and participants had as much time as they needed in order to complete the sentence.

4. RESULTS

For the statistical analysis of the results we performed the Fisher's exact test, a non-parametric statistical test for small samples that are not normally distributed. In all statistical comparisons, participants' responses (correct and incorrect responses) were treated as the dependent variable, while the different participants' groups (PD, mAD, controls), number (singular vs. plural), grammatical aspect (perfective, imperfective) and tense (present) were treated as the independent variables.

Groups' percentages of correct responses are illustrated in Figure 1. mAD group performed lower (74% correct responses) than PD group (94.5% correct responses) and control group (98.5% correct responses), with mAD being statistically worse ($p < .01$, in all comparisons) compared to both PD and control group, while PD group performed equally well ($p = .103$).

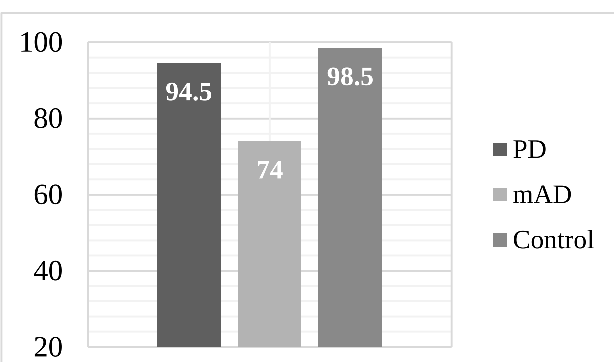

Figure 1: Performance (% correct) in the sentence-completion task of PD, mAD and control groups.

Participants' correct responses in regular and irregular forms are presented in Figure 2. No dissociation between regular and irregular verbs was observed both for individuals with mAD and PD ($p > .05$ and $p = .863$, respectively).

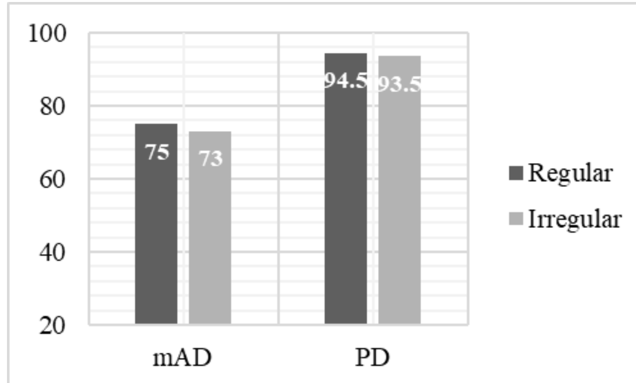

Figure 2: Individuals' with PD and mAD performance (% correct) in regular and irregular forms.

mAD performance (% correct) in regular and irregular forms with respect to number, tense and grammatical aspect is illustrated in Figure 3. No statistically significant difference between regular and irregular forms was found for number, tense and grammatical aspect ($p > .05$, in all comparisons). Concerning the performance in the different grammatical categories, the highest score was achieved for number, followed by tense and aspect, where participants performed lower. This difference reached significance, with aspect being statistically worse compared to both tense and number ($p = .039$, in all comparisons).

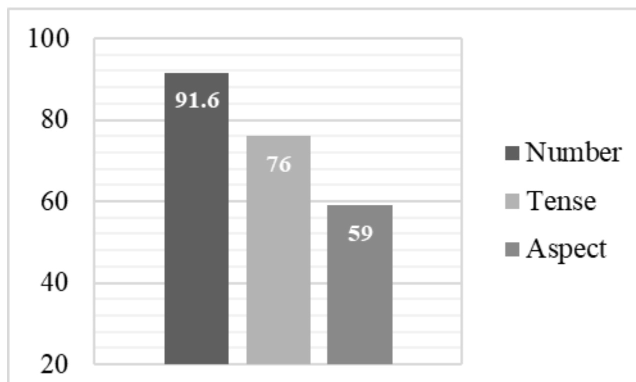

Figure 3: Individuals' with mAD performance (% correct) with respect to plural, tense and aspect.

Error analysis revealed that mAD participants had no difficulty in producing the present tense of regular (*delati*$_{inf}$ – ***delam***$_{1sing}$) and irregular verbs (iti$_{inf}$ – grem$_{1sing}$). In detail, participants were able to use correctly the appropriate suffix to form the present tense of both regular and irregular verbs. The most frequent mistake in the category of tense was the substitution of the target irregular form with a regular one of a verb that was semantically close to the target one and correctly formed [*hodim* (regular, I am walking) -> *grem* (irregular, I am going)]. Regarding aspect, in regular verbs mAD individuals tended to produce the imperfective form of the verb instead of the perfective target (**na**pisala$_{perfective}$ → pisala$_{imperfective}$). In irregular verbs participants tended either to produce the no-target aspect category (jemali$_{imperfective}$ →

vzeli$_{perfective}$) or to substitute the target verb with another irregular semantically related verb.

5. DISCUSSION

In this study we investigated the production of regular and irregular forms as they are manifested in the categories of number (singular vs. plural), tense (present tense) and grammatical aspect (perfective and imperfective). With this study, we attempt to contribute to the existing literature on the irregularity issue by bringing evidence from Slovene, where (ir)regularity is manifested in multiple domains.

Concerning the overall performance of mAD, PD and control groups, only individuals with mAD were found statistically impaired in the production of regular and irregular forms compared to both PD and control groups, while PD's group performance was equal to the control's group. Moreover, in mAD group no dissociation between regular and irregular forms was observed. The current findings do not support the D/PM, contra to studies that replicated it [10]. On the other hand, our results are in line with studies that failed to support the D/PM and suggested that declarative and procedural memory are involved in language processing but they might not play a specific role in (ir)regular forms production [7].

The lack of dissociation between regular and irregular forms in Slovene might be explained by the fact that Slovene is a morphologically rich language. In detail, contrary to English, grammatical rules are applied both to regular and irregular forms. Suffixation is applied to form the regular plural (miza$_{sing}$ – miz**e**$_{pl}$ "table – tables") and present tense (delati$_{inf}$ – dela**m**$_{1sing}$ "to work – I work"), while prefixation to form the perfective aspect (risati$_{imperf}$ – **na**risati$_{perf}$ "to draw – to finish drawing"). However, suffixation is also applied to irregular forms of number, present tense and grammatical aspect due to the fact that Slovene manifests agreement (case, person, gender etc.), thus after retrieving the irregular forms from declarative memory, speakers need also to apply grammatical rules according to agreement (see Terzi et al [11] for a similar explanation for Greek-speaking PD patients).

Regarding individuals with mAD performance in number, tense and grammatical aspect, difficulties in completing the perfective form of regular verbs, might suggest impairment in producing the aspectual prefix. Morphology of number and tense (both formed by suffixation) seems to be spared. These findings are in line with Kavé and Levy [13] who report impaired prefixation and preserved suffixation in AD. Nonetheless, aspect has been found to be impaired compared to tense, in languages that use suffixation to form it (Fyndanis et al. [3] for Greek). Thus, further research is needed to clarify whether morphological or other factors (e.g. semantics) might interfere with clinical populations' ability to produce aspect.

To sum up, the current study is one of the first attempts to investigate the issue of irregularity in Slovene. Our findings do not support the proposed D/PM [9] for the production of regular and irregular forms, suggesting that PD and mAD individuals' difficulties in regular or irregular forms are not directly connected with declarative and procedural memory limitations. Finally, due to the small sample of participants and stimuli further research is needed to come up with more accurate results regarding the issue of irregularity in Slovene.

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Dva pristopa k opredelitvi in preučevanju delovnega spomina

Two approaches to defining and studying working memory

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POVZETEK
Prispevek se osredotoča na vidno-prostorski delovni spomin in predstavlja dva odmevnejša teoretska okvirja za preučevanje delovnega spomina: Baddeleyjev in Hitchev multikomponentni model delovnega spomina in Cowanov model vpetih procesov. Opisuje, kako modela razumeta in opredeljujeta delovni spomin, njegove komponente in vključene procese ter kakšna je vloga le-teh pri omejevanju njegove kapacitete. Na koncu predstavimo, kako se komponente modelov povezujejo z možganskimi sistemi.

Ključne besede
Delovni spomin, multikomponenti model, model vpetih procesov, reprezentacije, aktivno vzdrževanje.

ABSTRACT
The paper focuses on visual-spatial working memory and presents two prominent theoretical frameworks for the study of working memory: Baddeley's and Hitch's multicomponent model of working memory and Cowan's model of embedded processes. It describes how models understand and define working memory, its components, and the processes involved, and their role in limiting its capacity. In the end we present how the components of the models relate to the brain systems.

Keywords
Working memory, multicomponent model, model of embedded processes, representations, active maintenance.

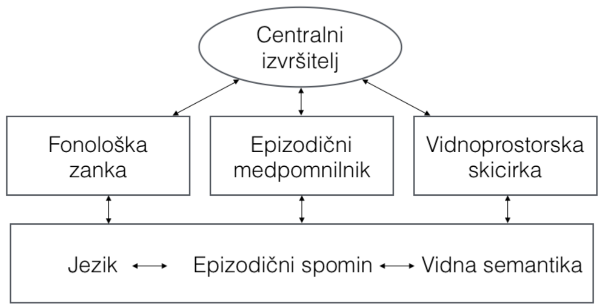
1. UVOD
Delovni spomin je sposobnost vzdrževanja in aktivnega manipuliranja z informacijami potrebnih za dosego trenutnega cilja, medtem ko se pojem kratkoročnega spomina nanaša na enostavno začasno shranjevanje informacij [1]. Delovni spomin je ena izmed temeljnih kognitivnih sposobnosti, ki omogoča opravljanje vsakodnevnih aktivnosti. Visoko korelira s splošno inteligentnostjo [2] in je pogosto oškodovan pri boleznih možganov [3], njegov upad pa je značilen tudi za zdravo staranje [4]. Zaradi njegove osrednje vloge v kogniciji je raziskovanje temeljnih mehanizmov delovnega spomina izrednega pomena za razumevanje človeške kognicije.

V preteklosti se je glavnina raziskav osredotočala na verbalni delovni spomin [5], vrsto delovnega spomina, v katerem informacije hranimo v obliki besed in zvoka. To pa ni edina oblika informacij, ki jih je potrebno hraniti pri izvedbi vsakodnevnih opravil. Pogosto se zanašamo na vidne ali prostorske informacije, ki nam omogočjo vzdrževanje podob in položajev v okolju, ko le-ti niso neposredno dostopni v našem vidnem polju.

Eno izmed ključnih raziskovalnih vprašanj pri preučevanju vidno-prostorskega delovnega spomina se nanaša na mehanizme, ki so temelj njegovi omejeni kapaciteti. Raziskave kažejo, da je v vidnem delovnem spominu v danem trenutku možno vzdrževati 3–4 enote informacij [6]. V sklopu preučevanja kapacitete so aktualne številne znanstvene diskusije, npr. ali so enote omejene kapacitete vidnega delovnega spomina reprezentacije integriranih objektov ali individualnih lastnosti [7], ali omejitve izhajajo iz modalno-specifičnih shramb ali iz omejitev v procesih pozornosti [6].

Kaj omejuje kapaciteto delovnega spomina, skušajo pojasniti številni modeli, ki so se razvili v okviru kognitivne psihologije in nevroznanstvenega preučevanja in razlagajo njegovo strukturo, vključene komponente in procese. Dva izmed odmevnejših teoretskih okvirjev za preučevanje delovnega spomina sta Baddeleyjev in Hitchev [1, 8] multikomponentni model delovnega spomina in Cowanov model vpetih procesov [2].

2. MULTIKOMPONENTNI MODEL DELOVNEGA SPOMINA
Baddeley in Hitch [8] v svojem modelu delovni spomin opisujeta kot hipotetični sistem omejene kapacitete, ki omogoča začasno shrambo in manipulacijo informacij, potrebnih za izvedbo številnih kognitivnih aktivnosti. Model vključuje več komponent: "suženjske" komponente za začasno shranjevanje informacij, ki poleg shramb vključujejo procese za osveževanje informacij, in izvršilno komponento, ki aktivno upravlja z informacijami v delovnem spominu ter preko nadzora procesov pozornosti opredeljuje vnos in iznos iz shramb (Slika 1).



Slika 1: Multikomponentni model delovnega spomina. V model so vključene komponente za kratkoročno shranjevanje informacij (fonološka zanka, epizodični medpomnilnik in vidnoprostorska skicirka), ki se povezujejo z vsebinami iz dolgoročnega spomina, ter centralni izvršitelj, ki le-te nadzira in določa, katere informacije vanje vstopajo.

Sprva sta bila v model vključena dva sistema za shranjevanje informacij [8]: fonološka zanka, zadolžena za vzdrževanje informacij v fonološki obliki, in vidno-prostorska skicirka, ki hrani vidne in prostorske informacije. Baddeley in Hitch sta nadalje predvidela, da fonološka zanka sestoji iz pasivne shrambe omejene kapacitete (fonološka shramba) in aktivnega procesa za osveževanje informacij (artikulatorni kontrolni proces), ki ponovno aktivira in pomaga preprečevati propadanje spominskih sledi. Logie [9] je s preučevanjem vidno-prostorskega delovnega spomina nadgradil Baddeleyev in Hitchev model. Analogno fonološki zanki je za vidno-prostorsko skicirko predvidel, da tudi ta sestoji iz pasivne shrambe za vidne informacije (vidna shramba) in aktivnega sistema za osveževanje in prostorsko manipulacijo informacij (notranja skicirka) [9].

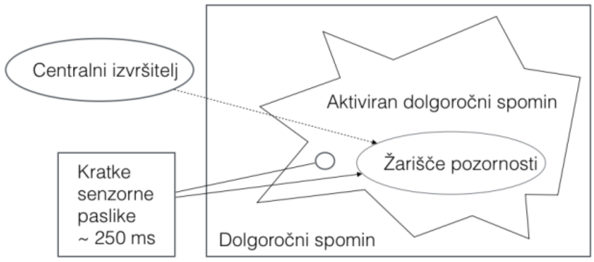
Poleg fonološke zanke in vidno-prostorske skicirke sta Baddeley in Hitch [8] v izvirni model vključila centralnega izvršitelja, ki igra vlogo nadzornika in upravlja celotni sistem ter omogoča manipulacijo z informacijami, hranjenimi v shrambah. Njegova glavna naloga je nadzor pozornosti—usmerjanje, razdeljevanje in preklapljanje pozornosti. Medtem ko imajo sistemi za shranjevanje omejeno spominsko kapaciteto, je kapaciteta centralnega izvršitelja omejena s pozornostnimi viri [1].

Četrta komponenta, epizodični medpomnilnik, je bil modelu dodan kasneje [10]. Njegova naloga je hranjenje integriranih informacij različnih modalnosti v obliki kratkih epizod in povezovanje z dolgoročnim spominom [10]. Začetna predpostavka je bila, da je shranjevanje integriranih informacij močno odvisno od pozornostnega nadzora centralnega izvršitelja, vendar so empirična spoznanja potrdila, da je epizodični medpomnilnik — v nasprotju s fonološko zanko in vidno-prostorsko skicirko, ki vsebujeta lastne mehanizme osveževanja informacij — pasivna struktura, ki ne potrebuje pozornosti centralnega izvršitelja za vzdrževanje informacij, temveč da je le-ta potrebna za obrambo pred motečimi dražljaji [1].

3. MODEL VPETIH PROCESOV

Ideja modelov stanj [11], katerih najbolj vidni predstavnik je Cowanov model vpetih procesov [2], je podati bolj splošen opis sistema delovnega spomina v okviru procesov, ki jih vključuje. Model vpetih procesov namesto sistemov za začasno shrambo in centralnih izvršilnih procesov, ki le-te nadzirajo, delovni spomin vidi kot sistem za nadzor usmerjanja pozornosti na trenutno aktivirane vsebine epizodičnega in semantičnega dolgoročnega spomina. Znotraj te perspektive je usmeritev pozornosti k notranjim reprezentacijam, ki so shranjene bodisi v dolgoročnem spominu [npr. 2, 12] bodisi vzpostavljene preko senzoričnih in motoričnih sistemov [npr. 13, 14], podlaga kratkoročnemu vzdrževanju informacij v delovnem spominu

Model vpetih procesov predpostavlja, da je delovni spomin aktivni del dolgoročnega spomina in pri tem opredeljuje dve temeljni komponenti [2]: aktiviran dolgoročni spomin in žarišče pozornosti (Slika 2). Aktiviran dolgoročni spomin predstavlja zbirko reprezentacij, ki so za omejen čas v posebej dostopnem stanju. Nima omejene kapacitete v smislu možnega števila sočasno aktiviranih reprezentacij, temveč je omejen s časom in interferenco med reprezentacijami. Druga komponenta je žarišče pozornosti, ki predstavlja podmnožico reprezentacij v aktiviranem dolgoročnem spominu. Žarišče pozornosti je na informacije usmerjeno bodisi avtomatično z orientacijskim refleksom na podlagi sprememb v okolju bodisi voljno s pomočjo centralnih izvršilnih procesov. Medtem ko so senzorne reprezentacije lahko aktivirane avtomatično, je za integracijo reprezentacij in nove povezave v delovnem spominu potrebna pozornost.



Slika 2: Model vpetih procesov. Predstavljena informacija najprej sproži kratko senzorno pasliko. Ta aktivira relevantne reprezentacije v dolgoročnem spominu (senzorne in kategorične). Nekatere od teh informacij preidejo v žarišče pozornosti bodisi zaradi avtomatičnih odzivov bodisi s pomočjo centralnih izvršilnih procesov, naravnanimi v skladu s cilji tekoče naloge.

4. PODOBNOSTI IN RAZLIKE MED MODELOMA

Čeprav se modela v izhodiščih razlikujeta—multikomponentni model deli komponente glede na vsebino shranjenih informacij (jezikovne, vidno-prostorske, integrirane informacije) in vključenih procesov (hramba informacij, osveževanje informacij, aktivna manipulacija s pomočjo izvršilnih procesov), medtem ko se modeli stanj namesto na obliko informacij osredotočajo na funkcijo — sta v svojem bistvu komplementarna [9]. Oba predvidevata dva sistema, ki sta vključena v vzdrževanje informacij. En omogoča vzpostavitev in hrambo reprezentacij informacij, medtem ko drugi njihovo aktivno vzdrževanje. Multikomponentni model predvideva [1], da so reprezentacije vzpostavljene in vzdrževane v spominskih shrambah "suženjskih" komponent za shranjevanje informacij (fonološka shramba, vidna shramba) in da je njihovo aktivno vzdrževanje omogočeno preko procesov osveževanja (npr. artikulatorni kontrolni proces, notranja skicirka) ter s pomočjo centralnih izvršilnih procesov, ki aktivno obdelujejo informacije v teh shrambah [15]. V modelu vpetih procesov [2] kot v modelih stanj v splošnem [11] so reprezentacije vzpostavljene bodisi znotraj sistemov za dolgoročni spomin bodisi znotraj senzoričnih in motoričnih sistemov, medtem ko centralni izvršilni procesi omogočajo njihovo aktivno vzdrževanje v žarišču pozornosti.

Oba modela torej kažeta na pomembnost obeh vključenih sistemov, razlikujeta pa se po tem, kako razumeta vlogo obeh sistemov pri omejevanju kapacitete delovnega spomina. Multikomponentni model delovnega spomina omejeno kapaciteto razume kot emergentni pojav delovanja več komponent [9]. Čeprav centralni izvršitelj nima omejene spominske kapacitete za hranjenje informacij, je omejen s pozornostnimi viri. Sistemi za shranjevanje informacij so na drugi strani omejeni s tem, koliko informacij lahko v njih shranimo. Tako za fonološko zanko kot vidno-prostorsko skicirko je značilen propad reprezentacij s časom (približno dve sekundi), če te niso ustrezno osvežene. Model predpostavlja, da ima fonološka shramba omejeno spominsko kapaciteto [2], proces osveževanja pa nima omejitve v smislu števila enot, ki jih lahko artikulira, temveč lahko vsebine osvežuje, dokler so te dostopne v shrambi. Analogno fonološki zanki, Logie [9] za vidno-prostorsko skicirko predpostavlja, da je vsebina vidne shrambe omejena z vidno kompleksnostjo reprezentacij (številom dražljajev v naboru, številom celic v vidni matriki), ki propadejo, če vsebine niso osvežene s pomočjo notranje skicirke, katere kapaciteta je omejena z dolžino niza informacij (npr. položajev), ki ga beleži [9].

Modeli stanj [2, 11] na drugi strani predvidevajo, da omejitve kapacitete delovnega spomina primarno izhajajo iz omejene kapacitete žarišča pozornosti. Centralni izvršitelj omogoča aktivno vzdrževanje v žarišču pozornosti samo za omejeno število reprezentacij v aktiviranem dolgoročnem spominu. Čeprav ima le-ta neomejeno spominsko kapaciteto, je aktivacija relevantnih reprezentacij v aktiviranem dolgoročnem spominu omejena s časom in z interferenco [2].

5. MODELA V POVEZAVI Z MOŽGANSKIMI SISTEMI

Čeprav sta predstavljena modela mišljena kot konceptualni opis strukture in procesov delovnega spomina in njun namen ni preslikava komponent na možganske sisteme, sta skladna s spoznanji nevrofizioloških raziskav, ki kažejo, da imajo posteriorna in prefrontalna področja možganske skorje različno vlogo pri kratkoročnem vzdrževanju vidno-prostorskih informacij [16]. Študije kažejo, da so posteriorna področja možganske skorje tista, ki so vključena pri vzpostavljanju in/ali kratkoročnem shranjevanju vidnih oz. prostorskih reprezentacij [17], medtem ko prefrontalne regije nadzirajo usmerjanje pozornosti za njihovo aktivno vzdrževanje [18]. Vloga prefrotnalnih področij se tako sklada s Cowanovimi izvršilnimi procesi, ki nadzirajo, kaj je v žarišču pozornosti, in Baddeleyevimi sistemi osveževanja, ki ohranjanjo in reciklirajo vsebino iz shramb, ter centralnim izvršiteljem, ki skrbi za nadzor vsebin v shrambah. Posteriorne regije se v okviru Cowanovega modela povezujejo tako z aktiviranim dolgoročnim spomin kot tudi žariščem pozornosti [2], medtem ko se v okviru multikomponentnega modela posteriorne regije povezujejo z vsebino v komponentno-specifičnih shrambah, vključno z epizodičnim medpomnilnikom [1].

Model vpetih procesov predpostavlja, da v delovnem spominu vzdržujemo aktivirane vsebine iz dolgoročnega spomina in vsebine, vzpostavljene preko senzoričnih in motoričnih sistemov, medtem ko multikomponentni model predvideva, da je senzorika ločena od reprezentacij v shrambah. Novejše študije kažejo [za pregled glej 15], da področja za shranjevanje v posteriornih regijah niso edinstvena delovnemu spominu, temveč temeljijo na istih mehanizmih, ki so vključeni v reprezentacije informacij v zaznavi [19, 20], kar se sklada z modelom vpetih procesov in ugotovitvijo, da tako zaznava kot kratkoročno ter dolgoročno shranjevanje informacij temelji na delovanju istih anatomskih regij [19].

6. ZAKLJUČEK

Ideja modelov delovnega spomina je torej hipotetični prikaz njegove strukture in delovanja. Čeprav modela uspešno pojasnita mnoge kognitivne pojave, povezane s kratkoročnim shranjevanjem informacij in njihovo aktivno manipulacijo ter se v mnogih vidikih smiselno povezujeta z delovanjem možganov, njun namen ni pojasniti vseh njegovih vidikov. Razumemo ju lahko kot delovno platformo, ki jo je v skladu z empiričnimi spoznanji potrebno razvijati naprej.

7. OPOMBA AVTORJEV

Prispevek je nastal v okviru raziskovalnega projekta J3-9264 in raziskovalnega programa P5-0110, ki ga je sofinancirala Javna agencija za raziskovalno dejavnost Republike Slovenije iz državnega proračuna.

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Podoba omejene racionalnosti in povratni učinki spreminjanja odločitvenih okolij
The Image of Bounded Rationality and Feedback Effects of Modifying Choice Environments

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POVZETEK
V članku predstavim idejo omejene racionalnosti, empirični program hevristik in pristranosti ter nekatere nadaljnje izsledke vedenjskih znanosti o odločanju, ki kažejo, da so odločitve ljudi neoptimalne in velikokrat pristrane. Nato na kratko predstavim področje odločitvenih spodbud, ki poskuša s spremembami odločitvenih okolij in podobnimi intervencijami človeško odločanje izboljšati. Ustavim se tudi pri vedno bolj prisotni manipulaciji odločanja s pomočjo "pametnih" algoritmov in velikih podatkov. V zadnjem delu prispevka se sprašujem o možnih povratnih učinkih spreminjanja odločitvenih okolij. Vedenjske znanosti o odločanju in programi poseganja v odločitvena okolja namreč ne upoštevajo možnosti, da posegi v odločitvena okolja ne spreminjajo le posameznih odločitev, ampak tudi odnos odločevalcev do odločanja in s tem morebiti spremenijo tudi odzive odločevalcev na same posege. Posegi v odločitvena okolja tako potencialno povratno vplivajo sami nase, tj. na to, kako na odločevalce učinkujejo.

Ključne besede
Hevristike, odločanje, odločitvene spodbude, omejena racionalnost, pristranosti, povratni učinki, spremembe odločitvenih okolij.

ABSTRACT
First, I present the idea of bounded rationality, the heuristics and biases research programme, and some further findings of behavioural decision sciences which show that people's decisions are not optimal and are many times biased. Next, I briefly present the decision nudge programme that aims at improving human decision-making by modifying choice environments. I also briefly stop at choice manipulation by "smart" algorithms and big data. In the last part of the paper, I consider possible circular effects of modifying choice environments. I argue that decision sciences and various attempts at modifying choice environments do not take into account the possibility that changes in choice environments not only affect a certain range of choice but also attitudes of decision-makers towards decision-making. However, by that, they also alter how decision-makers react to the implemented interventions and changes. Changes in choice environments thus potentially exert influence on themselves; i.e., they exert influence on their desired effects on decision-makers.

Keywords
Biases, bounded rationality, choice environment modification, decision-making, decision nudge, heuristics, feedback effects.

1. OMEJENA RACIONALNOST
Herbert Simon je v svojih seminalnih delih [20, 21] podal odmevno kritiko idealizirane podobe odločanja, ki so jo zagovarjale takratne normativne teorije. Slednje so v grobem predpostavljale, da so odločevalci zelo dobro informirani, da natančno poznajo svoje preference, izide potencialnih odločitev, da so izidom sposobni pripisovati vrednosti ali (subjektivne) koristi in da so, na podlagi takšnih podatkov, zmožni "izračunati" optimalno pot oz. pot, ki je vsaj blizu tega ideala.

Simon je takšno idealizirano podobo odločanja zamenjal z bolj realno, ekološko smiselno podobo. Zanj odločevalci ne posedujejo nekakšne vsevedne in računsko neomejene racionalnosti, ampak so v njej močno omejeni (od tod pojem omejena racionalnost; ang. *bounded rationality*). V članku *A Behavioral Model of Rational Choice* Simon npr. pravi: "Če posplošim, je naša naloga, da zamenjamo globalno racionalnost ekonomskega človeka z neke vrste racionalnim vedenjem, ki je kompatibilno z dostopom do informacij in računskimi zmožnostmi, ki jih organizmi, vključno z ljudmi, dejansko posedujejo v okoljih, v kakršnih ti organizmi obstajajo." [21, p. 99] V članku *Rational choice and the structure of the environment* nadalje razlaga: "Ker organizem […] nima ne čuta ne pameti, da bi odkril "optimalno" pot – če sploh domnevamo, da je koncept optimalnega jasno definiran –, se moramo ubadati le z iskanjem mehanizma izbire, ki ga bo vodil v zasledovanje "zadovoljive" poti; poti, ki bo dopuščala zadovoljitev vseh njegovih potreb na neki določeni ravni." [20, p. 136]

Simon skratka poudarja, da na odločanje ne moremo gledati kot na nekakšen proces optimizacije oz. proces racionalnega maksimiranja vrednosti ali koristi[1]. Prvič, zaradi omejenosti kognitivnega sistema; drugič, zaradi nedostopnosti vseh za odločitev relevantnih informacij; tretjič (to je moj dodatek), ker je

[1] Pomenljiva je Simonova opazka o nejasnosti definicije optimalnosti, ki jo lahko beremo kot dvom v načelno – vsaj normativno – opredeljivost optimalnosti izbir (glej tudi [23, 24]).

vprašljivo, če je v večini vsakodnevnih situacij čim boljša ali optimalna izbira sploh v interesu odločevalcev.

Simon je tako eden od začetnikov pogleda na odločanje, ki poskuša v zakup vzeti tako realnega odločevalca kot okolje, v katerem se ta odloča.

2. HEVRISTIKE IN PRISTRANOSTI TER NEKATERE DRUGE "ZMOTE" ODLOČANJA

Raziskovalni program hevristik in pristranosti[2] Tverskega in Kahnemana [31], njuna teorija odločanja pod pogoji tveganja (teorija obetov; ang. *prospect theory*) [13] in Simonove ideje o omejeni racionalnosti so močno zaznamovali sodoben pogled na presojanje in odločanje.[3] Le ta odločevalce koncipira kot organizme, ki jih vodijo predvsem nezavedne hevristike in ki se, vsaj v določenih kontekstih[4], v svojih presojah sistematično motijo ter sklepajo slabe, vsekakor pa ne optimalne ali zanje najboljše odločitve.

Tversky in Kahneman sta v svojem seminalnem članku iz leta 1974 [31] opisala tri intuitivne hevristike, nekakšne mentalne bližnjice, ki vodijo naše presoje. Glavna funkcija takšnih hevristik je poenostavljanje kompleksnosti problemov, ki v določenih okoliščinah vodi do pristranih presoj in odločitev: hevristiko reprezentativnosti (ang. *representativness heuristic*), hevristiko sidranja in prilagajanja (ang. *anchoring and adjustment heuristic*) ter hevristiko dostopnosti (ang. *availability heuristic*).

Naj kot primer opišem hevristiko sidranja in prilagajanja. Pri tej hevristiki so naše ocene raznih količin osnovane na začetnih vrednostih, ki jih, ko o neki stvari presojamo, nezadostno prilagodimo in tako podamo pristran odgovor. To se zgodi, čeprav so morda stvari, o katerih presojamo, z začetnimi vrednostmi povsem nepovezane. Različne podane začetne vrednosti tako vodijo v različne ocene enakega problema. V kontekstu odločanja so učinki te hevristike lepo razvidni v študiji Englicha, Mussweilerja in Stracka [5]. V svoji študiji so nemškim sodnikom s povprečno petnajst let izkušenj prebrali opis ženske, ki so jo ujeli pri kraji v trgovini. Nato so sodniki vrgli kocko, katere met je imel za rezultat vedno 3 ali 9. Ko se je kocka ustavila, so sodnike vprašali, ali bi žensko obsodili na čas zapora v mesecih, ki je večji ali manjši od številke na kocki. Potem so jih vprašali, na koliko mesecev bi jo obsodili. Ko je met kocke pokazal 9, je bila povprečna predlagana zaporna kazen osem mesecev, ko 3, pet mesecev. S tem so nakazali na možnost, da hevristike (v tem primeru hevristika sidranja in prilagajanja) vodijo tudi življenjsko pomembne odločitve.

[2] Ožje gledano pristranost pomeni sistematično napako, npr. v presojanju.

[3] Omenjena članka sta najbolj citirana članka s področja presojanja in odločanja (glede na pregled člankov, identificiranih po naslednjih ključnih besedah v naslovu na portalu Web of Science: decision* ali decid* ali choice* ali choos* ali judg* ali risk* ali uncertain* ali heuristic* ali bias*).

[4] Čeprav Kahneman [12] zagovarja stališče, da je preučevanje pristranosti skladno s pogledom na intuitivno mišljenje in odločanje kot v splošnem uspešno, pa bi po mojem večino raziskovalcev presojanja in odločanja, ki sledijo programu hevristik in pristranosti, trdilo, da je takšnih kontekstov pravzaprav ogromno.

Naj na kratko predstavim nekaj klasičnih pristranosti presojanja in odločanja za ponazoritev sodobne predstave o odločanju. V kontekstu odločanja je ena najbolj odmevnih "pristranosti" – ki predstavlja tudi primer kršitve enega izmed osnovnih aksiomov začetnih normativnih modelov odločanja – učinek uokvirjanja [13, 32]. Gre za to, da različne formulacije odločitvenega problema vplivajo na to, kaj izberemo (tudi zaradi dostopnosti različnih vidikov problema), ne glede na to, da imajo drugače formulirani izidi logično enako verjetnost dogoditve (klasičen primer je npr. problem azijske bolezni [32]). Nadalje, naše preference niso tako stabilne, kot so včasih mislili – študije kažejo, da so močno odvisne od naših predhodnih izbir [4, 6]. Študije tudi kažejo, da raje izbiramo manjše trenutne ali kratkoročne nagrade v primerjavi z večjimi, v času bolj oddaljenimi [17]. Nadalje, ljudje smo močno nagnjeni k temu, da ostajamo pri varnih izbirah oz. pri tem, kar že imamo (ang. *status quo bias*), tudi v primeru, ko aktivna izbira prinaša očitne dobičke [1]. Čustva, ki so sicer bistvena za odločanje, velikokrat vodijo do slabih izbir [1, 2]. Vsaj v nekaterih kontekstih se slabo odločamo tudi z vidika lastne sreče [8]. Ne nazadnje, včasih smo celo slepi za lastne izbire – nimamo dobrega vpogleda v razloge za lastne, dozdevno jasne in preudarne, odločitve [10].

Seveda našteti primer primeri specifičnih pristranosti in "zmot" odločanja kot taki ne pomenijo, da je odločanje človeka vedno ali večinoma zmotno oz. slabo. Vseeno pa se znanosti o odločanju bolj nagibajo k pogledu, da ljudje nimamo prav veliko vpliva na lastne odločitve, ki so obenem – pa naj si bodo sklenjene preudarno ali intuitivno – velikokrat podvržene najrazličnejšim pristranostim.

Na podlagi takšne podobe odločanja se nekateri raziskovalci zavzemajo za implementacijo specifičnih intervencij, ki bi posameznikom in/ali družbi kot celoti omogočile boljše odločanje in končne izbire. V nadaljevanju se bom osredotočil na strategijo spreminjanja odločitvenih okolij, predvsem na program odločitvenih spodbud.

3. SPREMINJANJE ODLOČITVENIH OKOLIJ

Eden izmed programov poseganja v odločitvena okolja, ki si za cilj postavlja izboljšati človeško odločanje, je program odločitvenih spodbud (ang. *decision nudge*[5]). Thaler in Sunstein [26, 29], ki sta program idejno zasnovala, zagovarjata t. i. dobronamerni libertarni paternalizem – dobronamerno vodenje človeških izbir z ohranjanjem svobode izbire: "Opremljen z razumevanjem vedenjskih izsledkov o omejeni racionalnosti in omejeni samokontroli, bi moral libertarni paternalist poskušati voditi človeške izbire v smeri spodbujanja blaginje, ne da bi odpravil svobodo izbire." [26, p. 1159]

Program odločitvenih spodbud kot eno izmed poti spreminjanja odločitvenih okolij predlaga spremembo privzetih pravil oz. izbir (med drugim na podlagi spoznanj o pristranosti statusa *quo* [1] in averzije do izgub [13]). Predlaga, da v odločitvena okolja vgradimo takšna privzeta pravila oz. privzete začetne/avtomatične izbire, ki so za odločevalce dobre oz. boljše kot te, ki so trenutno prisotne – predvsem takšne, ki povečujejo premoženje, blagostanje in zdravje posameznika oz. družbe. Ljudje se za aktivno izbiranje namreč ne odločajo prav pogosto, če pa že se oz.

[5] *Nudge* bi lahko prevajali tudi z dregljaj ali sunek; sam bom uporabljal besedo odločitvena spodbuda, saj gre, vsaj v osnovi, za dobronamerne posege.

so v to spodbujeni, trdi program, se mnogokrat ne odločajo sebi v prid. Dobre privzete izbire so z vidika programa odločitvenih spodbud tako večinokrat boljša alternativa od odločitvenih okolij, kjer se morajo odločevalci aktivno odločati. Na primer (primeri so vzeti iz [28]):

- Če želimo, da uporabniki menz jedo bolj zdravo, jim v prostoru restavracije na primer zdrave izdelke predstavimo pred nezdravimi; ne pa, da uporabnikom predstavimo obe vrsti hrane skupaj in jih pozovemo, naj se aktivno odločijo za zdravo hrano.

- Če želimo, da ljudje (več) varčujejo za pokojnine, spremenimo odločitveno okolje tako, da jih avtomatično vpišemo v določeno varčevalno shemo (še bolje je, da se v shemi mesečni znesek varčevanja povečuje z rastjo dohodka); ne pa obratno, da se morajo aktivno vpisati v varčevalno shemo, da sploh varčujejo.

- Če želimo, da ljudje po smrti darujejo svoje organe, jih ob rojstvu avtomatično opredelimo kot darovalce organov ali pa se morajo kot pogoj za pridobitev vozniškega dovoljenja opredeliti do tega ali želijo po smrti darovati organe (slednje je sicer delno že primer aktivnega odločanja).

Znanje o človeškem vedenju z namenom izboljševanja družbe in odločitev posameznikov uporablja tudi širše področje t. i. vedenjskih uvidov (ang. *behavioural insight*). Spekter uporabe je zelo raznolik: spoznanja se uporablja kot vodilo pri analizi, spreminjanju in ustvarjanju družbenih politik (*policy-making*) in struktur; kot vodilo oz. pomoč pri analizi in reševanju ekonomskih problemov; za namen spodbujanja specifičnih odločitev itd. Takšnih strategij za modifikacijo družbenih struktur in vplivanja na odločevalce se vedno bolj poslužujejo tudi mnoge inštitucije, vlade in korporacije: npr. Evropska komisija, Evropska unija, lokalne vlade, Svetovna banka [14, 16, 30, 35].

V literaturi je sicer zaslediti vedno več diskusij o tem, ali dobronamerno – oz. tako vsaj eksplicirano – spreminjanje odločitvenih okolij pravzaprav pomeni neupravičeno manipulacijo odločanja in vedenja [3, 11, 27]. Ne glede na to, kako se do vprašanja opredelimo, pa uvid v odločanje ljudi odpira mnogotere možnosti zlonamerni manipulaciji odločanja oz. manipulaciji odločanja v smereh, za katere si lahko predstavljamo, da si jih ljudje ne bi želeli. Primer je vedno bolj prisotna manipulacija odločanja s pomočjo "pametnih" algoritmov, velikih podatkov in uvidov v osebnost posameznikov: od manipulacije potrošniških izbir in izbir na volitvah do manipulacije vedenja uporabnikov spleta, socialnih omrežij in raznih aplikacij [15, 36, 37].

S temi zelo pomembnimi vprašanji se v nadaljevanju ne bom več ukvarjal. Posvetil se bom možnosti, ki jo – tako dobronamerne kot slabonamerne – intervencije spreminjanja odločitvenih okolij ne upoštevajo. Na kratko bom orisal možnost povratnih učinkov spreminjanja odločitvenih okolij na same učinke intervencij, ki naj bi odločanje "potisnile" v to ali drugo smer.

4. POVRATNI UČINKI SPREMINJANJA ODLOČITVENIH OKOLIJ

Znanosti o odločanju in programi poseganja v odločitvena okolja ne upoštevajo možnosti, da posegi v odločitvena okolja ne spreminjajo le posameznih odločitev, ampak tudi same odločevalce in njihov odnos do odločanja: na primer njihova implicitna ali eksplicitna prepričanja o odločanju, voliciji ali samokontroli; njihove motive za odločanje; koliko (aktivnega) odločanja si odločevalci sploh želijo; odločevalčeve predstave o lastnih sposobnostih, ki so relevantne za odločanje; njihovo vrednotenje smiselnosti tehtnega razmisleka o odločitvah. [glej tudi 22, 25 za podobno idejo v drugih kontekstih]. Posegi v odločitvena okolja tako inherentno odpirajo možnost, da se odločevalci na posege skozi čas začno odzivati drugače kot so predvidevali "arhitekti" odločitvenih okolij. Kajti odločevalci prav zaradi posegov – in podobe omejenosti odločanja, ki jo ti implicitno vnašajo v odločitvena okolja – potencialno spremenijo lasten odnos do odločanja in tako morebiti tudi to, kako se odločajo. Posegi v odločitvena okolja tako potencialno povratno vplivajo sami nase, tj. na to, kako na odločevalce skozi čas učinkujejo (ideja delno izvira iz del Hackinga [npr. 7] in Varele [npr. 33]).

Johnson in sodelavci [11, p. 488-490] se v svojem članku med drugim sprašujejo o tem, koliko alternativ naj "arhitekt izbire" predstavi potencialnemu odločevalcu. Arhitekt, pravijo avtorji, je v svoji odločitvi soočen z različnimi vprašanji. Je določeno število predstavljenih alternativ prenizko ali previsoko? Naj vse alternative predstavi naenkrat ali eno za drugo? V kakšnem vrstnem redu naj jih predstavi? Pravijo, da mora arhitekt izbire pri odgovoru upoštevati in najti ravnotežje med dvema kriterijema: a) več predstavljenih možnosti po eni strani pomeni večjo verjetnost, da odločevalcu ponudimo možnost, ki se ujema z njegovimi preferencami; b) po drugi strani več možnosti pomeni večjo kognitivno obremenitev. Da lahko arhitekt odgovori na to vprašanje ravnotežja, mora po njihovem v zakup vzeti tudi značilnosti odločevalcev: a) koliko se je odločevalec pripravljen ukvarjati s procesom izbire; b) zadovoljstvo odločevalca s procesom odločanja; c) bolj splošno, značilnosti procesov, ki vodijo do končne izbire; d) dodajajo še, da je odgovor na vprašanje ravnotežja odvisen tudi od lastnosti posameznih odločevalcev (npr. starost).

Vse te značilnosti odločevalcev so vsaj delno odvisne od specifičnih, kulturno pogojenih, odločitvenih okolij, s katerimi so odločevalci v interakciji, v katerih živijo in se v njih odločajo. Študije kažejo, da je pomen osebne izbire (da se za nekaj lahko odločimo sami, namesto da odločitev za nas sklene nekdo drug) in motivacija, ki iz nje izhaja, močno odvisna od kulturnega okolja [9]. Enako velja za zadovoljstvo z odločanjem [18] ali prepričanja o mentalnem naporu in iz njih sledečo sposobnost izvajanja samokontrole (ki predstavlja pomemben proces v odločanju) [19]. Na naše odločitve in dejanja vplivajo celo abstraktna prepričanja (npr. prepričanja o svobodni volji) [34], ki so lahko bistveno kulturno zaznamovana.

Podoben razmislek lahko naredimo o intervencijah, ki gradijo na prepričanju, da so dobre privzete izbire skoraj vedno boljše kot aktivno odločanje [28]. Res je, da smo ljudje kognitivno omejeni in da lahko preveč odločanja vodi v najrazličnejše negativne posledice za odločevalce. Po drugi strani ni jasno, kakšne posledice bi za odločanje (in učinke sami intervencij) prinesla družba, kjer bi dobronamerni vladar (arhitekt izbire) kreiral večino aspektov odločitvenih okolij. Morda bi "vseprisotno" zmanjševanje spodbude za aktivno, premišljeno in samoreflektirano odločanje vodilo v predrugačenje družbenih vrednot, kot sta recimo avtonomija odločanja in odgovornost za lastne odločitve. Morda bi imelo radikalno zmanjšanje spodbujanja aktivnega odločanja za posledico, da odločevalci ne bi imeli ne motivacije, ne veščine aktivnega odločanja, kar bi morda še povečalo možnost zlonamernih manipulacij odločanja s strani dozdevno dobronamernega arhitekta izbire. In čeprav je arhitektura izbire vedno prisotna – ne glede na to ali jo nekdo namerno ustvari ali ne –, pa spremembe odločitvenega okolja potencialno vodijo do spremembe samih odločevalcev in s tem do učinka, ki naj bi ga nanj imele.

5. ZAKLJUČEK

Trend sodobne družbe se pomika v smer relativno velikih sprememb odločitvenih okolij: vedno več inštitucij uporablja izsledke vedenjskih znanosti o odločanju za kreiranje in spreminjanje družbenih in bolj specifičnih odločitvenih okolij in vedno več podjetij poskuša odločanje manipulirati s pomočjo "pametnih" algoritmov, velikih podatkov in poznavanjem človeške duševnosti. Trend, ki odpira širok prostor, v katerem spremembe odločitvenih okolij – *na trenutno nepoznan način* – spremenijo same odločevalce, njihov odnos do odločanja in učinke, ki naj bi jih na odločevalce imele.

Posegi v odločitvena okolja v tem smislu na dolgi rok ne učinkujejo tako kot predvidevajo raziskovalci odločanja ali arhitekti izbire. Čeprav so odločevalca na začetku želeli spoznati "takšnega, kot je", z namenom, da bodo dosegli želene spremembe, so ga v svoji interakciji z njim že spremenili. Ob tem pa so potihoma pozabili, da odločevalec ni nespremenljiva entiteta, ki je neodvisna od interakcij z arhitektom izbire.

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Expected human longevity

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ABSTRACT
In this paper we discuss the fall of ancient civilizations and possible future extinction causes for humans. Then we estimate the longevity of human civilization based on the absence of observable extraterrestrial civilizations and astronomical data using the Drake equation. If there are not many advanced civilizations in our galaxy, our longevity can be estimated at up to 10 000 years.

Keywords
Human extinction, Drake equation, Civilization collapse

1. INTRODUCTION
It seems that nothing in this world can last forever. For example, our Sun burns 600 million tons of hydrogen per second, generating the light that is required to make our planet habitable. According to astronomers, in 4-5 billion years it will go through an exciting, yet terrifying death, probably swallowing the Earth in the process. On the other hand, humans are familiar with the fact that nobody has yet lived over 122 years, but again find it hard to accept that nations and countries face similar destiny. When presented in the National Council of Slovenia that with the fertility rate below 1.6 Slovenians and other major nationalities in Slovenia will cease to exist in a couple of hundred years, the social media protests seemingly related to man-woman issues appeared, although the event was centered around the longevity issues [5]. But history teaches us that in the past there were many flourishing developed civilizations, yet none of them survived for a very long period of time. As people rise and fall, so do civilizations. The same is valid for human civilization – it will inevitably die out one day.

What are the possible causes of the end of our civilization? Using the Drake equation, can we predict how much time we have left and how can we extend it?

Finally, are we like a child cognitively incapable of accepting the incoming fate? Children understand the meaning of death only at the age of 5 [11]. Will we as a civilization live healthy and long or perish at first major obstacle?

1.1 Definition of a civilization
A civilization is defined as a complex society which is characterized by urban development, social stratification imposed by a cultural elite, symbolic systems of communication and a perceived separation from and domination over the natural environment [14].

1.2 Fall of ancient civilizations
There are many different reasons why ancient civilizations went into decline or even extinction. Here we mention a couple of civilizations and the reasons for their decline.

- **The Maya civilization**
  There are several theories about the fall of Maya civilization but the prevalent is that climate changes and consequent drought were the main causes. Other possible causes include social disorder, over-population and warfare [2].
- **Minoan Civilization**
  Minoans were one of the first civilizations in Europe. They were located in Crete, Greece and were wiped out by tsunamis following a volcanic eruption [4].
- **Roman Empire**
  Roman civilization probably collapsed due to many reasons. A weak army, constant barbarian invasions, political instability, overpopulation and epidemics are only few of the causes that might have lead to downfall of this once powerful civilization [12].
- **Native Americans**
  The decline of Native Americans happened when Europeans discovered America in 1492. They brought new diseases to the continent which no Native American was immune to. Furthermore, Europeans started with colonization and Native Americans had no proper weapons to resist them [15].

A recent theory from [8] claims that the downfall of most civilizations was accompanied by ideologies that conflicted with the production process due to changed conditions. The stories of civilization declines are, however, often presented as cautionary tales to frighten us into correcting the error of our ways to prevent the end of our own global civilization [8]. They focus on climate change, human-caused environmental impacts and overpopulation because these three factors are the major global concerns of our time. They have a strong appeal to us because of the ubiquity of disaster-based stories. There are also several positive components in these stories, e.g. they promote environmental responsibility, global concern and sustainable growth.

Space or earth phenomena can cause extinction or at least significantly decrease the number of humans, as the Toba supereruption around 70 000 years ago indicates. It is estimated that at most 10 000 people survived at some point afterwards [9]. But these events might be less likely in the near future due to long intermediate intervals between Earth catastrophes and the relative short-term predictions of the human civilization [1], [10]. In this paper we concentrate on the human-induced problems.

While the doomsayers are a constant phenomenon in our life, and they come indeed in all forms and ideas, more often than not unsupported by data [6], serious analyses were often able to predict the human-caused grim outcomes. The scientific warnings should not be perceived as a pessimistic or doomsayer viewpoint, but as cautions to prevent major problems and even the collapse of our civilization. Whatever the case, with current knowledge and technology it might be possible to scientifically correctly predict most likely current civilization dangers and at least some estimations for the time-span of our civilization.

1.3 Possible causes of extinction of the human race

In this section we will discuss some of the possible causes for human extinction, based on an article by Bostrom [1].

- **Nuclear holocaust**
  USA and Russia hold about 93 percent of all nuclear weapons, but other countries are starting to stockpile them as well. Even worse, the treaty preventing arms races has been called off.

  There are various opinions whether an all-out nuclear war could eradicate humankind. Some believe that it would be hard to reach all possible settlements, for example the ones that are isolated from other people like the mountains of Tibet or remote islands in the South Pacific [13]. Also, there are nuclear shelters preventing the chosen ones. But even if we survive the initial impact, the long term climatic effects would lead to a nuclear winter and the number of people would decrease to drastically low numbers. While humans as a species would probably survive, the level of human civilization would decline dramatically, probably demanding several centuries to regain the former technological state – if ever.

- **Global warming**
  Ever increasing releases of greenhouse gasses could start a feedback loop and the temperatures could continue to rise. Even more species would go extinct and we would be unable to produce crops. If a negative spiral would enhance heating up the planet, life would become unbearable outside with negative consequences similar to those of a nuclear winter.

- **Artificial intelligence**
  The development of artificial intelligence will likely lead to superintelligence in the future. It is possible that in the case of a conflict between humans and superintelligence the entire human civilization could get annihilated [16].

- **Pandemic**
  A new deadly disease could infect the entire world population. There could be an genetically engineered biological agent with long latency and high mortality. Those viruses could be released by a lunatic or spawned unintentionally [7].

- **Asteroid or comet impact**
  This is a very small risk, but if an object 100 km wide would collide with Earth all advanced life could perish. There have been multiple extinctions on Earth and at least some were caused by impacts from space. The best known is the one eliminating dinosaurs around 65 million years ago when an object about 10 to 50 kilometers in diameter hit the Yucatan peninsula in Mexico. As a consequence, around 75 percent of all plant and animal species went extinct.

- **Accidental or deliberate misuse of nanotechnology**
  It might be possible to construct bacterium-scale nanobots that are self replicating and can feed on organic matter. Such robots could ultimately eat or destroy the entire biosphere. This is one of the examples where humans construct a new mechanism capable of destroying civilization.

Can we avoid extinction of a particular nation or the human civilization in the first place? Clearly, the answer is no, and the real question is how long will human civilization persist, analogous to a question about a particular individual. In the next section we present a model that predicts the longevity of human civilization based on the Drake equation.

2. THE DRAKE EQUATION AND ESTIMATING THE LONGEVITY OF HUMAN CIVILIZATION

In 1961 Frank Drake proposed an equation for calculating the number of detectable civilizations in our galaxy at any given moment. The equation consists of several parameters [3]:

$$N = R_* f_p n_e f_l f_i f_c L,$$

where R_* is the rate of star formation per year, f_p is the fraction of stars with planets, n_e is the number of Earth-like (or otherwise habitable) planets per star that has planets, f_l is the fraction of habitable planets with actual life, f_i is the fraction of life-bearing planets that develop intelligence, f_c is the fraction of intelligent civilizations that are detectable and L is the average longevity of such civilizations. Finally, N is the number of detectable civilizations. In the original article the authors used point values to estimate each one of the parameters. Sandberg et al. used a different approach in [10] - instead of using point values they used probability distributions for the parameters listed on table 1.

We used the Drake equation with the Sandberg's approach for the basis for our calculations. Since the parameters in the equation are all estimates we can solve equation for L and take N as a variable. The estimation of N can be somewhat limited from observations of our stellar neighbourhood. The equation for computing L is therefore as follows:

$$L = \frac{N}{R_* f_p n_e f_l f_i f_c} \tag{1}$$

2.1 Estimation of parameters

We used probability distributions to model each variable as in the paper presented by Sandberg [10]. For the distribution of the number of civilizations in our galaxy we set the lower bound at $N = 1$ and the upper bound at 10^4. The reason for this estimate is as follows: We have been trying in vain to get a signal from foreign civilizations even though quite extensive and expensive searches of the universe were performed. The search for extraterrestrial intelligence (SETI) is a collective term for scientific searches for intelligent extraterrestrial life. Various methods and approaches are used to detect signs of transmissions from civilizations on other planets, but most commonly monitoring of electromagnetic radiation is performed. The first scientific investigations began in the early 1900s, and focused international efforts have been going on since the 1980s. While some consider UFOs as a proof of foreign civilizations visiting us, there are no scientifically confirmed results so far. Since some projects were carried out using huge resources and time, that is a rather disturbing indication. Furthermore, it should be noted that this paper relies purely on the known and generally accepted scientific knowledge and UFOs are not part of it. If we therefore assume that detectable civilizations are evenly distributed throughout the galaxy, then there are at most 10 000, since otherwise we would have already observed one (radius of the galaxy is 10^5 light years while we can detect signals as far as 10^3 light years). Consequently, the range of L is theoretically from 10^{-2} to 10^{13}, i.e. from 3 days to ten trillion years.

Parameter	Distribution
R_*	log-uniform from 1 to 100
f_p	log-uniform from 0.1 to 1
n_e	log-uniform from 0.1 to 1
f_l	log-normal rate, described in paper[10]
f_i	log-uniform from 0.001 to 1
f_c	log-uniform from 0.01 to 1
N	point values: 1 to 10 000

Table 1: Probability densities for the parameters in Equation (1)

To estimate the longevity of human civilization, we did not model the parameter N with distributions. Instead we used multiple point-values as inputs to the equation. For example, suppose there are 1, 10, 100, 1 000, 10 000 civilizations in our galaxy now – what can we conclude about our longevity in that particular case?

Several hundreds of models either of different nature or of significantly different parameters were designed and tested, but here we present only one.

3. EXPERIMENTS

The computing was performed in a stochastic way: for a chosen N, a value of each parameter was randomly generated using the predefined probability density, and L was computed according to the Drake equation. The obtained probability distribution denotes the longevity of human civilization under chosen probability distribution for the given parameters and for the chosen N – the number of technologically advanced civilizations in our galaxy, i.e. the ones that transmit electromagnetic signals to space. From the obtained probability density, several derived graphs can be generated, e.g. the one in Figure 1.

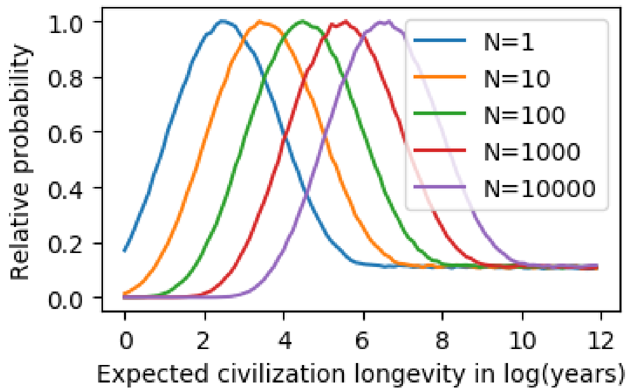

Figure 1: Graph for log(L), i.e. for expected human longevity based on the values of N – the number of civilizations in our galaxy.

N	median	stabilization	volume
1	2 200	13 600	2700
10	22 000	11 100	10 000
100	220 000	9 300	63 700
1000	2 200 000	5 800	545 600
10 000	22 000 000	/	1 000 800

Table 2: Median and stabilization values for different N.

The same relations are also presented in side-view in Figure 2 and in 3D in Figure 3. Bigger N seemingly corresponds to better chances for longer human longevity, in a positive correlation with N. In addition, our longevity is obviously limited, but the exact relations are somehow difficult to comprehend due to the non-linear scale.

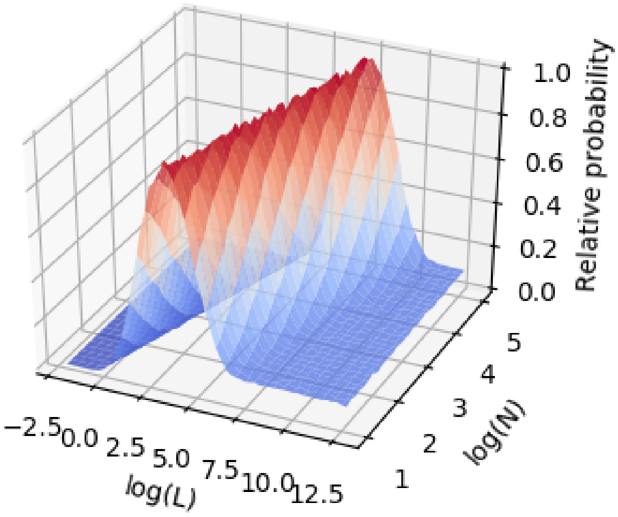

Figure 2: Longevity based on N, side view.

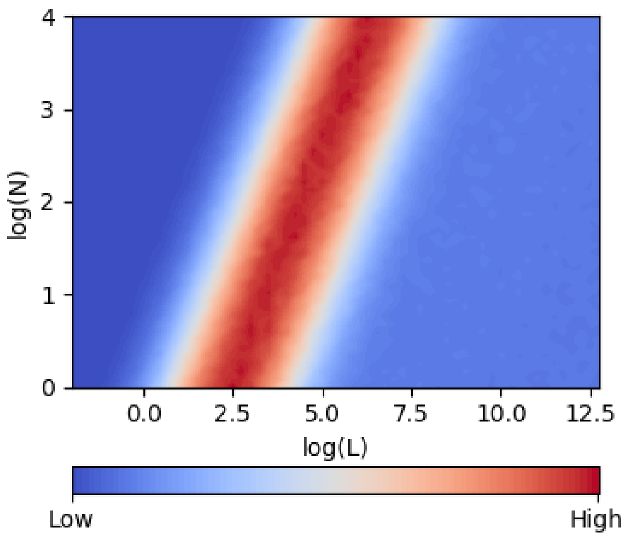

Figure 3: Longevity based on N, top view.

If instead of logarithmic scale, the graph of probability densities is presented in a linear scale (Figure 4), the impression is now quite different. The "true" relation between N and L is as follows:the majority of possibilities for smaller N are at the left part of the graph resulting in a bigger bump accompanied with a slower decline. The point of stabilization, i.e. when a decline is less than 1 percent in a corresponding 100 years is presented in Table 2 as "stabilization". One can also calculate median longevity by computing it for each graph, denoted as "median". The difference between "stabilization"

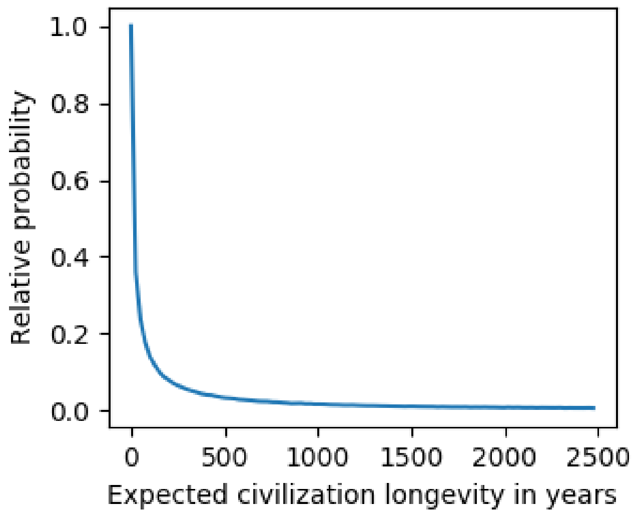

Figure 4: Graph for longevity, i.e. $\log(L)$ in linear scale for $N = 1$.

and "median" is that median represents a point dividing all simulations into two equally frequent intervals, while stabilization indicates the end of steep, i.e. more than 1 percent decline in the probability densities. While median linearly grows with the number of civilizations, stabilization declines denotes where the peak in probability densities on the left is getting smaller than 1 percent. At N equal to 10 000, no decline is bigger than 1 percent. The right-most column "volume" denotes the percentage of the current integral of probability densities in a millennium decreases to less than 1 percent compared to the best 100 years (normalized). These relations are highlighted in Table 3 where the average over an interval 0..1000, 1000..2000, 10 000..11 000 etc. is divided by an average over best (i.e. usually the first) 100 years. These numbers denote how much more probable are the first 100 years compared to the first 1000 etc.

N	0-1000	1000-2000	10 000-11 000	100 000-101 000	1 000 000-1 001 000
1	0.186	0.024	0.002	0.000	0.000
10	0.289	0.073	0.010	0.001	0.000
100	0.600	0.276	0.058	0.006	0.000
1000	0.871	0.789	0.298	0.053	0.005
10 000	0.275	0.749	0.843	0.299	0.048

Table 3: Probability densities of 1000 years for different N at 5 specific longevities normalized to the highest value in 100 years.

The reason why we present graphs in logarithmic scale is that the linear scale does not enable the reader to comprehend anything outside the relevant scope. For example, Figure 4 would consist of two lines if the max years would be 25 000 instead of 2 500 – one vertical on the left and one horizontal on the x axis.

4. CONCLUSION

The aim of this research was to establish probability densities of longevity of human civilization. In this paper we presented results of just one model while we have tested hundreds of them. The model analyzed here shows that if there are more civilizations, we have higher probability of living longer. Regardless of N and after initial fluctuations very close to the left, the curve of longevity is monotonic, decreasing. At N equal to 1, i.e. if we are the only ones in our galaxy, we will probably live only for approximately 2 000 - 14 000 years. At N equal to 10, the expected high-probable longevity is from 11 600 to 22 000 years. At N equal to 10 000 there is no peak at the left and the probability density very slowly declines. In other words – there is not any explicit pattern and predictions are undecidable.

Our maximum survival time seems to be about 10 000 - 20 000 and maybe up to 100 000 years. But most likely, the expected time is substantially shorter.

This study might be relevant because it indicates that we need to start acting wisely sooner rather than later to prevent grim scenarios. Namely, if the predicted time would be say millions of years, there would be no need to go to Mars and other planets soon, we should not worry too much about global warming or other problems. But if the predictions indicate that these dangers might hamper our progress relatively quickly, at least in terms of cosmic timing, we should actively analyze them and react appropriately.

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Volume C

Odkrivanje znanja in podatkovna skladišča - SiKDD
Data Mining and Data Warehouses - SiKDD

Uredila / Edited by

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http://is.ijs.si

7. oktober 2019 / 7 October 2019
Ljubljana, Slovenia

PREDGOVOR

Tehnologije, ki se ukvarjajo s podatki so v devetdesetih letih močno napredovale. Iz prve faze, kjer je šlo predvsem za shranjevanje podatkov in kako do njih učinkovito dostopati, se je razvila industrija za izdelavo orodij za delo s podatkovnimi bazami, prišlo je do standardizacije procesov, povpraševalnih jezikov itd. Ko shranjevanje podatkov ni bil več poseben problem, se je pojavila potreba po bolj urejenih podatkovnih bazah, ki bi služile ne le transakcijskem procesiranju ampak tudi analitskim vpogledom v podatke – pojavilo se je t.i. skladiščenje podatkov (data warehousing), ki je postalo standarden del informacijskih sistemov v podjetjih. Paradigma OLAP (On-Line-Analytical-Processing) zahteva od uporabnika, da še vedno sam postavlja sistemu vprašanja in dobiva nanje odgovore in na vizualen način preverja in išče izstopajoče situacije. Ker seveda to ni vedno mogoče, se je pojavila potreba po avtomatski analizi podatkov oz. z drugimi besedami to, da sistem sam pove, kaj bi utegnilo biti zanimivo za uporabnika – to prinašajo tehnike odkrivanja znanja v podatkih (data mining), ki iz obstoječih podatkov skušajo pridobiti novo znanje in tako uporabniku nudijo novo razumevanje dogajanj zajetih v podatkih. Slovenska KDD konferenca pokriva vsebine, ki se ukvarjajo z analizo podatkov in odkrivanjem znanja v podatkih: pristope, orodja, probleme in rešitve.

FOREWORD

Data driven technologies have significantly progressed after mid 90’s. The first phases were mainly focused on storing and efficiently accessing the data, resulted in the development of industry tools for managing large databases, related standards, supporting querying languages, etc. After the initial period, when the data storage was not a primary problem anymore, the development progressed towards analytical functionalities on how to extract added value from the data; i.e., databases started supporting not only transactions but also analytical processing of the data. At this point, data warehousing with On-Line-Analytical-Processing entered as a usual part of a company’s information system portfolio, requiring from the user to set well defined questions about the aggregated views to the data. Data Mining is a technology developed after year 2000, offering automatic data analysis trying to obtain new discoveries from the existing data and enabling a user new insights in the data. In this respect, the Slovenian KDD conference (SiKDD) covers a broad area including Statistical Data Analysis, Data, Text and Multimedia Mining, Semantic Technologies, Link Detection and Link Analysis, Social Network Analysis, Data Warehouses.

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Preferences of Users on Cross-Site OER Recommendations: Stay or Leave?

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ABSTRACT

In education we can find different open educational resource (OER) providers that are serving resources in different modalities, formats and languages. These providers can be the actual resource creators or re-distributors that redirect the user to the actual provider. In recent work, we developed a recommendation engine which provides content-based recommendations from multiple resource providers, enabling the users to navigate between the providers and their resources. In this paper, we investigate the users' choice on the recommended items focusing on the cross-site user learning activities. The results show that the users tend to stay on the same website and not choose the first item in the recommendation list.

CCS CONCEPTS

• **Information systems** → *Content ranking*.

KEYWORDS

open educational resources, recommendation system, cross-site recommendations, learning analytics, data visualization

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1 INTRODUCTION

Open Educational Resources (OERs), as defined by the UNESCO,[1] are teaching, learning and research materials, digital or otherwise, that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions. As such, digital OERs have many advantages over traditional learning materials. Namely, OERs reduce the costs for the students, the dissemination of information is faster, and the resources can be accessed from everywhere. However, there are also some reservations, such as quality and reliability of the materials, and intellectual property rights ownership. Additionally, an OER user faces a very fragmented landscape of repositories containing OERs, which makes finding relevant OERs a difficult task for both students and teachers.

Therefore, we aim to connect the scattered OERs by enriching the material with additional semantic information, automatic and machine translation, as well as providing services for cross-site recommendations to make finding appropriate OERs easier. Currently, the repositories are highly specialised in terms of scientific domains, content type, level of education, and language. From the perspective of a student, the student may have to search OERs in different repositories for each class which is an undesirable situation. Such search is inefficient and time consuming, it also leads to sub-optimal search results and a negative user experience with OERs.

In this paper, we aim to provide some insight into the preferences of the users regarding cross-site recommendations. To discover users' preferences, we analyse user transition

[1]Definition adopted from https://en.unesco.org/themes/building-knowledge-societies/oer.

data from content-based cross-site recommender engine embedded into two OERs repositories. We focus on the cross-events, which happen when the user selects OER materials from a different repository from the list of recommendations. The findings are the first step in evaluating how users perceive such recommendations, how good the recommender is, and to further improve the recommendations.

2 RELATED WORK

Recommender engines produce the results which are identified as the most relevant to the user by using different methods such as content-based or collaborative filtering. Considering the personal differences such as interest, study goal, time restriction, and capabilities of owned devices, not all users would choose the first ranked item in recommendations. For example, Hajri et. al [4] created a recommendation engine to support MOOC learners with complementary OERs. Their study identifies that some learners did not prefer to use external resources to not disperse themselves. This result implies that user may not like to navigate cross-site even though they are provided with an item recommendation very related to their interest. Thus, understanding users' preferences on recommended items is very crucial for maintenance and improvement of recommender engines [2] so that personalised items could be provided to meet each user's preferences [1]. This paper is designed to understand users' cross-site navigation through recommendations on OER and their choice of the item to study.

3 CROSS-SITE RECOMMENDATIONS OF OPEN EDUCATIONAL RESOURCES

In order to provide cross-site and cross-language recommendations, we have developed a content-based recommender system which recommends resources based on the similarity of their content. We propose semantic representation of the resources based on Wikipedia concepts, i.e. Wikipedia pages which were identified and linked to particular parts of the material's content. Wikipedia concepts are then used to represent the resources of different modalities - providing a "concept" overview of the resource's content. This semantic representation allows comparing and calculating the similarity between resources of different languages, thus enabling recommendations containing resources in different languages. The recommender system design is described in [5].

Our recommendations are designed to provide the most similar resources based on the user query. The query can be either a) a link to another resource or b) a free-form text. For this paper, we focus on the first option, where the user provides a link to another resource. The recommendations are ordered by resource's similarity to the provided query, i.e. more similar resources appear higher on the list.

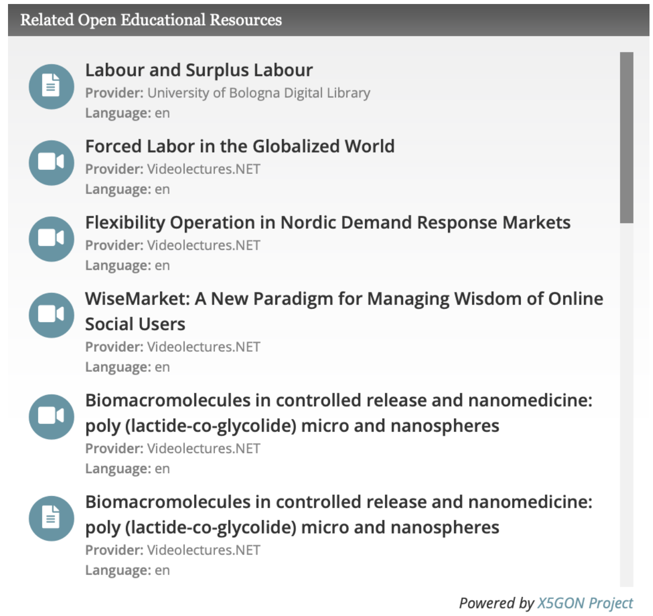

Figure 1: Snapshot of the recommendation window on videolectures.net resource (date: 25.07.2019).

The recommender system has been provided as a service with a public application programming interface (API).[2] In addition, we have also provided a plugin which allows a website to include the list of the OER recommendations given a query. Figure 1 shows an example of the recommender plugin output on the videolectures.net repository[3].

The data about users' transitions between the OER materials and recommendations is stored as csv files (we retrieved it on: 04.07.2019) Please note that we only have the transitions directed from www.VideoLectures.net (VL) and www.upv.es (Universitat Politècnica de València - UPV) due to the data sharing policies. We have implemented learning analytics techniques to analyse and visualise the users' preferences on recommendations by using the Python programming language.

4 ANALYSIS ON USERS' PREFERENCES

In the transitions dataset we have 233,221 transitions showing the users navigating from one page to another through the recommended items. Please note that we only have the transitions directed from VL and UPV due to the data sharing policies. The data used in our experiments was retrieved on July 4th, 2019.

The users are usually provided with around 20 items in the recommendation list. The data shows that the users tend to choose the item ranked 8.89. Usually, only 5 to 7 items

[2]Documentation is available at https://platform.x5gon.org/documentation
[3]http://videolectures.net/

Table 1: Frequency of Navigation amongst OER repositories

Directed from	Directed to	Frequency
VL	VL	176,594 (76%)
VL	UPV	14,212 (6%)
VL	UOS	553 (0.2%)
VL	Nantes	8 (0.0034%)
VL	MIT	8,854 (3.8%)
VL	Bologna	32,882 (14%)
UPV	VL	14 (0.006%)
UPV	UPV	92 (0.04%)
UPV	UOS	0 (0%)
UPV	Nantes	0 (0%)
UPV	MIT	0 (0%)
UPV	Bologna	12 (0.005%)

could fit into the recommendation window, which means that the users tend to scroll down in the recommendation window rather than click on the first recommended item.

According to the statistics, the users have chosen an item from the first page 88914 times (38%) and have scrolled down to chose an item 144,291 times (62%) in the case that 6 items shown at once in the recommendation window (see Fig.1).

Navigation amongst OER sites

Since the recommendations are cross-site, it is possible for the users to move from one OER repository to another. Because of the data sharing policy among the providers, we can track the transitions from VL and UPV to any partner providers. The sankey diagram in Figure 2 shows the navigation amongst the OER repositories. Table 1 shows the exact number how many times a user is directed from one repository to another.

Apart from the users' decision to choose an item from different domains, the number of items recommended by domain could have an effect on the users' choices. Figure 3 shows the percentage of recommended items by domains on VideoLectures.net and UPV, respectively. We can see that the providers mostly recommend an item from their own domain.

The results can be summarised as follows:

- When a user is on a material, most probably they choose the next material from the same domain, indicating that they prefer to stay on the same website.
- The users have mostly chosen the next item from the VL, Bologna, UPV and MIT respectively.
- All transitions to Nantes, UOS and MIT were directed from VL.
- There is at least one transition from the VL to each of the OER repository listed while there are no transitions between UPV and UOS, Nantes, and MIT. The reason could be that the content of the resources are not similar on these particular repositories so they are rarely shown to the users.

Chosen vs. Not Chosen

Even though there surely are reasons for a user not to choose the first ranked item in the recommendation list which cannot be traced in the data, we hypothesise that the users would choose one of the first shown items since they are more similar to the viewed item based on their contents. Therefore, observing the trends with the chosen item by investigating its similarity to the other given recommendations would give us insight into the users' behaviours.

A heat map is a convenient tool to visually show the trends. Figure 4 compares the features of the first item in the recommendation lists and the chosen item by the user.

The features are chosen for comparison are explained below.

Author. Author of the material

Language. Spoken language in the video or the provided language in the text

Provider. The website domain of the material provider e.g. videolectures.net

Type. Type of the material e.g. pdf or mp4

Wikipedia Concepts. The Wikipedia concepts linked to the resource's content. These were acquired through the Wikifier [3], a web service that finds and links text elements to Wikipedia concepts.

The items ranked first in the list and selected by the users are not included here. In the graph, the more purplish the more different, the more greenish the more similar.

According to the graph, the author information is the least similar feature between the selected item and the first item shown in the recommendation list. This implies that the users rarely chose the item authored by the same author of the first item in the list. It should be noted here that one of the reasons for this could be the lack of materials authored by the same author. It is also observed that language, provider and type are not necessarily the same.

The first ranked item is contentwise the most similar item to the currently viewed item (see Section 3). However, the items chosen by users are not always the most similar items. This result implies that the currently implemented content-based filtering method is not enough to meet the users' preferences, and other aspects must be considered.

5 CONCLUSION

The presented research is designed to investigate users' navigation between the different open educational resource

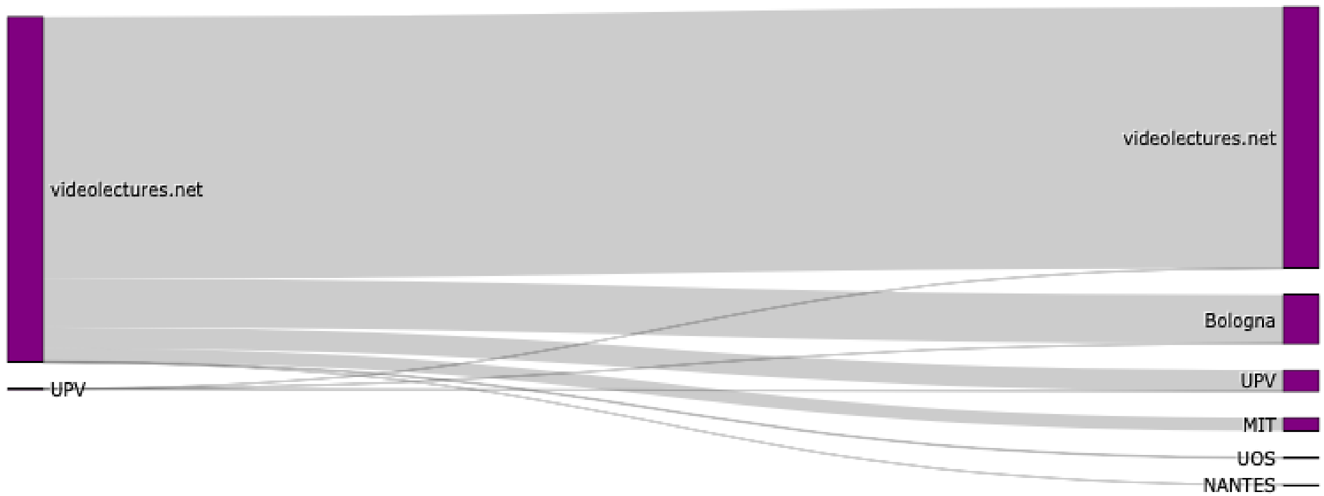

Figure 2: Navigation amongst the OER providers

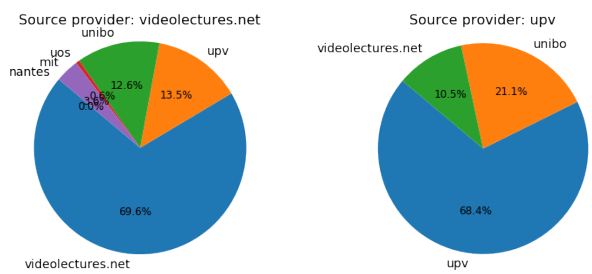

Figure 3: Number of materials recommended by domain

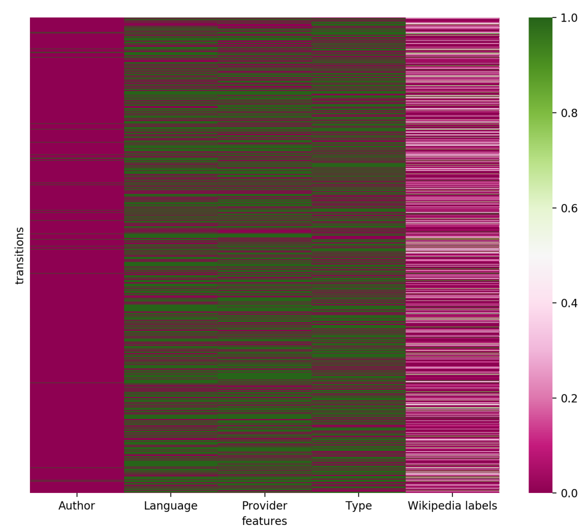

Figure 4: Comparison of the selected item and the first ranked item in the recommendation list

providers through an embedded recommendation engine on their platforms. We observe that the users mostly chose to stay within the same domain provider. Interestingly, we observed that the users did not choose the first couple of items that are ranked higher in the recommendation list, but they rather chose items ranked at around 8th place. This result shed light on users' preferences on cross-site OERs but also pave a way to further research to i) deeper behavioural analysis on user preferences and ii) improve the recommender engine which not only implement a content-based filtering but a method which is modified with personalised attributes.

6 ACKNOWLEDGMENTS

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The Next Big Thing In Science

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ABSTRACT

This paper presents an approach to predicting the future development of scientific research based on scientific publications from the past two centuries. We have applied machine learning methods on the Microsoft Academic Graph dataset of scientific publications. Our experimental results show that the best performance is obtained for a noticeable increase of the topic frequency in the last 5 years compared to the previous 10 years. In this case, our model achieves precision of 74.3, recall of 71.7 and F1 of 73.0. Some topics that our model identified as promising are: *proton proton collisions, higgs boson, quark, hadron, mobile augmented reality, variable quantum, molecular dynamics simulations, hadronic final states, search for dark matter*.

CCS CONCEPTS

•CCS Information systems Information retrieval Document representation Content analysis and feature selection

KEYWORDS

Science analysis, machine learning, data representation

1 Introduction

With the ever-increasing pace of scientific developments, it is becoming difficult to keep track of current scientific research topics, let alone predict the promising lines for future research. As the quality and quantity of digitized scientific publications is growing, it has enabled modelling the development of scientific publications over time with greater accuracy and efficiency. In our research we explore how a simple Perceptron algorithm performs, given a considerable amount of data.

Our research hypothesis is that scientific topics that will be important in the future, already exist in today's scientific articles. To identify them, we applied machine learning methods on a large database of publications, namely the Microsoft Academic Graph [1]. We have defined a machine learning problem, such that the model predicts early indicators suggesting which scientific topics in today's literature will likely become important in the future.

In related work, researchers have addressed a similar problem also on a part of the Microsoft academic database of publications. They used a binary classifier to predict future developments in science. However, their research was on "Finding rising stars in academia early in their careers" [6]. Their representation comprises of authors' personal and social features. The research presented in [7] focuses on predicting emerging topics based on citation and co-citation data using clustering methods. The topics are classified to understand the motive forces behind their emergence ("scientific discovery, technological innovation, or exogenous events"). Emerging topics were also addressed in [8] where keywords from MeSH terms of PubMed database are filtered based on their increment rate of appearance in life science publications. In our research, we automatically generate frequent NGrams from the paper titles and use them to construct a machine learning model for predicting which topics will become popular in the future.

The main contributions of this paper are the proposed problem definition, data representation and the identified topics which are promising as the next big thing in science. The rest of the paper is structured as follows. Section 2 describes the data, Section 3 describes the problem, Section 4 presents the experimental results and Section 5 provides discussion.

2 Data Description

One could say the main element of science is an idea, invention or finding which occurs at the beginning of a scientific process. What follows is a period of scientific investigation, testing the idea in different contexts, proving the invention is useful or applying the findings in different scenarios. If proven to be valuable, new products or research is developed based on it. In our research, we rely on the fact that scientists are typically strict and consistent with naming conventions, enabling us to track the evolution of particular scientific topics through time.

In our research we have used the titles of scientific articles to identify when a scientific topic first appears, how frequently it appears through time, and when it stops being used. There are many databases of scientific articles in the world, but only some are open and available for research. Today, the biggest open database of scientific articles is known as the "Microsoft Academic Graph" which was released for research use in 2016. The database size is 104 Gigabytes, and it includes references to 125 million scientific articles from the year 1800 to 2015 from all areas of science. Each scientific article in the database is described by its: title, authors, their institutions, the journal or conference where it was published and the year of publication. The data is available from: https://www.microsoft.com/en-us/research/project/microsoft-academic-graph/ .

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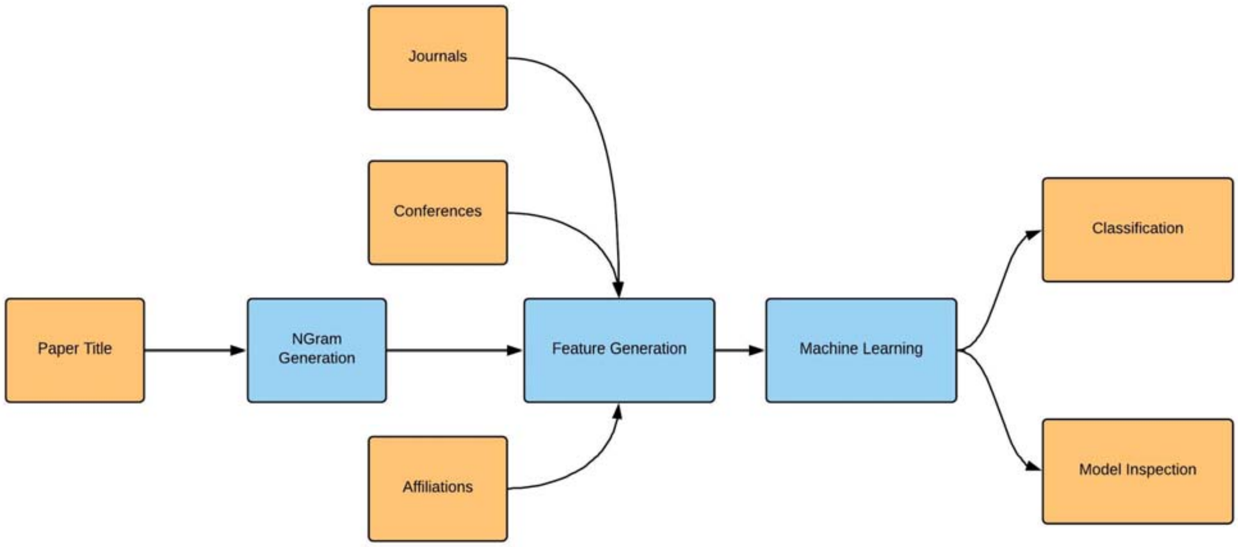

Figure 1: Architecture of the system including NGram extraction, feature generation and machine learning. The generated model is used for classification to predict the popular topics as well as to identify the most important features.

From the 125 million article titles, we extracted 2.5 million candidate topics, each corresponding to a phrase consisting of 1 to 5 consecutive words (also referred to as NGrams). The NGram must appear at least 100 times in the database of paper titles to be considered as a topic. Table 1 shows the distribution of NGrams

NGram	Total
1-Gram	300,000
2-Gram	1,000,000
3-Gram	800,000
4-Gram	300,000
5-Gram	100,000
All NGrams	2,500,000

Table 1: The number of NGrams generated from the publication titles

Figure 1 illustrates the process of feature generation and machine learning on the examples which represent the selected topics. The NGrams are generated from the paper titles, keeping only the frequent NGrams. For each frequent NGram, a feature vector is constructed using affiliations, conferences and journals of the papers in whose titles the NGram occurred.

For each topic, we find the longest span of years in which the topic appears in an article title at least once. Only topics which have the span of 15 years or longer are considered. This leaves us with about 1 million topics. Each topic is represented by a set of features describing the last 10 years before it became popular. The features include bag of affiliations, bag of journals and bag of conferences of the publications in which the topic occurred. For each topic we report the total frequency over the 10 years and the slope of a line through the (year, frequency) points.

For instance, “SVM” as a topic has occurred in papers published by authors affiliated with Oregon State University (slope 0.5), Max Planck Society (slope 3), University of Waterloo (slope -0.5). We can see that the popularity of the topic “SVM” in the Max Planck Society has increased within the observed 10 years.

Each topic is described by approximately 55,000 features (23,000 journals,1,300 conferences and 30,700 affiliations). Each topic is classified as either positive, if it became popular within the span of 15 years or as negative otherwise. Popularity is defined as a large difference in slopes of topic frequency in the 10 consecutive years compared to the following 5 consecutive years. We performed experiments varying the threshold (slope difference) from 1 to 5. A slope difference of 1 in our data results in 34% of examples being labeled as positive while a slope difference of 5 results in 20% of our examples being labeled as positive.

3 Problem Description and Algorithm

The problem we are solving is predicting early indicators suggesting which scientific topics are likely to become important in the future. The core task is to use the data from over 200 years of scientific discoveries from publications and to extract the early signs of a scientific topic becoming popular. Using machine learning algorithms, we have trained a statistical model to classify scientific topics into two categories: those which became important and those which did not. The model was trained on the data from the year 1800 to 2015 to predict which topics will become relevant in the next 5 years from 2015.

For machine learning we used the Perceptron MaxMargin algorithm [2], an improved version of the perceptron algorithm. The improvement is in using two different margins, one for each class:

$MinPosMargin = \frac{1}{\sqrt{BadPosExs}}$ $MinNegMargin = \frac{1}{\sqrt{BadNegExs}}$

Where $BadPosExs$ and $BadNegExs$ are the numbers of misclassified positive and negative examples respectively in the previous epoch of training. In our experiments, we ran 3,000 epochs to build the model (meaning that we went through all the training examples 3,000 times). The learning rate was set to 0.02 in the case of no misclassifications in the previous epoch, and in the case of misclassifications, it was calculated as follows: $LearningRate = \frac{1}{\sqrt{BadPosExs+BadNegExs}}$

As we are training a linear model, by examining the model itself, we can see the weights assigned to the features. The higher the weight, the more important the feature for the positive class. This means that by examining the model, we can see which affiliations, journals and conferences contribute the most to a topic becoming popular in the future.

4 Experimental Results

We split the topics into a training (70%) and test set (30%), where the training set is used to train the model and testing set is used to test the model. The statistical model, trained with the MaxMargin Perceptron algorithm produced the following results on the testing data (see Table 2): Precision: 74.3 Recall: 71.7 F1: 73.0 for a slope difference of 1. This means the model correctly identifies 71.1% of the topics that became popular (recall) and 74.3% of the topics predicted to become popular really became popular (precision). As the slope difference increased the performance decreased, for instance, precision drops from 74.3 in slope difference 1 to 37.9 in slope difference 5. This is likely due to the increasing difficulty of the classification problem as the number of positive training examples decreases. The fact that the classification accuracy increases with the slope difference does not reflect improvement of the model's performance, as it is very close to the majority class (66% at slope difference 1, 80% at slope difference 5).

Slope Diff	Precision	Recall	F1	Accuracy
1	74.3125	71.6824	72.9737	63.1452
2	54.1432	60.3341	57.0712	60.1984
3	44.1246	46.7691	45.4084	69.2293
4	38.8584	47.1334	42.5978	76.6491
5	37.8595	45.1482	41.1838	82.9061

Table 2: Precision, recall, F1 and accuracy on test data for slope difference from 1 to 5.

Figure 2 shows the model's performance (estimated by a combination of precision and recall, F1) for 5 progressively stricter criteria of labelling topics as positive (slope difference 1-5).
We can see that the performance on the training and test set does not differ much on slope difference 1. As the slope difference increases, the performance on the test set drops relative to the performance on the training set.

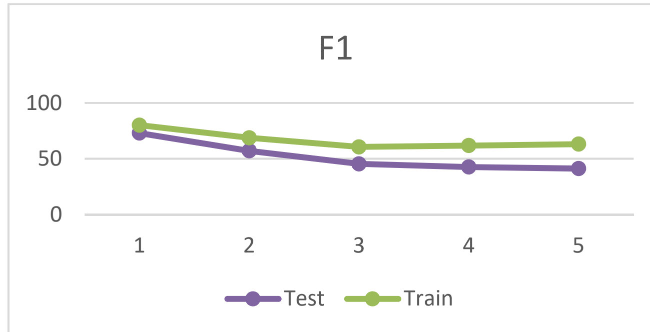

Figure 2: Graph of model performance (measured by F1, the higher the better) for test and train data and 5 slope differences.

Looking at the resulting machine learning model we can see the following: if a scientific topic gets increasing attention from important research institutions (universities and research institutes), and is getting published by important journals and conferences within 10 years from its first appearance, then we can expect the increased use of the topic in scientific publications in the next 5 years.

In addition to the previous experiments, we have also built a perceptron model from scientific publications from 2006-2015.This model was used to predict future popular topics outside our dataset (5 years in the future from 2015). Looking at the results, one can notice several interesting topics predicted as promising. For instance: *proton proton collisions, higgs boson, quark, hadron, mobile augmented reality, variable quantum, molecular dynamics simulations, hadronic final states, search for dark matter.*

If we take a closer look at feature vectors of the promising topics during 2006-2015, we can notice for example that "*search for dark matter*" occurs in 56 papers with affiliation to *Purdue University* with a growing number of publications over the years (slope 4.14).

Another example is "*proton proton collisions*" which occurs in

- 610 papers with affiliation to the *Universite catholique de Louvain* with a growing number of publications over the years (slope 56.5).
- 8674 papers with affiliation to *CERN* with a growing number of publications over the years (slope 295.9).

Looking at the perceptron model trained on the data from 2006-2015, we can notice some of the most influential affiliations, conferences and journals are: *CERN, Journal of Proteomics & Bioinformatics, Industrial Research Limited, Circulation-*

cardiovascular Imaging, Molecular BioSystems, Metamaterials, Atw-international Journal for Nuclear Power, Data Science Journal, IEEE Geoscience and Remote Sensing Letters, Columbia college, Princeton university school of engineering and applied science.

5 Discussion

We analyzed 125 million articles from the "Microsoft Academic Graph" from over 200 years of scientific publications. In order to perform the experiments, we implemented the data preprocessing, feature generation and perceptron algorithm in C++. The resulting model was tested on a random 70/30 train/test split. The results show good performance, achieving F1 73.0%. The model predicts 71.7% of the scientific topics which became important in the history of science.

The possible direction for future work includes repeating the experiments on the new updated dataset, possibly considering the paper abstracts which have been made available in the dataset to be added to our feature set. It might also be beneficial to use the citation graph structure provided in the updated dataset. Another direction of future work would be applying the proposed approach to other similar datasets such as AMiner [3] or the Open Academic Graph [4, 5]. Yet another interesting direction of research would be to compare the performances of different machine learning algorithms and different data representations. Lastly, a more in-depth analysis of the topics predicted to become popular in the future would also be interesting.

We would also like to investigate ways to provide a publicly accessible online version of the system.

ACKNOWLEDGMENTS

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Deep Language Classification for Relabeling of Financial News and its application in Stock Price Forecasting

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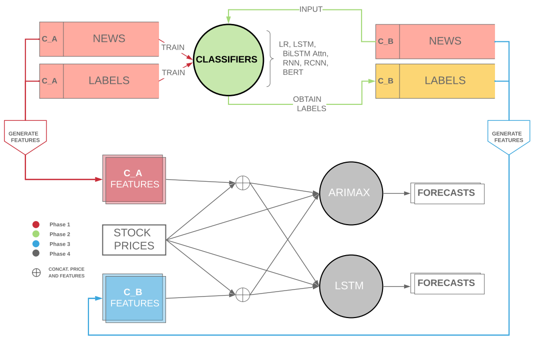

Figure 1: Workflow of the employed methodology.

ABSTRACT

This paper aims at assessing the performance of the transfer learning task consisting of training set of classifiers on high frequency financial news data for 74 publicly traded companies, with domain specific labels. This source of data is provided by the Jožef Stefan Institute and is used exclusively for the purposes of this research. The trained classifiers are then used to attribute labels to an unlabelled source of high frequency aggregated news, *Event-Registry*. The aim is for the relabelled data to be used in the generation of exogenous features for use in time series forecasting of the companies' prices. It is found that using a fine-tuned BERT [1] model yields the most semantically coherent labels, and the features generated from the newly labelled data prove to yield the highest accuracy forecasts on held out price data.

Keywords

Deep Learning, NLP, Language Model, Finance, BERT, Stocks, Forecast

1. INTRODUCTION

In recent years both natural language processing and algorithmic feature and signal based trading have been subject to an increasing level of automation, with statistical methods arguably being at the core of both. While the methods developed in both fields are still largely disjoint, in both these fields there is an attempt at modelling sequential data generating processes, be it natural language or price signals. Furthermore, empirical evidence strongly suggests that the dissemination of news regarding a financial entity such as a publicly traded company will in some way or another affect how active market participants will react.

This paper begins by characterizing the data from both corpora: the domain-specific labelled corpus and the *EventRegistry* corpus will hereby be referred to as C_A and C_B respectively. This data is initially used for the training of word2vec [7], doc2vec [5] and fasttext [2] to generate word embeddings to be used downstream in a set of deep language classifiers: LSTM, BiLSTM with Attention [6], CNN [3], and RCNN [4]; a logistic regression model serves as a baseline. Furthermore, BERT is employed, however as is standard practice, pretrained word vectors constitute the model's initial state which is then fine tuned on the C_A. The trained classifiers are then used to attribute labels from C_A to C_B. While there is no standard metric for the evaluation of the pertinence of the attributed labels, this is approached through employment of semantic similarity metrics and t-SNE in an attempt to extrapolate a relationship between semantic and projected spatial clustering.

The time series forecast setting consists of two separate subtasks performed twice, once on the data from C_A where the true labels are available, hence the feature vector construction is not subject to potential mislabelling in terms of semantic incoherence, then again on the relabelled C_B corpus with BERT labels as basis for feature construction.

Each set of features is used firstly as a series of exogenous regressors in an ARIMAX setting, this primarily in order to gauge coefficient significance and quality of the forecast with respect to the baseline of no exogenous regressors. Concurrently, each set of features is used as inputs to a two layer LSTM followed by a feed-forward net, which allows forecasting of both the stock price and the news series, however it is to be kept in mind that the explicit exogeneity relationship which characterizes ARIMAX is not maintained in the LSTM setting.

2. DESCRIPTION OF THE CORPORA

Corpus C_A consists of 3M timed news headlines between Jan 1st 2006 and Dec 31st 2018. For each headline, the associated label as well as the company in question are given. There are 53 labels however the distribution of labels over the news entries is heterogeneous, resulting in an imbalanced dataset. Therefore a balanced subset of the 120,000 entries per label from the 20 most frequent labels (yielding 2.4M entries) was selected. Of these, the train, validation, test split was selected as 75/15/10. This data split is used in the training, validation and testing of all classifiers examined. The selected subset of data contains news entries from 74

	mean	min	25%	50%	75%	max
C_A	4389	20	1298	2493	5550	37800
C_B	13489	43	2029	5522	14815	236856

Table 1: Distribution of news counts for the 74 companies.

publicly traded companies.

On the other hand, C_B consists of roughly 1M timed news headlines from Jan 1st 2014 to May 31st 2018, exclusively for the 74 companies examined. This is the corpus on which labelling is to be performed. In Table 1 summary statistics for C_B and for the subset of the C_A consisting only of the 74 companies examined is presented, both at their unadulterated frequency. C_A and C_B have a mean news headline length of 11.05, 11.36, with standard deviation of 4.52 and 9.34, respectively. Their empirical distributions are approximately χ^2-distributed.

Finally, a second corpus from *EventRegistry* consisting of 50 *dmoz* labels was made available, however this corpus contains no associated company information. From this corpus, only those headlines whose class belongs to a subset of 20 top level categories, chosen by hand due to similarity with C_A's labels, has been kept. This data subset (hereby corpus C_{B2}) is not used in modeling and plays only a very minor role in the evaluation of the relabelling performance in section 3.3.

3. CLASSIFICATION AND LABELLING

All classifiers are trained on C_A according to the chosen split. This section begins by outlining the methods used for word embedding generation used in all classifiers except BERT, then covers overall model performance. In order to assess the ability for a given classifier to attribute semantically consistent labels to C_B corpus, cosine similarity between the label vector and its neighborhood, defined here as the subset of the 30 words with the highest empirical probability of occurring for each label, according to each classifier, is computed.

3.1 Generation of Word Embeddings

In standard literature, in order to perform text classification the elements of a labelled corpus $C = \{(c, D)\}$, where (c, D) is a class-document pair, the elements $w \in D$, where $D \subset V$ and V is the vocabulary, must be mapped to a vector space, typically $\mathbb{R}^n$, where $n = \{|V|, \mathbf{d}\}$ depending on whether a count based model is used or whether one aims to represent each word as a (typically dense) $\mathbf{d}$-dimensional vector.

In general, a neural embeddings model aims at finding

$$\hat{\theta}, \hat{\mathbf{E}} = \underset{\theta, \mathbf{E}}{\operatorname{argmin}}\ L$$

Where $\mathbf{E} \in \mathbb{R}^{|V| \times \mathbf{d}}$ is the embeddings matrix which can be then passed on to downstream tasks such as text classification, and L is a loss function over the corpus, the context for each word in the corpus, given the embeddings matrix, and all other trainable parameters θ.

In this paper, word2vec, doc2vec and fasttext[1], using Continuous Bag of Words, Distributed Memory (DM), and Bag of Tricks respectively, are used to obtain three separate embeddings matrices given the training corpus. The embeddings are chosen to have $\mathbf{d} = 300$. All models were trained for 20 epochs, with a minimum count of 4, and a context window of size 7. All other parameterizations are as in [7], [5], [2], respectively.

3.2 Classifier performance on C_A

In this section performance of the LSTM, BiLSTM with Attention, CNN, and RCNN, and BERT, is analyzed. Results of training a logistic regression model serve as a basis for comparison.

3.2.1 Logistic Regression

In order to gauge classifier performance all generated word embeddings are used in training a logistic (softmax) regression classifier, as this is taken to be the simplest model trainable on the data[2]. This classifier aims at maximizing

$$P(c \mid D) = \text{softmax}\left(W_c \sum_{w_i \in D} \text{embed}_{\mathbf{E}}(w_i)\right)$$

where the summation term yields the embedding for the document[3]. The classifier is trained on all three sets of word embeddings, with 72% average class accuracy for fasttext, 69% for word2vec and 68% for doc2vec. The labels attributed to misclassified samples for each class are generally evenly distributed amongst the other 19 classes.

3.2.2 Deep Word Embedding Classifiers

LSTM, BiLSTM with Attention, CNN, and RCNN are the four deep classifiers tested. As fasttext embeddings have yielded the highest accuracy on C_A, these will be the embeddings used for these models. This choice does not in general guarantee classifier optimiality, however it gives grounds for standardized comparison. In order to further enforce this, all LSTM-based models were trained with the following common hyperparameters:

|V|	d	LSTM_out	batch_size	epochs
263,088	300	256	64	5

For all LSTM-Based models the initial hidden and cell states were set as $(h_0, c_0) = (\mathbf{0}, \mathbf{0})$. For the CNN the following hyperparameters were given. The model was trained for 5 epochs with the same embeddings as the previous cases. Furthermore, one channel was used in input and eight in output. Kernel sizes were 2,3,4, the stride was set to 2 for all layers and the vertical padding to 1.

All models were trained using Cross Entropy as the loss function and ADAM as the optimizer, with a learning rate $\eta = 10^{-3}$, no weight decay, and numerical stability parameter $\varepsilon = 10^{-8}$.

[1]No subword information was used as no significant accuracy was gained in subsequent use of the embeddings.

[2]Logistic Regression with Bag of Words as input, trained on a subset of data exclusively from the year 2017, yields an average class accuracy of 70%

[3]Obtaining the document embedding from the word embeddings is not a trivial problem, however addition is sufficient for the purposes of this classifier.

3.2.3 BERT

BERT leverages masked language modeling and the enocoder from the transformer archictecture in order to learn contextually coherent word representations. Unlike the previous cases BERT is initialized with its own pre-trained embeddings; all hyperparameters are kept as in BERT-Base as specified in [1]. The model was trained for 5 epochs.

Given that BERT uses wordpiece for tokenization, the size of its pretrained vocabulary is not indicative of the true dimensionality of vocabulary space. The model was adapted for classification trained using Cross Entropy as the loss function and ADAMW as the optimizer, with a learning rate of $\eta = 10^{-3}$. Furthermore a scheduler with a linear warmup is implemented, with 100 warmup steps.

For all models, a weighted average of precision and recall, along with the F1 scores of the best and worst scoring classes are given in Table 2.

3.3 Evaluation of Labelling on C_B

In order to attempt at quantifying the pertinence of the domain-specific labels attributed to C_B, the cosine similarity between the label and and the 30 most frequent words attributed to it (net of english stopwords and special characters), constituting a threshold on the empirical distribution of words for each label, is computed for all classifiers; then, the empirical similarity quartiles are computed for said classes, and the maximum over all classes for each quartile is reported[4]. In order to have some idea of how this compares to labelled data, this is repeated both for C_A and for C_{B2}. The results are reported in Table 3[5].

In accordance with intuition, those labels with worse test performance across models have a less relevant set of top words associated to them. It is interesting to note how the similarity between BERT's attribution of C_A's labels on C_B is in all cases higher, and the standard deviation lower, than is the case with C_{B2}. It is to be noted that these are not fair grounds for comparison as the corpora are different, however this does point to BERT's ability to capture semantic similarity in a more 'natural' manner than the other models.

4. FEATURE GENERATION FROM NEWS

Feature vectors are constructed by taking the relevant news events for each company for all trading days between Jan 1st 2014 to Dec 31st 2017. For each trading day, for each company, the count of the events for each category is assigned as the elements of the feature vectors (20 dimensional). The labels are the original ones for C_A, and C_A's BERT-attributed labels for C_B. The price series data used is the daily close price adjusted for dividends. The following operations were performed in order to assure consistency in the construction of feature vectors, for each company:

- For each day, obtain the feature vectors as described above for three time intervals: Pre-Hours (00:00-09:30), During Trading Hours (09:30-16:00) and After Hours (16:00-24:00). Any day over the entire year (365 days) where no events happen is attributed a zero vector.[6]
- Given the adjusted close price is being used, the assumption is made that today's close will be affected by news from today's pre-trading hours, today during trading, as well as yesteday's after hours. Therefore yesterdy's after hours vector is added to today's pre-trading hours vector and to today's trading hours vector.
- Given that the trading days a year are 252, feature vectors indexed at a non trading day are made to contribute to the next trading day (ex: the resulting feature vectors for a weekend are added with next monday's).

This construction assures the removal of any look-ahead bias (we are only interested in the scenario where the news affects the price, and not when the news event manifests itself as a reaction to a change in the stock price), however this construction does assume that news on a given day takes at most one trading day to incorporate into price.

5. FORECASTING USING NEWS

In this section the predictive performance for feature vectors generated from both C_A and the C_B with BERT-attributed C_A labels will be evaluated. The training period is the first three trading years: Jan 1st 2014 - Dec 31st 2016, and the held out period is the last 52 weeks.

5.1 Features as exogenous variables

An ARIMAX model is initially employed to test for significance of the categories of the events. In this setting, each dimension of the feature vectors constitutes a univariate time series. It is therefore these 20 exogenous series which are used as regressors in the ARIMAX setting.[7] For each price series the optimal order, ARIMA(p, d, q), is computed based on SBIC, and the inferred order is maintained when including the respective exogenous variables[8]. It is found that 3.68 ± 2.07 categories are statistically significant in predicting the price for C_A, and 1.78 ± 1.55 for C_B.

5.2 Features as inputs in LSTM

A unidirectional two-layer LSTM network is employed in order to gauge performance of price as well as news forecasting. The inputs to the networks are, for each time step, the 10 previous observations for both the close price and the 20 news series. Minmax scaling is used in order to render the input space more isotropic and promote gradient stability; all variables are then rescaled after training.

In Table 4 error metrics are computed for the holdout period from Jan 1st 2016 to Dec 31st 2017 (the final year of data). The Diebold-Mariano test is computed pairwise for each forecast: C_A, C_B, and the vanilla ARIMAX and LSTM

[4]The maximum is taken as the relabelled dataset is in all cases unbalanced.

[5]In addition, t-SNE is used to project label and neighborhood into $\mathbb{R}^2$; observable clusters are, expectedly, less well defined on the relabelled C_B than the clusters identifiable when projecting C_A.

[6]This yields 22K, 40K, 49K events for C_A, and 218K, 270K, 367K events for C_B, for the respective brackets.

[7]The training period must for some stocks be lengthened to compute coefficient significance (guarantee exogenous nonsigularity).

[8]Inferred order directly including exogenous series would sometimes yield $p = q = 0,\ d = 1$; this is never the case on just the series.

Model	Embed	Wavg. Precision	Wavg. Recall	Best Class	F1	Worst Class	F1
LR	fasttext	72%	70%	Exploartion	1.00	Insider-Trading	0.35
LR	word2vec	72%	69%	Exploration	1.00	Insider-Trading	0.35
LR	doc2vec	73%	68%	Credit	1.00	Insider-Trading	0.28
LSTM	fasttext	74%	74%	Credit	1.00	Labor-Issues	0.46
BiLSTM	fasttext	71%	68%	Investor-Relations	0.85	Marketing	0.40
CNN	fasttext	75%	74%	Credit	1.00	Analyst-Ratings	0.41
RCNN	fasttext	75%	73%	Exploration	0.99	Insider-Trading	0.44
BERT	BERT	79%	78%	Legal	1.00	Stock-Prices	0.52

Table 2: Model Performance on C_A's Test Set.

	LR	CNN	RCNN	LSTM	BiLSTM	BERT	C_A	C_{B2}
mean	0.142	0.103	0.118	0.119	0.148	0.388	0.507	0.281
std	0.282	0.274	0.285	0.274	0.272	0.294	0.381	0.334
min	-0.219	-0.213	-0.213	-0.213	-0.213	-0.107	-0.054	-0.150
25%	-0.021	0.009	-0.021	-0.017	0.067	0.176	0.365	0.143
50%	0.165	0.126	0.155	0.107	0.145	0.395	0.579	0.282
75%	0.316	0.269	0.294	0.301	0.279	0.610	0.762	0.435
max	0.666	0.667	0.668	0.666	0.745	0.802	1.000	1.000

Table 3: Maximum cosine similarity quartiles across all classes for all models on C_B. The last two columns act as a baseline showing similarity scores for the two labelled corpora.

	mae	rmse	minmax	D.M.		
ARMIAX						
NONE	4.916	5.898	0.063	-	24	25
C_A	4.399	5.614	0.055	35	-	44
C_B	4.376	5.482	0.061	31	47	-
LSTM						
NONE	7.158	8.033	0.103	-	20	31
C_A	1.553	1.930	0.018	22	-	41
C_B	1.001	1.348	0.015	50	54	-

Table 4: Median forecast error metrics across all stock prices and forecast disparity counts between models (number of stocks for which a given forecast prevailed).

forecasts respectively.[9]

It is found that when no news is used the model is more likely to learn a degenerate prediction (a constant) than when news is used as input. However, forecasts using news are for all nondegerate cases more volatile than those without. Since this behavior appears to be pseudo-deterministic, degenerate predictions were left in when calculating error metrics and performing the DM test.

6. CONCLUSIONS

In the present work it has been shown that BERT is able to perform the classification task with the highest accuracy out of all models, as well as yield the most semantically consistent labels on the previously unseen corpus C_B. Furthermore, it has been shown that utilizing features generated from news for forecasting stock prices for the given sample of companies over the selected interval yields significantly better predictions than not using news for ARIMAX. The LSTM network however seems to predict prices with much higher accuracy in all nondegenerate cases, with news features from C_B yielding the set of predictions with lowest median error across all measures, indirectly pointing to BERT's efficacy in relabelling. In terms of news forecasts with this model however, it is with C_A's data that news series forecasts are on average more reliable.

[9]While the test does assume the loss differential to be covariance stationary, which isn't often the case for ARIMAX, plotting all three sets forecasts for this model class seems to empirically validate the vedrict of the test statistic (in cases when $DM \sim \mathcal{N}(0,1) \gtrless \pm 1.96$).

7. ACKNOWLEDGMENTS

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Semantic Enrichment and Analysis of Legal Domain Documents

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ABSTRACT

In text mining document enrichment processes are used to improve information retrieval. Document enrichment helps us extract metadata from the text which can then be used in document classification.

This paper presents the legal domain document enrichment process and analysis of the enriched data. The process of enriching the documents with multiple layers of annotations is described. The focus is on legal domain documents data set, but the proposed procedure can be generalized to any type of documents.

Keywords

document enrichment, semantic annotations, ontology, analysis, legal domain

1. INTRODUCTION

Document enrichment process helps to improve information retrieval. Nowadays, more and more data has to be processed which makes information retrieval systems extremely valuable. Using document enrichment, more information can be gained about the documents which can be optimized for retrieval.

In the legal domain, extracting meta data about the legal domain documents improves building search engines which are designed to help lawyers efficiently access documents related to a certain topic. In this paper, we present an enrichment process of the legal domain documents. Different types of annotations are used to enrich the data; word-level features which are associated with word information, Wikipedia concepts gained by the process of Wikification and InforMEA ontology terms that cover the field of Environmental Law and Governance. Next, preliminary analysis on the enriched documents is used to review the results. Throughout the paper the focus is on legal domain documents. This approach can be generalized to other document data sets. Our contribution is applying semantic annotation and mapping with ontology on environmental legal domain documents.

The remainder of the paper is structured as follows: Section 2 is related work. Next, the data set is described in section 3. Section 4 presents the methodology used for the document enrichment process. Analysis of the results is in section 5 and finally, we present future work and conclusion in section 6.

2. RELATED WORK

Much work has been done on semantic enrichment of text. Some tools provide a generic pipeline that can be applied and embedded into more complex pipelines. Such pipelines include word and sentence tokenization, part of speech tagging, dependency parsing, and named entity recognition. Examples of such tools are software packages or libraries for different languages, like Spacy [5], Scikit Learn [14], Stanford CoreNLP [11], and MITIE [4].

Semantic enrichment methods have been used to improve the features when building classification models of documents in different domains. An example of this can be found in [7], where two levels of semantic enrichment were used before and after training to classify medical domain documents. In [1], they used dependency parsing, ProbBank [9], and hypernyms from WordNet [13] among other syntactic and semantic features to build relation classification models for the SemEval-2010 Task 8. We also see in [10], the use of mapped cross-domain ontologies in improving information retrieval in the biomedical and chemical domain documents.

In this paper, some of the tools and techniques will be used plus others, mentioned above, and applied to the legal environmental domain documents, providing further analysis about information extracted from the corpus based on the enrichment process.

3. DESCRIPTION OF DATA

We used EUR-Lex, an online service that provides different documents regarding the European Union, as a source to extract our data [3]. For each document, a set of descriptors or keywords was provided among other metadata, in addition to the document title and text. Based on the descriptors and the language of the text, the environmental legal documents were filtered which were provided in the English language and used as the main source of data for document enrichment. The resulting data set, after filtering and cleaning, was around 72k documents.

After preliminary inspection of the data, the documents vary greatly in length. The longest document contains about 560k words whereas the shortest contains 27 words. Nevertheless, approximately 99% of the documents have less than 30k words, 90% of them have less than 5k words and 66.6% have under a 1000 words. Sometimes it can be noticed that classification models produce better results on sets of documents with similar length. Mentioned numbers indicate the potential of providing more precise classification on a set of documents where only few documents are removed from the initial data set.

4. DATA ENRICHMENT PROCESS

4.1 Standard NLP pipeline Annotations

As a first step in data enrichment process, the traditional natural language processing analysis methods were used. The Stanford CoreNLP library was chosen, which is a set of human-language technology tools developed at Stanford University [11]. Using the library, the documents were tokenized into words and then a set of basic syntactic and semantic information was extracted for each word:

- The tokenized word
- The lemma, or dictionary form of the word
- The part of speech of the word in the text.
- Set of synonyms for the word using WordNet lexical database [13], when applicable.

In addition, entity recognition methods were used to identify entities that were categorized into following 11 category classes:

- Named entity classes: PERSON, LOCATION, ORGANIZATION, and MISC
- Numerical entity classes: MONEY, NUMBER, ORDINAL, and PERCENT.
- Temporal entity classes: DATE, TIME, and DURATION.

The MISC category represents an entity mention that was not classified in any of the mentioned classes. An example of these entities are document types ('Regulation') and languages ('English'). Other classes are self-explanatory.

4.2 Wikification

The second annotation step was wikification, which is extracting entities with a relevant Wikipedia concept from the text.The JSI Wikifier tool was used, which is a service developed in Jozef Stefan Institute, that annotates a given raw text with annotations each representing a Wikipedia concept [8].

For each document in our data set, we used Wikifier on the raw text provided and obtained a list of annotation objects; each contains the following information:

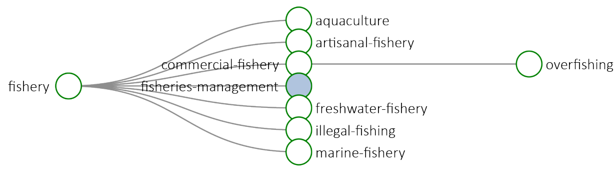

Figure 1: A snapshot that contains a subset of the InforMEA ontology tree.

- The annotation name representing the Wikipedia concept
- Wikipedia page URL of the annotation
- Wiki data classes: the set of classes from WikiData knowledge base [6] that this annotation belongs to.
- One of the DBPedia [1] identifiers that corresponds to the annotation.
- The page rank score of the annotation.
- The cosine similarity between the the document text and the Wikipedia page that the annotation represents.

4.3 InforMEA Ontology

Finally, to provide information about the potential environmental categories that the documents are categorized into, InforMEA ontology was used to map the document with relevant environmental ontology terms. The ontology has 532 unique terms that form a hierarchical structure based on the 'broader' relation between ontology concepts. A subset of the ontology tree visualization representing the branch 'fishery' is shown in figure 1. More detail, along with the ontology tree, is available on GitHub [12].

To annotate the documents with InforMEA Ontology terms, a simple string matching method was used between the ontology terms and the metadata provided. For each document, the following enrichment data was used to search through for words that matched with any ontology terms:

- The normalized words of the documents
- The synonyms of those words
- The wiki-data classes of the Wikipedia annotations extracted from the document

The reason for using the wiki-data classes instead of the Wikipedia concepts themselves is that the Wikipedia concepts are usually too specific to match with an ontology term, whereas the Wiki data classes represent the topic or the category that this concepts falls into. In fact, the Wikipedia concepts were included in the initial experiments, but had to be omitted later as they did not produce any matches.

5. ANALYSIS OF RESULTS

After annotation was done, extracted information was analysed to get an initial evaluation about the nature of the corpus.

Content analysis produced the most frequent words which are associated with document type or legal body, such as council, state, and member. After removing stop words and numbers as they were not relevant, the TF-IDF analysis produced similar outcomes to the normal word counting analysis. The TF-IDF analysis is presented as a word cloud in Figure 2.

Figure 2: Words with the highest TF-IDF value counted over all documents. The TF-IDF value measures the importance of the word to a document.

Out of the 72k documents in the corpus, 157k unique Wikipedia concepts were extracted, with only 22 of them having occurrences in over 10k documents. Furthermore, about 50k concepts appear in only one document and 100k concepts appear in up to three documents. This indicates that most of the concepts are unique to the documents. In regards to Wikipedia concepts, the most frequent Wikipedia concepts are shown in Figure 3. The majority of the concepts can be associated with the European union. From the same figure, some concepts can be associated with law and environment, such as "law", "agriculture" and "regulation". This indicates that the process of wikification is able to acquire relevant information. In addition, Geo-spatial concepts are extracted through the process. Their presence can be acknowledged in the country names which are also amongst the most frequently found Wikipedia concepts. Nonetheless, the wikification process was able to find concepts for which connection with the documents is not clear. This will be investigated in future work.

When inspecting the entities extracted, it was observed that 18M entities were obtained through the annotation process with 1.08M distinct entities. Entities were categorized into 11 classes mentioned in the section 4.1. Figure 4 shows the distribution of the classes across all documents. The most frequent class was NUMBER. Numbers appeared in page numbers, article numbers and other similar locations. After removing the NUMBER class, the number of unique entities became 483k. The classes which were the most interesting were LOCATION, ORGANIZATION, and PERSON, since these classes can help in identifying people and organizations that are mentioned in the legal documents, and locations enable the mapping of the legal documents with the geo-spatial information.

Most frequently occurred LOCATION named entities were country names. In the ORGANIZATION class legal bodies were mainly found; almost all of them were associated with the European Union. In almost every document at least one ORGANIZATION and one LOCATION entity appeared.

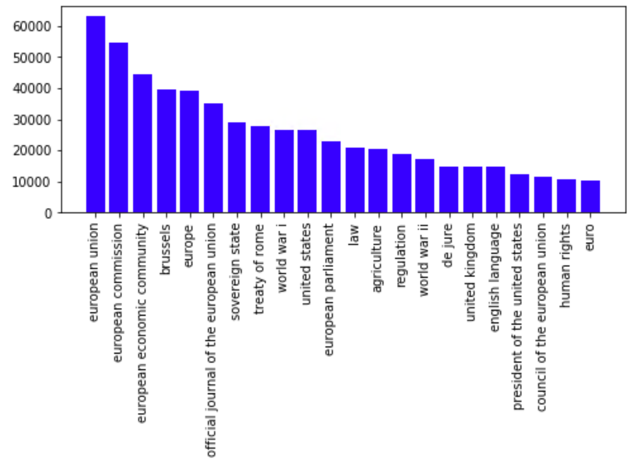

Figure 3: The most frequent Wikipedia concepts found in the enriched data set. The majority of the concepts are associated with law, environment and geo-spatial features.

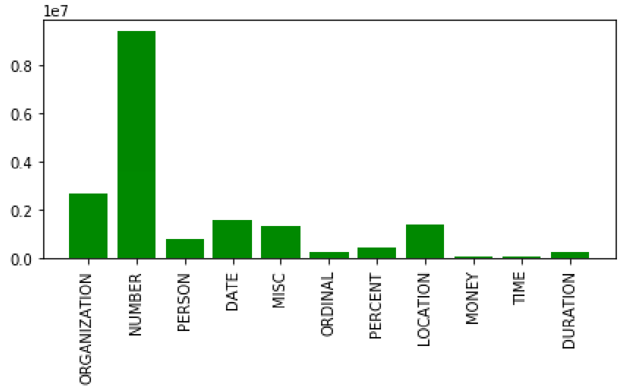

Figure 4: Distribution of 11 entity classes in the annotated data set. The class with by far the highest frequency is NUMBER; we can find them in page numbers, article numbers and other similar locations.

In comparison to Wikipedia concepts and entity results, a similar pattern of results was obtained from the analysis performed on the word-level features. Therefore, we omit the representation of the outcomes.

Finally, the analysis of the InforMEA ontology mapping is presented. The mapping was done between ontology terms and terms from Wikipedia data classes, normalized words and word synonyms. The distribution of most frequent ontology terms is presented in Figure 5.

The most frequent ontology term 'committee' can be found in other annotation classes as 'commission'. Additionally, ontology terms associated with organizations, logistics and the environment appear amongst the most frequent ontology terms.

6. CONCLUSION AND FUTURE WORK

In conclusion, a semantic enrichment methodology consisting of three main processes; annotation, wikification and

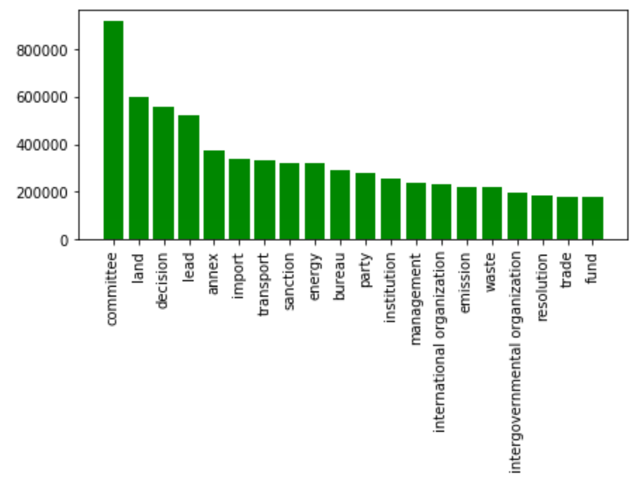

Figure 5: The 20 most frequent ontology terms. Terms are chosen from the aggregated set of normalized words, word synonyms, and wikidata classses of the extracted wikipedia annotations.

mapping to the InforMEA ontology, was performed on legal domain documents. In addition, the analysis on the extracted metadata was provided on the corpus scale to examine the nature of the dataset semantics.

Based on the analysis, some problems were observed with the wikification process as it produced a few unrelated matches. The plan is to address this problem in more detail, observe the reasons behind them, and if possible, try to partly solve the problem.

Regarding the named entities annotation, consideration of adding more finely-tuned annotations, like geo-spatial locations, would help in providing more accurate metadata about the documents. Furthermore, improvement could be made on the baseline string matching that was used to match documents with InforMEA ontology terms. By building classification models, the intention is to use the extracted annotations as features among others.

Finally, the enrichment was mainly done to provide additional metadata on the documents that will be used in later processes. Later plans for further work will be to use the annotations in query expansion to improve legal document retrieval.

7. ACKNOWLEDGMENTS

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Health News Bias and its impact in Public Health

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ABSTRACT

The impact of health-related news in today's society is increasing as is the awareness of the globalization of the worlds' habits and threats, and the impact on the continuous pursuit of a better quality of life. The risk of news media bias and the consequences it might have in the population is of great concern for public health, as are the available resources to identify the bias and further explore the news stories. In this paper we discuss several aspects, angles and perspectives on news media bias in the health domain, with a particular focus on digital epidemiology. We also present decision support tools developed to support decision makers in these explorations in the context of the MIDAS project, leveraging Big Data analytics to support decision making in public health. The presented resources provide health professionals with a global perspective on the worldwide news coverage of monitored health topics (such as, e.g., infectious diseases, mental health or childhood obesity), together with a workflow of tools allowing them to explore potential bias. Moreover, we discuss the specific challenges of news bias in the health domain, analyzing some typical examples, and using the Event Registry technology to further explore them. The exploration potential of the latter, in the health domain, is enhanced with the integration of an automated classifier based on MeSH Headings that allows researchers to explore the news using a similar workflow to that of exploring biomedical research in PubMed.

CCS CONCEPTS

• Information Systems • Human-centred Computing • Life and Medical Science

KEYWORDS

Data mining, health news, news media bias, Big Data, Public Health, digital epidemiology

1 HEALTH NEWS MEDIA BIAS

News media bias is a ubiquitous phenomenon that has generated various research studies in different fields. Practically any media outlet can be biased, but the public should be aware of it and news media bias should be minimized thereby offering more objectivity to the news reporting. Health related news, in particular, have a high impact on the population that tends to be more sensitive to their content. It is fairly well known that the media plays an influential role in public responses to health issues [6]. Although, the bias in health-related news can be considered in the same light as the overall news bias, with similar effect in most cases, it also has very specific aspects deriving from the domain it is based on and the kinds of stakeholders it relates to. Often, the complexity of the information (due to the continuous innovation in medicine) along with the lack of detail can lead to misinterpretations and unconscious bias both at the media outlet and its audience. This is a common problem in the communication of science [13].
Examples of these are frequent in the context of precision medicine, where some difficult concepts and methods from genetics and life sciences play a key role while being a sensitive topic within the common public opinion.

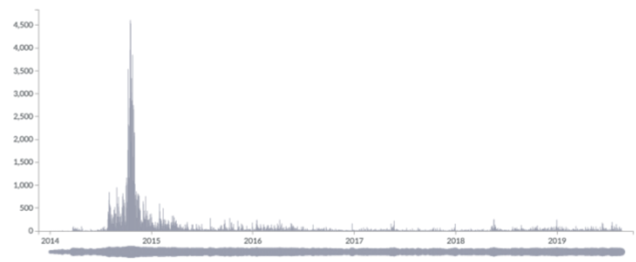

Figure 1: MIDAS news dashboard screenshot showing a temporal intensity visualization module for the query *Ebola virus disease* to analyze and compare the media coverage on the disease outbreak during 2014 and 2019, considering only news sources located in the USA.

Another angle on news media bias is the amount of news on certain disease-related aspects, that are more abundant in media sources that are located far from where they are occurring, providing us with an idea that the occurrence is local. An example of this in the public health scenario, is the large amount of news published by news sources located in the USA about the Ebola outbreak, and the small number of cases detected in this country. The frequency of news items can be sometimes confused with its potential impact in the local citizens, by the less informed audiences. The transfer of that unclear message to a diversity of social media channels is then inevitable, as well as the subsequent accelerated proliferation of the misinformation and unconscious news bias.
The chart in Figure 1 shows two perspectives on health news bias while representing the news on Ebola virus disease media coverage limited to news sources in the USA. On one hand the peak in 2014 is not representative of the low number of cases identified in the USA. On the other hand, the weight of the disease in 2015 and now in 2019 is not representative to the high relevance of this topic to the global public health today. In July 17, 2019, the World Health Organization (WHO) was once again announcing an Ebola Outbreak in Congo with public health emergency of international

concern [14]. Though, the news coverage this time is much more local than it was back in 2015 as the reader can see in Figure 2.

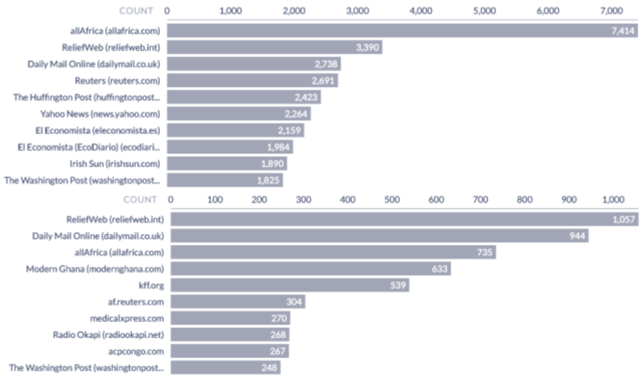

Figure 2: The coverage of the Ebola outbreak in 2014 (above) and in 2019 (below), showcasing the very different top 10 news sources covering the similar event.

A well-known generator of health news media bias was the case of the Google Flu Trends, a good example of collective intelligence estimating the influenza activity for more than 25 countries. This system was based on the queries for influenza related keywords on the Google search engine [3]. The Influenza season of 2012/2013 showed the inaccuracy of this system that, until then was closely following the data collected by the Centers for Disease Control (CDC), as seen in Figure 3. Although being more a case of algorithm bias per se, it was the responsible for false conclusions that could have had a bigger impact without the classical mechanisms in place by National and International Institutions.

2 CHALLENGES OF HEALTH NEWS

Unlike most news topics, health related topics are often close to the interest and well-being of the general public, with a large impact in the social media [2]. An example of that is the ongoing worldwide public discussion about child vaccination. However, aside from the popular diseases (such as influenza, measles, etc.), the media coverage is often not complete or does not provide an accurate coverage (not all topics are *news worthy*). The rising popularity of a certain disease implies the increase of the references to it in the media, not in parallel with the status of the disease itself. This sometimes falls into what is known as *mainstream bias*, i.e., a tendency to report what everyone else is reporting, and to avoid stories that will fall out of the core of popular news.

On the other hand, the awareness of a certain disease or the general status of public health is not always well represented in the media. Most of the times this lack of representation reflects the incomplete awareness of the general public to the state of the health nationwide. It is also the case when that awareness is higher in some countries and smaller in others. This is often the case differentiating the so-called developed countries to the so-called 3rd world countries. An example of this is the coverage of the news about the Zika virus outbreak in 2015/16.

Another angle that is relevant to this discussion is the different concepts of news media bias and what is 'news-worthy' discussed in [5]. Although the acknowledged importance of a complete global coverage of the status of the health of the population, some aspects of health have higher priority than others, independently of their relevance in the Public Health context. These priorities are defined by the media houses and publishers according to the expectation on the impact that the news will have in their audiences. In a more extreme sense, sensationalism is the bias in favor of the exceptional over the ordinary, aiming to give the impression that rare events, such as a victim of the Ebola outbreak in the USA, are more frequent than common events, such as a child with Type 2 Diabetes originating from obesity and a sedentary lifestyle.

A more accurate analysis of the media coverage of an epidemiological phenomenon needs to be handled in the same way studies are. While an epidemiological study results may reflect the true effect of an exposure to the development of the outcome under investigation, it should always be considered that the findings may in fact be due to an alternative explanation [8].

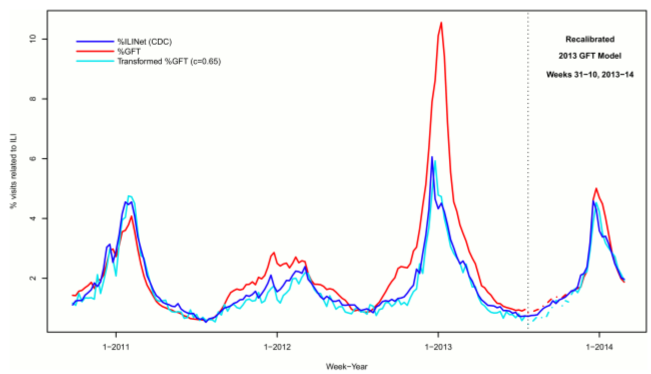

Figure 3: Incorrect estimations of the Google Flu Trends (in red) based on online queries, against the CDC (in dark blue) for the influenza season of 2012/13 [10].

3 THE TREND OF CHILDHOOD OBESITY IN WORLDWIDE NEWS

In the following section we focus on a specific Public Health priority, the well-known epidemiological case of childhood obesity that is of a major EU concern. To do that we will use Event Registry (ER), customized by the MIDAS Horizon 2020 project, funded under 'Big Data supporting public health policies' to develop a Big Data platform that facilitates the utilization of healthcare data, making that data amenable to enrichment with open and social data [1]. The Event Registry system collects and annotates in real-time news articles published by over 100,000 news publishers worldwide [4]. It provides the user with public health news articles in more than 10 languages as well as world events mentioned in these articles, permitting to explore what is currently being reported about in the media worldwide. ER can (a) identify and download news content from publicly available news sources, (b) analyze and semantically enrich the articles regardless of the language, (c) combine the articles that report about the same event into a single event, (d) extract the relevant event information and (e) make all information searchable [7]. The worldwide health monitoring potential of this tool was discussed in [12] in the context of public health decision-making support, in particular as an epidemic / pandemic intelligence tool [15].

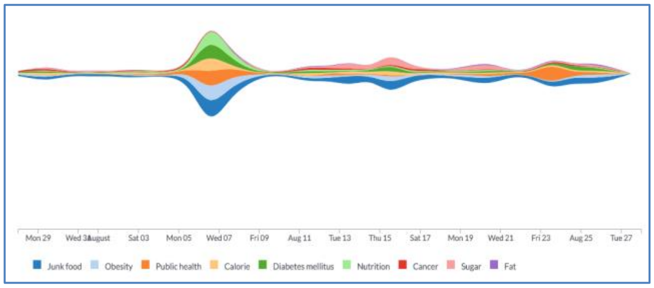

Figure 4: The concept trends associated with the query “childhood obesity” over the worldwide news in the past three years, highlighting related topics such as cancer, diabetes, nutrition, junk food or sugar.

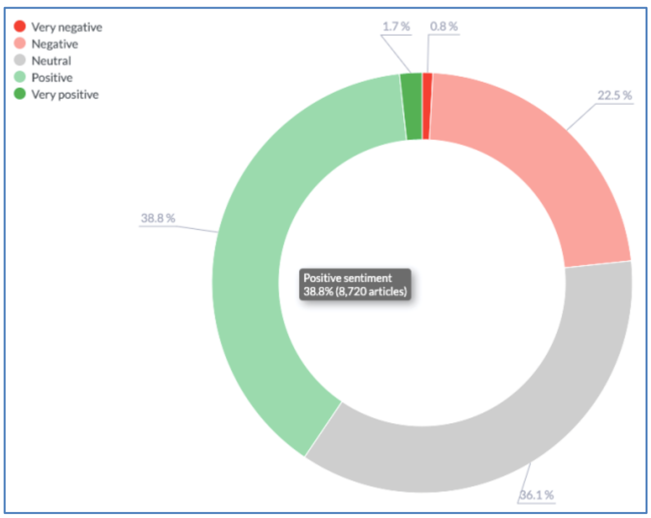

Figure 5: The sentiment analysis of worldwide news relating to “diabetes melitus type 2”, with a 38.8% of positive sentiment identified highlighting the good results of the continuous efforts done to overcome this problem of modern society.

The user of ER can, query the dataset of worldwide news on “childhood obesity” to explore the trends and major concepts related with this query through the mentions in worldwide news (see Figure 4). Trending information is computed by comparing how frequently individual concepts/categories are mentioned in the articles. By default, trends are computed by comparing the total number of mentions of a concept in the last two days compared to the number of mentions in the two weeks before. The trend for each concept is computed as the Pearson residual. The returned concepts are the ones that have the highest residual [9]. The sentiment analysis in Figure 5 over the topic “diabetes melitus type 2” serves as a base of discussion to another angle on other aspect of news bias in the health domain: the sentiment expressed over news on a disease. The example shows that, although the immediate negative sentiment over such a topic, the positive sentiment can be identified in the good results from the continuous effort on fighting such a modern societal problem. In Figure 6 we show a screenshot of the pie chart of categories of worldwide news associated to the query “childhood obesity”. In that visualization module we observe that the media coverage of school meals nutrition in the context of public health was only 0.36% of all the news about childhood obesity during 2018. On the other hand, there was a coverage of 4.42% on child welfare in the context of the Society category, while the coverage on the business about sweeteners was 0.94%.

4 IMPACT IN PUBLIC HEALTH DECISION MAKING

Research in the field of automatic detection of news media bias shifts its attention to sentiment analysis and opinion mining in the news. Most sentiment and opinion mining analysis has been done on very subjective texts like product launch reports, movie reviews or blogs, where the opinion of the author is expressed freely in a very subjective and biased way. Recently, sentiment analysis of news articles, where an opinion of a journalist should not be present, is getting more attention. An example of such an approach is the news media bias analysis of finding over and under-stated facts of a particular news outlet [11].

In the example of Figure 1, the event of the Ebola outbreak is identified immediately after the news articles that report about it are collected. One can explore the evolution of the news publishers awareness of the epidemics in a timeline by looking at the related news articles represented in a world map, as they were identified or updated during a selected period of time. ER can find articles and events related to a particular entity, topic, date, location or category, as well as measure their impact on social media (Twitter).

For each world event, ER is able to provide extensive information. Its event clustering permits us to distinguish between subtopics and perspectives in the stories relating to that particular event. Beside the whole list of articles that describe the event, the user can also see the list of top concepts, the trending of the articles, and subcategories it falls into. If a user is not interested in all events, (s)he can easily limit the list of articles and events displayed based on specific interests, location, etc.

In particular, Governmental Institutions are interested on what is the public opinion over public health related legislation such as the Sugar Tax, where sentiment analysis can be an approach with great potential. This and related measures were applied in several EU countries to fight against childhood obesity and consequential diseases such as diabetes mellitus type 2. The role of social media is of great importance in this context but also contributes with a lot of noise. A query on “Sugar Tax” in ER allows us to identify not only the news articles about this measure but also the social media mentions of those news items, permitting the user to estimate the impact of the issue in the population.

A new version of ER is in development, integrating an automated annotator assigning MeSH Heading descriptors to snippets of free text provided by the user. This will allow the annotation of the news articles with those useful classes, designed to enhance the exploration of biomedical research in the well-established search engine PubMed. The latter is part of the workflow and know-how of most health professionals. The new ER instance, built in the context of the MIDAS project will allow those health professionals to explore the worldwide and local news using the MeSH Heading descriptors much as they use them in their searches in PubMed. The new system will also provide MeSH Heading-based visualization modules such as the one discussed above and in Figure 6, providing an efficient perspective of the news coverage over subtopics of the search query, allowing for a fast identification of potential news bias, designed for the health domain, to support decision making in public health.

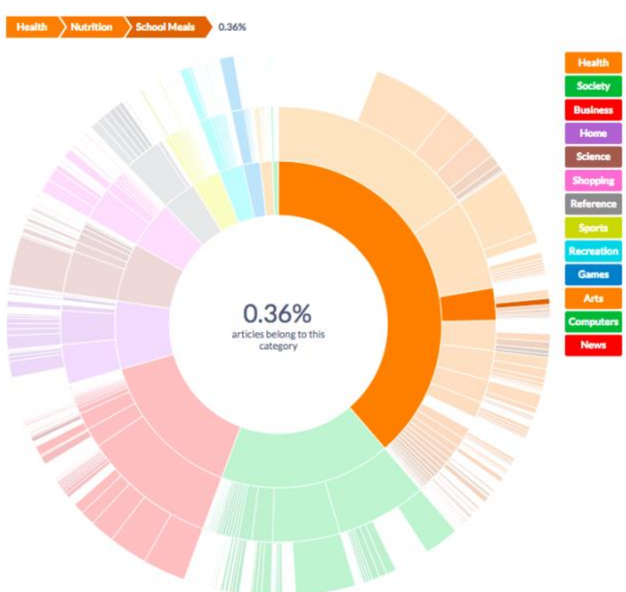

Figure 6: The categories associated to the query "childhood obesity" over the worldwide news during 2018. This shows that the media coverage of school meals nutrition in the context of public health was only 0.36% of all the news about this topic.

5. CONCLUSIONS AND FURTHER WORK

Media bias is a universal concern. Despite the fact that newspapers and reporters or journalists are supposed to provide the readers with impartial, objective, unbiased and reliable information, the reality is somehow different. Every news story has a potential to be biased. Every news story has a potential to be influenced by the attitudes, cultural background, political and economic views of the journalists and editors. In this paper we have discussed several angles of the news media bias in the context of health-related news with a particular focus on epidemiology. We have also presented some approaches and tools that permit data exploration and can help balancing the information in worldwide media coverage.

This includes some of the ER visualization modules which can help us to explore what is the news coverage of a certain health-related measure feeding the general population awareness. Moreover, the upcoming Event Registry instance built in the context of MIDAS will be offered with an automated MeSH classifier of text. This open source service will be used to classify the news with the MeSH headings and will enable queries using these. That will permit researchers to be closer to the information they are looking for, using a similar workflow as the one used in queries over PubMed. That will be useful to health professionals in particular that use PubMed daily in their biomedical research, and fully understand the usability of the MeSH descriptors. We will further analyze news bias when the first results of early adopters are available. Further work also includes the bias detection through advanced text mining techniques. This includes the analysis of the used metrics that can be itself a potential bias generator.

ACKNOWLEDGMENTS

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Latent distance graphs from news data

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ABSTRACT
Network analysis is one of the main topics in modern data analysis, since it enables us to reason about systems by studying their inner relations, for example we can study a network by analyzing its edges. However, in many cases it is impossible to detect or measure the network directly, due to noisy data for example. We present a method for dealing with such systems, more concretely we present a probabilistic model called latent distance network, which we use to model news data from **EventRegistry**. In the end of the article we also present experimental results on predictions of latent distance model with methods of machine learning.

1. INTRODUCTION
News articles offer a constant stream of new information about business activities, political events, natural disasters and a variety of other topics. Finding structure in such data is inherently difficult, because of the high levels of noise, repetitions and lack of structure. In order to systematically extract useful information from news, [6] developed a system called **EventRegistry**. It is able to collect news articles from various sources and languages, group them together according to their content and then extract relevant information from the texts about the grouped articles (entities, people, locations, topics). The groups of articles about the same content are called events and in this work we will explore the structure of connections between various topics of such events. Namely we will build a network of connections between topics that appear in the news events, track the evolution of connections through time and predict future relationships.

This will be done through the framework of latent distance graphs, because each event will be placed in an embedded space according to its content. The distance to other events in this space will then represent the similarity between them. Latent distance graphs are an example of metric random graphs, where the probability of connection between two nodes is dependant on their position in the space. These types of graphs are also called network models, which represent multi-dimensional data. In our case the transformation of the events from EventRegistry will yield vectors in a 300 dimensional Euclidean space that are then used for calculation of a distance function that determines probability of connection between nodes. The procedure to extract a network of connections from the events data can be generalized, because one can apply it in any case where the distance between objects is well defined.

The rest of the paper is organised as follows, section 2 describes the news data that we were using. In section 3 we introduce the word embeddings that are used to obtain vector forms of news events. In section 4 we explain the latent distance model. section 5 presents the analysis done on the graphs and section 6 concludes by pointing out the main results, stressing some difficulties of our approach and giving directions for further work.

2. DATA
We have worked with the news data from the EventRegistry and in particular, we download all of the news events from business category in years 2017 and 2018. This yields theevents overall and it was obtained with python package **EventRegistry**. Every event that was obtained contains information about which entities were involved and **EventRegistry** also provides classification of events into certain categories as defined in the *dmoz* taxonomy. These categories are structured hierarchically and are divided into various subcategories, where, for example, category "Business" is split further into "Banking and services" and then into "Investing". For further details see [6].

3. WORD EMBEDDINGS
Here we give a brief overview of how the word (word2vec) embeddings are being calculated, for detailed explanation we advise reader to consult [9]. One of the algorithms which can calculate the word embeddings is called word2vec and it can be trained by one of the sub-algorithms, called Continuous-Bag-Of-Words (CBOW) and Skip-Gram (SG). We give more precise explanation of the Skip-Gram algorithm since we use

it in the process of generating the latent model.

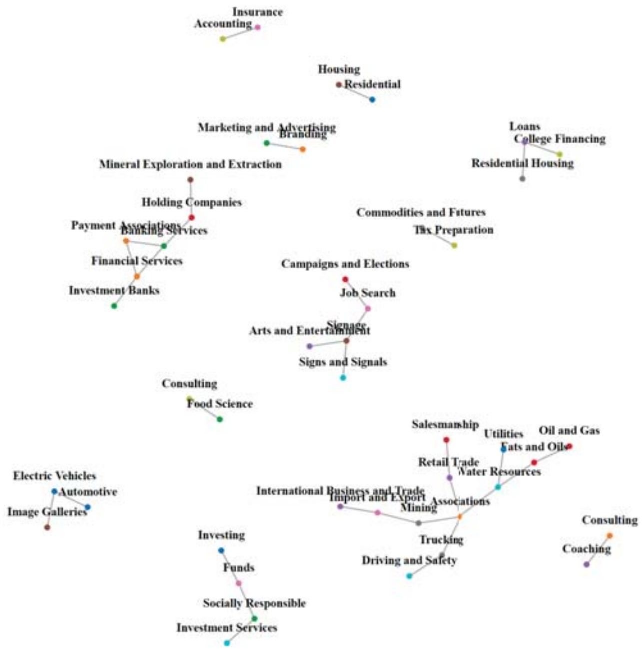

Figure 1: Latent distance graph of the Business category

3.1 Skip-Gram

The Skip-Gram (SG) sub-algorithm trains a shallow neural network (NN) to learn the vector representation of each word in the sentence from its surrounding context words. Namely for each word w_n, the neural network predicts the surrounding context words Con, where the user has to define the number of surrounding words that are being predicted. For example if $Con = 2$, we predict the pair (w_{n-1}, w_{n+1}). The NN that is being trained has only one hidden layer between the input and output layer, which in practice gives two transformations of the input vector. The first one from the input to the hidden layer and the second one from the hidden layer to the output. Hence we have the target word at the input layer of the NN and the context words are at the output layer.

In order to give more detailed overview of the algorithm we need to set some notation first. Let x be a word in vocabulary and let N be the size of the vocabulary, so $x_1, ..., x_N$ are all the words in the vocabulary. Then let K be the dimension of the hidden layer and $C = Con$ be the number of context words. Also denote by W the $N \times K$ weight (transformation) matrix. The equation for hidden layer is in this case then

$$\mathbf{h} = W^T x = W^T_{k,.}, \tag{1}$$

where $W_{k,.}$ is the k^{th} row of the transformation matrix W. From the hidden layer to the output layer we apply another transformation matrix that is denoted by $W^{'}$. The output layer in this case then consists of C multinomial distributions and we use the matrix $W^{'}$ to calculate the score vector $\mathbf{u}$ for the j^{th} unit on c^{th} context word as follows:

$$u_{c,j} = u_j = (W^{'}_{.,j})^T \mathbf{h} = (W^{'}_{.,j})^T W^T_{.,k}, \tag{2}$$

for all $c = 1, 2, .., C$. The final output is the given by:

$$\mathbb{P}(w_{c,j} = w_{out,c} | w_I) = y_{c,j} = \frac{exp(u_{c,j})}{\sum_{i=1}^N exp(u_i)}, \tag{3}$$

here $w_{c,j}$ is the j^{th} word on the c^{th} panel of the output layer and $w_{out,c}$ is the true c^{th} word among the output context words, thus $y_{c,j}$ is the final output of the j^{th} unit on the c^{th} panel. The authors of both CBOW and SG [8] have noted that SG is slower than CBOW but produces better results for infrequent words. For more detailed exposition please see [9].

3.2 Events to vectors

In order to obtain vector forms of events, we use all of concepts and their weights that are extracted from the news article of every event by EventRegisty. In particular the vector form of each event is calculated as

$$\text{Event}_i \equiv e_i = \sum_{c \in C_i} w(c) \cdot \text{word2vec}(c), \quad \forall e_i \in E, \tag{4}$$

where C_i represents the set of all concepts of the event i and $w(\cdot)$ is gives a value of the weight of the concept in the event in the in the interval $(0, 100]$. Each event is then represented as a numeric vector in $\mathbb{R}^N$, where N is dependant on the dimension of the word2vec space. In our case we choose $N = 300$, since we are using the pre-trained word2vec model by Google.

4. LATENT DISTANCE NETWORK MODEL

Latent distance networks or graphs can be considered as particular examples of random graphs ([2]). Random graph consists of the set V of vertices or nodes, set E of edges. It is normally denoted by $G(n, p)$, where $n = card(V)$ and p is the probability of an edges between two vertices. One of the most basic examples of random graphs is the Erdos-Renyi graph $G_{ER}(n, p)$, which is defined by saying that each edge is included in the graph with probability p independent from every other edge. Having this example in mind, we can define random graphs with n vertices by giving probability distribution for edges, this is construction carries over to latent distance graphs, where probabilities for edges are derived from probability distribution of distances between vertices.

The latent distance graph is represented by $N \times N$ adjacency matrix. The latent distance model is given as follows, we first define a distance function on $\mathbb{R}^N$ by:

$$d(x_k, x_{k'}) = \rho e^{-\frac{\|x_k - x_{k'}\|^2}{\tau}}, \tag{5}$$

where ρ represents the sparsity of the network and τ represents characteristic distance scale. Each vertex of the network is at this stage represented by some vector $x_k \in \mathbb{R}^N$ (as describe in 3.2). To get a random model we need to specify some probability distribution of distances between vertices, which will give us the probabilities for edges between vertices. These then correspond to the adjacency matrix of our network and in the case of the latent distance graph it is given by:

$$A_{k,k'} \sim Bern(d(x_k, x_{k'})). \tag{6}$$

Thus the entries of the adjacency matrix A are given by Bernoulli distribution of distances between vertices of the graph. Such networks were also considered in [7] in connection with Hawkes processes defined on networks. Note that one could choose any other appropriately normalized metric i.e. taking values in $[0, 1]$, on $\mathbb{R}^N$ and the construction would work as well. Moreover in Erdos-Renyi graph $G(n, p)$ the sharp threshold for the connectedness is given by $\frac{ln(n)}{n}$ (see [4]). To the best of our knowledge no such sharp threshold is know for the latent distance graphs.

4.1 Generating the latent model

In this section we describe how we generated the latent distance graph from news data.

4.1.1 News data latent model

After we obtain the numeric forms of the events via the procedures described in section 3 we are able to form a latent model on top of news data. The embedded events now correspond to vectors in $\mathbb{R}^N$, which gives us a finite set of vectors $(x_i)_{i=1}^K \subset \mathbb{R}^N$. We can then construct the weight matrix, which is basically the matrix of distances between different pairs of points,

$$W = (w)_{i,j}^K = (d(x_i, x_j))_{i,j}^K, \tag{7}$$

where $d(.,.)$ is the distance function (5). Once we have the weight matrix we can generate the latent distance graph by defining matrix of probabilities as the adjacency matrix:

$$p_{i,j} = Bern(W_{i,j}), \tag{8}$$

where $p_{i,j}$ represents the probability between two nodes x_i and x_j.

5. GRAPH ANALYSIS

We perform some basic analysis on latent distance graphs derived from news data. We generated the adjacency matrices for each day in a one year time period, thus we get 365 graphs. Each represents the activity of the events from the business category. We also perform clustering of the events into 100 most frequent subcategories interacting with business category. We perform this so that we replace the adjacency matrix which depends on number of events we consider, say K, with a matrix depending on fixed number of parameters and make a aggregated distance matrix W_{agg}, which we define as follows:

$$(W_{agg})_{k,l} = \sum_{i,j}^{K} \mathbf{1}_{c_k=i,c_l=1} w_{i,j}. \tag{9}$$

Now we can generate a new graph whose nodes now represent categories under consideration. Example of such a graph is given in Figure 1. Then we can generate adjacency matrices of these graphs for a fixed time period, one year in our case.

5.1 Graph evolution

Now that we have sequence of graphs $\{G_1, G_2, .., G_{365}\}$, we can view this sequence as evolution of the network in given time frame. Thus we can check the interaction of category i in $\{G_1, G_2, .., G_{365}\}$ by just summing over all the adjacency matrices and looking into appropriate row. For example in the Table 1 below we show interaction of subcategories **Banking and services** and **Oil and Gas**. To be concise we only show top five interacting subcategories.

We also computed the degree of the the nodes in $\{G_1, G_2, .., G_{365}\}$ and plotted the time series of each node, see Figure 2. From Figure 2 we can see that there is some change in the degrees through time and this opens up a possible direction to study such networks dynamically.

Dependencies between categories					
Fixed category	Cat1	Cat2	Cat3	Cat4	Cat5
Banking and services	Holding Companies	Financial Services	Finance	Payment Associations	Investment Banks
Oil and Gas	Fats and Oils	Mining and Drilling	Import and Export	Payment Associations	Job Sharing

Table 1: Dependencies of categories in the dynamical network

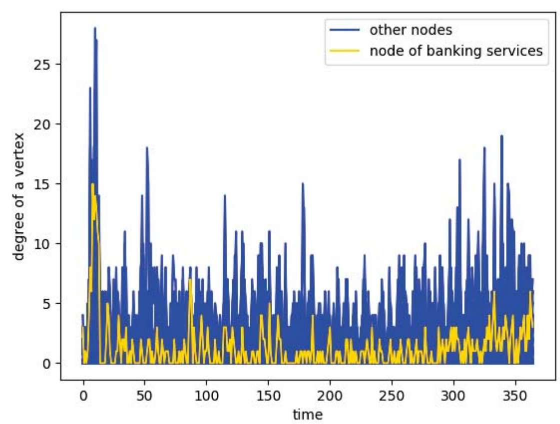

Figure 2: Degrees of nodes through time

5.2 Predictions

We use neural network model to make predictions about potential structure of the network in the near future. Specifically we build the model on the top level categories i.e. **Buisness**, **Politics** and others. We use the aggregation process (9) to generate all the adjacency matrices for all levels, which can then be put into vector form, so that we can then use them as inputs for LSTM Neural Network model [5]. For the model we used LSTM Neural Network, where we used three residual LSTM layers and final dense layer. We optimized with mean squared error (MSE) with ADAM optimizer [5]. The results of the experiments are displayed in Figure 3 and Figure 4.

6. CONCLUSIONS AND FUTURE WORK

In this work we collect data from EventRegistry about all business events from years 2017 and 2018 and build a latent distance model on top of it. We are able to do this by transforming the textual news data to numeric vector forms through word embedding algorithm word2vec. The latent graph model that is produced in this manner gives us a reasonably good representation of EventRegistry data as

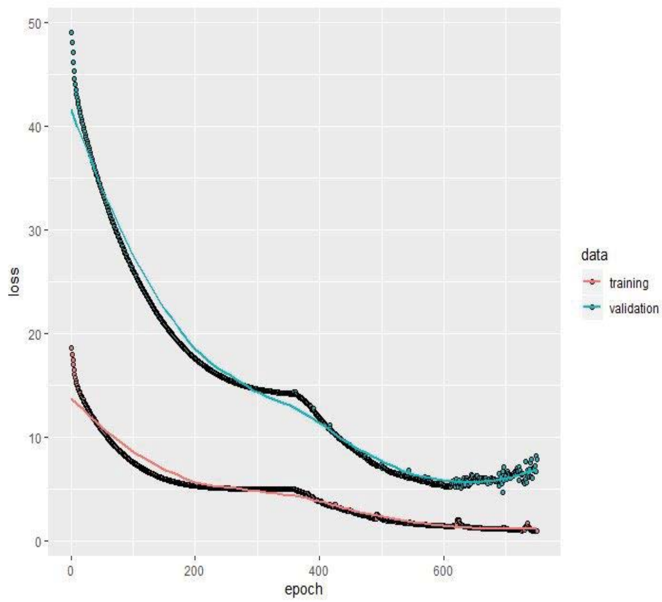

Figure 3: MSE of learning on whole Neural Network

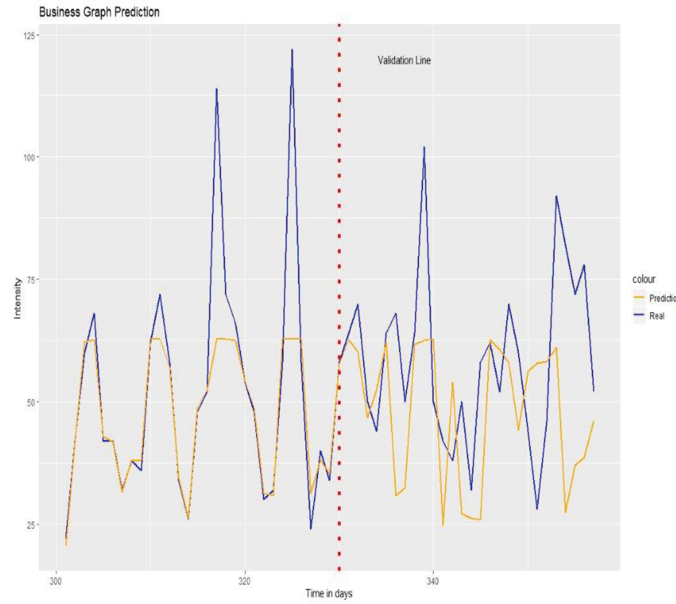

Figure 4: Training and prediction scores for Business category

can be seen in Figure 1. However we believe that this model could be used on other similar data sets as long as difference between object can be defined with some metric. In order to avoid issues with noise we used a more compact representation of events, where we clustered them into a predefined set of categories. In this compact form the adjacency matrices of graphs were then fed into a LSTM model for prediction of how the graph will evolve in the next step. The results of this part were reasonably good and can be seen in the Figure 3 and Figure 4.

Let us now point out some difficulties of this approach. The first one is that it seems that the representation depends to some extent on word embeddings that are used. This can be seen from example in Table 1, where we have strong connection between **Oil and Gas** category and subcategory **Fats and Oils** which should not be connected. The second problem is the sparsity of the adjacency matrices, which makes it very hard to achieve good performance with machine learning techniques as well perform spectral analysis [1] on the adjacency matrices. This last point is connected to theory of dynamical graphs, where our presented sequence $\{G_1, G_2, .., G_{365}\}$ serves as one example. In future work we would like to try to extend the LSTM model from above to predict lower level categories as well. This would be done in several steps where each level would be predicted after the previous one. Finally we would like to understand how to resolve the sparsity problem (some techniques for dealing with this problem are presented in [3]) and then apply techniques from dynamical graphs [1], in particular we would like to know spectral distortions [1] of these graphs.

7. ACKNOWLEDGMENTS

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Document Embedding Models on Environmental Legal Documents

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ABSTRACT
Finding similar documents in a big document corpus based on context has many practical applications especially in the legal sector. In this paper, our focus is on the documents related to environmental law which have been collected in a database of approximately 300k documents. We analyzed the performance of different representation models (called document embeddings) on our database and found that evaluating the results is difficult, due to the size of the database. The approaches presented can be applicable for other text datasets.

Keywords
text analysis, natural language processing, environmental law, machine learning, word embedding, document embedding

1. INTRODUCTION
When working with a large number of documents one can perform different tasks, such as finding patterns and topics within a documents, labeling documents based on their content, and finding documents that are similar to each other. These tasks can be found in multiple domains - one of them being the legal domain. There, lawyers spend hours finding documents and parts of these documents to support their legal cases.

In this paper, we present our preliminary results for finding similar documents. We employ word embeddings for creating different document representations - called document embeddings. The goal is to construct a document embedding model that enables the user to quickly find documents that are similar to a user chosen document. The documents used for evaluation are from the legal domain, but the approach can be applied to more general text datasets.

The remainder of the paper is as follows. Section 2 describes the data sources used for creating the document embeddings. Next, section 3 presents the content extraction and enrichment tool used for extracting additional document metadata. In addition, it describes different models of document embeddings using the pre-trained word2vec and fasttext word embedding models, as well as our word embedding model trained exclusively on the collected environmental documents. Section 4 presents the preliminary results of the document embedding analysis, followed by the description of future work in section 5. We conclude the paper in section 6.

2. DATA
The legal datasets used for the analysis were collected from two main sources: the first is ECOLEX [1], an online information service on environmental law led by Food and Agriculture Organization of the United Nations (FAO), the International Union for Conservation of Nature (IUCN) and United Nations Environment Programme (UNEP). The second dataset was acquired from EURLEX [3], a database of entire European Union law.

2.1 Data Acquisition
The data was collected using dedicated web crawlers. In particular, we attempted to collect as much information about each document as possible. In total, 220k and 800k different legal documents are available on ECOLEX and EURLEX datasets, respectively. The documents are ranging from the start of 20th century up until the year 2019.

There is much document metadata which is available for documents from both sources, such as the document's title, its authors, various dates (i.e. day of proposal, the day it went into force, etc.), the subject of the documents and various keywords (which are called "descriptors" in the EURLEX dataset). Bearing this in mind, there are many differences between the two acquired datasets. In this article we focus on the following: the ECOLEX dataset consists entirely of environmental law. In addition, the dataset contains much more metadata, including geospatial information (i.e. locations and countries affected by the given document), as well as a short abstract. On the other hand, the EURLEX dataset contains less metadata, but provides the complete

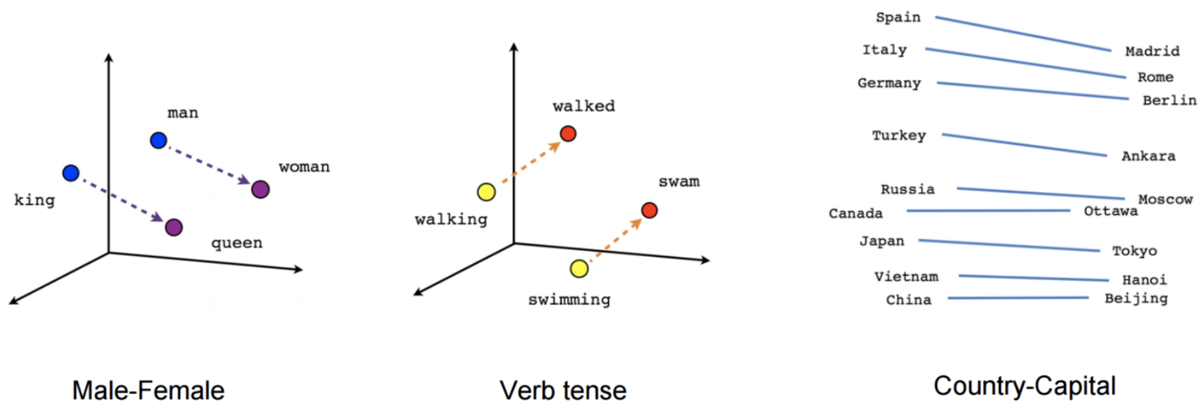

Figure 1: Word relationships captured by word embeddings. They are able to identify different relations such as male - female terms, verb tenses and other.

document content in raw text for most cases in the dataset.

Additionally, the datasets are different in two important metadata attributes: the keywords in the ECOLEX dataset and the descriptors in the EURLEX dataset. These keywords are words or phrases that best describe what the document is about. It is to be expected that documents that have similar keywords are also similar in content. While keywords and descriptors serve similar purpose in the respective dataset, they are not the same. A particular keyword might not be included in the descriptors word corpus and vice versa. Furthermore, keywords that describe some document are different from descriptors that describe a similar document.

2.2 Dataset Statistics

Out of the 800k EURLEX documents collected, 300k were filtered out based on whether the full text of the document is available in English, German and Slovene language. Since we are interested in documents dealing with environment, further filtering was done using document descriptors, keeping only documents with at least one environmental descriptor. In total, approximately 75k documents were considered to be appropriate for our analysis.

Since the ECOLEX documents are already focused only on environment, no further filtering was required.

3. METHODOLOGY

In this section we describe our approach for analyzing a big corpus of documents, namely document embeddings. Even though a lot of pre–processing was necessary to prepare the documents' texts for later use (making sure all letters are lowercase, stripping the punctuation from the text, removing words that appear frequently in the language – for example prepositions), we will not discuss this further in the paper. We also appended additional information to the documents using the content extraction and enrichment tool, which we describe in section 3.1. Further, we focus on word embeddings and different methods of how to use them to create document embeddings in sections 3.2 and 3.3, respectively.

3.1 Content Extraction and Enrichment Tool

To enrich the documents, we annotated all documents using the InforMEA ontology, a hierarchy of environmental terms. Also, document's text was sent into Wikifier - a web service that extracts major Wikipedia concepts from the text. The resulting concepts were added to the document's metadata. These annotations add additional keywords and concepts to the document, improving our representation of documents that may have poor keywords representation, and adds additional metadata to documents that already had a good keyword representation but might be missing some important keyword.

3.2 Word Embedding

In natural language processing, word embedding has been a popular method for representing textual data in the past years. It is a model trained on character n–grams of the word and on what is called context: the target word's neighboring words. In the model, the words are represented as vectors – usually in high-dimensional space - where the inherited geometric relations mimic relationships between words in the language. Word embeddings are able to capture both syntactic and semantic information about the word. Some of the relationships between words captured by word embeddings are shown in figure 1.

The most popular word embedding models available to the public are word2vec [10] and fasttext [9]. What sets them apart is what they consider to be an atomic embedding element: word2vec considers a word to be the smallest part of language to embed, while fasttext uses character n-grams as well - it embeds them as if they were words. Because of this we can extract embeddings for out-of-vocabulary terms, providing embeddings of rare and previously unseen words. We decided to employ two models: a) the pre-trained fasttext model for the English language, and b) the model trained on our database of environmental legal documents. In addition, aligned vectors for 44 languages [6, 4] are available, which will be used in the future work to enable cross-lingual search of documents.

3.2.1 *Training a Word Embedding Model*

One of the word embedding models we employed was trained on our database. Instead of having a a large vocabulary of pre-computed word embeddings trained on Wikipedia and Common Crawl, this newly trained model is trained on documents from a more specific domain - resulting in a vocabulary limited to the topics found in the documents within the corpus (e.g. in our case environmental law). This approach might improve the performance in cases when the language is domain specific.

The new fasttext model has been trained using the gensim library. In order to be consistent with the pre-trained fasttext model, we decided the trained model should provide word embeddings as 300-dimensional vectors. We set a threshold of 4 appearances to avoid noise. In comparison with the vocabulary of the pre-trained fasttext model, the vocabulary of our model is 5 times smaller, consisting of approximately 500k tokens. Its initial performance is described in section 4.1.

3.3 Document Embedding

To be able to retrieve and compare documents, they must first be represented in a form that the machine will be able to understand. Similar as for words, the most common form of document representation is as a vector. We chose to represent a single document as an average of word embeddings of words found in that document. In other words, let $W = \{w_1, w_2, \ldots, w_n\}$ be a list of words that appear in a document, and let $\{x_1, x_2, \ldots, x_n\}$ be the list of word embeddings associated with the words in the document. Then the document embedding is calculated by following the equation

$$d = \frac{1}{|W|} \sum_{w_i \in W} x_i.$$

Further, we considered some other embedding methods. The first approach is to define the document embedding as an average of word embeddings of only the most significant words, namely document descriptors for the EURLEX dataset or keywords for the ECOLEX dataset. The reasoning behind it is that it might speed up the calculation, but it comes at a cost of neglecting a lot of information we have about documents and the possibility of reducing the quality of the result. To avoid the listed downsides, we propose a combined embedding, which would be defined as a linear combination of two embedding methods described above. This embedding unfortunately loses the advantage of fast computation, but it does give more weight to more important words of the document. In order to decide which method performes better, we performed some analysis which is described in section 4.

Once the document embeddings are calculated - depending on the chosen method and word embedding model - we are able to find semantically similar documents by calculating the distance of their embeddings. Figure 2 shows the mapping of the document embedding into the 2-dimensional space using the t-SNE algorithm [8].

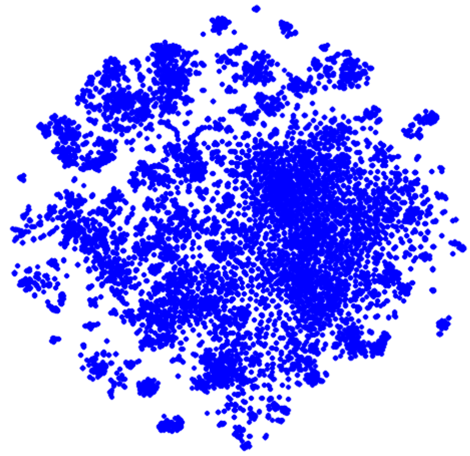

Figure 2: Planar projection of document embeddings of the first 15k English legal documents in the EURLEX corpus. Our assumption is that similar documents have similar embeddings and therefore form clusters, which we evaluated manually.

4. PRELIMINARY RESULTS

We split our analysis in two parts. In section 4.1 we tested various document embedding models based on the choice of word embedding models. In addition, we perform an analysis using different approaches of constructing document embeddings given a pre-trained fasttext word embedding model, which is described in 4.2.

4.1 Performance of Different Word Embedding Models

When deciding which document embedding model to use, the choice of word embedding model is very important. We are interested in which of the two word embedding models described in section 3.2 produces a better document embedding model. In this part of the analysis we chose to construct document embeddings as the average of word embeddings of words appearing in the text of the document.

Manually checking the results for some arbitrary examples we noticed that the newly trained word embedding model outperforms the pre-trained one when the source document is not particularly similar to any other document in the database. Our observations are based on using only the model trained with parameters described in section 3.2.1. Further analysis of training parameters will be performed in the future.

4.2 Performance of Different Document Embedding Models

It is hard to evaluate and compare different document embedding models. We performed manual checking and found satisfactory results in some cases. To test the model we picked a random document and found the k "most similar" documents using the k-nearest neighbors algorithm [5] and the cosine distance.

What follows is an example of such a search for $k = 5$ using a document embedding model based on the text of the document (the title is not included). The first item is the title of the source document, while the rest are the titles of the most similar documents:

1. **Source:** European Convention for the protection of animals kept for farming purposes.
2. Convention on the protection of the Mediterranean Sea against pollution (Barcelona Convention).
3. Protocol concerning Mediterranean specially protected areas.
4. Protocol for the protection of the Mediterranean Sea against pollution from land-based sources.
5. Protocol of amendment to the European Convention for the protection of animals kept for Farming purposes.

The given results are quite good, but it seems like the document on the fifth position is the most similar to our source document - showing that the presented model still has potential for improvement. Figure 3 shows the result of the search for 10 most similar documents using the text of the document in document embeddings. Marked with the red dots are the documents acquired from the search results.

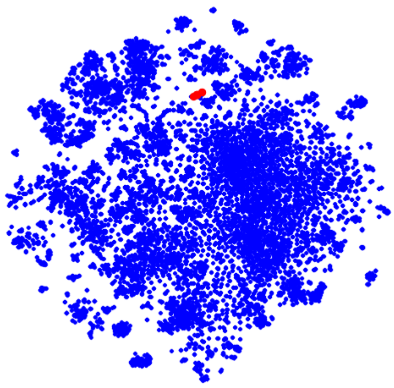

Figure 3: Projection of a document embedding model using the words from documents text as a representation. Red dots represent the 10 document embeddings that are closest to the embedding of the source document.

5. FUTURE WORK

Manually checking the complete corpus of a few 100k documents is time consuming. The amount of documents is huge and we also do not have the ability to tell how good the results are. There is no easy way to define a metric that could compare how well different models perform. Therefore, we will try to evaluate and improve our model using the users feedback. We will develop a service which will enable the user to perform queries for the legal documents. Each time a user makes a query, the system will note the documents that the user checked. With this feedback we will be able to update and improve our model.

In addition, we will consider another distance metric called the Word Movers Distance [7] when calculating the document similarity using word embeddings.

6. CONCLUSION

Word embeddings and document embeddings have proven to be useful when performing analysis on a large textual dataset. The available word embedding models on which we based our research - word2vec and fasttext - are exhaustive and easy to use. What we have done so far has given satisfactory results on recognizing similar documents, which we hope to improve with further work, especially by finding a model that will fit our dataset of environmental legal documents best and then developing it based on user feedback.

7. ACKNOWLEDGMENTS

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Local-to-global analysis of influenza-like-illness data

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ABSTRACT

The need for appropriate, robust and efficient epidemic intelligence tools is increasing in this age of a connected society. Global health initiatives, such as Influenzanet, potentially have a central role in the future of Public Health. This paper presents the contributions to the Influenzanet initiative, describing a new monitoring system for local hubs and their data sources, based on Elasticsearch.

It is often the case that the exploration of internally generated data is prioritised by national public health institutions, and therefore cannot be addressed in the global Influenzanet platform. This platform can be used by health professionals without programming expertise to encourage and enhance their independence from busy in-house IT departments and further contribute to the effectiveness of their own research.

The most meaningful data visualization modules can then be considered for integration into the full Influenzanet platform that will serve the complete network, thus collaborating at a global level. With this approach we also show the importance that an active hub in carrying out its own investigations towards its own priorities. In that regard and as an example, we also describe new results on the application of state-of-the-art approaches to a local data set, using the Portuguese ILI seasons between 2005 and 2013. This study is based on the application of the Streamstory approach. It aims to show the potential of this versatile approach in: (i) identifying data-driven ILI seasons; (ii) relating the ILI incidence to the dimensions of weather data; and (iii) comparing the incidence throughout four different ILI definitions.

CCS CONCEPTS

• Real-time systems • Data management systems • Life and medical science

KEYWORDS

Public health, Influenzanet, ILI, Elasticsearch, Streamstory

1 Introduction

With the recent worldwide threats to health being reported throughout the media, the need for efficient epidemic intelligence tools is paramount. It is important to note that the influenza virus is also part of these epidemic threats requiring monitorization, despite its less mediatic weight. The speed of mutation of the virus makes any epidemic unpredictable. Its socioeconomic impact is evident in the number of workplaces affected every year during the season and the associated mortality in particular demographic groups (very young, very old). Influenzanet is a participatory surveillance monitoring system based on volunteers, submitting an online symptom questionnaire on a weekly basis, this enables a real-time global view of the incidence of influenza-like illness (ILI) across Europe. Note that the confirmation of influenza virus would require biological evidence and, thus, (often expensive) sample collection. The data set is collected in real time by the Influenzanet system and each volunteer provides a profile survey (including important information such as being a smoker, usual transport, etc.) and the weekly questionnaire of symptoms (see an example of the latter in Figure 1). The latter gathers the information that permits the identification of the presence of ILI that can be defined in at least four different ways according to the symptoms considered [6].

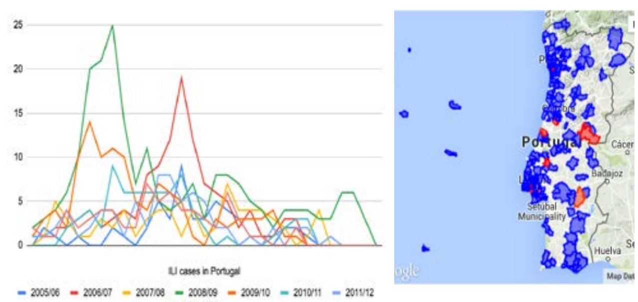

Figure 1: Incidence of influenza in Italy, between 2009 and 2013, collected by the local Influenzanet hub Gripenet.pt

2 Monitoring and exploring the local data

The Influenzanet system is deployed in more than ten European countries working in parallel under the same IT data collection framework, with some variety in the focus of the ILI monitoring [7]. This is usually aligned with the local public health priorities and ongoing studies, where most of the work is done by health experts, some of whom have some data science know-how or else are backed-up by in-house technical support.

To guarantee some independence to the less technical staff we have developed a data visualization dashboard that provides the user with real-time access to a local data set sourced on the national volunteer participants. This is based on Elastic Search technology, together with the Kibana open source data visualization plugin. Part of this work was developed in the context of the European Union research project MIDAS [3], by applying the know-how obtained in building a similar system to monitor and manage the scientific knowledge open data set MEDLINE [5]. Note that the latter can be used to provide complementary information and be deployed in parallel to the Influenzanet dashboard.

The local Influenzanet data can be delivered to the dashboard through an API to the main platform. The update of the back-end system is driven by import scripts that appropriately load the new dataset into a new index in Elastic Search. This new Influenzanet-local index (comprised of one for surveys and the other for the symptom questionnaires) generates the database that serves the monitoring system. The dedicated dashboard based on Kibana has a native integration with Elastic Search and, therefore gets the index imported automatically to dynamically build the new visualization modules and dashboards. The public instance that can be derived from a dashboard is dependent of the choices in the definition of that dashboard.

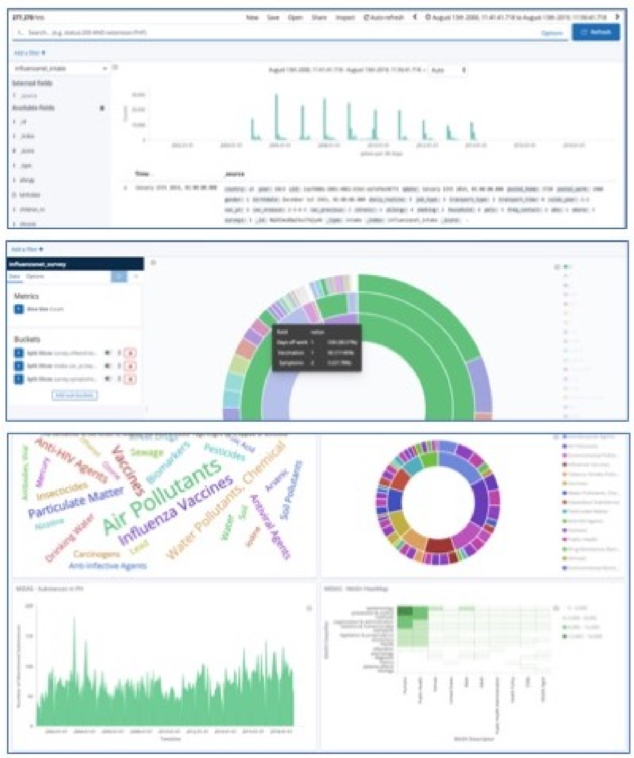

Figure 2: Dashboard of visual modules to monitor KPIs at each local Influenzanet hub, based on Elasticsearch and Kibana

It is often the case that specific interests in the local exploration of the Influenzanet data arise, directly related to the local public health priorities and ongoing studies. The possibility to explore their own local data through a technological tool offered as a service, can be of great value to the Influenzanet hubs (i.e., national Influenzanet-related institutions that collect the data). Although the data must be collected using a homogeneous approach to enable overall comparisons, the exploration of that data can target specific aims. The Elasticsearch-based system presented in this paper empowers the user with less technical expertise to build data visualization modules from subsets of the dataset that correspond to their own KPIs (Key Performance Indicators) they wish to monitor. This service will support an evidence-based policy-making by the national public health authority. The following are example queries made over the example data visualisation modules available in the Influenzanet dashboard:

- What are the most prominent symptoms per year?
- What is the coverage of Influenzanet surveys? (counts of questionnaires per country/year)
- When in the year the symptoms are more prevalent?
- What is the relationship between the incidence of ILI, the days at work and taking the Influenza vaccine?

The technical independence from the often busy IT departments enables health professionals to go further and faster in the exploration of their data through interactive visualization modules displayed through a dynamic dashboard (see Figure 2).

The architecture within the system relies on two useful tools provided by the Kibana technology (see Figure 3). The data collection is loaded by the local Influenzanet hub and is immediately made available at the Influenzanet data query dashboard, where the parameters of the data can be easily accessed and manipulated to subset the data or to produce powerful Lucene-based queries. With the saved subsets of data the user can create interactive visualization modules that will then integrate with the monitoring dashboard.

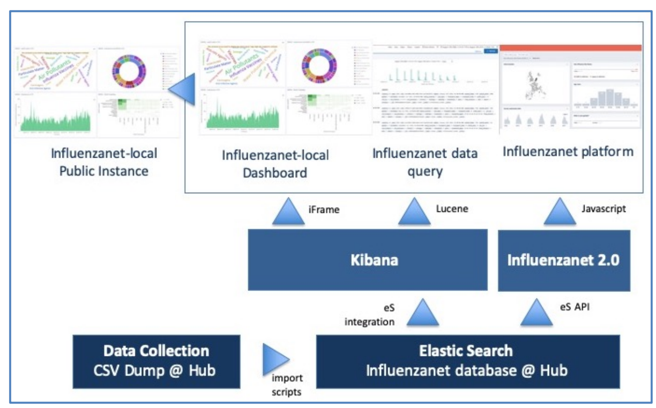

Figure 3: The architecture of the Elasticsearch-based system that enables the visualization of local own data at each Influenzanet hub

The Influenzanet network is preparing version 2.0 of its platform [6] that includes a modern architecture, making use of public APIs and storing the data locally, separating it by user data, survey data, and content data [4] [1]. The new Influenzanet platform will provide the Influenzanet hubs with a common set of data visualization modules. The plan is to augment "classical" Influenzanet data collection with additional sensor data from mobile phones [2]. Moreover, it includes a micro service architecture based system for better scalability and a more flexible development process. The backend of the new platform will be offered as Software as a Service (SaaS) but can also be downloaded as a self-hosted version. It will leverage this service in the perspective of having access to the most meaningful data visualization modules throughout the Influenzanet hubs. The latter will be evaluated and can be integrated if they represent common value to other members of the Influenzanet network.

There are an ever increasing number of data sources that potentially could be used to gain new insights into areas such as disease prevention and policy formulation/evaluation, but these are not optimised for use within a data analytics type user interface. The **MIDAS** project was funded under a call for '*Big Data supporting Public Health policies*' to develop a big data platform that facilitates the utilisation of healthcare data beyond existing isolated systems, making that data amenable to enrichment with open and social data. This aligns closely with the efforts in Influenzanet, and the research work we have developed uses 5 year sample of this dataset. For this reason we made available a live demo page with videos and demos that can be shared with Influenzanet partners [8]. All of the tools and technologies presented in this paper are open source, available at the Quintelligence GitHub repository [11].

3 Using Streamstory to explore Influenzanet data

In the context of the visualization of complex data, the problem of visualization for the analysis and exploration of large multivariate time series is addressed by the Streamstory system [9][10]. This system computes and visualizes a hierarchical Markov chain model which captures the qualitative behaviour of the systems' dynamics. It provides us with a multi-scale representation of the data based on a hierarchical model which allows us to interactively find suitable scales for interpreting the data.

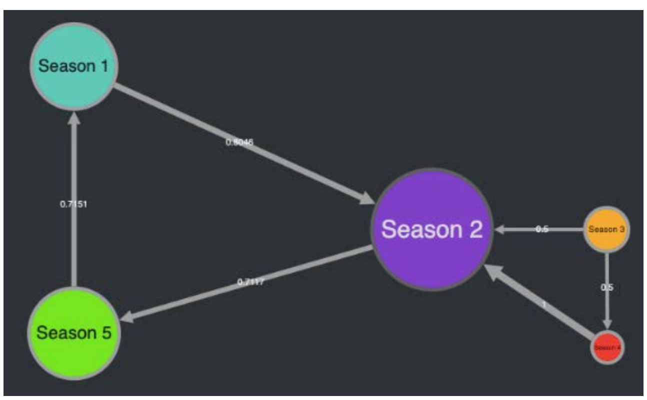

Figure 4: New data-driven seasons of the ILI incidence identified, subdividing the regular ILI season (marked as season 1, season 3, etc.), learning from historical Influenzanet data from Portugal during 2005-2013

We consider Streamstory in the context of the MIDAS project to look into the seasonality definition of ILI based on the sourced data from the Influenzanet platform. This system was developed by the AI Lab at the IJS and refocused by Quintelligence within the MIDAS project to visually analyse the Influenzanet dataset. It is Open Source. In this research, we consider the data across 8 seasons for Portugal, from 2005 to 2013 to try to identify time intervals during the ILI season where the dynamics of the time-series behaves similarly. In this first analysis we call data-season to each state and try to identify the most prominent ones throughout the ILI season. We can identify five seasons where most of the time is spent in the first and in the last data-seasons. Moreover, the data-seasons 3 and 4 seem to be skipped at times with a direct passage from data-season 2 to data-season 5 (see Figure 4). In a second analysis we used Streamstory to examine the relationship between the ILI incidence and two different dimensions of weather data: temperature and humidity (naturally correlated to rainfall). The diagram in Figure 5 shows that the second largest state is assigned to high humidity, eventually corresponding to the also high ILI incidence. The highlighted red coloured state of high ILI incidence is strongly related to high humidity but also low temperature which seems to be pointing to the weather in the end of winter.

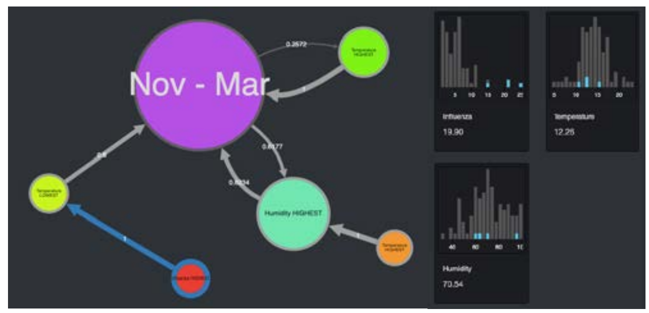

Figure 5: Correlation between the incidence of ILI and the different dimensions of weather data

A third analysis brings us to the comparison between the behaviour of ILI according to five coordinates, four of which corresponding to different ILI definitions: (i) historical, (ii) ECDC, (iii) including fever, and (iv) CDC. The diagram in Figure 6 shows the dynamics of the data when considering the 8 ILI seasons in Portugal altogether, highlighting the differences between the ILI definition used when counting incidence. The low incidence when considering ILI definition containing fever seems to have a strong expression in this analysis, followed by the high incidence of ILI defined using the historical and the ECDC definitions. The largest state is not related to any of the definitions in particular. When looking to its coordinates diagram, we can observe a higher influence of the ECDC definition, followed by the definition including fever. The CDC definition and the historical definition seem to have low weight in this largest state. A global analysis can be made through Streamstory to compare the ILI incidence in different countries. In the example of Figure 7 we compare five ILI seasons for Portugal and Italy. The close relation between the ILI behaviour in the two countries is usually similar between December and February, according to the diagram of states. Portugal and Italy tend to act distinctly in particular for the peaks of the epidemic, usually happening in Italy in November and February. Such a visualization might help us better understand the global behaviour of the epidemics throughout Europe, complementing the statistics provided by the Influenzanet platform itself.

Given the early stage of the Streamstory technology, it is difficult to have a clear global view on the obtained results and their meaning. Nevertheless, the approach seems to be promising, enabling a versatile analysis of the behaviour of the data through the diagrams of states, but also through the complementary coordinate diagram and the components histograms.

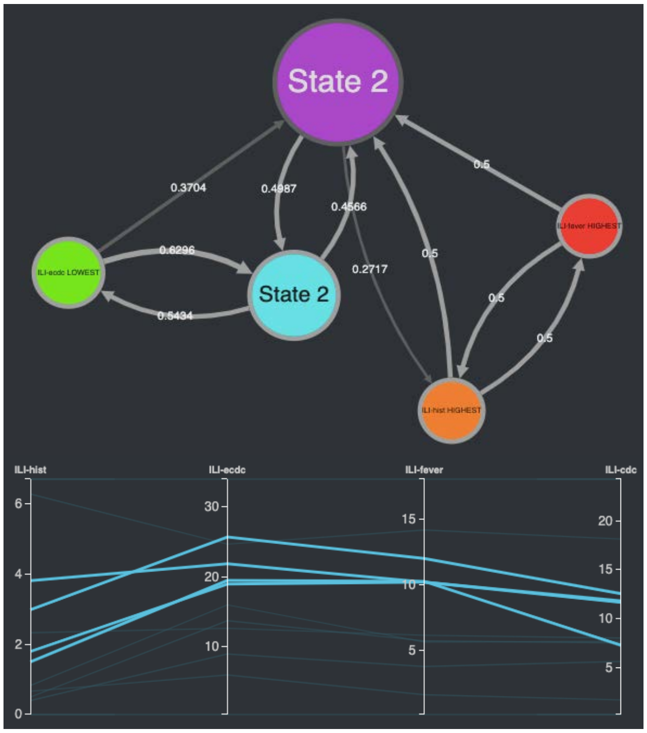

Figure 6: Comparison of the behaviour of ILI across four ILI definitions (with states generated by ILI cases per week)

4 Conclusions and further work

In this paper we discussed the research opportunities brought by the exploration of local data at each of the Influenzanet hubs. While the value of this data source is global, the local data explorations can target specific studies linked to priorities defined by the national public health institutes. The simplicity and ease of use of the discussed technology, offered as a service, permits the non-technical user to be much more independent of the in-house and overall technical support (often scarce in health organizations) to explore the local data in an almost real-time dimension. Moreover, some of the most meaningful data visualization models linked to those data explorations can be considered in the general platform to bring value to all the members of the Influenzanet network. Moreover, those visualization modules, common throughout the Influenzanet network, can provide means of comparison between countries and ILI seasons. Thus, the Kibana-based tool discussed in this paper can be of great value to digital epidemiology in general. Furthermore, the usage of advanced tools such as Streamstory might enable insights in the data that were otherwise unreachable. Versatile approaches such as this permit us to study the behaviour of the data through its dynamics over a diagram of related states. In that, we can identify new data-driven seasons, relate the ILI season to the several coordinates of the weather data, and look through the weight of the different ILI definitions. Nevertheless, the meaningfulness of this kind of general approach demands a large effort on the interpretation of the results in the public health context that they belong to. Although the obtained results are good indicators to the promising potential of the usage of this technology, clear interpretations of the relations between states must be tackled within public health experts to enhance the usability of the technological tool as a public health tool.

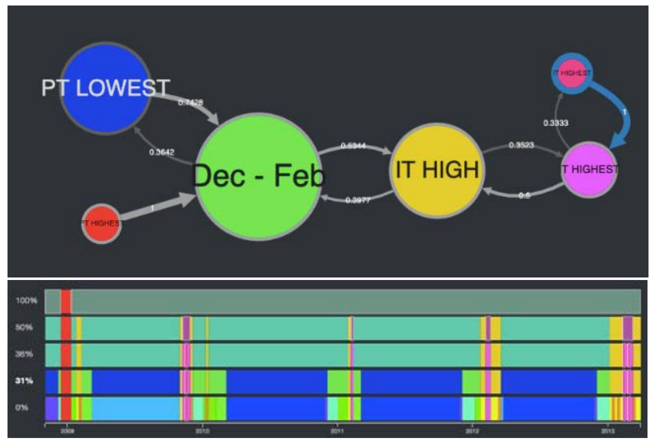

Figure 7: Comparison between the incidence of ILI in Portugal and Italy, and the corresponding state history

ACKNOWLEDGMENTS

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Feature Selection in Land-Cover Classification using EO-learn

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ABSTRACT

Applying machine learning to Big Data can be a cumbersome task which requires a lot of computational power and memory. In this paper we present a feature selection technique for land-cover classification in earth observation scenario. The technique extends the state-of-the-art feature extractors by pruning the dimensionality of the required feature space and can achieve almost optimal results with 10-fold reduction of the number of features. The approach utilizes a genetic algorithm for generation of optimal feature vector candidates and multi-objective optimization techniques for candidate selection.

Keywords

remote sensing, earth observation, machine learning, feature selection, classification

1. INTRODUCTION

Earth observation (EO) has become one of the major sources of Big Data. European Sentinel-2 mission, which acquires global data with 5-day revisit time, reports a total of 6.4 PB of satellite imagery products being available to the users via Copernicus services [2], whereas the total cumulative amount of EO data available from European Space Agency (ESA) is estimated to exceed 140 PB.

A huge amount of data have motivated EO and machine learning communities to invest into methodologies to work with such high volumes. Since 2016, as observed in Big Data from Space conferences, the community has tackled and solved the problem of storing, pre-processing and applications of basic machine learning and extensive deep learning algorithms for mainly solving classification problems. Processing pipelines have been established and are used regularly for solving different EO tasks [6].

The research has already approached the limits of the accuracy of the models. Our research has therefore focused on trade-off between model accuracy (of the current state-of-the-art) and processing efficiency. The approach is expected to be used in systems, which require a fast response with reasonably good results. Possible approaches include the use of fast classification techniques (i.e. Very Fast Decision Trees), which were taken from the field of stream mining, and optimization of the feature selection process.

This paper presents an early attempt to provide effective feature selection in land-cover classification. We illustrate that it is possible to significantly reduce the dimensionality of feature space of the state-of-the-art feature extractors [1, 8, 9] applied to a time-series of satellite images. Experimental data has been acquired by EO-learn library from PerceptiveSentinel[1] project.

2. DATA

Acquiring EO data is achieved using services provided by European Space Agency (ESA). For our experiments we have used Sentinel-2 missions data. This data includes scalar features from 13 different sensors with a resolution from 10 m × 10 m to 20 m × 20 m. A more detailed description of data available within Sentinel-2 missions is provided in [6]. EO-learn library [3] presents an abstraction layer over ESA services, which provide access and basic pre-processed (i.e. atmospheric correction, cloud detection and similar) products.

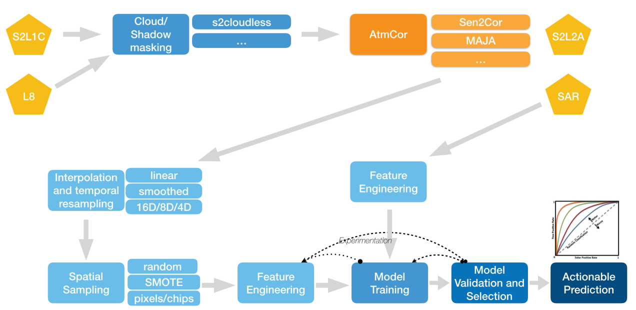

Figure 1: Data flow (acquisition and pre-processing) with EO-learn library using Sentinel-2 data. EO-learn modules are depicted with light blue containers.

Figure 1 depicts the data flow in a typical experiment. The top row depicts components for Level-1 and Level-2 pre-processing, which include cloud detection and atmospheric corrections. Products are being stored in the cloud and are accessed via EO-learn library. EO-learn modules are independent and can communicate with one another through a unified data structure (`EO-patch`) that can include satellite

[1]http://www.perceptivesentinel.eu/

imagery data, enriched features, metadata and even corresponding vector data. For example: a feature engineering module for calculating normalized differential vegetation index (NDVI) from raw data would take `EO-patch` including the original 13 bands as an input and would output the same patch with an added NDVI index. Such modules are reusable and are being accumulated in the EO-learn library and made available to the community. Complex data processing and analytics pipelines can therefore be established literally within minutes.

3. METHODOLOGY

Based on satellite imagery our task is to classify land-cover in Slovenia. For this task we are using a time-series of images from the same year, which capture the dynamics of growth of particular vegetation and enable better accuracy of the models than a single image. Labels for building classification models have been acquired from a patch of land-use data (Slovenian LPIS data). The models can be applied to a wider area, where ground-truth data is not available and can even uncover some ground truth data mistakes (or generalizations). Our goal is to solve the task as fast as possible yet still accurate.

We base our methodology on the extraction of the state-of-the-art features from Sentinel-2 dataset. On top of this dataset we perform intelligent feature selection procedure based on multi-objective optimization approach.

3.1 Feature Engineering

We have acquired a time-series of satellite imagery for year 2017 and selected 27 small tiles ($1\,\mathrm{km} \times 1\,\mathrm{km}$) from Slovenia randomly (ensuring, that appropriate distribution of different land-covers was consistent). We have performed cloud detection and then provided linear interpolation (simply because it is the fastest) over the remaining data points for each of the bands and additional indices. From these interpolated data we have extracted the phenological features suggested by Valero et al. [8]. The features have been calculated from following indices: NDVI, NDWI, EVI, SAVI, ARVI and SPI[2] [5, 6]. These indices provide various information from the time-series which are important for land-cover classification (i.e. speed of growth, length of maximum index interval, etc.). All together we have used 108 different features within our experiments. Some examples of the features are depicted in Figure 2.

3.2 Feature Selection

A feature selection algorithm should choose a limited amount of features out of the pool of 108, which would still provide enough information for almost optimal classification of land-cover. We employed a modification of the POSS genetic optimization algorithm [7] for the task. The algorithm would select a candidate solution (a selection of features) and slightly modify (mutate) it. The mutations have to be considered carefully, since the number of selected features must be kept as small as possible. The problem can be formulated as $f : 2^N \to \mathbb{R}$, where N is the number of all

[2]normalized differential vegetation index, normalized differential water index, extended vegetation index, soil-adjusted vegetation index, atmospherically resistant vegetation index and standardized precipitation index

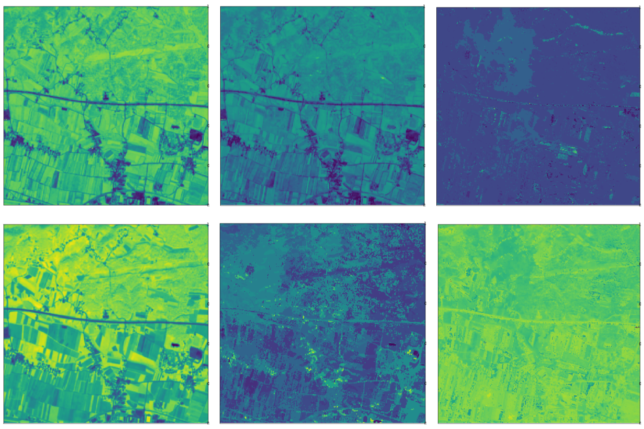

Figure 2: A sample of features extracted from a time-series of images: standard deviation of NDVI, max difference in NDVI in a sliding window, length of time interval where max mean value is attained (with specified tolerance), mean NDVI and rate of NDVI time-series change corresponding to the longest positive interval.

features. We are looking for a subset $A \subseteq 2^N$ that optimizes (minimizes or maximizes) the selected criterion function.

A naïve genetic algorithm without proper weighting of a number of features behaves poorly on most tested classifiers. If optimizing only the accuracy score (i.e. F_1), the algorithm would almost always converge towards selecting all the features (since the dataset is large and there is generally no danger of overfitting). We modified the POSS algorithm to search possible feature space and optimize the number of selected features as well as the accuracy score with a 2-dimensional multi-objective optimization.

The main idea of the algorithm is as follows. We have N features, which we encode into a solution candidate $S = \{f_1, f_2, \ldots, f_N\}$. A bit f_i represents whether the i-th feature is selected (value 1) in the candidate solution or not (value 0). We keep the current optimal elements on a 2-dimensional Pareto front, which is determined by $1 - F_1$ score and number of selected features (for illustration see Figure 4). This approach can easily be extended to any other fixed dimension. $1 - F_1$ is selected for convenience in selection (elements on Pareto front are those that are not comparable to any others in the current Pareto front, as determined by strict product order for each dimension, strict or non-strict is just a matter of preference when considering equality, but non-strict version more naturally excludes duplicates). In each iteration, the algorithm uniformly samples an item from the Pareto front and tries to improve it. Each bit f_i is then flopped with probability $\frac{1}{N}$, where N is the number of features.

This newly constructed candidate is then evaluated for its performance (F_1). All the items on the Pareto front are then compared with this new item. If there exists no such item that is comparable or bigger from the new item, the new item is on the Pareto front and is subsequently added to it. All items that are comparable or smaller than new item are removed from the Pareto front, as they are (strictly) Pareto sub-optimal. Strictness is useful since it removes the duplicates (in a non-strict product weak ordering, even if the relation is non-linear, as in the case in the Pareto front, the product ordering is antisymmetric) [5].

4. RESULTS

Results of the early feature selection experiments are depicted in Figures 3 and 4. We have tested the methodology with the most popular classification techniques used in remote sensing (apart from deep learning): gradient boosting (LightGBM implementation [4]), random forests and logistic regression (baseline). Gradient boosting has proven to be a superior method whereas logistic regression performed the worst. SVM classifier was not considered since its training time complexity $\mathbb{O}(N^3)$ is too high for frequent re-training, needed in the feature selection algorithm.

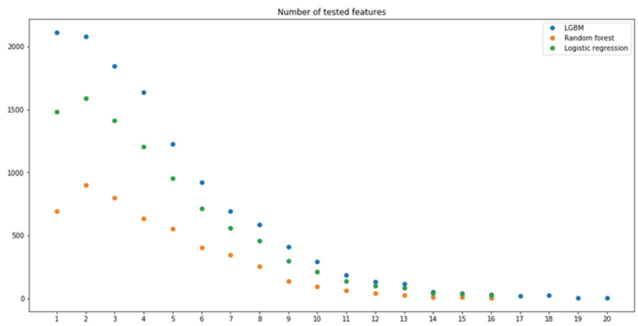

Figure 3: Number of tested candidates (y) per number of features (x). Gradient boosting is depicted with blue, random forests with orange and logistic regression with green dots.

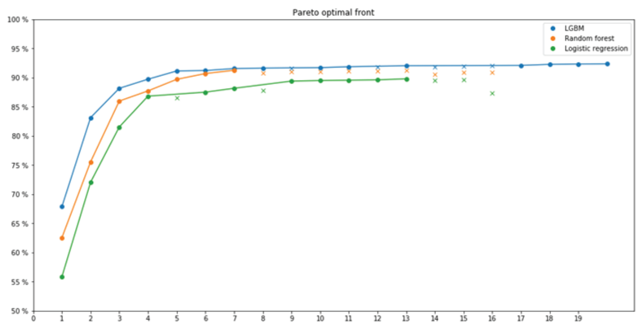

Figure 4: The best candidate F_1 score (y) per number of features (x). The lines depict the Pareto front for a particular classification algorithm. The optimal number of features for random forests and logistic regression is smaller than the size of the longest tested feature vector. Gradient boosting is depicted with blue, random forests with orange and logistic regression with green colour.

Figure 3 depicts the number of tested candidates per number of features. Number of features starts to decline sharply, but is a bit jumpy. This represents an expected behaviour considering the random nature of the feature selection algorithm and incremental difficulty of greatly increasing the number of features.

Figure 4 shows that smaller number of tested examples with a high number of features does not significantly affect F_1 score (considering small changes of a random element on the Pareto front, this seems reasonable). The same figure also shows, that already with a careful selection of just a few "good" features, classification produces quite good results. The figure also nicely depicts part of Pareto front and shows that high quality of feature selection might also improve the classification in some cases.

A clear plateau shape can be seen in Figure 4, hinting, that there is a reasonable choice of a subset of features. Selecting a small, but optimal subset of all features can yield good accuracy score of the classification algorithm, with decreased memory and computation footprint. The most important consequence of using an optimal subset of features is, that it saves a lot of time for data preparation (not extracting unneeded features, not sending/saving unneeded data) and most importantly makes the model reasonably small and fast, which allows usage even on a plethora of low computational power devices.

In the results presented above, LightGBM classification algorithm performance is unmatched by either random forest or logistic regression. This is an expected result since boosting can skew the feature space and can inherently introduce non-linear features into the model. The most illustrative case for the strength of proper feature selection is however seen in the case of random forest algorithm. We can observe from Figure 4 that already with 7 wisely chosen features (out of 108) one can achieve the optimal F_1 classification score. The reduced number of features speeds up the feature extraction step (less features need to be calculated) and modeling (less data is needed, fewer features are considered) and reduces the memory consumption demand.

5. CONCLUSIONS AND FUTURE WORK

This is the early paper on feature selection used for land-cover classification. It shows great potential of the methodology and up to 15-fold reduction of the number of needed phenological features in order to still achieve state-of-the-art accuracy. The methodology could be used with potentially great benefits also on other types of feature vectors in land-cover classification (i.e. with resampled index values), where it would automatically find the features that can distinguish between various land-cover classes. The main underlying reason for our research lies in the provision of computationally effective methods for faster, easier and cheaper EO data analysis.

There are still research challenges to be considered in this work. Firstly, benefits of feature reduction to the computational tasks should be examined in depth. The most important phase of the process is the inference phase (land-cover classification on large areas). However, preliminary results indicate that speed-up and memory consumption might be smaller than expected based on common sense.

Feature selection should be tested with other faster classification methods (i.e. based on incremental learning [5]), which trade accuracy for the faster computation. The latter might be beneficial in particular use cases (i.e. on-the-fly classification for on-line EO browsers like SentinelHub or large scale classification). A comprehensive study of benefits within full-stack pipelines (from data acquisition to inference) should be conducted.

Earth observation community has striven towards achieving optimal accuracy of the classification algorithms in the past few years. Especially deep learning algorithms have shown to require vast amounts of computational time, which is sometimes difficult to obtain. Presented work, together with research into computationally effective classification methods, might be a step towards sacrificing some of the accuracy in order to achieve final results sooner and with less struggle.

6. ACKNOWLEDGMENTS

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Identifying events in mobility data

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ABSTRACT

Today we are used to being interconnected via our smartphones and having our phone location tracked by different apps. ICT technology enables real-time monitoring and processing the user location data from GPS coordinates of a phone. Based on observing the user mobility, Artificial Intelligence methods can be used to improve transportation, proactively provide mobility recommendations and acquire knowledge using the user context. This paper describes the application of machine learning algorithms on user mobility data to identify and understand potentially interesting events. The data for this research was collected from a sample of users consenting to be monitored through our in-house developed smart phone app. A pilot study that includes 227 users that were tracked over a period of 7 years yields fairly positive evaluation results in terms of predictive accuracy of identified events but succeeds in identifying exclusively "well-known" events related to users going to or coming from the office and/or lunch. This shows that machine learning methods can be a suitable choice for identifying events in mobility data but there is still room for improvement.

CCS CONCEPTS

• CCS Information systems Information systems applications Data mining

KEYWORDS

Users mobility, network analysis, event detection, machine learning, clustering.

1 INTRODUCTION

Given the data of user mobility, we were looking into using social network analysis and machine learning methods to understand causal templates and identify and predict events in the user mobility data. To this end we have defined an event as an action that is a consequence of some user and/or environment property. For instance, such event is the user driving in the morning if the weather is cold, otherwise the user would be using some other means of transportation. The weather being cold is a cause for the event of driving.

The idea for identifying events is to build a social network of locations that the users are frequently visiting and compare traces of different users to identify typical behaviors. Once we have the traces of typical behaviors, we look for significant diversions in traces and hypothesize that they are consequences of some specific user or environmental context, for instance, from work the user is usually going home but every Tuesday afternoon we observe that the user is going to gym instead not to home. We use machine learning methods to categorize the events based on identified properties of the users/environment correlated with diversions of traces (these properties are seen as potential cause of an event). For instance, on Tuesday afternoons, when the previous location is work, the user frequently uses a bicycle. Then we find regularities in the properties to group the events (and causes). For instance, under specific circumstances some users go from work to gym instead of going home (relevant circumstances here could be that a user likes exercising and the period is Tuesday afternoon).

This paper is organized as follows. Section 2 shortly lists all related research that was done on the same or very similar data to the data used in this research. In Section 3 the data is presented together with the performed pre-processing. Section 4 describes the experimental evaluation with descriptions of the methodology and results. Section 5 provides interpretation and discussion of the experimental results. Section 6 concludes the paper and gives directions for future work.

2 RELATED RESEARCH

When referring to user mobility data nowadays, we mostly refer to GPS data provided by the user's smart phone or other wearable device. Sometimes, this data also includes the readings of other sensors, if present and functional (e.g. accelerometer). Tracking a user thus means collecting a series of GPS coordinates readings in a time sequence.

In [6] the authors argue that the raw GPS data is noisy and messy. Thus, when analyzing user paths, they group the GPS coordinates based on time and distance resulting in the detection of the so-called stay-points or locations where a user spent more time. Figure 1 depicts the idea of stay-point detection by clustering in space and time. The blue points in Figure 1 represent a spatio-temporal cluster of GPS coordinates called a stay-point.

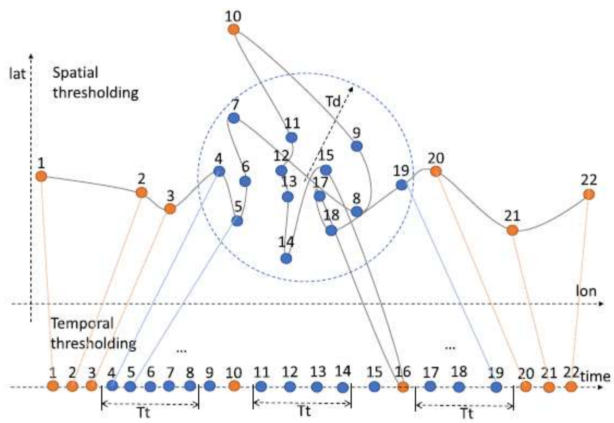

Figure 1: Outlier removal and spatio-temporal clustering [6]

The authors of [7] went a step further and used the data produced by the previous spatio-temporal clustering [6] to try to identify and give a rating to points of interest (PoI) based on users' behavior.

In [2] natural language processing (NLP) methods are used by the authors in combination with previously mentioned methods and crowdsourcing to provide additional user context.

Predicting users' mobility is what the authors of [5] tried to achieve by predicting the next location and mobility pattern of a user using probabilities and the Markov state-space model.

In [9] the authors aimed at detecting the most likely transportation mode of a user and in [1] they tried to motivate the users to make a more ecologically-friendly transportation choices.

Finally, the authors of [8] devised a methodology for visualizing qualitative patterns in multivariate time series that was tested also on user mobility data.

3 EXPERIMENTAL DATA

Raw data was collected from 432 users in a span of nearly 7 years (from 5.7.2012 until 7.4.2019). The users installed a mobile app that tracked their whereabouts by sending a reading to the database every 30 seconds. Every reading sent to the database included: the "activity ID", "the user ID", "timestamp", "GPS coordinates" (LAT and LON), additional data (accelerometer readings, GPS accuracy readings, …). Not all 432 users were sending data continuously for all 7 years (some users came later or left earlier, some smart phones switched off because of power source issues, sometimes GPS signal was out of range, …).

Because GPS data from users' phones was noisy and messy as argued by the authors of [6], we used their method to preprocess our raw data. The pre-processing steps taken to "clean" our data are described in Section 3.1.

3.1 Pre-processing the data

Data pre-processing was performed in two steps. First, clustering in space and time was applied to a set of uninterrupted 30 seconds GPS readings. Second, any remaining outliers were removed.

3.1.1 Clustering in space and time

This type of clustering is best understood by looking at Figure 1 (taken from [6]). Points, marked with numbers from 1 to 22 and connected with a line in this figure, represent a series of 22 uninterrupted 30 seconds GPS readings from one user. Every point has an associated timestamp and the values for LAT and LON. The clustering is performed using one time and one space threshold. A time threshold of 5 minutes and a space threshold of 120 meters (the threshold values that were actually used throughout our experiments) mean that all GPS readings that fall within a radius of 120 meters for more than 5 minutes will be clustered together to form one stay-point. Start and end times in this stay-point correspond to the first and last GPS readings in the cluster, respectively. A GPS coordinate for this stay-point is the average of LAT and LON values of all GPS readings in the cluster. The non-clustered GPS coordinates represent the so-called paths. In Figure 1 we can notice two paths (1-3 and 20-22) and 1 stay-point (all blue points 4-19).

3.1.2 Outlier removal

When performing the spatio-temporal clustering described in Section 3.1.1, we requested that all the remaining paths must contain at least two GPS coordinates. The GPS coordinates that do not belong neither to a stay-point, nor to a path after clustering, are considered outliers and thus removed.

3.1.3 The pre-processed data

After clustering and outlier removal described in Sections 3.1.1 and 3.1.2, the data contains 235,683 records, of which 114,923 are stay-points and 120,760 are paths. Every stay-point is described by a start time, an end time and a GPS location of its center. The paths, on the other hand, are ordered sets of readings, where each reading has a timestamp and a GPS location. Some paths can contain hundreds of readings, some of them can even be circular (starting and ending in the same GPS location).

Since some of the users that were tracked traveled a lot to all parts on the globe, we decided to simplify things by considering just those stay-points and paths for which all GPS coordinates were inside a rectangle (N 45° - 47° LAT, E 13° - 17° LON) that is limited to Slovenia in the Ljubljana nearby area. This also simplified our dealing with time, as all the data is in the same time zone. We also did not consider daylight-saving times. This reduction leaves our data with 110,072 records from 227 users, of which 58,188 are stay-points and 51,884 are paths.

Since our goal is to identify events in user mobility data, we need additional features describing the data that may later serve as event descriptors. The only two features we have at the moment are "time" and "position" (in space). From "time" we created six new features as follows:

- Time of day,
- Hour,
- Weekday,
- Weekend,

- Season, and
- Holiday.

"Time of day" is a discrete feature with 10 values (see Table 1), "Hour" is just the hour part of the timestamp, "Weekday" is a discrete feature with values MON – SUN, "Weekend" is a binary feature (T if SAT or SUN, F otherwise), "Season" is one of the 4 seasons (Winter, Spring, Summer or Autumn), Holiday is a discrete feature denoting all known Slovenian holidays.

Table 1: Values for the discrete feature "Time of day"

Timestamp	*Value*
6 AM – 8 AM	Early morning
8 AM – 11 AM	Morning
11 AM – 1 PM	Mid-day
1 PM – 3 PM	Early afternoon
3 PM – 5 PM	Afternoon
5 PM – 7 PM	Late afternoon
7 PM – 10 PM	Evening
10 PM – 12 PM	Late evening
12 PM – 4 AM	Night
4 AM – 6 AM	Dawn

From "position" we created just one additional feature, namely "Region" that maps a GPS coordinate to one of the 5 geographic regions in Slovenia (Štajerska-Prekmurje, Dolenjska-Hrvaška, Primorska-Istra, Gorenjsa-Avstrija, Gorica-Italija); a sixth "region" was added for the capital (Ljubljana).

4 EXPERIMENTAL EVALUATION

In this experiment we decided to additionally simplify things by "reducing" all the 51,884 paths to just the initial and final positions, disregarding all the 30-seconds position readings in-between. By doing so the notions of "path" and "stay-point" lose their meaning, since now we can consider a stay-point as a path whose initial and final positions are the same. Thus, we can drop the "type" (stay-point/path) feature and consider all 110,072 activities from 227 users in the same way.

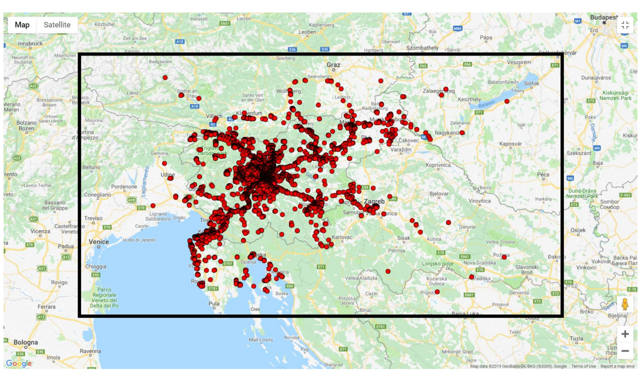

Figure 2: Visualization of experimental data on the map of Slovenia (Google Maps API)

We also decided to round all LAT and LON values to 2 decimal places. This was done since minor fluctuations in the GPS signal were being treated as different locations. By reducing our precision, we smoothed out this noise. The visualization of this data on a map of Slovenia is shown in Figure 2 – the black rectangle represents the observed region.

We now observe the 20 most visited GPS locations. 18 of the 20 most visited locations are all located around or near one of the most popular locations – they are depicted in Figure 3, with the black circle representing the most popular one. For each location we sample all paths that contain this location either at the beginning, the end or on both sides. This generates 20 new datasets. Just the results for the dataset associated with the most frequent location is presented in this paper, since for the other 19 datasets the results are very similar, and this is just the first experiment intended to be more of a proof of concept than a thorough result.

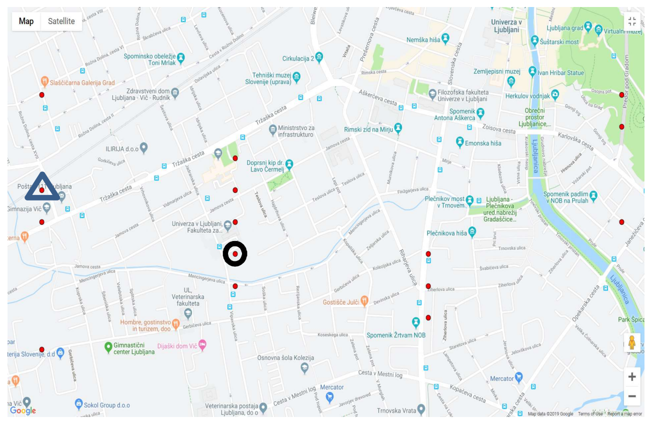

Figure 3: The 18 most popular locations (Google Maps API)

The most frequent location's dataset now contains 17,582 activities (2-point paths). At this point we decide to observe the difference between users that come to the most frequent location, those that leave the most frequent location and those that stay at the location. We create a new *Class* attribute that will serve as our dependent variable for the predictions and assign the values "In" (5,356 examples), "Out" (6,947 examples) and "Stay" (5,225 examples) to it, reflecting the users coming, leaving or staying. So, we end up with a dataset with 17,582 examples, 14 independent attributes – (6 for "time", 1 for "space") x 2 (for start and end point) and a quite balanced class attribute.

4.1 Methodology

For machine learning we used the WEKA workbench [3,4]. The algorithms used were PART (rule learning), J4.8 (decision trees), SMO (SVM), Random Forrest and Naïve Bayes. All the algorithms were ran with the default parameters; the evaluation was performed using 10-fold cross-validation observing classification accuracy as the performance measure. The task we are addressing is supervised learning to build a model for distinguishing between the three types of users that are visiting the most frequent location. In our data the most frequent location turned out to be the Jožef Stefan Institute, which is the working place for most of the users.

4.2 Results

The results of this experiment are presented in Table 2. Classification accuracies are presented as percentages together with standard deviations.

Table 2: Results of selected algorithms on most frequent location's dataset

ML algorithm	*Average accuracy (%) / STD*
Majority class	*39.5 ("Out")*
Naïve Bayes	65.5 / 2.45
J4.8	68.1 / 2.76
PART	68.5 / 2.19
SMO	**71.4 / 1.99**
Random Forrest	70.2 / 2.01

The results in Table 2 show that all five algorithms perform within the 65% to 70% classification accuracy, with SMO having slightly higher accuracy. The majority class value in this case is "Out" appearing in just 39.5% of all the examples.

Not shown in Table 2 is the co-occurrence of certain attribute values with specific class values: "Time of the day = Morning" frequently co-occurs with class value "In" in the generated models; "Time of the day = Mid-day" frequently co-occurs with both class values "In" and "Out"; "Time of the day = Late afternoon" frequently co-occurs with class value "Out". There is a lot of migration between the most frequent location (black circle on Figure 3) and one of the other top 20 frequent locations (blue triangle on Figure 3).

5 DISCUSSION

As the results in Table 2 clearly show, the Support Vector Machine classifier (SMO) has the highest accuracy, but the difference compared to the second best, Random Forrest, is not big. All selected machine learning algorithms clearly outperform the majority classifier with around 70% accuracy.

The frequent co-occurrence of attribute values with specific classes show the following:

- in the morning people tend to come "In" to the frequent location (they come to work),
- in the late afternoon people tend to go "Out" from the frequent location (they leave the office),
- at mid-day (around noon), both "In" and "Out" links suggest people go for lunch or a snack,
- a lot of migration between the most frequent location and one of the other frequent locations suggests people have some sort of engagement on this other frequent location – indeed it turned out that the other frequent location is in fact the building where a lot of mobility users work in their spin-off companies.

In Figure 3 the "grid effect" of rounding up the GPS coordinates is clearly visible and sometimes the rounded coordinates do not correspond exactly to the physical locations of the points-of-interest.

6 CONCLUSIONS AND FUTURE WORK

Our pilot study on identifying events in mobility data provided fairly positive experimental evaluation results in terms of predictive accuracy of identified events. However, the events identified are "well-known" events related to the users going to or coming from the office and/or lunch.

On the other hand, over-simplification of the mobility data did not "pay off" in our case, which is clearly visible in the form of the "grid effect" of rounded GPS positions and lack of interesting/surprising relationships in the constructed models.

One possible direction that we are looking at for the future research is to re-run the experiments on the original pre-processed data (described in Section 3) and focus our attention on the changes in user paths. Instead of rounding the GPS coordinates changing the parameters of the clustering used for stay-point creation described in section 3.1.1 seems to be a more promising direction to take.

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Early land cover classification with Sentinel 2 satellite images and temperature data

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ABSTRACT

The weather is one of the main factors for events that happen on the surface of the earth. Surprisingly, no effort was made to use weather features together with satellite images for land cover classification. In the paper, we use temperature data along with satellite images to improve the accuracy of the classification and to get classification as early in the year as possible. Every year has different conditions, so the temperature can be used as an objective criterion at what time to do classification.

Keywords

remote sensing, weather, earth observation, machine learning, feature selection, classification, temperature

1. INTRODUCTION

Precise classification of land cover is important for agriculture and food security. It is especially important to make the classification as early as possible so the farmers can know the situation of their land better and can take appropriate action.

Since ESA launched the Sentinel 2 mission that provides big amount of data, a lot of research is focusing on satellite data and land cover classification [9, 5, 15, 14]. We found no paper where the weather would be used to improve the land cover classification. Most of the research using weather is focused on predicting the yield [11, 6, 1].

Literature shows that weather plays one of the most important roles in the growth of vegetation and development of crops [8, 7, 16]. It is expected that it will play an even more important role in the future, with climate change trends [7]. According to literature the most important weather variables for the development of vegetation are temperature, precipitation and the duration of sunlight. The most important of them is temperature. The research shows that time for growing is better correlated with temperature than the number of days from planting [1]. The plant growing models talk about the fact that the plants have some optimal temperature above which the plants grow best. It is also important that the temperature does not go above some threshold [8]. Weather variables are also important for farmers decisions. Based on weather condition the farmer can choose when what and how to seed [7].

In the paper, we try to improve our classification prediction with the help of temperature. We are trying to find the moment when the temperature is above some threshold for long enough.

2. DATA

2.1 Data Acquisition

In the article, we use satellite data from the ESA Sentinel-2 mission [3]. The Sentinel-2 mission has two satellites that circle the earth with 180° phase. The same point is visited at least once every five days. Satellites collect data in 13 different spectral bands. Spatial resolution is 10m, 20m or 60m, depending on the band.

We downloaded satellite data with the sentinel-hub library [12] integrated in the eo-learn library [13]. Eo-learn is the library that makes access to and processing of earth observation data easier. We used eo-learn also to preprocess the data. Data were downloaded for times between July 1, 2015 and June 30, 2018.

Temperature data are from the ECMWF (European Centre for Medium-Range Weather Forecasts) archive [2]. ECMWF is the archive that stores accurate historical data, both observed and forecasts weather data for the world. The data used in the article has approximately 15×15 km resolution.

Data for land cover are from the website of the Slovenian Ministry for farming, forests, and food [10]. Data are publicly available and contain 25 classes. The land use data are mostly created with aerial photography called orthophoto. In case that the area is impossible to categorize from the image, the terrain inspection is made.

2.2 Data Preprocessing

Most preprocessing of satellite data are already made by ESA, like atmospheric reluctance or projection [4]. Thus, our data is already clean and ready for use.

The biggest challenge in our satellite data set was missing data when the clouds cower some images or some parts of it. To eliminate that problem we took images provided by ESA and filtered out the pixels that were covered by clouds using the cloud mask. The cloud mask was provided by eo-learn's AddCloudMaskTask() task. That way we got images only with cloudless pixels.

The other concern was that all images were not taken on the same date and now we have some missing data from cloud removal. Therefore we took a time series of each pixel and linearly resampled all bands over time. We resampled it on every 16th day starting on 1.1.2016 and up to 31.12.2017.

That way we produced a data set that had all images at the same timestamp. Linear respelling also filled the gaps from filtering the images with clouds.

The land cover data had 26 different classes, but some classes were too small. We joined the related classes under five more general classes (grass, forest, crop land, urban area and other).

3. METHODOLOGY

The idea of the experiment was that when the temperature is above a certain threshold the plant stars to grow. Because they grow differently, it is easier to classify the areas with different vegetation. Therefore we looked for the time when the temperature is high enough for land covers to be easier to classify.

3.1 Feature Vectors

Experiments were conducted in the area of Slovenia. We used data from years 2016 and 2017. Data from 2016 were used to train the model and data from 2017 for testing. We randomly chose 150 patches in the size of 50 × 50 pixels (500 m × 500 m). Then we sampled from those patches approximately 50 000 pixels with the class that we are interested in and 50 000 pixels that are not from that class. That way we get balanced data sets, that we can use to train our learning algorithm. Thus, we created two vectors for each class, One for learning and one for testing.

For each date, we counted the number of days that average temperature exceeded some maximum temperature (T_{max}). We calculated that for T_{max} from -10°C to 26°C for every 2°C. Those features we added to the time series of pixels. Because the temperature data has smaller spatial resolution than satellite data, we appended to each pixel the temperature data from the weather data point that is the closest to the coordinates of that pixel.

For all pixels' time series, we found the first timestamp for which the number of days with temperature above T_{max} was higher than the chosen number of days. We took the values of bands at that timestamp for each pixel. That was done for both years, resulting in two feature vectors, one to train the model and the other to test it.

Because some higher temperatures were not reached often enough, some did not include all pixels. If less than 70% of all pixels passed the criteria, the experiment under those criteria was not made.

3.2 Experiment

On data sets from 2016, we trained the decision tree classifier. The decision tree function is from the sci-kit learn python library and was used with default settings. To evaluate models we calculated predictions for the year 2017, and calculated $F1$ score. In all experiments we made two class classification.

We did experiments systematically for all calculated temperatures T_{max} and for all possible numbers of days from 1 to 30.

To compare results we made another experiment where we trained the model on the data from one date and tested it on the closest date next year. We compared $F1$ scores from both experiments, to see if the model, trained with data set chosen with help of temperature, perform better.

4. RESULTS

The maximum $F1$ score from the experiment with the data set determined by temperature is better for all classes than the maximum $F1$ score from the second experiment (table 1). That means that the temperature helped us improve the classification.

Figure 1: F1 scores from model trained and tested at the same date. Maximum values are used to compare results from first experiment.

	Forest	Grass	Crop	Urban area	Other
Max $F1$ score-temp	0.76	0.74	0.70	0.73	0.59
Max $F1$ score-time	0.74	0.67	0.62	0.64	0.53
Diff	0.02	0.07	0.08	0.09	0.06

Table 1: Table shows maximum F1 scores for all five classes, from both experiments and the difference between them.

Figure 2 shows the difference between F1 scores from the experiment with temperature and the maximum F1 score from

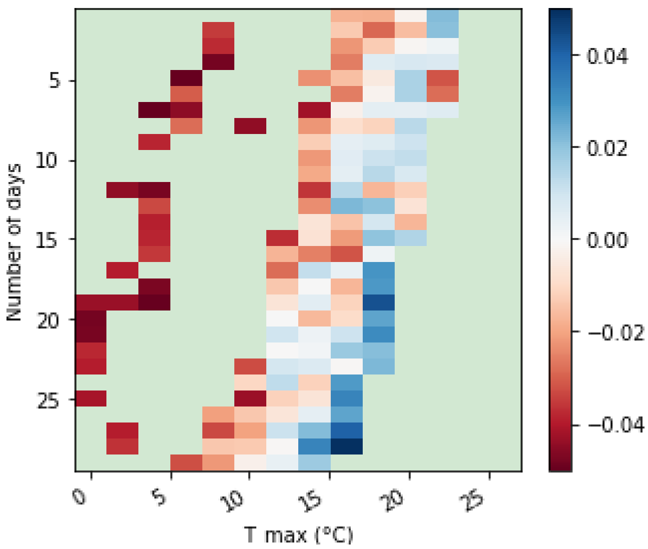

Figure 2: The figure shows the matrix of difference between $F1$ scores from the experiment with temperature and the maximum $F1$ score from the second experiment. Blue color shows times when the $F1$ score is better than in first experiment and red color when the $F1$ score is worse by less than 0.05. Green area is where the classification was worse by more than 0.05 or the times when less than 70% of pixels were available for training. This figure is from the classification of grass.

other experiment. The experiment from figure 2 was made for grass classification. We get similar images also for other classes. On the figure, we notice that we get two islands, one at the temperature around $4°C$ and the other around $16°C$. Each island corresponds to data at different dates. The data from the same island are from similar dates. The distribution over dates for both islands is shown in figure 3.

The classification of grass, forest, and urban area produces the same kind of islands, while the crop and other produces only one big island. We assume that this is due to non-homogeneous vegetation in those two classes.

From figure 1 we see that the classification of the grass in the second experiment is the best at the end of August ($F1 = 0.67$). An even better classification score (up to 0.07, $F1 = 0.74$) can be achieved with most of the classification made before august (blue, orange and green bars from figure 3).

Another useful result from approach with temperature is that the classification can be made earlier in the development of plants. Relatively good classification ($F1 = 0.63$) can be achieved by the end of April (red, purple, brown and pink bars from figure 3).

For forest and urban area, the first island gives also slightly worse classification but we can classify earlier. While the second island gives us better results at the approximately same time. The classification of both classes with one island is approximately at the same time, but it achieves better results.

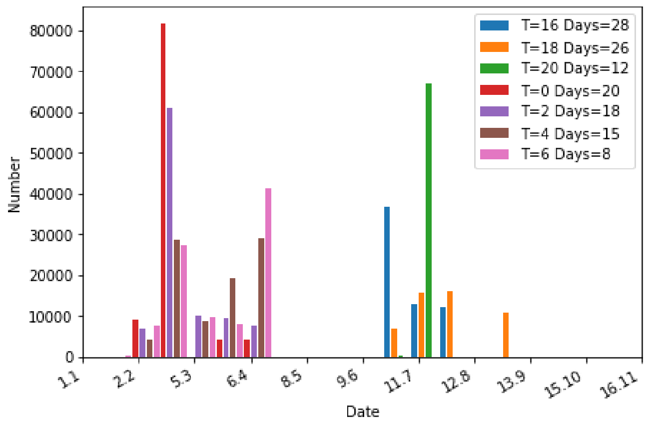

Figure 3: Histogram shows the number of pixels with certain time stamp, at chosen T_{max} and number of days. It shows only some representatives of both islands.

5. CONCLUSIONS

In the article, we showed that temperature can help us determine when is the most appropriate time to do classification. Because the conditions are not the same everywhere, temperature gives us a good and objective tool to determine when is the best time to do classification.

We also showed that we can do classification much earlier than we thought. Plants do not need to fully grow. We can identify its development as early as March or April.

The problem with that method is that we can not know in advance when the optimal time for classification will come. And when that time comes it is not the same for all areas but is determined locally, by local weather condition. Therefore usually, one model can do all classification in one month and a half, for the whole area of Slovenia. But for a farmer who is interested in the growth and development of his plants, that is usually not a problem, because his farm is usually smaller than the resolution of weather data. That means that he can get all classification data for his farm in a day. But if he is from the colder regions of Slovenia he might still wait for some time before getting predictions.

In the future, the goal would be to add other weather features like precipitation or sun duration. Another important use case would be to focus on agriculturally more interesting plants like corn, wheat, and others. That would be important to ensure food security in years with the bad weather condition.

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How overall coverage of class association rules affects the accuracy of the classifier?

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ABSTRACT

Associative classification (AC) is a data mining approach that combines classification and association rule mining to build classification models (classifiers). Experimental results show that in average the CBA-based approaches could achieve higher accuracy than some of the traditional classification methods.

In this paper, we focus on associative classification, where class association rules are generated and analyzed to build a simple, compact, understandable and relatively accurate classifier. Furthermore, we discuss how overall coverage and average rule coverage of such classifiers affect their classification accuracy. We compare our method that uses constrained exhaustive search with some "classical" classification rule learning algorithm that uses greedy heuristic search on accuracy in some "real-life" datasets. We have performed experiments on 11 datasets from UCI Machine Learning Database Repository.

Experimental evaluation shows that with decreasing overall coverage our proposed method tends to get slightly worse classification accuracy than the "classical" classification rule learning algorithms. Otherwise, the accuracy is similar or on some datasets even better than Naive Bayes and C4.5. On the other hand, the average rule coverage of our proposed method seems to have no effect on classification accuracy.

CCS CONCEPTS

• Computing methodologies → Machine learning → Machine learning approaches → Rule learning

• Computing methodologies → Machine learning → Cross-validation

• Computing methodologies → Machine learning → Learning paradigms → Supervised learning → Supervised learning by classification

KEYWORDS

Attribute, frequent Itemset, Minimum Support, Minimum Confidence, Class Association Rules (CAR), Associative Classification.

1 INTRODUCTION

Frequent patterns and their corresponding association rules characterize interesting relationships between attribute conditions and class labels, and thus have been recently used for effective classification. Association rules show strong associations between attribute-value pairs (or items) that occur frequently in a given dataset. Association rules are commonly used to analyze the purchasing patterns of customers in stores. Such analysis is useful in many decision-making processes, such as product placement, catalog design, and cross-marketing. The discovery of association rules is based on frequent itemset mining.

Associative classification mining is a promising approach in data mining that utilizes the association rule discovery techniques to construct classification systems, also known as associative classifiers. In the last few years, a number of associative classification algorithms have been proposed such as CBA: Classification based Association [11], CMAR: Classification based on Multiple Association Rules [10], CPAR: Classification based on Predicted Association Rule [13]. These algorithms employ several different methods, such as rule discovery, rule ranking, rule pruning, rule prediction and rule evaluation. Machine learning is one of the main phases in knowledge discovery from databases, which extracts useful patterns from data. Associative classification (AC) is lately among the focus areas in machine learning. AC integrates two known data mining tasks, association rule discovery and classification. The main aim is to build a model (classifier) for the purpose of prediction. Classification and association rule discovery are similar tasks in data mining, with the exception that the main aim of classification is the prediction of class labels, while association rule discovery describes correlations between items in a transactional database. In the last few years, association rule discovery methods have been successfully used to build accurate classifiers, which have resulted in a branch of AC mining. Several studies [4,9,10,11] have proved that AC algorithms are able to extract classifiers competitive with those produced by decision trees [3,12], rule induction [5,6,8] and probabilistic approaches [2].

In comparison with some traditional rule-based classification approaches, associative classification has two main characteristics. Firstly, it generates a large number of association classification rules. Secondly, support and confidence thresholds are applied to evaluate the significance of classification association rules. However, associative classification has some weaknesses. First, it often generates a very large number of classification association rules in association rule mining, especially when the training dataset is large. It takes great efforts to select a set of high quality classification rules among them. Second, the accuracy of associative classification depends on the setting of the minimum support and the minimum confidence. Unbalanced datasets may heavily affect the accuracy of the classifiers. Third, the efficiency of associative classification may be also low, when the minimum support is set to be low and the training dataset is large. Although associative classification has some drawbacks, it can achieve higher accuracy than rule and tree-based classification algorithms on certain real life datasets.

In this paper, we propose a simple classification method that selects a reasonable number of rules for classification, then, we find the overall coverage and average rule coverage of the classifier. We perform experiments on 11 datasets from the UCI Machine Learning Database Repository [7] and compare the results with some of the well-known classification algorithms (Naïve Bayes [2], PART [8], Ripper [6], C4.5 [12]).

2 PRELIMINARY CONCEPTS

Association rules consist of two parts, an antecedent (if) and a consequent (then). An antecedent is an item found in the data. A consequent is an item that is found in combination with the antecedent. Association rules are generated from frequent itemset by analyzing the dataset and *support* and *confidence* thresholds are used to identify the most important relationships. *Support* is an indication of how frequently the items appear in the dataset. *Confidence* indicates the number of times the if/then statements have been found to be true.

Associative classification is a special case of association rule discovery in which only the class attribute is considered in the rule's right-hand side (consequent), for example, in a rule such as X→Y, Y must be a class attribute. One of the main advantages of using a classification based on association rules over classic classification approaches is that the output of an AC algorithm is represented in simple if–then rules, which makes it easy for the end-user to understand and interpret it

Let D be a dataset with n attributes $\{A_1, A_2, ..., A_n\}$ that are classified into M known classes and $|D|$ objects. Let $Y = \{y_1, y_2 \dots . y_m\}$ be a list of class labels. A specific value of an attribute A_i and class Y is denoted by lower-case letters a_{im} and y_j respectively.

Definition 1. An itemset is a set of some pairs of attributes and a specific value, denoted $\{(A_{i1}, a_{i1}), (A_{i2}, a_{i2}), \dots, (A_{im}, a_{im})\}$.

Definition 2. A class association rule R has the form $\{(A_{i1}, a_{i1}), ., (A_{im}, a_{im})\} \to y_j$ where $\{(A_{i1}, a_{i1}), ., (A_{im}, a_{im})\}$ is an itemset and $y_j \in Y$ is a class label.

Definition 3. The support count *SuppCnt(R)* of a rule *R* in *D* is the number of records of *D* that match *R*'s antecedent (left-hand side).

Definition 4. The support of rule *R*, denoted by *Supp(R)*, is the number of records of *D* that match *R*'s antecedent and are labeled with *R*'s class.

Definition 5. The confidence of rule R, denoted by *Conf(R)*, is defined as follows: $Conf(R) = Supp(R)/SuppCnt(R)$.

3 PROBLEM DEFINITION

Our proposed research assumes that the dataset is a normal relational table which has N examples described by L distinct attributes. These N examples are classified into M known classes. An attribute can be categorical (or nominal) or continuous (or numeric). In this paper, we treat all the attributes uniformly. Categorical attribute's values are mapped to a set of consecutive positive integers. Numeric attributes are discretized into intervals (bins), and the intervals are also mapped to consecutive positive integers. Discretization methods will not be discussed in this paper as there are many existing algorithms in the machine learning literature that can be used.

Our first goal is to generate the complete set of strong class association rules that satisfy the user-specified minimum support and minimum confidence constraints, and the second goal is to extract a reasonable number of strong CARs by pruning to build a simple and accurate classifier, the third and main goal is to find the overall coverage, average rule coverage and accuracy of the intended classifier.

4 OUR PROPOSED METHOD

Our proposed method consists of three steps. Firstly, a complete set of strong class association rules is generated from the given dataset. We then select a reasonable number of strong rules to build our simple and accurate classifier in the second step. Finally, we find the overall coverage, average rule coverage and accuracy of the classifier.

4.1 Generating class association rules

Association rule generation is usually split up into two separate steps:

1. First, we find all the frequent itemsets in a dataset by applying minimum support threshold. This step is the most important one, because, if minimum support is set to low, then we may have huge number of rules that lead to combinatorial complexity. If minimum support is set to high, then we may lose some interesting or strong rules, therefore, appropriate minimum support must be applied by analyzing the dataset.
2. Second, minimum confidence constraint is applied to generate strong class association rules from these frequent itemsets generated in the first step.

The second step is straightforward, that is why, we pay more attention to the first step. Apriori is a seminal algorithm described in [1] and it is mostly suggested for mining frequent itemsets.

Once the frequent itemsets from the dataset have been found, it is straightforward to generate strong class association rules from them (where strong CARs satisfy both minimum support and minimum confidence constraints). This can be done using following equation for confidence:

$$confidence(A \to B) = \frac{support\_count(A \cup B)}{support\_count(A)}. \qquad (1)$$

The equation (1) is expressed in terms of itemsets support count, where A is premises (itemsets that is left-hand side of the rule), B is consequence (class label that is right-hand side of the rule), *support_count*$(A \cup B)$ is the number of transactions containing the itemsets $A \cup B$, and *support_count*(A) is the number of transactions containing the itemsets *A*. Based on this equation, CARs can be generated as follows:

● For each frequent itemset in *L* and class label *C*, generate all nonempty subsets of *L*.

● For every nonempty subset *S* of *L*, output the rule "*S*→*C*" if $\frac{support\_count(L)}{support\_count(S)} \geq \min\_conf$, where $\min\_conf$ is the minimum confidence threshold.

4.2 Building our proposed classifier

We build our intended simple classifier by extracting the reasonable number of strong class association rules (already satisfied the minimum support and confidence requirements) that are generated in 4.1. Our proposed method is outlined in Algorithm 1.

Algorithm 1: Simple and accurate classification algorithm

Input: a set of CARs with their *support* and *confidence* constraints
Output: a subset of rules for classification

```
1:   D= Dataset();
2:   F= frequent_itemsets(D);
3:   R= genCARs(F);
4:   R= sort(R, minconf, minsup);
5:   G=Group(R);
6:   for (k=1; k≤ numClass; k++) do begin
7:       X= extract(class[k], numrules);
8:       Classifier= Classifier.add(X);
9:    end
10:   for each rule y ∈ Classifier do begin
11:       if y classify new_example then
12:       class_count[y.class]++;
13:   end
14:   if max(class_count)==0 then
15:       predicted_class=majority_class(D);
16:   else predicted_class= index_of_max(class_count);
17:   return predicted_class
```

In lines 1-2 find all frequent itemsets in the dataset by using the Apriori algorithm. Line 3 generates the strong class association rules that satisfiy the minimum support and confidence constrains from frequent itemsets. In line 4, CARs are sorted by *confidence* and *support* in descending order as follow:

Given two rules R_1 and R_2, R_1 is said having higher rank than R_2, denoted as $R_1 > R_2$,

- If and only if, $conf(R_1) > conf(R_2)$; or
- If $conf(R_1) = conf(R_2)$ but, $supp(R_1) > supp(R_2)$: or
- If $conf(R_1) = conf(R_2)$ and $supp(R_1) = supp(R_2)$, R_1 has fewer attribute values in its left-hand side than R_2 does;

Line 5 defines how to group the class association rules by their class labels (for example, if the class has three values, then, rules are grouped into three groups). In lines 6-9, we extract the reasonable number of rules per class that are equal to *numrules* to form a simple and accurate classifier. These set of rules become our final classifier. In lines 10-13, classification is performed by extracted CARs in line 6-9, if the rule can classify the example correctly, then, we increase the corresponding class count by one and store it. In lines 14-17, if none of the rules can classify the example correctly, then, algorithm returns the majority class value for the training dataset. Otherwise, it returns the majority class value of correctly classified rules.

4.3 Overall coverage and average rule coverage

After our classifier is built in 4.2, it is straightforward to compute the overall coverage and average rule coverage of the classifier. To compute the overall coverage, we count the transactions that are covered by the classifier and divide it to total number of transactions in dataset. For the rule coverage, we count all the transactions that are covered by each rule in classifier and we take the average of them divided by total transactions.

Algorithm 2: Overall and average rule coverage of the classifier

Input: dataset and classifier
Output: overall coverage and average rule coverage

```
1:   n=D.length();
2:   C= Classifier;
3:   fill(classified_example)=false;
4:   for (i=1; i≤ C.length(); i++) do begin
5:       for (j=1; j≤ n; j++) do begin
6:           if C[i].premise classifies D[j].premise then
7:               rulecover[i]++;
8:               classified_example[j]=true;
9:       end
10:    avg_rulecover=avg_rulecover+ rulecover[i]/n;
11:  end
12:  for (i=1; i≤ n; i++) do begin
13:      if classified_example[i] then
14:          count++;
15:  end
16:    Overallcover_dataset=count/n;
17:  return Overallcover_dataset, avg_rulecover
```

First line finds the length of the dataset. We form our classifier introduced in 4.2 (method is already created in lines 6-9 of algorithm 1) from the intended dataset in line 2. In the third line, we fill all initial values of *classified_example* array as false. Lines 4-11generally find the average rule coverage of the classifier. More precisely, we try to classify all the examples in the dataset by our classifier in lines 5-9. If rule's premise (left hand-side of the rule) classifies the example's premise (left hand-side of the example) in the dataset, then we increase the count for that rule's coverage and we mark that example as classified (this helps to compute the overall coverage of the dataset). Line 10 calculates the average rule coverage. We count all correctly classified examples in the dataset in lines 12-15 and overall coverage of the dataset is found in line 16. Line 17 returns the overall coverage and average rule coverage.

5 EXPERIMENTAL RESULTS

To find out the overall coverage, average rule coverage and to compare our results with some existing well-known classification methods on accuracy, we performed experiments on 11 real-life datasets from the UCI Machine Learning Database Repository. We used the WEKA software to explore the classification methods and 10 times random-split method (average result is taken over 10 experiments) is used to perform experiments for both our method and other classification methods. In order to get enough rules for each class value and achieve a reasonable overall coverage, the parameter "*#Rules per class*" was set to 50 for all experiments. For other classification algorithms, Naive Bayes (NB), C4.5, PART (PT) and JRip (JR), we set up the default parameters.

Table 1. Overall coverage and average rule coverage

Dataset	# attr	# Cls	# recs	Min sup (%)	Min conf (%)	#Rules per class	Overall coverage (%)	Avg. rule coverage (%)	Accuracy (standard deviation) (%)				
									SA	C4.5	PT	JR	NB
Breast.Cancr	10	2	286	5	70	50	77.2	6.83	74.8(3.1)	72.0(3.5)	69.9(2.7)	68.9(4.4)	72.7(2.9)
Vote	17	2	435	1	80	50	93.1	28.86	95.4(2.4)	95.1(1.8)	95.5(1.4)	95.5(1.1)	89.1(1.9)
Balance.Sc	5	3	625	1	80	50	87.6	3.04	80.2(2.5)	67.2(2.4)	77.3(3.2)	77.4(2.0)	91.9(2.2)
Car.Evn	7	4	1728	0.8	70	50	76.2	7.14	81.4(2.8)	89.5(1.5)	95.0(1.5)	83.4(2.5)	84.8(0.9)
Tic-tac-toe	10	2	958	3	80	50	71.9	2.67	84.4(2.4)	84.7(3.2)	89.3(2.8)	97.5(0.6)	69.9(1.9)
Nursary	9	5	12960	2	60	50	98.0	3.78	88.6(2.6)	96.2(0.4)	98.7(0.4)	95.9(0.3)	90.4(0.4)
Hayes	6	3	160	1	50	50	100.0	5.56	80.1(7.1)	76.0(4.2)	73.3(7.7)	79.3(5.5)	79.7(7.9)
Mushroom	23	2	8124	20	80	50	84.4	4.76	68.2(1.6)	68.1(0.8)	64.3(0.7)	68.8(2.9)	69.7(0.5)
Lymp	19	4	148	3	70	50	81.0	18.76	75.3(6.4)	80.0(3.6)	79.0(6.9)	81.0(6.7)	85.1(4.1)
Monks	7	2	554	1	70	50	93.0	2.93	94.3(2.2)	98.4(2.7)	98.4(2.4)	98.4(2.2)	96.2(2.0)
Spect	23	2	267	0.5	60	50	81.4	27.21	78.6(3.1)	70.6(2.3)	67.1(5.3)	70.2(3.3)	69.9(4.1)
Average							85.8	10.14	81.9(3.3)	81.6(2.0)	82.5(3.2)	83.3(2.9)	81.8(2.6)

By analyzing the table of results (Table 1) we can observe that our classifier achieved better average accuracy than C4.5 and Naïve Bayes (81.9, 81.6 and 81.8 respectively). Standard deviations were higher for all methods on "Hayes" and "Lymp" datasets, that is, the differences between accuracies fluctuated and were reasonable high in 10 times random-split experiments. The overall coverages were lower than 80% on "Breast cancer", "Car evaluation" and "Tic-tac-toe" and in those cases also the accuracy is slightly worse than that of the "classical" classifiers. On almost all other datasets our method achieves similar or slightly better accuracy. On the other hand, average rule coverage is surprisingly high on "Vote", "Lymp" and "Spect" datasets, but seems to have no effect on classification accuracy.

6 CONCLUSION AND FUTURE WORK

Our comparison on selected 11 UCI ML datasets shows that with decreasing overall coverage our proposed method tends to get slightly worse classification accuracy than the "classical" classification rule learning algorithms. This fact is not surprising, since uncovered examples get classified by the majority classifier. When the overall coverage is above 85%, the accuracies of our classifier is similar or (on some datasets) ever better then Naive Bayes and C4.5. On the other hand, the average rule coverage of our proposed method seems to have no effect on classification accuracy.

This research shows that overall rule coverage should be considered when selecting (pruning) the "appropriate" class association rules which we plan to implement in future research.

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Epileptic Seizure Detection Using Topographic Maps and Deep Machine Learning

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ABSTRACT

One third of all epileptic patients is resistant to medical treatment. The construction of machines, that would detect an imminent epileptic attack based on EEG signals, represents an efficient alternative, that would help to increase their quality of life. In this article we described the implementation of an automatic detection method, based on the signal of different frequency sub-bands, using topographic maps and deep learning techniques. We constructed an ensemble of five convolutional neural networks, to classify samples of each sub-band and chose the final decision by a majority voting. The ensemble obtained 99.20% accuracy, 96.48% sensitivity and 99.27% specificity when detecting seizures of one patient. Moreover, when the networks were trained with samples taken randomly from the inter-ictal intervals, we identified on 18 of 21 seizures some false positive classifications close to the seizure onset, thus anticipating the detection of the seizure. Such misclassifications did not occur when training was performed with samples taken within five minutes of the seizure onset.

KEYWORDS

Epileptic Seizure Detection, Deep Learning, Topographic Maps, Electroencephalogram.

1 Introduction

Epilepsy is a neurological disorder characterized by sudden seizure attacks, that may cause in patients loss of consciousness and motor control. It is esteemed that epilepsy affects about 50 million people world-wide and represents up to 1% of the global burden of disease[6]. Although in the last decades many anti-epileptic drugs (AEDs) have been introduced[4], to more than 30% of the patients these treatments are ineffective. Therefore, their daily life activities are very restricted because of the unpredictability of the attacks. The development of different approaches, that could timely inform patients of an imminent epileptic attack is necessary to increase their quality of life.

The most used tool to monitor brain's electrical activity is the electroencephalogram (EEG). However, due to the complexity of the EEG signals, visual detection of epileptic seizures from the signal often results misinterpreted or mistaken. Therefore, in the last decades much research has been oriented towards finding automated detection procedures, that would efficiently analyze large chunks of signals, timely give out warnings and help the medical staff to deliver treatment on time[8].

Since the first studies of epilepsy seizures with EEG, it is known that an epileptic attack has a detectable electrical discharge in the brain (EEG onset), prior to the manifestation of convulsions, loss of consciousness and others symptoms (clinical onset)[7]. The time window between these events usually ranges between 0 to 30 seconds, sometimes reaching over 1 minute. Therefore, being able to detect early enough the EEG onset of the seizure could give enough time to the patient to get the treatment or at least to reach a safe environment.

Based on these motivations, we constructed the following model for epilepsy seizure detection, based on topographic maps generated from EEG signals and deep machine learning classifying techniques.

2 Experimental Setting

In this work we used data from the EPILEPSIAE database[5]. We selected a single patient, with a defined focal epilepsy in the temporal lobe. The recording of the patient of about 161.1 hours contained 22 seizures, averaging 3.28 seizures per day. However, one seizure was discarded from the study since it was described as not reliable. The sampling frequency of the machine was 256 Hz.

The work is composed by two studies, which follow the general processing pipeline: raw data is preprocessed and transformed from time to frequency domain, then the relative powers calculated from the signals of the frequency sub-bands are used to generate topographic maps, which are then fed to the classifier. After a regularization procedure, the performance of the model is evaluated. Figure 1 schematically describes the mentioned pipeline.

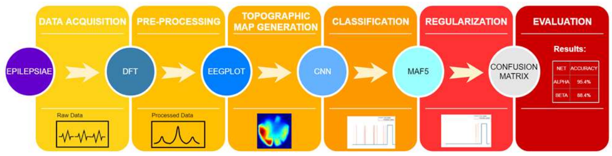

Figure 1: Processing pipeline of the DM process

2.1 Study 1: 80% overlap

2.1.1 Pre-Processing and Feature Extraction

Raw data needs to undergo few pre-processing steps, before it can be used to generate topographic maps. Here, we used functions from the EPILAB® [3] package. Next, with a high-pass filter kept the frequencies between 0.1Hz and the Nyquist frequency, which in this case was 128 Hz, and then a 50 Hz notch filter was applied to remove possible power line artifacts.

EEG signals are non-stationary. Many mathematical tools for analysis assume the stationarity of the signal. One way to enforce an "artificial" stationarity is by segmenting the signal and making the analysis of the segments globally valid[11]. Initially, the chosen length of segments (sliding time windows) was 5 seconds, with an overlap of 80%. This allows to assume stationarity in these five second windows and preserve frequency resolution. Furthermore, by overlapping by 80% we obtain four time more samples than we would have obtained without it and we might detect additional information that could not be captured between the end of a window and the beginning of another. Five seconds window's length represent a good compromise to keep sufficient time and frequency resolutions and is often used in EEG analysis [2].

While pre-processing the data in time windows, 5 basic frequency features were extracted. Features corresponded to the relative powers of different frequency sub-bands obtained with the Discrete Fourier Transform (delta, theta, alpha, beta, gamma).

2.1.2 Topographic Map Generation

Topographic maps were generated using the *eegplot* function by I. Silva [9], publicly available on MATLAB Exchange. A map was generated for every seizure timepoint, for all five features, resulting in 929 samples for each feature (dataset A). To balance the datasets, the same number of non-seizure samples was generated with randomly selected timepoints. Both sets of samples were further on divided for training (80%), validation during training (10%) and testing (10%).

A second testing set was generated (dataset B), with non-seizure samples taken every second in series from the five-minute interval prior the seizure and half the number of seizure samples after the seizure. Unfortunately, due to limited data, the seizure samples were the same as the one used for training. The new testing set had 6775 non-seizure samples and 929 seizure samples. A clear representation of the datasets is shown in Table 1.

Table 1: Representation of the datasets

Dataset	Objective	Description
A	Training + Testing	- 929 ictal samples - 929 non-ictal samples taken randomly Separation of data: 80% train., 10% valid., 10% test
B	Testing	- 929 ictal samples (same as data set A) - 6775 non-ictal samples (5 min before the seizure + half the number of seizure samples, after the seizure)

2.1.3 Training and Classification

The classifier we used was an ensemble of five convolutional neural networks, one for each feature. All networks had the same topography, however they differed in the hyperparameters' value. The best hyperparameters for the networks were selected after a grid search on the initial training set. An example of the network structure is shown in Table 2.

Table 2: Example of a network structure

Layer:	Name	Output	Learnables
1	InputLayer	766x884x3	0
2	Conv1	383x442x16	448
3	BatchNorm1	383x442x16	32
4	ReLu1	383x442x16	0
5	MaxPool1	383x442x8	0
6	Conv2	383x442x8	520
7	BatchNorm2	192x221x4	8
8	ReLu2	383x442x8	0
9	DropOut1	383x442x8	0
10	MaxPool2	192x221x8	0
11	Conv3	192x221x4	132
12	BatchNorm3	192x221x4	8
13	ReLu3	192x221x4	0
14	DropOut2	192x221x4	0
15	FullCon1	1x1x32	5431328
16	ReLu4	1x1x32	0
17	FullCon2	1x1x2	66
18	SoftMax	1x1x2	0
19	ClassOutput		0

The networks were trained for 32 epochs, using the RMSprop optimizer, randomly shuffled minibatches of 16 samples and the training performance was validated every 30 iterations. The same networks were also used to test the second testing set.

2.2 Study 2: 98% overlap

2.2.1 Pre-Processing and Feature Extraction

Due to the limited ictal data in the first study, we decided to perform a second one with more samples. To augment the data, we increased the overlap to 98%, which produced ten times more samples. Besides the overlap, all the pre-processing steps were performed identically as in the first study.

2.2.2 Topographic Map Generation

In the second study the training samples were not selected randomly as in the first study, but they were picked from the intervals from five to one minute prior every seizure (dataset C). We intentionally kept the last minute out of training, with the intent of obtaining again the FP classifications close to the seizure onset. Furthermore, to balance the seizure and non-seizure datasets we added some more randomly picked non-seizure samples.

Next, similarly as in the first study, we generated another testing set with the samples taken in series, starting from one hour before the seizure (dataset D). However, in the second study the samples were taken every two seconds, due to the notorious computational overhead. Again, a better representation of the datasets is shown in Table 3.

Table 3: Description of used datasets

Dataset	Objective	Description
C	Training	- 8342 ictal samples - 5280 non-ictal samples (5-1 min before seizure) - 3062 non-ictal samples (taken randomly) 20% of the samples were used for validation
D	Testing	- 950 ictal samples - 37800 non-ictal samples (1 hour before seizure, samples taken every two seconds)

2.2.3 Training and Classification

In the second study we used the same topography of the classifier as in the first study, however the networks were trained with the new training set (dataset C). We opted to use the same hyperparameters as in the first study, since we used the same sub-bands and the same seizures of the same patient. We used the same training procedure, apart from the number of epochs and validation frequency, which were set to 16 and 500 respectively, due to the augmented data.

3 Results

3.1 Study 1: 80% overlap

The ensemble increased almost all the classification scores, comparing single individual networks, apart from the sensitivity in the theta sub-band network, which was originally higher than in the ensemble. The evaluation metrics are shown in Table 4.

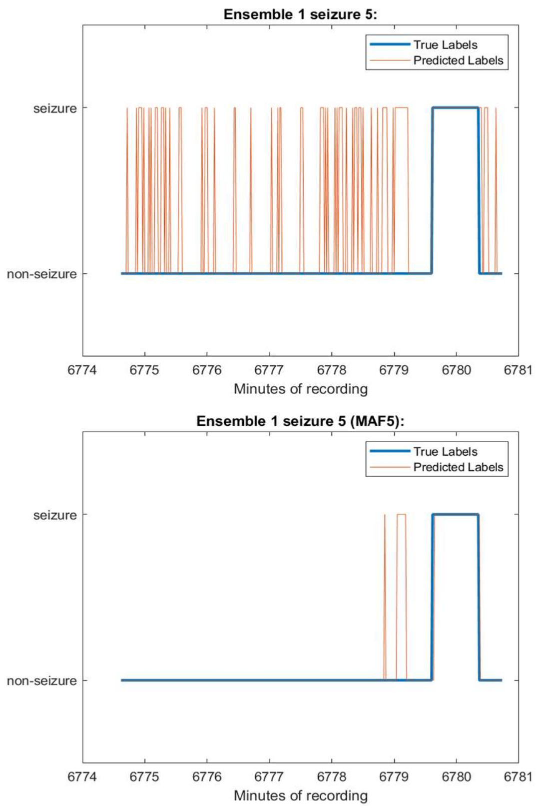

Figure 2: The effect of applying the MAF5 filter

Table 4: Evaluation metrics

	TP	TN	FP	FN	AC	SS	SP
Alpha	85	77	16	8	87.10%	91.40%	82.80%
Beta	86	79	14	7	88.71%	92.47%	84.95%
Gamma	80	86	7	13	89.25%	86.02%	92.47%
Delta	80	80	13	13	86.02%	86.02%	86.02%
Theta	89	88	5	4	95.16%	**95.70%**	94.62%
Ensemble 1	88	91	2	5	**96.24%**	94.62%	**97.85%**

When tested on the second set of samples, the specificity dropped to 89.88%, meaning that on this interval there was an increase of FPs. Since the samples were selected in series, we decided to apply a moving average filter (MAF5) to reduce FP predictions. Both AC and SP increased, while the SS dropped. These results are presented in Table 5. Furthermore, in Figure 2 is presented the effect of the MAF5 filter.

After applying the MAF5 filter, on 18 of 21 seizures we could identify FP classifications, within 1 minute before the seizure (see Figure 2). Such misclassifications are promising, since they suggest the model could even anticipate the seizure onset. This was also a reason, that led us perform a second test.

Table 5: Results of first study

	AC	SS	SP
Normal	90.99%	99.65%	89.88%
MAF5	**96.68%**	**92.56%**	**97.23%**

3.2 Study 2: 98% overlap

In the second study we tested the networks directly on the dataset D. After applying the MAF5 filter, the ensemble obtained 99.20% accuracy, 96.48% sensitivity and 99.27% specificity, as shown in Table 6.

Table 6: Results of second study

	AC	SS	SP
Normal	85.34%	98.96%	84.99%
MAF5	**99.20%**	**96.48%**	**99.27%**

We also noticed that the FP classifications close to the seizure onset did not occur in the second study. Moreover, they appeared further away from the seizure, mostly from 40 minutes to 10 minutes before (see).

4 Discussion

The first ensemble increased almost all the classification scores compared to individual networks. However, when tested with a series of samples taken close from the seizure onset, the number of false positives increased, while the seizures remained correctly classified. We believe that this high classification score of the

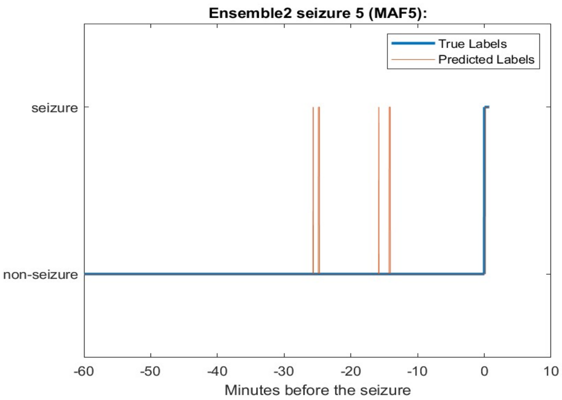

Figure 3: FPs appearing far from the seizure onset

seizure set was due the fact that 80% of the seizure samples used for this testing, were also the same used for training the network. Therefore, it is believed, that the network "remembered" those samples and classified them correctly.

The high increase of false positive classifications with the new test set are believed to be due the fact that the samples used for training, which are taken randomly from all the non-ictal intervals, were distinct from the ones really close the seizure onset. This leads to believe, that there is a noticeable change in the signal while approaching the transition from the non-ictal to the ictal phase. However, by applying the MAF5 filter, the score increased. The MAF5 filter could potentially suit the real-time detection, since it only requires a delay of few samples. In the case of 5 second sliding windows, with 80% overlap, this delay would be of 2 seconds with the filter size 5, which fits early detection necessities.

After applying a moving average filter, with a stride of five, to reduce the number of false positive classifications, we noticed that for 18 out of all 22 seizures, within a range of 1 minute, some false positive classifications persisted (as seen in Figure 2). This is curious, since these false predictions could anticipate the occurrence of an imminent attack. Thus, we retrained the networks with augmented data, to see if these false predictions persist.

After testing the second ensemble on the dataset D, we could not identify the false alarms close to the seizure onset as in the previous testing. Moreover, only four seizures had a false alarm within five minutes before the seizure. We believe that this is a consequence of the training set C. Although samples from one minute before the onset were left out of training, with the intention of producing some false alarms, they were classified correctly in the test. Another evidence supporting our claim are the false predictions far from the seizure, that appear in most of the seizures. Hence, to get rid of them and produce the false predictions close to the seizure onset, the training set should include more samples that are far away from the seizure. However, these results show that there is a difference within non-ictal samples far from the seizures and non-ictal samples close to them.

5 Conclusions

As expected, the second study's classification scores outperformed the first one, since it was trained on a larger dataset. It obtained a 99.20% accuracy, 96.48% sensitivity and 99.27% specificity. However, it failed to replicate the FP predictions close to the seizure onset, as the first one did.

Overall, the model obtained scores that are comparable to the state-of-the-art results[1,8,10]. Although this model does not have an early prediction performance, it still yields good detection scores. Furthermore, both studies give some insights on the early detection, that might be possible to perform, due to the diversity of the non-ictal samples, located far and close to the seizure.

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Demand Forecasting for Industry 4.0: predicting discrete demand from multiple sources for B2B domain

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ABSTRACT

Demand is the amount of certain product required by buyers at a point in time. Demand forecasting tries to predict future demand based on available information. It is considered a key component of each manufacturing company since improvements on it translate directly to resources planning, stocks and overall operations.

In the context of Industry 4.0, industry digitalization provides an ever-increasing number of data sources which can be consumed to gain visibility over all operations and used to optimize different processes within it. This also opens new possibilities into the field of demand forecasting, where multiple data sources can be integrated to get timely data for accurate forecasts.

We describe an efficient approach for demand forecasting for discrete components B2B industry. The proposed approach provides as good or better forecasts as logisticians for most months in six months period and achieves savings considering all test months period.

CCS CONCEPTS

• Information systems → Information systems applications → Enterprise information systems → Enterprise resource planning • Computing methodologies → Machine learning →Machine learning approaches • Computing methodologies → Artificial intelligence

KEYWORDS

demand forecasting, industry 4.0, B2B manufacturing, time series analysis

ACM Reference format:

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1 INTRODUCTION

Demand forecasting is the task of predicting the number of units of a specific good for a given point of time in the future before we actually get all orders from the customers. It is a critical factor in just-in-time supply chains, where companies are expected to offer short lead times for products with complex production processes made of raw materials or components with longer lead times. In this paper we focus on solving this task by using machine learning techniques.

As a socioeconomic phenomenon there are many aspects that may enhance predictions when captured into features, such as economic context (does demand increase with economic growth, how it is affected by price changes, are there substitute products, what kind of market do we operate on), other context facts (marketing campaigns, fashionable features, product established in market or a new release) or inherent product properties (product category, whether is perishable, etc.). By considering a wider context, we may mitigate demand signal distortions that happen at each new intermediary level of a supply chain, in what is known as the bullwhip effect [1]. Another factor of uncertainty is the forecasting horizon: further the horizon, less likely is to be the future similar to past and present state of matters and more difficult to be predicted accurately [2].

When considering forecasting techniques, it may be important to consider characteristics of demand. Authors discriminate demand along two main variables: by considering variability in demand timing and quantity. A classification scheme is described in *Figure 1*.

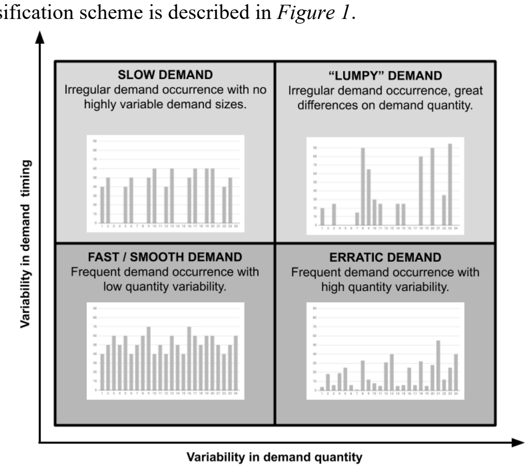

Figure 1: demand classification as per Williams et al. [3] and further elaborated in [4]

In our case we focus on demand forecasting for items from the B2B discrete manufacturing industry which are established in the market and sold under perfect market conditions. Since most of the products correspond to fast moving inventory, we do not discriminate between different demand types and treat all the products in the same way.

Publications addressing demand forecasting explored auto-regressive moving averages [5, 6, 7, 8], multiple linear regression [9] (MLR), Bayesian approaches [10], support vector regressors (SVR) [11] and artificial neural networks (ANN) [12]. In our research we consider naïve forecasting (last observed value as prediction), auto-regressive moving average (ARIMA), MLR, SVR and gradient boosted regression trees (GBRT) [13] models and compare them to logisticians predictions issued in two points in time: six weeks and three days before the event. We do not consider ANNs due to our limited amount of available data to train them.

The remainder of this paper is structured as follows. In Section 2, we define the problem, features, metrics and briefly describe forecasting techniques. Section 3 describe our dataset and preprocessing steps. In Section 4 we describe the experiments we conducted and results we obtained. Section 5 presents conclusions and directions for further work.

2 PROBLEM DEFINITION

Demand forecasting requires to predict the number of units for a product that will be ordered at a given future point in time. We consider different time horizons: H_1, … H_n, and train a specific model for each of them. The goal is to make accurate predictions about future demand based on historical demand data, annual sales plans, open sales orders and some contextual information.

2.1 Features

The main features we obtain from datasets correspond to historical data describing observed demand for each product, high-level estimations such as annual forecasts (describe expected product demand over the year), low-level demand proxies such as open sales orders for a given point in time, and contextual data (economic indicators, prices for relevant raw materials, vacation periods at buyers and manufacturer companies).
Derivative features are meant to explore the relation between the original variables as well as how do they relate to each other in different points in time. This way they reflect the direction and magnitude of trends in comparison to previous months. Months immediately before the target date provide information about recent demand and context behavior, while values from the same months but considered a year before help to learn seasonality patterns where it may exist.
The annual sales forecast and open sales orders give us some insight to the expected future. The annual forecast displays total amount to be sold over the year and a projected sales distribution. Open sales orders give us a weak signal about expected demand and may help to better estimate the target value given the rest of the feature's context. Both can also be related to learn if projected sales accurately reflect the annual forecast, differ by some factor or may not follow original expectations at all. In a similar way we learn past relations between projected and real demand as well as the relation between open sales at a given point in time and later demand realization.
Since we have two forecasting horizons with a six weeks separation and data available at a monthly frequency, we are able to compute additional features for models aimed to predict three days before the event horizon.

2.2 Metrics

To measure forecast performance across models we chose the mean absolute error metric. This metric is not sensitive to occasional large errors, which is important in the context of demand forecasting, where at specific points in time demand may display abnormal behavior that cannot be forecasted. The model should not be strongly penalized on them when trained. The metric also provides a straightforward interpretation (errors are measured in the same units as data and error magnitudes directly correlate on how well/bad the model performs). This does not turn into an issue when comparing different models, since by working on same dataset, we measure all models in same units and magnitudes.
We use the same metric as objective and evaluation metric for models we train.

2.3 Prediction techniques

We take into account five types of forecasting techniques: naïve forecasting, autoregressive integrated moving average (ARIMA), multiple linear regression (MLR), support vector regressor (SVR) and gradient boosted regression trees (GBRT). ARIMA and MLR are widely used in the literature to forecast fast moving products, while gradient boosted regression trees, to the extent of our knowledge, were not applied to demand forecasting in the B2B manufacturing industry.
Naïve forecasting method considers that the value to take place at time t+1 will be close to the one present at time t and thus the best proxy is to use the same value of time t as prediction. In our case we consider the last demand value we are able to observe given a time horizon as the output value of our prediction.
ARIMA is a stochastic time series method that grounds its predictions on three components: auto-regression (estimates white noise affecting the data by regressing the variable on own past values), integration (reduction of seasonality and trend by differencing the time series) and moving average (considers previous values to estimate the target value).
Both, the naïve forecasting and ARIMA are limited only to demand forecasting historic values and cannot consider a broader context in their predictions.
MLR is a simple method that explains linear relationships between a continuous dependent variable and multiple independent ones. The independent variables may be continuous or one-hot encoded categorical ones.
SVR is a regression method based on support vectors, where a kernel is used to map low dimensional data into a higher dimension and then best hyperplane and boundary lines are computed to predict target values. The method allows to fit the error within a certain threshold. In our case we use a radial basis function kernel (RBF kernel), which helps us to consider non-linear relationships between features.
GBRT makes use of gradient boosting, which generalizes boosting to an arbitrary loss function, and uses regression trees to approximate the negative gradient. These are built iteratively, each tree representing a step of gradient descent when optimizing the loss function.

3 DATA DESCRIPTION

3.1 Dataset

Our dataset was provided by manufacturing B2B industries and contains information about 69 products over a period of 68 months.
Among features we have historic demand data for all products, annual demand plans and open sales orders when the forecast is issued. Our prediction target is the amount of a certain product to be demanded by buyers for a given month - on two prediction horizons: six weeks and three days ahead.

3.2 Data preparation

Given the original dataset, we first analyzed data density. We found that there are multiple products with scarce demand datapoints due to irregular demand or by the fact that started being produced later in time. Since demand points density may affect model results, we decided to create multiple datasets based on how many points of historical demand data do we have - all with identical features. This way for all experiments performed, we have datasets with 0+, 10+, 20+, 30+, 40+ and 50+ demand history points.

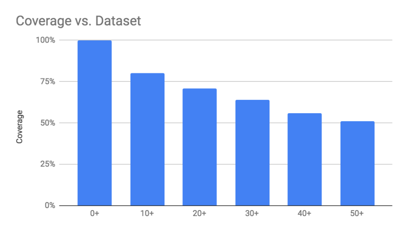

Figure 2: product coverage by dataset.

We then analyzed data distributions and observed that most features display Normal distributions when considering a single product, but over the whole dataset the distribution is lognormal. To mitigate this issue and differences in orders of magnitude, we first transformed them using a Yeo-Johnson transformation followed by standard scaling and a Min-Max transformation. The Yeo-Johnson transformation [14] ensures transformed values follow a Gaussian distribution, while the standard scaling centers them around zero with a standard deviation of one. By using the Min-Max transformation we get them into [0-1] range regardless of their original magnitudes. We also observed that some materials exhibit seasonality and trend but did not perform any ad-hoc preprocessing for them.
Among computed features, there are many that refer to past performance (same month or months close to it, for current year as well as the year

before). This cannot be computed where we lack enough history and thus decided to compute them and then prune the dataset to last 56 months to discard spurious values.
Considering that demand forecasting models are time sensitive, we use last six months for testing and devote the rest to train the models. We do so in such a way that the train set is not fixed, but we use all data up to the month to be predicted for training. By doing so, we had more records available to train models targeted towards last months and could ensure time proximity towards them.
We devote a month close to the test set as validation set. We performed an experiment to understand if excluding validation set the data from the train set affects results by degrading predictions or if including it causes the model to overfit. Results showed that including the validation set into the training set improved results without risk of overfitting and thus used this setup for the experiments.
The dataset with all features described is used for the MLR and GBRT models, while the naïve and ARIMA models use only historic demand data for a given product up to the month when the prediction shall be made.

4 EXPERIMENTS AND RESULTS

All experiments above were performed on datasets with demand records density of 0+, 10+, 20+, 30+, 40+ and 50+ records, to understand the tradeoff between data completeness and a greater number of records reflects in forecast results. In all cases we devote last six months to testing, and the rest of the data to train the model.
We use the following notation to describe models: *ModelName-FeatureSet-Transform-DatasetFiltering*
Valid *ModelName* values are SVR, MLR and GBRT; *FeatureSet*s can be 3m, 6m, 9m and 12m – notating that features were computed over a window of three, six, nine or twelve months. *Transform* can be "*wTT*" if transforms were applied to dataset target, otherwise we use "*nTT*". *DatasetFiltering* accepts three possible values: "*2Y*", "*3Y*" or "*4Y*" indicating that the dataset contains train records for two, three or four years respectively plus six months of test data.
Results are expressed in error ratio, computed as:

$$Model\ Error\ Ratio = 1 - \frac{MAE\ Model}{MAE\ logistician}$$

4.1 Feature set comparison

First experiment we performed was to understand how many months we should consider when looking back to create features in order to make better predictions. To this purpose, we developed four sets of features, created with a time window of three, six, nine and twelve months from target date. When considering a six weeks horizon, we found out that best results were achieved by GBRT-9m-nTT-4Y and GBRT-6m-nTT-4Y, followed by GBRT-3m-nTT-4Y which accounts for half of second-best predictions. For a three-day horizon, most best results were achieved by GBRT-3m-nTT-4Y, making best prediction for half of datasets and second-best prediction for two of three remaining ones.

FIRST BEST				
Dataset	Feature set	Records time span	Target transform	Model error ratio
0+	9m	4Y	NO	0.11
10+	6m	4Y	NO	0.15
20+	12m	4Y	NO	0.11
30+	9m	4Y	NO	0.14
40+	6m	4Y	NO	0.14
50+	6m	4Y	NO	0.17

Table 1: best results when considering six weeks forecasting horizon. All of them run with GBRT algorithm.

FIRST BEST				
Dataset	Feature set	Records time span	Target transform	Model error ratio
0+	3m	4Y	NO	0.12
10+	3m	4Y	NO	0.17
20+	6m	4Y	NO	0.09
30+	3m	4Y	NO	0.15
40+	12m	4Y	NO	0.19
50+	9m	4Y	NO	0.17

Table 2: best results when considering three days forecasting horizon. All of them run with GBRT algorithm.

4.2 Target normalization

We then compared trained GBRT models against new ones where same transformations as applied to features were applied to target values. Our assumption was that by transforming the target, which had a lognormal distribution, we should get a better spread of predictions and better results.
Most best results for six-weeks horizon were found at GBRT-6m-wTT-4Y and GBRT-9m-wTT-4Y models except for 10+ and 50+ datasets. When comparing models with and without target transform, most best results at models without target transform resulted in second best results if considered globally.
On the other hand, for three-day forecasting horizons, applying transformations to the target improved results most cases, but still half of best predictions could be found among models that do not require target transformation. In this context, GBRT-12m-wTT-4Y displayed best global performance for half of datasets considered.

FIRST BEST				
Dataset	Feature set	Records time span	Target transform	Model error ratio
0+	9m	4Y	YES	0.16
10+	12m	4Y	YES	0.18
20+	6m	4Y	YES	0.12
30+	6m	4Y	YES	0.15
40+	9m	4Y	YES	0.15
50+	9m	4Y	NO	0.17

Table 3: best results when considering six weeks forecasting horizon. All of them run with GBRT algorithm.

FIRST BEST				
Dataset	Feature set	Records time span	Target transform	Model error ratio
0+	12m	4Y	YES	0.15
10+	3m	4Y	NO	0.17
20+	12m	4Y	YES	0.11
30+	12m	4Y	YES	0.19
40+	12m	4Y	NO	0.19
50+	9m	4Y	NO	0.17

Table 4: best results when considering three days forecasting horizon. All of them run with GBRT algorithm.

4.3 Records history contribution

Since forecasting models are time sensitive, we explored if recent history is more relevant in such a way that older records may deteriorate forecasting results. We pruned the dataset removing all records older than two or three years in train set and compared models trained on them with those obtained from training on full history.
When analyzing a six-weeks horizon, we found out that pruning history leads to better results achieving almost all first- and second-best results globally. Best results were achieved by models with three years of history with best performance for GBRT-9m-wTT-3Y.
For a three-days horizon, we observed that GBRT models with different feature sets over pruned datasets performed worse than existing ones. Overall, we observe GBRT algorithm achieved best results with target transforms enhancing results on half datasets and that 12m was the most frequent feature set among competitive models.

FIRST BEST				
Dataset	Feature set	Records time span	Target transform	Model error ratio
0+	9m	4Y	YES	0.16
10+	12m	3Y	YES	0.22
20+	12m	2Y	YES	0.17
30+	9m	3Y	YES	0.18
40+	9m	3Y	YES	0.20
50+	3m	2Y	YES	0.20

Table 5: best results when considering six-weeks forecasting horizon. All of them run with GBRT algorithm.

FIRST BEST				
Dataset	Feature set	Records time span	Target transform	Model error ratio
0+	12m	4Y	YES	0.15
10+	3m	4Y	NO	0.17
20+	12m	4Y	YES	0.11
30+	12m	4Y	YES	0.19
40+	12m	4Y	NO	0.19
50+	9m	4Y	NO	0.17

Table 6: best results when considering three-days forecasting horizon. All of them run with GBRT algorithm.

4.4 Comparison against models from literature

In literature most cited models were naïve, ARIMA, MLR and SVR, being SVR the one with state of art results. We trained MLR and SVR under same conditions as our best models, to understand how compare against them.

For a six-weeks horizon, we observed that GBRT outperformed them in all cases. Results are consistent with descriptions from literature, where ARIMA estimates are better than the naïve forecast, but surpassed by the SVR model in all cases. SVR and MLR consistently displayed best results with features computed over last three months regardless of dataset pruning, but MLR shows a rapid prediction quality degradation on the rest of feature sets. Despite this, best results were delivered by MLR over SVR.

Results for three-days horizon were similar. MLR had worst results when using 9m or 12m feature sets, followed by naïve forecasting. MLR and SVR displayed best results for 3m and 6m feature sets with MLR beating SVR with a 3m feature set. All GBRT models outperformed MLR and SVR, achieving best performance when features and target are transformed but without dataset pruning.

FIRST BEST					
Dataset	Naive	ARIMA	Best MLR	Best SVR	Best GBRT
0+	-2.03	-1.70	-0.13	-0.86	0.16
10+	-2.04	-1.70	-0.41	-1.01	0.22
20+	-2.07	-1.73	-0.52	-1.13	0.17
30+	-2.08	-1.74	-0.35	-0.97	0.18
40+	-2.08	-1.74	-0.25	-0.87	0.20
50+	-2.02	-1.69	-0.28	-0.57	0.20

Table 7: best models against naïve, ARIMA, MLR and SVR, considering six-weeks horizon.

FIRST BEST					
Dataset	Naive	ARIMA	Best MLR	Best SVR	Best GBRT
0+	-1.73	-1.50	-0.22	-0.76	0.15
10+	-1.73	-1.50	-0.35	-1.01	0.17
20+	-1.77	-1.54	-0.54	-1.17	0.11
30+	-1.77	-1.53	-0.54	-1.08	0.19
40+	-1.77	-1.53	-0.49	-1.03	0.19
50+	-0.99	-1.49	-0.49	-0.47	0.17

Table 8: best models against naïve, ARIMA, MLR and SVR, considering three-days horizon.

4.5 Features contribution

We also explored how much do specific features contribute to predictions, comparing results obtained for best model to those that only take into account historical values of demand records, annual forecasts or open sales. Best results were obtained with demand history features with an average error of at most 8% greater than from models considering all features, with little variation among those trained for either time horizon. Models considering annual sales forecast (Model AF) had an error of 1.85 times the error of the best model on average, while models based only on future sales (Model FS) had greater error averaging 2.18 times that of the best models. We conclude the most important feature is demand history, while the rest of the features contribute to enhance results.

FORECAST 6 WEEKS - FIRST BEST				
Dataset	Model	Model AF	Model FS	Model demand
0+	GBRT-9m-wTT-4Y	1.80	2.24	1.07
10+	GBRT-12m-wTT-3Y	2.01	2.41	1.16
20+	GBRT-12m-wTT-2Y	1.80	2.09	1.15
30+	GBRT-9m-wTT-3Y	1.89	2.20	1.07
40+	GBRT-9m-wTT-3Y	1.89	2.30	1.02
50+	GBRT-3m-wTT-2Y	1.73	1.83	0.96
Average		1.85	2.18	1.07

Table 9: comparison of results with feature sub-sets considering six-weeks horizon.

FORECAST 3 DAYS - FIRST BEST				
Dataset	Model	Model AF	Model FS	Model demand
0+	GBRT-12m-wTT-4Y	1.84	2.43	1.07
10+	GBRT-3m-nTT-4Y	1.82	1.80	1.25
20+	GBRT-12m-wTT-4Y	1.83	2.40	1.02
30+	GBRT-12m-wTT-4Y	1.83	2.59	1.07
40+	GBRT-12m-nTT-4Y	1.69	2.05	1.02
50+	GBRT-9m-nTT-4Y	1.77	1.81	1.06
Average		1.80	2.18	1.08

Table 10: comparison of results with feature sub-sets considering three-days horizon.

4.6 R2 FOR BEST MODELS

After performing the experiments, we computed R2 scores to understand how much variance in the forecasted demand is explained by variables taken into account when performing the prediction. When comparing scores obtained for our best models against those from predictions made by logisticians, we found that our models achieve better scores here too by an average of three to six centesimal points.

5 CONCLUSION AND FUTURE WORK

Best models result in an improvement of 10% to 20% over logisticians predictions for both prediction horizons. There is a smaller gap on the three-day prediction horizon, where both predictions are closer to each other. In general, we observe an improvement in results when considering a higher demand history points density. This is also consistent with results regarding features relative importance.

GBRT consistently displays best performance for both forecasting horizons. Regarding feature sets, we observe most models perform best with features computed in a twelve- or nine-months window. When looking for models for six week forecasting horizon, pruning the dataset to a total of three years was optimal, but degraded results for three days horizon.

In the future we would like to enrich existing datasets with time series embeddings as well as products metadata. Time series embeddings should help identify similar timeseries and help make better predictions on products with similar behavior. Products metadata may be used in a similar way, since similar products should have similar demands. Product similarity can be considered from metadata point of view as well as from purchase closeness: items bought together will have similar demands, even though may have different characteristics.

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Empirical study on the performance of Neuro Evolution of Augmenting Topologies (NEAT)

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ABSTRACT

In this paper we provide empirical results on training a neural network with a genetic algorithm. We test various features of the generalized genetic algorithms, namely spieciation and fitness sharing and present the statistical analysis of all three variations. An obstacle avoidance problem was created in which the objective is for vehicles to traverse the course. We present interesting observations about the differences between evolutionary techniques and argue that there is a significant benefit in approaches that aim to diversify the gene pool as a mechanism for avoiding local minima.

I.2.1 ARTIFICIAL INTELLIGENCE Applications and Expert Systems

1 INTRODUCTION

Genetic algorithms (GA) have been used extensively for various optimization problems. Arguably, their wide usage spectrum can be accredited to their simplicity and the fact no assumptions are made about the problem. Consequently, most variations of genetic algorithms have strived to maintain these properties. Many techniques were proposed in an effort to diversify the gene pool and at the same time avoid getting stuck in local minima.

In some cases, finding multiple sub-optimal solutions is beneficial [4]. With the recent development of neural networks, genetic algorithms have regained a lot of attention as an viable learning technique. There are many variations to how typical GA functions such as gene encoding, crossover, and mutation are implemented when applied to neural networks. A very promising family of algorithms are descendents of the general NEAT algorithm.

Authors proposed some extensions of the original NEAT algorithm [10] such as rtNEAT [8] that allows evolution to occur in real time rather than through the iteration of generations as used by most genetic algorithms. The basic idea is to put the population under constant evaluation with a "lifetime" timer on each individual in the population. Phased pruning implemented in SharpNEAT framework [2] adds periodic pruning of the network topologies of candidate solutions during the evolution process. HyperNEAT [9] is specialized to evolve large scale structures. HyperNEAT has recently been extended to also evolve plastic Artificial Neural Networks and to evolve the location of every neuron in the network separately.

The first video game to implement Content-Generating NEAT (cgNEAT) [3] that evolves custom video game content based on user preferences is Galactic Arms Race, a space-shooter game in which unique particle system weapons are evolved based on player usage statistics. Neuro-Evolving Robotic Operatives (NERO) [5] is a video game that applies NEAT to train robots that compete among themselves. odNEAT [7] is an online and decentralized version of NEAT designed for multi-robot systems, it is executed onboard robots themselves during task execution to continuously optimize the parameters and the topology of the artificial neural network-based controllers.

2 IMPLEMENTATION

In this section we show specifics to our implementation. The optimization problem is agent based, two-dimensional driving simulation where the objective is to have agents traverse the obstacle course. The agent is considered evolved if it has made a full loop around the track without hitting the wall. It's fitness is based on the distance traveled within a fixed amount of time and is weighted by the amount of checkpoints reached. This ensures the agents move through course and avoid driving in circles.

Agents

Every tick of simulation the agent's task is to make a decision on the move it wants to perform within the environment. The decision pool consists of five possible moves, which are *do nothing*, *drive forward*, *drive backwards/brake*, *turn left* and *turn right*. The turning is dependant on the speed of the agent, so if the agent is standing still, turning has no effect on it. The decision is chosen with the use of the artificial neural network that is represented as agent's genome and it is based on the agents relative location within the track.

The agents are aware of their surroundings with the help of sight lines, which are represented as lines that fan out from the agent's location as shown in the figure 1. Each line calculates a possible intersection with a wall and tells the agent the distance to the closest wall in the line's direction, if one exists. With agent's speed values are then passed to the genome for a prediction.

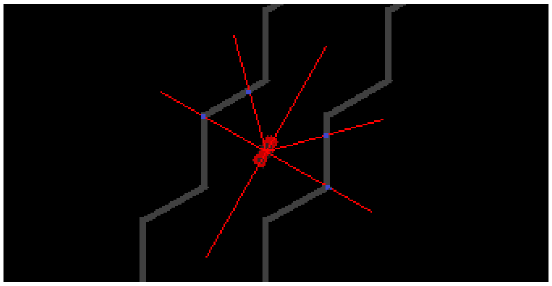


Figure 1: Figure shows the agent and his sight lines (red lines) and the detection of the wall on the track (blue points).

Genome encoding

Artificial neural network in the genome is represented as the list of nodes and a list of connections of the network as described in [10]. Upon their creation, all new genes are given an innovation number to ensure the differentiation between the genes. If the gene already exists somewhere in the population (i.e. connection that connects nodes x an y), it is given the same number as the original gene, otherwise a new incrementally higher innovation number is given to the gene. To ensure, that the same gene does not get more than one innovation number, genes must never be deleted, so the number doesn't get lost. For that purpose every connection has a value that represents whether the gene is active and should be represented in the phenotype of the agent. The starting artificial neural network of the agents is a fully connected network with the input layer of size 7 (speed and all sight lines) and output layer of size 5 (all the possible actions of the agents). Activation function of the nodes in the output layer is the *rectified linear unit* and all the other nodes use the *sigmoid* function.

Crossover

Innovation numbers provide a way to crossover two genomes by matching the genes of the two parents. The genes are split into groups of matching genes (genes that are contained in genomes of both parents), disjoint genes (genes that are contained in only one parent in the middle) and excess genes (genes that are contained in only one parent at the end). When creating an offspring genome, the matching genes are inherited from a random parent, whereas the disjoint and excess genes are inherited from the more fit parent[10].

Mutation

With crossover the population is likely to discard genes that don't provide good agent behaviour, but that can lead to gene deprivation. We introduce genetic innovation to the system by mutating the genome, where some mutations affect the topology and some the optimization of the network [11].

Edge mutation. When optimizing the current topology of the network the existing connections are being mutated. The weight of the connection is either being multiplied by a number between 0 and 2, to provide weight optimization or it is multiplied by -1, to change the polarity of the connection. In case of topological mutation we add a new connection between two unconnected nodes in a way, that doesn't create a cycle in a digraph representation of the network and we give it a random weight or we deactivate a connection. The mutation rates we used were 0.25 for *new connection/deactivate connection*, 0.8 for *adjust weight* mutation and 0.2 for *flip weight mutation.*

Vertex mutation. We can also mutate the genome of the network by adding new vertices to increase its complexity and add new options to the pool of solutions. A new vertex is added by choosing a random edge e between vertices A and B and deactivating it. A new vertex C is inserted, and two new edges created connecting vertex A and B with C. The weight of the edge leading to the new vertex C, is set to 1 and the edge leading to the vertex B is set to same wight of the disabled edge e to minimize the performance impact of the new genes on the genome. The mutation rates for the *new node* mutation that we used were 0.01.

Species

When adding innovation to the genome, it is likely that the mutation will first reduce the fitness of the agent and will be removed before it has the chance to evolve and optimize. To counter that and protect innovation, we introduce the notion of speciation, where the agents are split into groups that represent species, based on the genotypes.

Genetic Distance. To find the genetic difference between two genomes the idea of compatibility distance (δ) is introduced. The less genetic history two genomes have, the more disjoint (D) and excess genes (E) and the less matching genes they have[10]. There numbers can be normalized with the total number of genes in the larger genome (N) and use them to calculate the compatibility distance. We also take into account the average weight differences of matching genes ($\overline{W}$). The coefficients w_1, w_2 and w_3 represent the importance of each of the factors and can be adjusted.

$$\delta = \frac{w_1 E}{N} + \frac{w_2 D}{N} + w_3 \overline{W}$$

Every generation each agent is placed into a species, if he's compatibility distance to the species representative is smaller than the prefixed threshold (δ_t). If the agent does not fit into any of the species, he now represents a new species. The weights that were used in our case are $w_1 = 1.3$, $w_2 = 1.3$, $w_3 = 1.0$ and $\delta_t = 2.0$.

Selection. In the selection step, we remove the worse half of the agents from the population based on their fitness score. That would in general remove most of the innovation within the population, since the mutated agents tend to perform worse. So instead of removing bottom half in general, we do it per species. That means that every agent only competes with agents that are a part of the same species. This provides an extra layer of protection of the new genes that have not yet had the time to adjust and optimize.

Explicit Fitness Sharing. We used the *explicit fitness sharing*[1] niching technique, which normalizes the fitness (f) of the agent according to the size of the species that he's in. With niching it is unlikely that one species would take over the whole population therefore it widens the search in the solution space.

$$f_i' = \frac{f_i}{\sum_{j=1}^{n} sh(\delta(i,j))}$$

If the distance between the agents i and j ($\delta(i,j)$) is smaller than the threshold, the value of the sharing function sh is set to 1 otherwise its set to 0[6].

3 RESULTS AND CONCLUSIONS

Four tracks were prepared as shown on figure 4. We tested how the model performs if we remove the different features of the algorithm that provide the protection of the innovation within the population. Explicit fitness sharing and speciation were chosen. From that, we formed four tests: *normal*, that includes all sections of the algorithm, *no efs*, that have explicit fitness sharing disabled, *no speciation* with disabled speciation (only one species during simulation) and *no efs and speciation* that does neither include the explicit fitness sharing nor speciation. The size of the population was set to 1000 and all simulations ran for 250 generations wheres every generation was 750 ticks long. Each test was ran ten times on each of the tracks and for every generation max fitness, mean fitness, standard deviation and whether the model has found the sufficient solution were collected. Also every fifth generation we collected the data of all species, their size, max fitness, mean fitness and standard deviation.

Table 1 shows the aggregated results for individual tracks across multiple runs. Track 1 has seen the best results and least complexity in the neural network as agents only need to turn one direction to successfully traverse the track. The second best results were obtained by track 3, in which 75% of the simulations evolved and completed the track. Tracks 2 and 4 were arguably the hardest with 60% and 40% respectively. When considering only the evolution rate, all the test showed similar results, since all tests had 67.5-70.0% evolution rate. The test, where explicit fitness sharing was disabled found the best solution in two of the four tracks. This shows, that the weights for the explicit fitness sharing might not have been optimal, for the problem at hand. In the column $\mu(x)$ shows the mean fitness through all the generations and simulations of the test. The data shows, that the test where speciation and explicit fitness sharing were both disabled in general performed better. However the optimal solution was not found in any of the tracks. This could be a consequence of the model finding and optimizing to a local minimum fast, but due to the lack of innovation, being unable to escape.

Table 1: Table shows the data gathered from tests. Every row represents summarized data from 10 iterations of the test on specific track Fitness is represented as x and is normalized by the highest fitness achieved on that track. Tests: N-*normal*, E-*no efs*, S-*no speciation*, SE-*no efs and speciation*

	Track	Test	$max(x)$	$\mu(x)$	$\sigma(x)$	Evolved[%]
1	Track 1	N	0,99	0,12	0,58	100
2	Track 1	E	0,98	0,18	0,45	100
3	Track 1	S	1	0,13	0,57	100
4	Track 1	SE	0,98	0,21	0,46	100
5	Track 2	N	0,96	0,03	0,15	50
6	Track 2	E	1	0,05	0,20	50
7	Track 2	S	0,99	0,04	0,24	80
8	Track 2	SE	0,88	0,05	0,19	60
9	Track 3	N	0,98	0,05	0,24	80
10	Track 3	E	1	0,12	0,37	80
11	Track 3	S	0,93	0,06	0,26	80
12	Track 3	SE	0,83	0,09	0,28	60
13	Track 4	N	1	0,01	0,16	40
14	Track 4	E	0,61	0,03	0,14	50
15	Track 4	S	0,64	0,01	0,05	20
16	Track 4	SE	0,84	0,06	0,24	50

Figures 2, and 3 illustrate the impact of fitness sharing on the evolution of existing species and the emergence of new ones. We observe that the number of different species that emerged is significantly higher when fitness sharing is enabled. This is expected as the mechanism allows new species to be preserved across generations in order to diversify the gene pool. However, we also observe that a significant number of species that emerged survived across all generations and achieved significant improvements to their fitness (representative). Additionally, we can observe that in both cases,

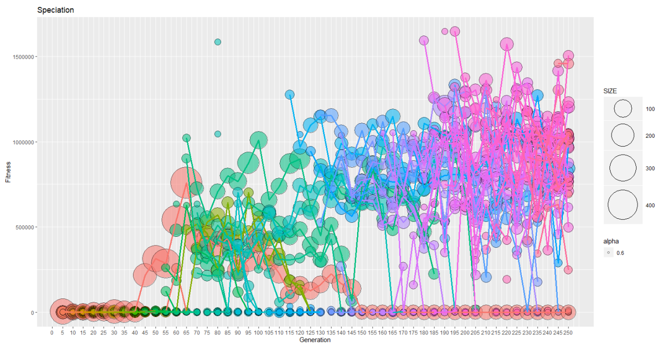


Figure 2: Species with explicit fitness sharing enabled

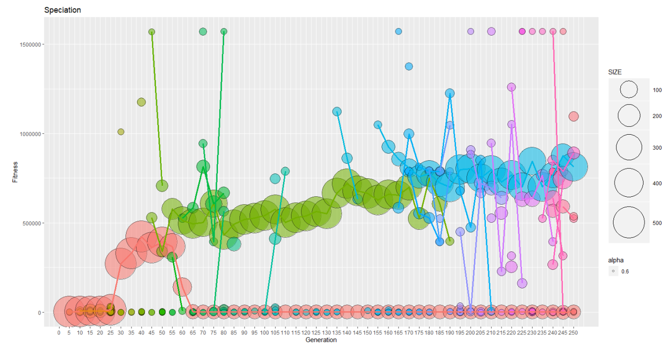
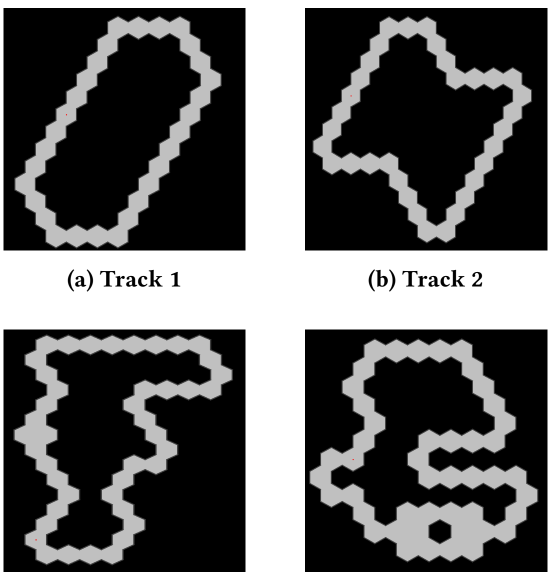


Figure 3: Species with explicit fitness sharing disabled



(a) Track 1 **(b) Track 2**

(c) Track 3 **(d) Track 4**

Figure 4: Tracks used for testing the model's performance

some newly emerged species never evolve and improve their fitness which eventually causes them to be removed. This indicates that even with explicit fitness sharing, species with bad genes do not impact the overall results even though their genes are initially protected.

With no fitness sharing, there is a trend of one big species and a few smaller ones, that explore the solution space and when a new innovation is found with better results, it takes over the population. Contrary to that, evolution of the population, that shares fitness splits into more species and is searches the space for a wider set of solutions.

All the presented software is available under opensource licence at Github[1].

[1]NEAT-driving: https://github.com/VakeDomen/NEAT-driving

4 ACKNOWLEDGMENTS

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Learning Hand-Eye Coordination on NAO and its Applications

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ABSTRACT
This paper focuses on learning hand-eye coordination on robot NAO. It elaborates on two different approaches for computing inverse kinematics using neural networks. It also presents two applications, based on the computed inverse kinematics: a system that enables the robot to play tic-tac-toe against a human opponent and a system that enables the robot to replicate simple shapes that it sees.

Keywords
robotics, inverse kinematics, vision recognition

1. INTRODUCTION
Inverse kinematics is commonly used for solving problems such as object grasping, visually guided tasks and also in 3D animation for interaction between characters and other objects in the animated world. While calculating the forward kinematics, that is the position of the end effector based on joint configuration, is a fairly easy problem to solve, inverse kinematics proves to be more challenging because of its multiple solutions.

Traditional methods are computationally expensive, because they rely on constructing and operating on large and complex matrices. Such is the iterative method, which requires the inversion of the Jacobian matrix. There are also alternative solutions that do not require matrices or rotational angles, such as FABRIK [1] (Forward and Backward Reaching Inverse Kinematics). This heuristic algorithm performs simple, iterative operations that gradually lead to an approximation of the solution, by finding the joint coordinates as being points on a line. Inverse kinematics for the NAO robot implemented with the FABRIK algorithm were described by Renzo Poddighe [5], in an article which focuses on a system that enables the robot to play tic-tac-toe, very much like one of the applications presented in this paper. We propose a third approach by calculating the inverse kinematic with neural networks.

2. NAO ROBOT
The first public version of robot NAO was presented in March 2008. Since then six versions of this humanoid have been produced, each having better cameras, CPU, speech synthesis in more languages and better face recognition. For work described in this paper we used NAO version 4.

It has 25 degrees of freedom. The motion ranges of two joints are important for the computation of inverse kinematics: the right shoulder roll which has the motion range from -76 to 18 degrees and the right elbow roll which has the motion range from 0 to 88.5 degrees. It has 1.6 GHz CPU ATOM Z530, 1 GB of RAM and 2 GB of Flash memory. The camera has up to 1280x960 resolution with 60.9 degrees horizontal field of view.

NAO's operating system is based on Linux Gentoo and named NAOqi OS. It has built-in libraries that are needed for the NAOqi Framework, the main software that allows communication between the different modules, programming and information sharing.

3. INVERSE KINEMATICS
Inverse kinematics was calculated with two different approaches for two different implementations. For the game of tic-tac-toe joint positions were calculated for pixels on the image of the gaming surface taken with the robot's camera. For drawing simple shapes joint positions were calculated for x and y coordinates of points on the tablet.

3.1 Neural networks
In both cases inverse kinematics was calculated using a regression neural network. For playing the game of tic-tac-toe, the angles in NAO's arm were measured, by tracking a red pen, while the robot moved it across the gaming surface. Recorded data consisted of pixel coordinates of the tip of the red pen in the image taken by the robot's camera and the shoulder and elbow roll angles. For drawing, the shoulder roll, shoulder yaw, elbow roll and elbow yaw were measured, using a graphic tablet and a stylus pen. While holding the pen the robot's hand was moved around on the tablet surface. As the robot was moving the pen, a program recorded the angle of each of the aforementioned joint and the position of the cursor. There were 279 training samples collected, for playing the game of tic-tac-toe and 10000 training samples for drawing simple shapes. With the second method of recording data we could gather a much more extensive sample size. We could not use the same method for playing tic-tac-toe because the model had to use the position in coordinate system of NAO's camera allowing the program

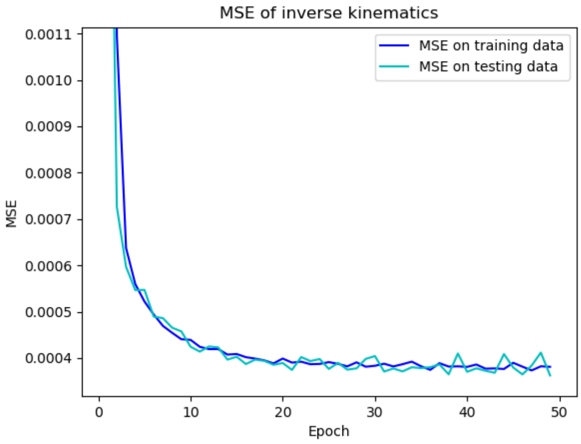

Figure 1: MSE of the neural network for learning inverse kinematics for drawing simple shapes.

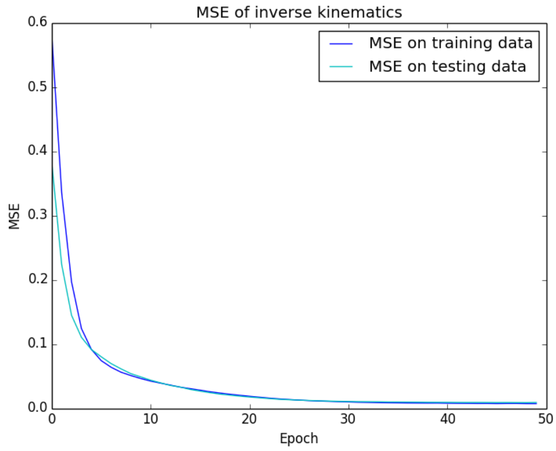

Figure 2: MSE of the neural network for learning inverse kinematics for playing tic-tac-toe.

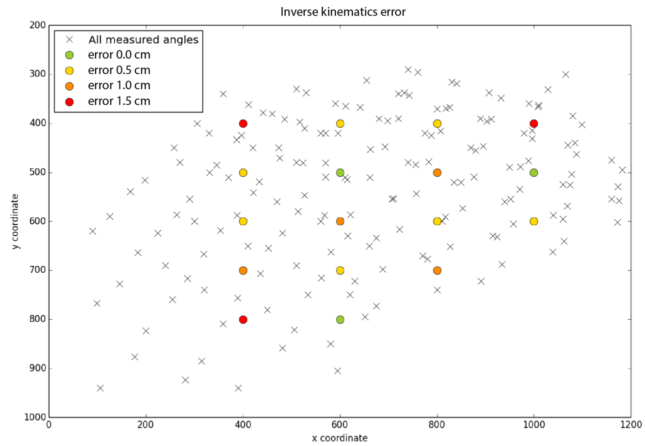

Figure 3: The pixels for which the corresponding arm angles were measured (crosses) and the error of the computed inverse kinematics (dots).

to work regardless of where in NAO's field of view the playing area was located. Meanwhile the model for drawing was transforming the coordinates from the picture taken with the camera onto a fixed surface in front of the robot. With fewer training samples the model worked better using just two degrees of freedom, meanwhile the model with larger sample size worked better with four degrees of freedom.

Inverse kinematics was calculated using a simple neural network. The neural network was implemented with Keras sequential model. Input variables are x and y coordinates. While neural network for tic-tac-toe had only one hidden layer, neural network for drawing had two identical hidden layers. They had 32 nodes and rectified linear unit activation function. The output layer had two/four nodes which correspond to the dimensions of the output variable (array of two/four angles in radians). To evaluate weights we used the mean square error loss function that calculates the mean error of both/all four angles and the efficient stochastic gradient descent algorithm Adam [3] for optimisation. To train the model we used 50 epochs and a batch size of 10 for the smaller neural network and 50 for the bigger neural network. The mean square error of the final model for drawing was 4.2×10^{-4}, the error at each epoch is shown in Figure 1. Mean square error of tic-tac-toe model was 6.2×10^{-3}, the error at each epoch is shown in Figure 2.

We also calculated inverse kinematics with Support Vector Regression. With training samples for drawing, the mean square error was 1.1×10^{-3}, which is considerably worse than 4.2×10^{-4} error obtained using neural network. With training samples for tic-tac-toe mean square error was 8.1×10^{-3}, while neural network error was 6.2×10^{-3}.

Because drawing requires higher precision, there were more samples collected and a bigger neural network built. It is also because of the large number of samples, that we get higher accuracy by predicting four and not just two angles. For playing tic-tac-toe, precision up to 1 cm is adequate and it can be achieved by predicting just two angles on a smaller data set. Measured precision of inverse kinematics is shown in the Figure 3.

4. APPLICATIONS

We developed two different applications for inverse kinematics. The first one enables NAO to play tic-tac-toe, a simple game where two players take turns in placing their mark (cross or circle) on a grid of size 3 x 3. The player that first succeeds in placing three of his marks horizontally, vertically or diagonally, wins the game. The second one focuses on NAO drawing solid simple shapes, which it captures with its camera.

4.1 Tic-tac-toe

To solve the problem of the robot playing tic-tac-toe, two additional separate modules were developed. A vision recognition module was developed, for recognising the location of the gaming grid and current state of the game. A strategy module was implemented, for deciding which move will most likely lead the robot to victory.

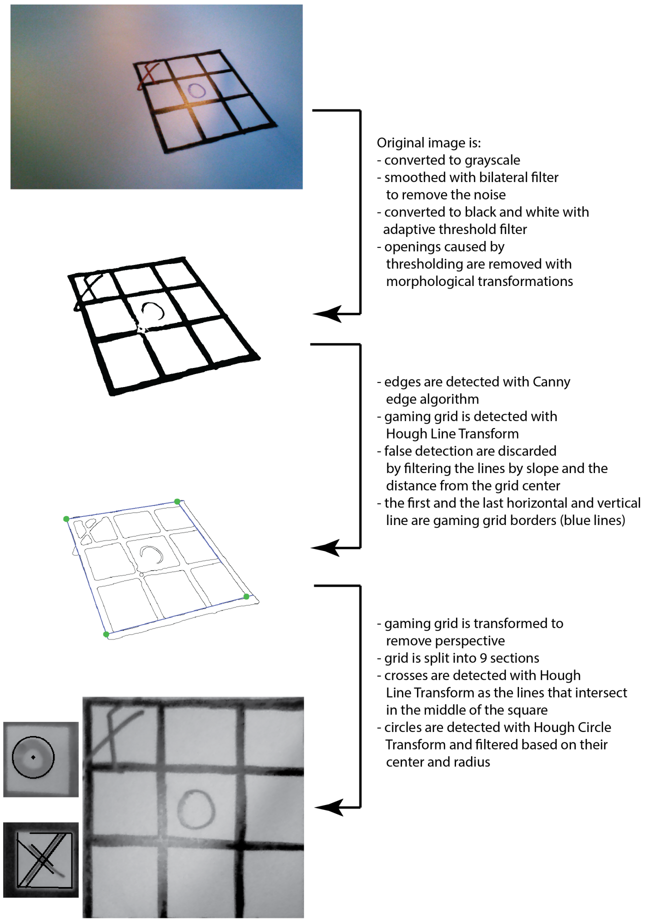

Figure 4: Recognising the state of the game.

The vision recognition component is written in Python using the OpenCV library. Before each move, the robot takes a picture on which the state of the game and the location of gaming board are detected.

The image processing pipeline is shown in Figure 4. Probabilistic Hough Line Transform [4], which returns an array of the start and the end points of all the detected lines is used for the gaming grid detection. These lines are then separated into horizontal and vertical lines and ordered by their position in the image. If there are more than four horizontal or vertical lines detected, they are filtered by their slope and the distances from the previous and the next line. The lines that deviate the most are discarded as false detections. After that, we can be sure that the first and the last horizontal and the first and the last vertical line are the borders of our gaming grid. The intersections of these four lines are also calculated and those four points are used to do a warp transform of the gaming grid, so that the camera perspective is removed and the grid is seen as from a vertical position.

The gaming grid is then split into thirds vertically and horizontally, which gives us nine fields on which there could be a circle or a cross. Hough Circle Transform [7] is used, for circle detection . If a circle is found, its radius and centre are compared to the expected values. Hough Line Transform is used, for cross detection. If there are lines found, possible intersections of these lines are compared to the expected values. If there is an intersection in the middle of the field, then a cross is detected.

In the experiments, the state of the game is correctly recognised in 39/40 cases, which is 97,5% success rate. In 1/40 cases there is an error in vision recognition because of falsely discarding one or more lines as false detections.

The second component of the system is an algorithm that chooses the next move, based on the current game state. Minmax decision rule with alpha-beta pruning was chosen for that, which makes the robot unbeatable at tic-tac-toe.

When the current state of the game is recognised in the image, that information is passed to the algorithm for choosing the next move. Inverse kinematics is then calculated, based on the location of the chosen move. Four arm positions corresponding to the field vertexes are calculated, which are then used for drawing the cross, by connecting the opposite vertexes of the field.

4.2 Drawing simple shapes

In this application our goal is to teach NAO to draw a simple shape that it sees through its camera. Besides calculating the inverse kinematics, another problem we face is computing the points (in the correct order) that the robot must reach to render the shape it was shown. To solve this we use computer vision to process an image that was captured by the robots camera.

When the robot is ready to draw, it will wait to be presented with an image. For the following algorithm to work the image must be of a solid shape on a single-coloured background. When the image is in the field of view of the robot's camera we capture it by pressing on one of the tactile buttons on its head. After the image is captured we need to process it with OpenCV library for Python in order to extract the contours. First the image must be converted from colour image to grayscale. Then a bilateral filter is used to reduce the noise while maintaining defined edges. On the filtered image we can then use canny edge detection [2] to find the edges of the shape we want the robot to draw. From the edge image we can then extract the contours as seen in Figure 5.

When extracting the contours we chose to store all the points along the boundary by not using any chain approximation. This makes the drawing process very slow but it is the most accurate for all types of shapes. Choosing simple or Teh-Chin chain approximation [6] works for curved lines but it can cause problems when drawing shapes with long straight lines. It reduces the number of stored points to mostly just the corner points which means the angles for connecting the points have to be interpolated over a relatively long distance. The angle interpolation of vertical lines produces jagged lines as seen in Figure 6.

After we have extracted the contours we use bounding rectangle to determine the height and width of the shape so we can scale it to fit the robot's drawing area. Once all the points in the contours are properly scaled we can calculate the angles of robot's joints using the model from the previous section.

Because of the friction between the pen and the drawing surface as well as because of the slight looseness of NAO's joints very small errors accumulate while the robot is drawing. This results in the contours on the render images not being connected at the ends, as shown in Figure 6.

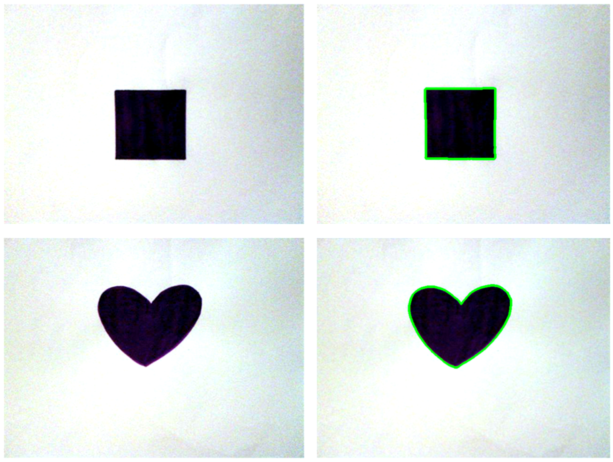

Figure 5: Two pictures NAO captured (on the left) and with extracted contours (on the right).

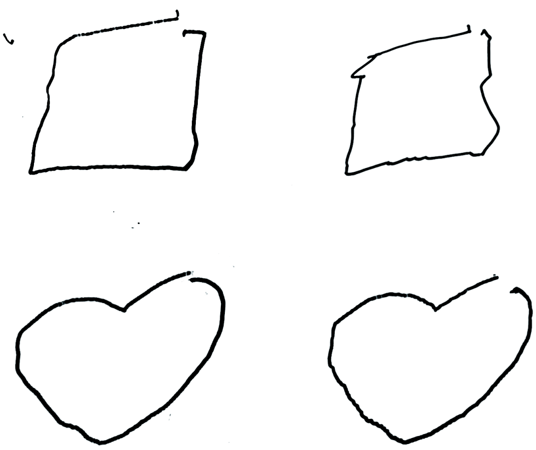

Figure 6: Two drawings produced without chain approximation(on the left) in comparison with two drawings produced with Teh-Chin chain approximation(on the right).

5. CONCLUSIONS

In this paper we solved the problem of hand-eye coordination using neural networks and applied it to two real life problems.

The first system is able to play tic-tac-toe game against a human opponent without losing a single game. Inverse kinematics is precise enough so that the cross that robot draws always has a centre inside the selected field on the gaming grid. Vision recognition correctly recognises the state of the game in 97% of cases. Currently NAO can only draw crosses. We wish to develop the system further so that it will be able to draw circles too. For drawing crosses, four angles that correspond to field vertexes need to be calculated. If the robot were to draw circles, we would need to calculate inverse kinematics for a few dozen positions corresponding to the circle on the field that the robot would draw. The precision of inverse kinematics would also need to be much higher.

The second system successfully extracts contours of solid shapes of one colour and replicates them. By making the image processing more robust we could generalise it to work for more complex drawings. We also wish to improve the processing by combining the current method of contour extraction with other methods of line detection so that the system will be able to draw simple lines that are not joined at the ends.

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Etika in stroka
Professional Ethics

Uredili / Edited by

Marjan Krisper, Franci Pivec, Matjaž Gams

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PREDGOVOR

Konferenca »Etika in stroka« je namenjena etiki v času informacijske družbe. Po Rushworth Kidderju je etika "znanost o idealnem človeškem značaju" oziroma "znanost o moralni dolžnosti". Richard William Paul in Linda Elder definirata etiko kot "nabor konceptov in principov, ki nas vodijo glede primernega in neprimernega obnašanja". V času informacijske družbe pa vse kaže, da se stare norme podirajo, da je osnova uspešnega političnega delovanja čim bolj uspešno zavajanje množic preko socialnih omrežij in popolnoma pristranskih medijev. Kot da resnica, moralnost, etika ne bi več obstajali, oziroma so nepomembni.

Posebej se to kaže v odnosu do znanosti oziroma dejstev oz. resnice. Ali je cepljenje škodljivo ali koristno? Ali lahko nasprotniki cepljenja nekaznovano povzročajo škodo svojim otrokom in otrokom drugih? Ali je omejevanje resnice s strani tehnoloških gigantov kot Google ali Facebook omejevanje svobode, ali pa gre za omejevanje hujskanja množic in sovražnega govora?

Zanimive teme za prispevke so naslednje: Etični kodeksi v računalništvu/informatiki, občutljivost univerzalne (filozofske) etike za digitalni svet, etična odgovornost IT strokovnjakov, IT v službi zavajanja, etika v e-trgovanju, etika digitalnega sodišča, etičnost Googla in Facebooka, avtentičnost e-dokumentov v arhivih, etika in umetna inteligenca, etika v robotiki.

Poseben poudarek je na aktualni temi: Etične smernice za zaupanja vredno Umetno inteligenco, na podlagi dokumenta Evropske komisije Ethics Guidlines for Trustworty Ai, ki zajema ključna etična vprašanja informacijske družbe.

Prvo leto konference smo zbrali osem zanimivih referatov, naslednje leto pa upamo na boljši odziv. Sočasno s konferenco bomo zbrali strokovna mnenja o etiki in predloge za izboljšanje. V skladu s pravili posveta v Državnem svetu bomo vprašanja oziroma pobude posredovali Vladi RS in predsedniku RS.

Franci Pivec, Marjan Krisper

Etika v raziskavah: razvoj vprašalnika za situacijsko analizo

Ethics in research issues: development of a situational analysis questionnaire

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ABSTRACT

In this paper, we describe the development of a questionnaire to be used in situational analysis of ethics principles in research matters in the organizations.

Keywords

Ethics, principles, survey

1. INTRODUCTION

As a part of the H2020 funded NewHorrizon project on responsible research and innovation we were investigating the question of the importance of non-regulatory / non-conventional ethics and research integrity issues in European Public Research Organizations to look beyond standard ethics regulatory issues and processes.

In our everyday life of a Center for Innovation and Technology Transfer we meet many researchers. Whenever we ask them a question: "What do you think about ethics in research?", we get a specific answer. The answer is: "----"(silence and a perplexed look in their eyes).

Thus, we decided to develop a research tool to analyze the perception of ethical behavior in different situations within public research organizations from researcher's personal and institutional point of view.

2. PREPARATION OF THE SURVEY

2.1 The motivation

The ethics issues we were interested in, went beyond the conventional ethical issues (as integrity, responsibility, honesty, competence) [3 General research on ethics] or more philosophical ones (dignity, non-maleficence) [4 JRC handbook] and strived away from the IPR issues (privacy, confidentiality, justice) [5 WIPO Handbook].

Also, the issues we set to analyze, were broader, but due to addressing specific situations also more concrete than the ones included in the [6 Consensus statement]. Even though this document emphasizes that the responsibility for ethical research lies with everyone who is active in research, but especially with leaders in research performing organizations, it remains open that the researchers' morals alone cannot ensure research integrity; good conditions for exercising integrity must also be created at the level of the organization and the research system. Also, in short-term, project-based positions, the role of the project leader in instilling ethical standards are crucial, as staff on shorter contracts are often not integrated in the organization to the same extent as permanent staff.

Having considered this, our analysis was based on a specific set of situations that were described as potentially ethically problematic by a group of scientists from three different countries, Sweden, UK and Slovenia. In the mentioned group Sweden represented the Nordic approach, UK the central European one and Slovenia the Balkan region approach to the ethical issues. The chosen group selected the initial set of situations to be surveyed and analyzed within the TTO Circle. The situations were modeled by JSI and the questions were developed at JSI.

3. RESULTS: THE QUESTIONNAIRE

3.1 The general motivation part

There were five main sets of questions in the questionnaire.

The first set of questions focused on the principles in the context of scientific research that would or would not require any of the solutions, focused on improving the ethics and ethical attitudes in those situations. An example of the questionnaire matrices is given below in Figures 2-5.

The general principles focused on topics as reliability in ensuring the quality of research, the honesty in developing and undertaking, reviewing, reporting research; the Respect for colleagues, participants, society; and the Accountability for the research from idea to publication, for its management and organization.

The main idea was to distinguish between different principles that should all be equally underlying in the research work.

There were four (4) principles and five (5) different categories offered with different levels of formalization, ranging from non-regulatory, through a code of conduct or a local policy, through legal framework in place and to on the spot enforcement. Also, the option of "no particular solution is required" was offered to enable those, who believe researchers need to be individualistic and of free will with no external boundaries also when ethical behavior is considered, to share their opinion (see Fig 1).

1. In the context of scientific research, do you think the following principles require any of the following solutions? *

	non-regulatory awareness raising via the listing of community expectations	a code of conduct or local policy	legal framework	enforcement	no particular solution is required
Reliability in ensuring the quality of research, reflected in the design, the methodology, the analysis and the use of resources;	☐	☐	☐	☐	☐
Honesty in developing, undertaking, reviewing, reporting and communicating research in a transparent, fair, full and unbiased way;	☐	☐	☐	☐	☐
Respect for colleagues, research participants, society, ecosystems, cultural heritage and the environment;	☐	☐	☐	☐	☐
Accountability for the research from idea to publication, for its management and organization, for training, supervision and mentoring, and for its wider impacts;	☐	☐	☐	☐	☐

Figure 1: The connection between research principles and required ethical monitoring solutions.

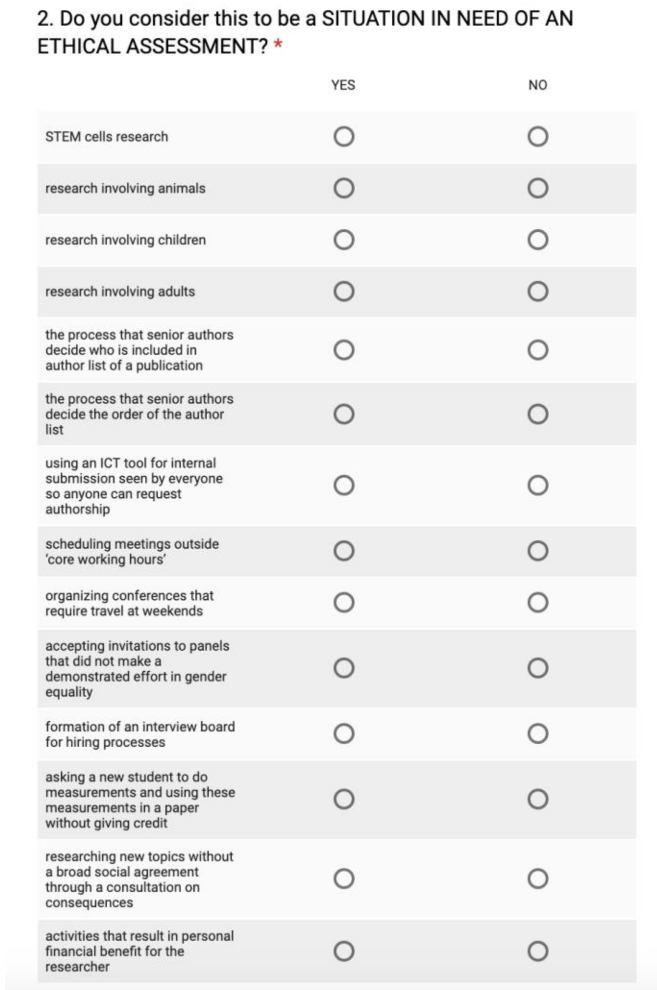
3.2 The personal involvement

The second set of questions focused on a set of specifically chosen situations, and questioned the necessity for each of these situations to be considered within an ethical assessment.

The focus within this set of questions was on a personal point of view, thus the described situations were described in a very addressing way. The purpose was to emotionally involve the respondent to answer from this or her personal point of view, neglecting the policies that could be in place in the environment he or she operates in.

The idea was to set the scene for later, organizational behavior-based questions. The inherent logic was that the questions and the answers should enable the topic of ethics in everyday research life to become internalized, to be considered as something that we are all connected to, before stating the position of the organization.

Thus, situations as “accepting invitations to panels that did not make a demonstrated effort in gender equality” or “asking a new student to do measurements and using these measurements in a paper without giving him credit” or “the process that senior authors decide the order of the author list” were introduced.



2. Do you consider this to be a SITUATION IN NEED OF AN ETHICAL ASSESSMENT? *

	YES	NO
STEM cells research	○	○
research involving animals	○	○
research involving children	○	○
research involving adults	○	○
the process that senior authors decide who is included in author list of a publication	○	○
the process that senior authors decide the order of the author list	○	○
using an ICT tool for internal submission seen by everyone so anyone can request authorship	○	○
scheduling meetings outside ‘core working hours’	○	○
organizing conferences that require travel at weekends	○	○
accepting invitations to panels that did not make a demonstrated effort in gender equality	○	○
formation of an interview board for hiring processes	○	○
asking a new student to do measurements and using these measurements in a paper without giving credit	○	○
researching new topics without a broad social agreement through a consultation on consequences	○	○
activities that result in personal financial benefit for the researcher	○	○

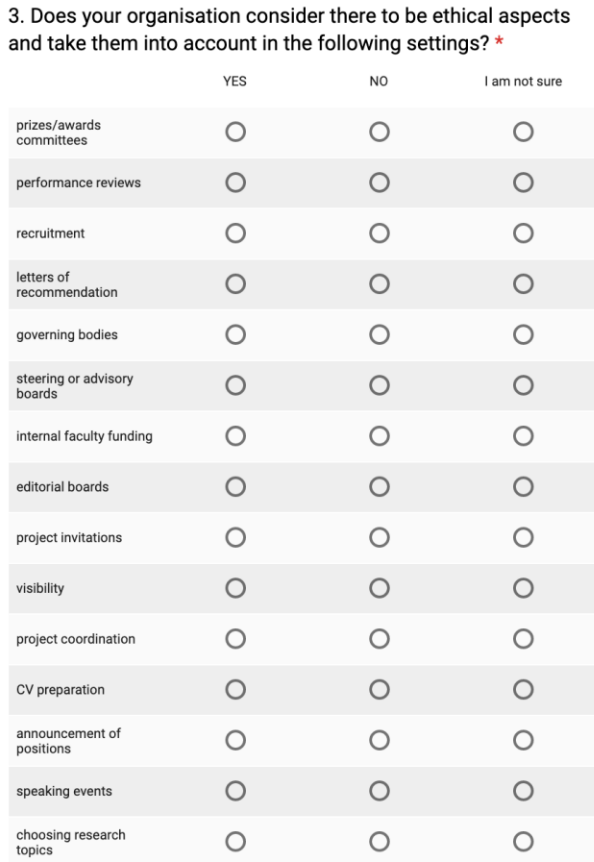
Figure 2: The situations listed to be assessed with respect to the necessity of ethical assessment from a personal point of view.

They were modeled in an inviting and personal way on purpose to incur personal responses.

3.3 The organizational view

The **third part of the enquiry** questioned about a similar, but less personally engaging set of situations, but from the point of view of the organization.

Does the organization itself perceive the situation to need an ethical assessment. Here we tried to see the difference between personal involvement in the ethical issues of personal situations that researchers need to live through and the ones recognized from the side of the institution. The difference to the previous set of questions is obvious. Here we address in a number of simple, straightforward situations, that can be easily understood in any research environment.


3. Does your organisation consider there to be ethical aspects and take them into account in the following settings? *

	YES	NO	I am not sure
prizes/awards committees	○	○	○
performance reviews	○	○	○
recruitment	○	○	○
letters of recommendation	○	○	○
governing bodies	○	○	○
steering or advisory boards	○	○	○
internal faculty funding	○	○	○
editorial boards	○	○	○
project invitations	○	○	○
visibility	○	○	○
project coordination	○	○	○
CV preparation	○	○	○
announcement of positions	○	○	○
speaking events	○	○	○
choosing research topics	○	○	○

Figure 3: The situations listed to be assessed with respect to the necessity of ethical assessment from an organizational point of view.

As such, they do not carry much emotional co-signature and it is thus more difficult to misinterpret them, but they are also not seen as situations in which the respondent is necessarily involved.

We wanted the respondents to enter the administration point of view, stating the views of the management of the research organization.

3.4 The possible remedies

The **fourth set of questions** focused on possible remedies or solutions that could be used by the organization to address the situations in need of ethical assessment and analyzed the use of such tools.

The listed solutions range from very light ones as for example awareness raising via listing of expectations from the community, which would majorly serve as an encouragement to think about such topics as ethics. Suggested solutions are: Through informal and formal guidelines and code of conduct or a local policy; to more strict and formal measures as the ethical review committee (and several of them in different fields of research) or the enforcement of some detailed procedural documents or policies; to the last and most prescribed solution in the form of a legal framework in terms of a national legislation.


4. In what form does your organisation take ethical issues into account? *

	YES	NO
Awareness raising via listing of the expectations from the community	○	○
Informal guidelines	○	○
Formal guidelines	○	○
Code of conduct or local policy	○	○
Ethical review committee	○	○
Field and context dependent ethical committees	○	○
Procedural documents (in terms of policy)	○	○
Legal framework (in terms of national legislation)	○	○
My organisation does not take ethical issues into account in the described settings	○	○

Figure 4: The possible tools to address the situations in need of ethical assessment, from an organizational point of view.

We also offered the option where the respondents could state that their organization does not take ethical issues into account in the described settings.

There were also some **content questions**, assessing the reasons about why and how does/ does not a specific research organization consider there to be ethical aspects and does/ does not take them into account to allow for personal explanations of the ethics in research as seen by the respondents. (in their own words).

In this part we dealt with issues of ethics in research beyond regulatory compliance from a personal point of view: single and outlying views were sought for here. We were interested in issues that the respondents see of interest beyond what is regulated in the sense of animals' rights and informed consent but could be related to management of science and technology and multilateral collaborations etc.

3.5 The tools available vs. the need

In **the final part** the questionnaire focused on matching the situations in need of ethical assessment with the tools available to deal with them – in particular it focused on the usage of the tools in practice.

Here we tried to understand the relation between the theoretical assessment of the need and the readiness to act on such needs institutionally.

This complex matrix was developed to obtain an insight to the actual type of remedy that the respondent should think would need to be available from the side of the institution, in order to fully address the ethical views on particular situations. The idea was to obtain actual strength of the remedy to be considered with respect to a particular situation. The starting point of the research was that some situations would require stronger remedies than other, but perhaps not all of them would be allowed the same level of interference due to the requested autonomy of the researchers.

ADDITIONAL 3: What type of INPUT do you think SHOULD be AVAILABLE from your Public Research Organization on ethical issues in the following settings (non optional extention of question 3)

	1. Awareness raising	2. Informal guidelines	3. Formal guidelines	4. Code of conduct	5. Ethical review committee	6. Several field dependent ethical committees for different contexts, situations, settings	7. Seve field depend ethica committ for differ fields c scienc
prizes/awards committees							
performance reviews							
recruitment							
letters of recommendation							
governing bodies							
steering or advisory boards							
internal faculty funding							
editorial boards							
project invitations							
visibility							
project coordination							
CV preparation							
announcement of positions							
speaking events							
choosing research topics							

Figure 5: The usage of the tools to address the situations in need of ethical assessment, from the organizational point of view.

4. CONCLUSIONS

The set up matrix of questions will allow further work and analysis about the use of ethical principles in public research institutions from a multiplicity of points of view: the general attitude, the more personalized point of view, the view of the organization and the possible remedies.

We plan to continue our work in terms of applying the questionnaire to a chosen set of relevant public research organizations in Europe, the JTC TTO Circle [1, 2].

5. ACKNOWLEDGMENTS

Our thanks to Michael Bernstein for allowing us the time to develop the attitudes to the questionnaire and to supply us with some important documents in the field. Thanks to Johan Benesch (Chalmers University) and Huw Jones (Aberystwyth University) for their inspiring support in the first phases of setting up the research questions.

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Etika v raziskavah, primer JRC "TTO Circle" organizacij; Ethics in research issues, an example of JRC "TTO Circle" organizations

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ABSTRACT
In this paper, we describe the use of ethics principles in research matters in the organizations, which form part of the Joint Research Center's TTO Circle ([1]).

Keywords
Ethics, principles, survey, TTO Circle, JRC

1. INTRODUCTION

As a part of the H2020 funded NewHorrizon project on responsible research and innovation we were investigating the question of the importance of non-regulatory / non-conventional ethics and research integrity issues in European Public Research Organizations to look beyond standard ethics regulatory issues and processes.

This work is based on previously developed situational analysis questionnaires for analysis of ethics principles in research matters in the research organizations, presented in our article "Ethics in research issues: development of a situational analysis questionnaire".

We carried out a short survey about the perception of ethical behavior in different situations within public research organizations from researcher's personal and institutional point of view.

2. PREPARATION OF THE SURVEY

The ethics issues we were interested in, went beyond the conventional ethical issues (as integrity, responsibility, honesty, competence) [3 General research on ethics] or more philosophical ones (dignity, non-maleficence) [4 JRC handbook] and strived away from the IPR issues (privacy, confidentiality, justice) [5 WIPO Handbook]. Also, the issues we set to analyze, were broader, but due to addressing specific situations also more concrete than the ones included in the [6 Consensus statement].
The survey took place among the members of the TTO Circle, which currently are 31. This is a finite amount of data, but highly prominent at the same time, as high-level officials of Public Research Organizations are involved in the TTO Circle operations ([1]).

The TTO Circle stands for the European Technology Transfer Offices circle. This is a network of research institutions, established with the aim to bring together the major public research organizations in order to share best practices, knowledge and expertise, perform joint activities and develop a common approach towards international standards for the professionalization of technology transfer.

The European TTO circle gathers the largest public research organizations across Europe. The network comprises currently 31 organizations (198349 scientific staff, 5243 softwares, 34338 patents and 4143 start-ups). The partners signed a Memorandum of Understanding formalizing their collaboration. They agreed to strengthen Europe's ability to create innovative products and services for the market. ([2]).

Jožef Stefan Institute has become a member of the TTO Circle in 2016. During the 2018 and 2019 a survey and an analysis of research ethics attitudes and behaviors has been carried out to understand the level of inclusivity for ethics and ethical assessments within the situations that arise in research operations.

3. EXECUTION OF THE SURVEY

A separate platform has been built to allow only single responses from specific institutions. It made available the basic information and rights of the respondent at any time and collected responses that could be reviewed but not changed after submission.

A developed situational analysis questionnaire has been uploaded to the platform and the link sent to the selected representatives of the member public research organizations of the TTO Circle.

The questionnaires were answered by the selected representatives. We collected 22 filled out questionnaires out of the 31 institutions. The TTO Circle organizations are a representative sample of the highest level of the European research attitudes. An almost 71% response rate confirms a high involvement of these organizations with the ethical issues.

The research organizations interviewed engage in different fields of research work (Fig.1), but the majority of them is involved in research and development also in the IT field (85% engineering sciences, 10% language, information and communication, 60% digitalization, ICT, big data).

These organizations are closely related to the issues of ethics of IT specialists and other specialists working in the research field and is crucial for the relation of science or facts to the truth as accepted by the general society.
However, there is also a wider question to be answered, namely, is the scientific and research operation itself immune to ethical issues?

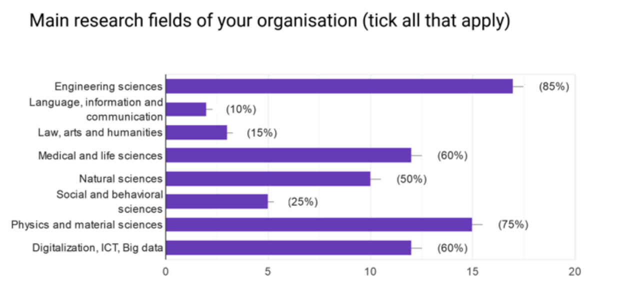

Figure 1: The distribution of research fields of the interviewed research organizations.

And how are particular situations, principles, themes addressed when faced in the research community, either from a personal point of view of a certain researcher or from the point of view of the whole organization?

4. RESULTS

4.1 The personal attitudes

The **necessity to involve ethical assessments in any of the four principles (reliability, respect, honesty and accountability)** was analyzed within the first set of questions.

The analysis showed that "reliability in ensuring the quality of research reflected in the design, the methodology, the analysis and the use of resources", is the most unifying principle among the four. More than 68% of respondents believe a code of conduct or a local policy should be set in place to assure reliability in research quality.

On the other hand, the only principle that evoked a response "no practical solution is required", even if in only 9% of respondents, was "respect for colleagues, research participants, society, ecosystems, cultural heritage and the environment". This can be understood as a proof that the respect for all involved in the research actions is either already very high (and thus no particular solution is required) or the situation is in the minds of the researchers to be left unaddressed (best as it is and as left to the research autonomy). Mind that 45% of respondents think that non-regulatory and 45% of respondents think that a code of conduct or local policy would be needed to address the issues of mutual respect in the research society.

The latter (non-regulatory, awareness raising or a code of conduct and local policy were also by far the most popular answers in all four principles in question (reliability, honesty, respect and accountability). As opposed to more than 77% of respondents asking for non-regulatory, awareness raising, code of conduct or local policy actions, the legal framework would be used by 21% of respondents on average and enforcement by only 14% of respondents (see Fig.2).

The **personal level of necessity to establish ethical assessment in some particular common research situations** was evaluated within the second set of questions. There were some situations that clearly showed preference of the respondents towards execution of ethical assessments: research involving animals 95%, research involving children 91%, STEM cells research 86%, activities that result in personal financial benefit for the researcher 86%, research involving adults 82%, asking a new student to do measurements and using these measurements in a paper without credit 82%.

There were situations that clearly showed the opposite preference – that the ethical assessment would be not needed: scheduling meetings outside the core working hours (77% thought this is not an issue in need of ethical assessment); and 73% thought that organizing conferences that require travel at weekends is not problematic either. It would be important to observe the distribution of answers here in terms of female and male respondents, but we do not have this data available.

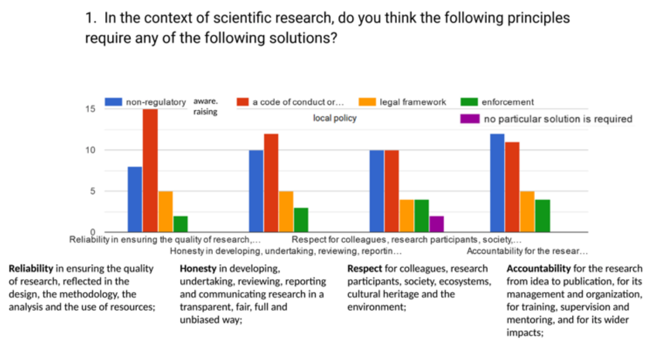

Figure 2: The solutions needed to assure the four basic principles in the context of scientific research.

There was a set of situations where a slight majority would require an ethical assessment: researching new topics without broad social agreement through a consultation on consequences 57%; the process that senior authors decide who is included in the author list of a publication and the process that the senior authors decide the order of the author list, both 55%; formation of an interview board for hiring processes 53%.

There was also a set of situations where a slight majority was against having the ethical assessments: using an ICT tool for internal submission seen by everyone so anyone can request authorship with 59% against and accepting invitations to panels that did not make a demonstrated effort in gender equality 55% against any ethical assessment needed.

The analysis showed a clear bias of the researchers towards already established procedures (which were named as necessary to be in ethical assessment), but less prevalent were topics that affect everyday life (work-life balance) and topics that are as of yet not part of the regulatory system (agreement with the cultural and social environment about the research topics).

Having understood these personal points of view we then also tried to analyze the organizational attitudes and set-ups.

4.2 The organizational attitudes

As expected, the organizational attitude has proven to be a more difficult issue than the personal attitude of the respondents, as on the average within the set of 16 questions almost 18% of respondents declared that they are not sure of what type the consideration of ethical issues within their organization is.

On the other hand there were some settings that clearly showed institutional orientation towards ethical assessment: for recruitment 83% of those who knew the institutional orientation regarded this setting as one that is covered by ethical assessment in their organization, 65% of institutions considered there to be necessity for ethical assessment for announcement of positions and 70% of institutions considered there to be ethical aspects and take them into account in terms of members of governing bodies and their operations with 56% considered there to be ethical aspects and take them into account in their advisory boards.

There were also some settings that clearly showed reluctance to involve any ethical aspect consideration: letters of recommendation 78% of the ones who knew the organizational position claimed their organizations do not consider there to be ethical aspects and do not take them into account; 75% for project invitations and 70% for operations of editorial boards; CV preparation (73%), speaking events (73%), but also (impressively) 64% for internal faculty funding allocation and for memberships.

For some settings the balance was slightly positive (prizes/award committees with 58% in favor of ethical assessments) and for some it was slightly negative (performance reviews 64%, visibility 60%, choosing research topics 58% for rejecting the ethical assessments).

The distribution of institutional orientations shows that the institutions try to address first the situations, connected to ethical aspects, that are also connected to financial and research position benefits, whereas every day research and research work aspects are currently being less considered.

If we wanted to **consider the forms in which the organizations take ethical issues into account**, we found out that the majority of organizations relies on awareness raising via listing of the expectations from the community to address the ethical issues (72%) and on formal guidelines (76%).

Less formalized option of informal guidelines 66%) and a more formal option of the code of conduct or local policy (57%) together with an ethical review committee (53%) were also used. More than 62% of organizations also have a procedural document (in terms of policy) to address the ethical issues and take them into account. The least used tools are field and context dependent ethical committees (76% do not use them) and legal framework in terms of national legislation (53% do not have it).

Surprisingly, 83% of the respondents stated that it is not true that their organizations would not take ethical issues into account in the described settings, namely that only 17% of the respondents are employed in institutions that would not be aware of the importance of ethical issues and ethical assessments in the described settings.

The analysis of forms in which the organizations take ethical issues into account shows that the organizational level of ethical responsibility is higher than the personal one, which could lead to improvements in ethical assessments of particular settings in the future years.

We also investigated **the type of input that the respondents think should be available from their organizations** in particular settings where ethical assessment might be necessary.

In project invitations, visibility, prizes/awards and committees the prevailing requested input from the research organizations to the side of research community would be awareness raising. Whereas in performance reviews the community would require formal guidelines and in project coordination a code of conduct. (and also, awareness raising of the same level). Surprisingly, in CV preparation there is an equal request for awareness raising and for legal framework in terms of national legislation.

Governing bodies should have formal guidelines in ethical aspects of their operation and in recruitment, speaking events and internal faculty funding a strong majority requires procedural documents in terms of a policy, closely followed by a request for formal guidelines.

Surprisingly, in many situations the research community requests their research organizations to impose a more transparent rule set in a more organized, more formal and more systematic way.

This shows that even though the organizations do take ethical issues into account and are leading the way to a more relaxed personal point of view of a particular researcher, there are improvements to be made in the way how organized and transparent are the processes of imposing these onto the research community.

5. CONCLUSIONS

The analysis showed a clear bias of the researchers towards already established procedures (those were named as necessary to be in ethical assessment), but less prevalent were topics that affect everyday life (work-life balance, agreement with the cultural and social environment about the research topics).

The distribution of institutional orientations showed that the institutions try to address first the situations, connected to ethical aspects, that are also connected to financial and research position benefits, whereas every day research and research work aspects are currently being less considered.

The analysis of forms in which the organizations take ethical issues into account showed that the organizational level of ethical responsibility is higher than the personal one, which could lead to improvements in ethical assessments of particular settings in the future years.

The type of input that the respondents think should be available from their organizations in many situations where ethical assessments might be necessary, shows that the research community requests their research organizations to impose a more transparent rule set in a more organized and systematic way. This showed that even though the organizations do take ethical issues into account, there are improvements to be made in the way how organized and transparent are the processes of imposing these onto the research community.

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Automation of Violence and the Disappearance of Moral Responsibility

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ABSTRACT

Committing violence often results in Perpetration-Induced Traumatic Stress, and thus humans go at length to avoid exposure to behaviors that involve physical force intended to hurt, damage or kill other human beings. Consequently, trends in twentieth-century warfare focused extensively on automation of killing by mechanical distancing of perpetrators from the victims and, more recently, by replacing human soldiers with UAVs (unmanned aerial vehicles) and other military robots. This substitution, of course, had problematic ethical consequences because it increased the propensity to use force. Today, however, we are witnessing an even harsher and more radical process of distancing, namely the introduction of automated decision-making which seemingly removes moral responsibility from human agents. Individual moral responsibility thus starts to disappear in an intricate web of military structures populated with automata, increasingly relegating the decision-making to information-processing algorithms. This relegation of moral responsibility could, in turn, contribute to heightened and irresponsible use of force, whereas the automated information-processing could help with the enforcement of unprecedented conformism.

Keywords

Violence, perpetration-induced traumatic stress, UAV, moral responsibility, automated decision-making, automatic target recognition

1. INTRODUCTION

Contemporary wars are being increasingly waged with machines. Even though the concept of “drone,” for instance, is an old one, the technology became popular only during and after the Balkan war in 1990s and “massively expanded under President Barack Obama” [6]. The use of machines such as UAVs results in soldiers having less and less physical and personal contact with enemy troops on the ground. This “distancing” [5], however, is a key prerequisite for killing and violence. Physical distance between enemy troops as an important “killing-enabling factor” (KEF) can thus be translated into emotional distance, bracketing spontaneous empathy and aversion to killing and resulting in easier decision to commit violence.

If, however, decision-making in the battlefield is itself automated with the help of AI, moral responsibility for casualties could be relegated to non-human actors (such as information processing algorithms), thus further increasing the distance and, consequently, contributing to increased likelihood for conflict.

2. HUMAN SPONTANEOUS AVERSION TO VIOLENCE AND THE AUTOMATION OF KILLING

Humans have spontaneous aversion towards aggression and killing of other human beings as well as animals that are closely related to humans (e.g. mammals and even vertebrates such as birds and fish). indeed, in order to commit violence to humans or, for that matter, to animals on has to “psychically numb” (7) or emotionally withdraw” (4) oneself. Despite this withdrawal, Perpetration Induced Traumatic Stress (PITS) is a likely outcome for those who commit violence [2]. Therefore, there is a twofold tendency to a/ conceal violence (removal of cues by, for instance, removing slaughtering from public view [3]) and to b/ further distance the perpetrator from the victim.

2.1. Distancing the Perpetrator from the Victim

Distancing the perpetrator from the victim is a fairly old technique of decreasing the so-called “nonfiring rate.” Indeed, as Dave Grossman shows, this rate was very high in traditional battles, including WWII, encompassing from 80 to 85 % of all soldiers, since “only a small percentage of musketeers in a regimental firing line were actually attempting to shoot at the enemy while the rest stood bravely in line firing above the enemies’ heads or did not fire at all.” [5, p. 26] In order to lower it, military tacticians used psychological training and conditioning techniques as well as aforementioned emotional distancing. However, one of the most successful tactics in this case is still pure physical distancing from the ‘target’. Dave Grossman quotes Gwynne Dyer’s observation in order to illustrate this point:

> … the intervention of distance and machinery between them [soldiers] and the enemy [is important]; they can pretend they are not killing human beings.

> On the whole, however, distance is a sufficient buffer: gunners fire at grid references they cannot see; submarine crews fire torpedoes at "ships" (and not, somehow, at people in the ships); pilots launch their missiles at "targets" [5, p. 108]

One aspect of this distancing is so-called "mechanical distance," characterized by use of different tools and increasingly UAVs and other military robots. Use of mechanical warfare interfaces in contemporary battlefield thus increases the likelihood of using force by decreasing the nonfiring rate in soldiers: "there has never been any difficulty in getting artillerymen, bomber crews, or naval personnel to kill. [5, p. 107]

Bearing this in mind, we can safely conclude that the future of warfare lies in still greater mechanical distancing of soldiers from enemies, in increased use of UAVs and military robots. The reason for this is not only safety of soldiers but, as shown above, successful lowering of nonfiring rates. Somewhat analogously to war industry one can expect that the slaughtering process in the industrial meat production complex will similarly become more and more automatized, thus lowering the stress and PITS symptoms in slaughterhouse workers while simultaneously lessening the likelihood of health and safety-related incidents at the workplace.

2.2. Distancing with the Help of Automated Decision-Making

If distancing from the victim or, for that matter, the enemy (or in some contexts the animal) is a trend in modern warfare and if twentieth and the beginning of twenty-first century witnessed this distancing in the form of mechanical interfaces, then the future development of distancing seems to belong to AI and automated decision-making and profiling. Indeed, UAVs are being increasingly used in different applications, including military domain. [1] Moreover, autonomous UAVs have or will soon have advanced ATR (automatic target recognition) algorithms and will, for instance, be able to execute complex maneuvers in air confrontation. [8] Autonomous UAVs with ATR will thus further unburden the pilots of moral responsibility in combats, thereby making it still easier to use and misuse the lethal technology.

Indeed, it seems that the relegation of responsibility of killing the enemy soldiers to wholly impersonal algorithms represents the last and final step in distancing the perpetrator from the victim. In fact, one could claim that what emerges with this process is a completely new concept of "distance" between the executor and victim, since conceptually the perpetrator and the victim become categorically different entities: the first being an impersonal algorithm and the second a "traditional" human being, a moral agent and patient. The process of distancing the perpetrator from the victim thus finally results in a categorical gap between the executor and the victim.

3. MORAL PROBLEMS RELATED TO AUTOMATED DECISION-MAKING

As noted above, categorical distance between the perpetrator and the victim seems to be the last step in the distancing of soldiers from enemies. If first distancing – the distancing with the help of mechanical interface that separated the killer from the victim – was morally problematic, the second distancing – the categorical gap between the executioner and the victim – seems to be even more so. The reason for this is threefold, as demonstrated below.

3.1 The Problem of Relegating Responsibility to Decision-Making Algorithms

Firstly, with the automated decision-making in combat situations the moral responsibility seems to start to dissolve and disintegrate to the point of its disappearance. The notion of moral responsibility is namely bound up with the concept of "moral agent", i.e. a person who can act morally and is thus also obliged to follow certain moral norms. Algorithms, i.e. decision-making programs, are ontologically speaking not entities in such a way that they could be regarded as "moral agents". Thus, if an autonomous UAV kills a civilian in a war zone by mistake it cannot, by definition, be morally blamed. Thus the question "Who is responsible for the death of the civilian casualty?" necessarily arises. But the answer to this question is not as straightforward as in more traditional combat situations – are we to blame the programmers from faulty algorithm, or sensor engineers, or the personnel that authorized the use of UAVs in the mission? It seems that moral responsibility in such cases becomes indefinitely relegated to non-specifiable others, thus making it difficult to ensure accountability.

3.2 Encouraging the Use of Force

Secondly, the disappearance of moral responsibility and accountability can encourage the use of force in the similar way that more traditional mechanical distancing decreased the nonfiring rate. That is, if the personnel is aware that moral responsibility can be relegated to unspecified or hardly specifiable moral agents, then the staff could be inclined to use the technology more often and in more precarious ways. Indeed, if the moral responsibility becomes lost in complex web of ontologically and categorically different actors (machines, algorithms, humans), then the temptation to abuse the technology with impunity seems to become tangible.

3.3 Encouraging Conformism and Uniformity

Thirdly, the use of automated decision-making could induce human subjects to unconsciously conform to the criteria by which algorithms are supposed to derive at decisions. This process might inadvertently significantly limit the freedom of expression of individuals. Similarly to "social credit systems," ATR algorithms could induce people to act and behave in such a way that makes them less likely to become targets, thereby infringing upon the scope of human expression.

4. CONCLUSION

The distancing of perpetrators from the victims as a decisive KEF with the help of mechanical interfaces (long-range artillery, bombers, submarines and more recently UAVs) was predominant in the twentieth century warfare that saw unprecedented number of war casualties. However, new and categorically different form of distancing started to take place in the twenty-first century with the advent of AI and ATR. Increasingly, actors in modern battlefield are algorithms that are ontologically different from human beings and thus cannot be regarded as typical "moral agents", i.e. subject that have the ability and obligation to act morally. This results in the dissolution of moral responsibility which starts to disappear in a complex web of human and non-human entities that populate modern warzones. Consequently, the temptation to use and abuse such technology emerges. The most dire scenario that can be imagined for the future warfare is a world full of autonomous military and policing robots that will enforce interests of no particular or traceable origin. In order to avoid that scenario, new and perhaps unprecedented regulations will have to come in power, limiting the potential abuse of military and policing technology. The form and shape of these regulations could be an interesting platform for further research.

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Etični vidiki digitalizacije

Ethical aspects of digitalization

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POVZETEK
Digitalna preobrazba poglablja že obstoječe etične dileme podedovane še iz industrijske dobe, hkrati prinaša tudi popolnoma nove etične izzive, na katere smo le malo pripravljeni. Z zornega kota normativne in uporabne etike smo osvetlili nekatere izzive za razvijalce in ponudnike, uporabnike ter regulatorje digitalnih storitev. Čeprav imajo vse omenjene skupine resne probleme povezane z etiko in vprašanji, kaj je dobro in kaj slabo za posameznike in družbo, je osrednje sporočilo namenjeno predvsem strokovnjakom s področja digitalizacije. Ob vsem strokovnem in razvojnem delu se morajo zavedati tudi svoje etične odgovornosti, ki je povezana predvsem z zasebnostjo in varnostjo podatkov. V bližnji bodočnosti pa bodo prišla v ospredje popolnoma nove etične zadrege okoli uporabe umetne inteligence in robotike.

Ključne besede
Digitalizacija, etični izzivi, normativna etika, uporabna etika, zasebnost, digitalna globalizacija

ABSTRACT
Paper title: Ethical aspects of digitalization

Digital transformation deepens already existing ethical dilemmas inherited from the industrial age. At the same time, it brings also entirely new ethical challenges that we are not well prepared for. From the perspective of normative and applied ethics, we have highlighted some of the challenges for developers and service providers, users and regulators of digital services. Although all of these groups have serious problems related to ethics, and the issues of what is good and what is bad for individuals and society, the central message is primarily intended for experts in the field of digitalization. In addition to their professional and development work, they must also be aware of their ethical responsibility, which is primarily related to privacy and data security. However, ethical concerns about the use of artificial intelligence and robotics are the coming new issues.

Keywords
Digitization, ethical challenges, normative ethics, applied ethics, privacy, digital globalization

1. UVOD
Vsaka človekova dejavnost, ki vpliva na druge posameznike ali družbo, nosi v sebi tudi etične probleme in dileme. Nobenega dvoma ni, da digitalna preobrazba družbe dramatično spreminja vlogo posameznika in samo strukturo družbe ter odnose v njej. Zato je razmislek o etičnih vidikih digitalizacije pomemben del razmišljanj o naši bodočnosti.

Informatiki in ostali strokovnjaki na področju digitalizacije živijo in delajo v okoljih, kjer so izzivi pretežno tehnične in kognitivne narave, zato pogosto o etičnih izzivih in posledicah svojega dela niti ne razmišljajo. Vendar se stanje izjemno hitro spreminja, saj smo v zadnjih dveh ali treh letih priča resnim razpravam o etičnosti nekaterih informacijskih storitev, posledicah totalnih monopolov tehnoloških multinacionalk, informacijskim zlorabam v političnem okolju in širjenju lažnih novic, da ne omenjamo še drugih tem.

Po drugi strani pa tudi filozofi in teoretiki s področja etike precej počasi dojemajo, kaj vse prinaša digitalizacija in sobivanje realnega in virtualnega sveta (Bavec in Manzin, 2011). Seveda ni vse tako črno, saj je vedno več sociologov in filozofov, ki so se posvetili tem temam. Mnogi povezujejo digitalno preobrazbo z družbenimi tveganji (Beck, 2009, Bauman, 2016), saj je digitalna bodočnost le delno predvidljiva, drugi se naslanjajo na področje uporabne etike (ang. Applied Ethics), ki pa daje precej poenostavljeno sliko celotne problematike (Frey in Wellman, 2008). Mimogrede, uporabna etika je študijsko področje tudi na znanih tehnološko usmerjenih univerzitetnih programih v Evropi in ZDA (npr. University of Oxford, Utrecht University, Norwegian University of Science and Technology ali University of California, Los Angeles - UCLA).

V vmesnem svetu pa živijo managerji in drugi navadni smrtniki, ki v večini primerov pragmatično sprejemajo, kar jim tehnologija ponuja in nimajo niti časa niti motiva razmišljati o etičnosti svojih digitalnih dejanj, pa naj bodo aktivna ali pasivna (Tarafdar, DArcy, Turel in Gupta, 2015). Tudi managerji, ki narekujejo digitalizacijo, praviloma enačijo etičnost z zakonitostjo in spodbujajo informacijske storitve, ne glede na morebitno škodo posameznikom (na primer osebni podatki) in družbi kot celoti. Od neetičnosti do nezakonitosti je namreč zelo dolga pot in zakonitost ne more biti alibi za neetičnost.

2. ŠIRŠI KONTEKST DIGITALNE ETIKE
Etika je filozofski nauk ali pogled na to, kaj je dobro in kaj slabo za posameznika ali družbo. Kot velja za vsak filozofski nauk, lahko tudi etiko obravnavamo z različnih zornih kotov in različnih predpostavk. Da vsaj malo omejimo področje, ki ga obravnavamo v tem prispevku, vzemimo kot izhodišče Sokrata in njegov pristop k etiki, ki je preprosto povedano naslednji. Ne dopoveduj ljudem, kako naj konkretno živijo, ampak jih spodbujaj in uči, kako naj vrednotijo dobra in slaba dejanja. Da se izognemo nepotrebnim začetnim nesporazumom, pa še dodajmo ugotovitev, da etika ne daje vedno pravilnih odgovorov na moralna vprašanja.

Z zornega kota digitalne preobrazbe družb, ko smo šele na začetku poti in niti ne vemo točno, kam gremo, je to kar primeren metodološki pristop. Glede na to, da šele spoznavamo družbene posledice digitalizacije, smo očitno še v fazi, ko se srečujemo z novimi etičnimi zadregami, na katere niti nismo pripravljeni (Russo, 2018). Zato so pretežno filozofska vprašanje več kot na mestu.

Sodobne teorije delijo etiko na meta etiko, normativno etiko in uporabno etiko:

1. ***Meta-etika*** je v bistvu skepticizem in je osredotočena na vprašanja, kako sploh razumemo, kaj je prav in kaj ne (na primer, ali bomo na področju digitalizacije in ožje umetne inteligence sploh lahko zagotovo vedeli, kaj je etično ali neetično). Del meta-etike je tudi kognitivizem, ki predpostavlja, da etični stavki izražajo predloge, ki so torej lahko pravilni ali nepravilni. Anti-kognitivizem pa seveda to srdito zanika.
2. ***Normativna etika*** se osredotoča na vprašanja, kaj je etično ali moralno, ko se odločamo o določenem dejanju. V bistvu presoja standarde, kaj je prav in kaj ne v konkretnem dejanju. Vprašanja povezana z digitalizacijo se na to področje zelo počasi prebijajo.
3. ***Uporabna etika*** pa poskuša uporabiti etična načela v realnem življenju in zajema vrsto specifičnih področij, kot so inženirska etika, bio-etika, poslovna etika in seveda *digitalna etika*. Zato bomo v nadaljevanju izhajali predvsem iz stališč uporabne etike.

Velika večina vseh razprav povezanih z etiko in digitalizacijo spada pod uporabno etiko, saj se največ etičnih vprašanj skriva v uporabi informacijskih tehnologij. Vseeno kaže vsaj omeniti tudi veliko širša etična vprašanja, ki spadajo pod meta-etiko in normativno etiko, kot so, na primer:

- Ali veljajo v digitaliziranem in virtualnem svetu enaka etična načela, kot veljajo v realnem svetu? Kaj sploh pomeni virtualni svet z etičnega zornega kota?
- Umetna inteligenca postaja človeku partner pri odločanju, ki pa ima vedno tudi etične vidike. Kje je točka singularnosti (trenutek, ko se bodo stroji lahko s pomočjo umetne inteligence sami učili in razvijali neodvisno od ljudi), ko bo človek prepustil strojem tudi etično presojo (Prinz, 2012)? Kako bomo takrat opredelili etičnost?
- Kaj z etičnega zornega kota pomeni izguba zasebnosti, kot jo poznamo v realnem svetu? Kaj pomeni nezmožnost medmrežja, da pozablja? Ali je to sploh etična dilema?
- Kaj je etičnega in kaj neetičnega v globalizaciji, ki jo spodbuja digitalizacija? Ali je potrebno upoštevati različna etična načela različnih kultur in okolij (van der Velden, 2008)? Ali sploh lahko obstaja globalna digitalna etika (Bao in Xiang, 2006)?
- Ali je programska koda govor? Nenavadno vprašanje, ki ga je sprožil Apple in s katerim se je že ukvarjalo ameriško sodstvo (Henshall, 2018), saj je povezano z ameriško ustavo, ki opredeljuje svobodo govora.

Podobnih načelnih in filozofskih vprašanj je seveda še veliko več, kar daje razmišljanjem o etiki in digitalizaciji poseben raziskovalni čar. Vendar se bomo v nadaljevanju omejili le na nekaj pomembnejših dilem, ki spadajo na področje *uporabne etike*.

3. UPORABNA DIGITALNA ETIKA

Digitalna preobrazba družbe ima svoje korenine v industrijski družbi, zato je večino etičnih dilem podedovala in jih ni sama povzročila. Marsikatere od teh podedovanih dilem pa je okrepila. Vendar je ta preobrazba tako radikalna, da je morala prinesti tudi radikalno nove etične izzive. Nekateri so že vidni, drugi pa nas še čakajo, za večino prihodnih izzivov pa skoraj zagotovo sploh ne vemo.

Etične izzive digitalizacije lahko v grobem razdelimo v tri skupine glede na njihove nosilce, ki se v določenih primerih lahko delno prekrivajo, vendar se v svojem bistvu razlikujejo:

1. Razvijalci in ponudniki digitalnih storitev
2. Uporabniki digitalnih storitev
3. Regulatorji digitalnih storitev

Vsaka od teh skupin ima svojo specifično vlogo v digitalizaciji in posledično drugačne etične dileme in vprašanja. Pomembno pa je, da so med seboj usklajene, saj predstavljajo verigo, katere trdnost določa najšibkejši člen. Neetičnost katere koli od teh skupin se neposredno prenaša na drugi dve in s tem ogroža etičnost celotnega sistema digitalizacije (Floridi, 2019).

Omenimo samo trenutno največji etični izziv digitalne preobrazbe, to je ogrožanje zasebnosti. Del neetičnosti izhaja iz samih ponudnikov storitev, kot sta Facebook ali Google, ki razpolagata z osebnimi podatki in z njimi upravljata kot s tržnim blagom. Nedolžni niso niti vsi uporabniki teh storitev, saj so agresivno trolanje, napadi na zasebnost drugih ali razširjanje lažnih in pogosto tudi nevarnih informacij vsakodneven pojav. Podobno velja tudi za države, ki igrajo vlogo regulatorjev in še zdaleč ne opravljajo svoje funkcije, kot bi si jo želeli. Po drugi strani pa so države tudi »interni ponudniki« digitalnih storitev in imajo resne etične probleme z obdelavo osebnih podatkov.

3.1 Razvijalci in ponudniki digitalnih storitev

Razvijalci in ponudniki globalnih digitalnih storitev imajo veliko več etičnih problemov, kot so pripravljeni priznati. Internet je omogočil velikim multinacionalkam, da so postale glavni nosilci in promotorji digitalne preobrazbe na globalni ravni, kar jim seveda prinaša ogromne dobičke. Zato niso posebej občutljive na etična vprašanja, ki bi te dobičke tako ali drugače omejevala (Bavec, 2012).

Tipičen primer je poslovni model Facebooka, ki bi nas moral resno zaskrbeti. Ni pa edini. Problem je predvsem v tem, da so se večinoma vsi spravili na osebne podatke, saj je milijarda uporabnikov neizčrpen vir podatkov in seveda denarja. Če k temu dodamo še različne zakonske pristope k varovanju podatkov v ZDA in EU, ali solo akcije Kitajske, potem te multinacionalke nimajo posebnih razlogov za dvigovanje svojih etičnih načel, saj jim večina uporabnikov te grehe odpušča. Trenutno večino naporov usmerjajo v lobiranje za svoje interese.

Včasih pa gredo tudi te multinacionalke preko etičnih načel, ko širša javnost tega enostavno ne more sprejeti. Tak primer so bila Googlova očala, ki bi v bistvu ubila koncept zasebnosti. Zgražanje je čutil tudi Facebook, ki je individualne osebne podatke dajal okoli 120 organizacijam in ne samo Cambridge Analitiki. Takih primerov je bilo kar nekaj.

Posebno, vendar izjemno pomembno področje digitaliziranih storitev, ki je polno neetičnih praks, so digitalni mediji, vendar je to tako specifična problematika, da zahteva posebno obravnavo. Še pomembnejše je področje digitalnih storitev v zdravstvu, ki se sicer naslanja na Hipokratovo etiko, vendar so se razmere v zadnjih 2400 letih spremenile, saj sta vsaj telemedicina in umetna inteligenca v medicinski diagnostiki popolnoma nova izziva tudi za zdravstveni sistem.

Če vse nekoliko poenostavimo, potem je trenutno največji etični izziv razvijalcev in ponudnikov digitalnih storitev, ne samo na globalni ampak tudi lokalni ravni, vezan na dilemo: spoštovati etična načela pri obdelavi osebnih podatkov in s tem bistveno zmanjšati dobiček, ali pa obratno. Trenutno so njihove odločitve skrajno vprašljive z etičnega zornega kota. Najbrž tudi ne bo šlo brez zakonske prisile, ki pa mora biti globalna zaradi globalnega značaja teh storitev.

V kategorijo ponudnikov digitalnih storitev spadajo tudi državne uprave in javni sektor, vključno z zdravstvom. Na primer, v Sloveniji se lahko upravičeno sprašujemo, ali je etično digitalizirati zdravstveni sistem, ne da bi zagotovil res visoko stopnjo varovanja osebnih podatkov. Slaba tolažba je, da je tak pristop za davkoplačevalce bistveno cenejši, čeprav je etično vprašljiv. Podobno etično problematično področje je videonadzor, ki ni več samo v funkciji varovanja določenih objektov, ampak je v funkciji nadzora nad gibanjem posameznikov na širšem območju.

Čeprav je uporaba podatkov v službah državne uprave vsaj v EU bistveno bolje in strožje regulirana, kot je v prej omenjenih multinacionalkah, se bomo morali o etiki digitalizacije državnih uprav še veliko pogovarjati.

3.2 Uporabniki digitalnih storitev

Kot smo že omenili, pa tudi vsi uporabniki niso povsem imuni na neetično uporabo digitalnih storitev. Agresivno trolanje in žalitve na raznih forumih so v popolnem nasprotju z etiko, pa naj jo gledamo s katerega koli zornega kota hočemo. Seveda lahko takoj podvomimo tudi v etična načela organizacij (običajno spletnih časopisov ali blogov), ki take komentarje objavljajo na svojih uradnih spletnih straneh. Vsaj načeloma obstajajo rešitve za ta problem, vendar se jih izogibamo, ker obstaja nevarnost, da gremo v drugo neetično in tudi politično skrajnost, to je omejevanje svobode govora.

Z etične plati je pomembno tudi področje računalniških iger, čeprav o tem skoraj nikoli ne govorimo. Računalniške igre so izredno obsežna industrija s stotinami milijoni rednih uporabnikov in brez dvoma spada v okvir digitalizacije. Imajo pa dva etična problema. Po eni strani so neetična dejanja lahko vključena v samo logiko iger, kar posledično lahko spreminja etična načela uporabnikov. Po drugi strani pa je etično vprašljiva izdelava nečesa, kar zasvaja ljudi in jim v bistvu škodi. Čeprav je primerjava nekoliko groba, je vse skupaj podobno tobačni industriji ali pa proizvodnji in prodaji neomejenih količin opioidnih analgetikov. Seveda pa vse igre ne spadajo v to kategorijo, saj je veliko iger izobraževalne narave in imajo lahko izrazito pozitiven učinek, posebej na mlajšo populacijo.

3.3 Regulatorji digitalnih storitev

V Evropski uniji polagamo velike upe v zakonske ukrepe in drugo regulativo, s katero bi omejili nezakonito delovanje ponudnikov in tudi uporabnikov digitalnih storitev (Stevis-Gridneff, 2019). Vendar ti ukrepi še zdaleč ne bodo rešili problema etičnosti, saj zakoni niso primerno orožje za boj z neetičnostjo. Spoštovanje etike je zavestna odločitev posameznikov in organizacij vpletenih v digitalno preobrazbo. Zato problema etičnosti v digitalizaciji zlepa ne bomo dokončno rešili. Lahko bomo veseli vsake »etapne« zmage.

Z zornega kota regulatorjev obstaja še težji problem. Digitalna preobrazba je globalen proces, zato ga lahko na lokalni ali državni ravni rešujemo le v zelo omejenem obsegu. Potrebni so globalni dogovori in konkretni normativni ukrepi (Zhao, 2018). Ampak tudi v tem primeru bodo etični problemi ostali, med drugim tudi zato, ker imajo tudi različne kulture različne poglede na etičnost. In, kot smo že omenili, ali sploh lahko govorimo o sprejemljivi globalni etiki na področju digitalizacije.

4. ŠE KRAJŠI RAZMISLEK

V tem prispevku večkrat omenjamo etičnost organizacij, vendar v teh primerih govorimo o deklarirani ali formalni etičnosti, ki jo organizacija pripisuje sama sebi. V praksi pa se večina problemov pokaže na ravni posameznikov, saj odločitve ne sprejema imaginarna organizacija, ampak jo v njenem imenu sprejemajo posamezniki (Yardley, 2018). Na področju digitalizacije so to strokovnjaki s področja informacijskih tehnologij in kognitivnih znanosti ter managerji, ki opredeljujejo cilje organizacije in digitalizacije.

Zato bi se morali tudi strokovnjaki in razvijalci digitalnih storitev, ki lahko vključujejo preproste informacijske sisteme ali kompleksno uporabo umetne inteligence, zavedati pomena etike in tega, kaj je prav in kaj ne. Kakor koli obrnemo, oni izdelujejo orodja za morebitno neetično uporabo. Reakcija enega od bivših razvijalcev pri Facebooku, ki se je na nekem intervjuju prijel za glavo z izjavo: »O bog, kaj smo storili«, je vredna globokega razmisleka. Tudi običajno opravičilo, da je orodje le orodje in da le uporabnik odloča, kako ga uporablja, je precej vprašljivo (Pinterič, 2015, Lomas, 2018). Informacijska tehnologija, za razliko od klasične tehnologije, še zdaleč ni nevtralno orodje. Tudi podatki niso nevtralni.

Trenutno se večina etičnih zadreg vrti okoli osebnih podatkov, vendar hitro prihajajo popolnoma novi izzivi, ki jih spodbuja razvoj umetne inteligence in robotike (Hagerty in Rubinov, 2019), na operativni ravni pa razvoj industrije 4.0. O etičnih izzivih umetne inteligence in raznih algoritmov na tem mestu ne bomo posebej govorili, saj posegajo daleč na filozofsko področje. Kljub trenutno zelo razgretim razpravam, nam še zdaleč ni jasno, kaj pomeni etično sobivanje inteligentnih robotov in ljudi. Še vedno razpravljamo o tem, ali bi roboti potrebovali uradno zabeleženo identiteto, ali bi morali plačevati davke namesto zaposlenih, ki so jih nadomestili, kdo bo odgovoren za morebitne napake ali zlorabe in podobno. Čeprav se nam zdi, da je na akademski ravni zadeva več ali manj jasna, v praksi še zdaleč ni. Paziti namreč moramo, da ne zaidemo v etične pasti ludizma, ki so zaznamovale začetne odpore proti industrializaciji.

Za konec zapustimo Sokrata in njegovo misel, da ne pridigaj, ampak spodbujaj k razmišljanju in kljub vsemu podajmo nekaj aplikativnih etičnih nasvetov, posebej razvijalcem digitalnih storitev.

Z etičnega zornega kota so tudi tehnološko usmerjeni razvijalci dolžni v svojih rešitvah upoštevati etična načela povezana z zasebnostjo, varnostjo in tudi splošno poštenostjo. Vendar to ni tako preprosto, kot se zdi na prvi pogled. Pogosto je neka aplikacija razvita v popolnoma drugačnem kontekstu, kot je kasneje uporabljena (na primer, video tehnologije v vojaških dronih in podobno). Zato ni slučajno, da tudi tehnološko usmerjeni programi na tujih univerzah poučujejo osnove uporabne etike v različnih okoljih, vključno z digitalno etiko. Študenti s področja informacijskih tehnologij pri nas takih znanj nimajo in jih na fakultetah o tem tudi ne poučujemo.

ACM (Association for Computing Machinery) ima svoj kodeks etičnega in profesionalnega delovanja (ACM Code of Ethics and Professional Conduct), ki se začenja s stavkom: »Aktivnosti računalniških strokovnjakov spreminjajo svet. Da bi delovali odgovorno, se morajo ozirati na širše učinke svojega dela ...«. Kodeks je izjemno poučen in nazoren, zato bi ga morali poznati tudi naši informatiki. Zanimiva je reakcija enega od bralcev tega kodeksa, ki je izjavil, »da sedaj ve, kaj mora povedati svojemu šefu, če bo od njega zahteval kaj neprimernega« (Pancace, 2018).

5. ZAKLJUČEK

V prispevku smo preleteli nekatere etične dileme digitalne preobrazbe. Teh je očitno veliko več in so tudi veliko težje, kot se nam zdi na prvi pogled. Vendar o etiki razpravljamo že tisočletja, pa še vedno nimamo vseh odgovorov in verjetno jih tudi nikoli ne bomo imeli. Skoraj zagotovo to velja tudi za etiko na področju digitalizacije. Kljub temu pa se moramo tudi tehnološko usmerjeni strokovnjaki, ki delamo na področju digitalizacije, zavedati etičnih načel in v skladu z njimi tudi delovati.

Naš osnovni problem je, da z izjemo neodvisnih raziskovalcev na univerzah in inštitutih, delamo po željah naročnikov in jim skoraj podzavestno prepuščamo tudi odločitve o etičnosti njihovih zahtev. Tako, kot velja za zdravnike ali raziskovalce, ki delajo z živimi bitji, bi se morali tudi mi držati etičnih načel, saj tudi mi neposredno vplivamo na človeška življenja in delovanje družbe. Vendar se zgodba šele začenja in zelo verjetno bomo v bodoče morali prilagoditi tudi nekatera že zakoreninjena etična načela novim razmeram, ki jih povzroča digitalizacija. Najbolj očiten bo ponoven razmislek o tem, kaj je zasebnost.

In še osebno priznanje. Ko sedaj razmišljam o etiki in digitalizaciji, včasih smo temu rekli informatizacija, spoznavam, da bi kar nekajkrat moral reči svojim šefom: »Ne, tega pa ne bom naredil na tak način!«.

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Osnove računalniške etike
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ABSTRACT
In this paper, several basic ethical issues are addressed in particular in relation to computer science and artificial intelligence.

Keywords
Etika, računalništvo in informatika

1. UVOD
Vprašanje etike se zadnje čase upravičeno postavlja čedalje bolj eksplicitno. V uvodu predstavimo dva primera: lažne novice in neetično poročanje o Melaniji Trump.

V zadnjih letih imamo izrazit pojav lažnih novic. Razmere so prišle tako daleč, da se v javnosti pojavljajo trditve, da večina znanstvenih prispevkov ni točnih oz. v ekstremnem primeru, da je bil članek o lažnih novicah v resnici lažna novica (COSMOS, Science of everything, Fake news journal paper revealed as fake news).

V resnici znanost še naprej na večini področij dosega odlične rezultate, čeprav je tudi tu očiten prodor ideologije zlasti v raznovrstne družboslovne vede. V naravoslovju in inženirstvu pa je na osnovi anonimnega recenziranja vsaj v kvalitetnih revijah in na kvalitetnih konferencah praktično nemogoče objaviti ideološko obarvane polresnice ali neresnice. Zato je toliko pomembneje iz prave znanosti in izmed pravih znanstvenikov izločati tiste, ki dajejo ideologiji prednost pred stroko.

Glede medijske trditve, da je bil prispevek v resni reviji o lažnih novicah v resnici lažna novica, pa tole: često citiran prispevek v kvalitetni reviji Nature Human Behavior na temo lažnih novic je bil umaknjen na zahtevo avtorjev [1], ker so našli napako. Torej ne gre za lažno novico, ampak za normalen postopek objav, preverjanja in popravljanja. Prispevek v medijih je torej napačen ali zavajajoč. Zdi se, da javnost ne razume, da raziskovanje temelji na preiskovanju, postavljanju in preverjanju hipotez in da je v resnici tudi »resnica« dinamična, teži pa k ugotavljanju več in več dejstev in zakonitosti.

Zadnjih nekaj let se razkorak med znanjem, spoznanji in javnostjo oz. mediji poslabšuje in to opažamo vsak dan v slovenskih in svetovnih medijih. Preprost primer so prispevki o prvi ameriški dami Melaniji, kako ima narobe oblečen čevelj, kako se je narobe prestopila itd. Pri tem se najprej pojavi prispevek v »main-stream« ameriških medijih, nato se kmalu pojavi še slovenska inačica.

To morda ni najbolj čista oblika lažnih novic, ker gre le za blatenje najbolj znane Slovenke, ki se s politiko sploh ne ukvarja, ampak se ukvarja z vprašanji, kako izboljšati življenje otrok in podobno. Ker pa je poročena s politikom, ki razburja, upravičeno ali ne, množico posameznikov in skupin, je tudi ona stalno kritizirana. Mediji so – tako levi kot desni – žal postali glasila političnih strank in ideologij (politokracija), posledica pa je, da se znanstveno dokazani argumenti čedalje manj cenijo, pa naj gre za cepljenje ali globalno segrevanje Gotovo ni etično napadati zakonskega partnerja nekoga, ki ga politično ne maramo, je pa poročanje o Melaniji eklatanten primer, kako so se mediji etično spustili na bistveno nižji nivo kot pred leti.

Osnovno poslanstvo avtorja tega prispevka je prinesti čim več stroke v odločanje in čim manj politike v stroko, predvsem pa povečati pomen raziskovanja, stroke, razvoja in seveda podporo v smislu upoštevanja in financiranja znanosti [2,3]. Slovenija še vedno ostaja na repu Evrope, tretja najslabša po financiranju akademske znanosti. Razkorak med stroko in ideologijami, politiko, lažnimi novicami, se povečuje v škodo stroke, zato je toliko pomembneje, da opozorimo na to stranpot.

2. ETIKA
Etika je po slovenski Wikipediji: »filozofski nauk o nravnosti, o dobrem in zlu. Razumemo jo lahko kot filozofsko disciplino, ki raziskuje temeljne kriterije moralnega vrednotenja, pa tudi splošno utemeljitev in izvor morale, je skupek moralnih principov. Po nekaterih filozofih pa je etika filozofska disciplina, ki se ukvarja s tematiko človeškega hotenja in ravnanja z vidika dobrega in zlega, moralnega in nemoralnega.«

Etika je podobno kot socialni odnosi (prijatelji, nasprotniki, nadrejeni …) opazna pri vseh socialno živečih skupinah živali in ljudi. Npr. če se kakšen osebek iz skupine počuti odrinjenega, zapostavljenega, protestira, ker se početje očitno ne sklada s predstavo o tem, kaj je »fer« oz. »pošteno«. Tako tudi za etiko lahko rečemo, da je sestavljena iz dveh komponent: ena je splošna za vsa živa bitja in druga je specifična, povezana z okoljem, kontekstom, kulturo določene skupnosti.

V tem prispevku etiko obravnavamo skozi koncepte, kot so poštenost, objektivnost, korektnost, koristnost za slovensko, evropsko in človeško civilizacijo [4]. V nadaljevanju sledi analiza vpliva tehnoloških gigantov (kdo vpliva na mnenja ljudi), povezano z vprašanji etike in digitalizacije [5], asilomarskih AI principov, v zaključku pa so povzeta osnovna etična stališča.

3. PROBLEM TEHNOLOŠKIH GIGANTOV
V tem prispevku se ukvarjamo z vprašanjem, ali tehnološki giganti vplivajo na ljudske množice, ali pa delujejo objektivno in tehnološko – kar bolj ali manj sami trdijo.

IT tehnološki giganti s praktično monopolnim položajem so recimo Facebook, Google, Apple, Twitter, in Uber, oziroma drugi navajajo: Facebook, Amazon, Microsoft, Google in Apple (FAMGA).

Posamezne afere kot ona z »The Cambridge Analytica«, kjer so bili zbrani podatki za vplivanje na volitve brez privolitve avtorjev informacij, so le vrh ledene gore. Pogosto se govori o problemih le skozi prizmo enega ali drugega političnega ali ideološkega stališča. V resnici pa praktično vse vpletene ideološke in politične strani nelegalno izkoriščajo informacije in skušajo vplivati, da bi drugo stran čim bolj mogoče izločili iz javnega vpliva, tako da jih obtožujejo sovražnega govora, lažnih novic in podobnega. Pri tem postaja čedalje bolj očitno, da imajo ti tehnični giganti enostavno preveč koncentrirane moči, da nad njimi ni nobenega neodvisnega nadzora in da imajo izredno velik vpliv na ljudske mase. Pojavljajo se masovne histerije, čarovniški pogromi nad drugače mislečimi, grožnje s smrtjo, rasistični in vse mogoči izpadi. Programi AI, ki so začeli recenzirati »objektivno« in izločati npr. posnetke z nasiljem nad živalmi, so sicer naredili velik korak naprej kljub občasnim problemom, recimo izločanjem robotskih bitk ali npr. posnetka, ko bogomolka zagrabi in poje kobilico.

Kljub pozitivnemu vplivu AI pri izločanju neprimernih besedil je na osnovi več poročanj v javnosti postalo jasno, da ali vrh ali vodilni zaposleni v IT gigantih tako ali drugače v cenzuro vpeljujejo svoje osebne in politične poglede. Torej smo iz časov npr. komunizma, kjer je komunistična partija nadzirala in usmerjala delovanje in miselni svet ljudi, kot je še danes recimo primer v Severni Koreji, prišli v družbo, kjer možgane perejo vodilni v tehnoloških gigantih. Njihov vpliv je daleč večji in močnejši kot so bili mehanizmi vpliva na možgane v komunističnih režimih stare Jugoslavije ali SSSR, zato imajo predvsem mladi močno oprane možgane. Za preprosto primerjavo se spomnimo, koliko političnih ali proti-komunističnih šal je bilo v stari Jugoslaviji (veliko in so si jih ljudje pripovedovali v ožjih krogih) in koliko je sedaj političnih in proti-ideoloških šal (malo). S stališča šal je sedanje stanje bolj podobno razmeram v komunistični SSSR ali Severni Koreji. Zdi se, da so predvsem mladi izrazito pod vplivom vodilnih ideologij.

Avtor prispevka je poskusno spraševal razne skupine ljudi naslednja vprašanja:

1. Kolikšna je razlika med pokojnino moškega in ženske v Sloveniji?
2. Koliko je razlika med beneficijami ene ure moškega in ženske?
3. Ali so lahko objektivni programi rasistični?
4. Kakšen IQ ima Donald Trump?
5. … in vprašanja tipa »Ali je cepljenje povezano z avtizmom?«
6. …. in vprašanja tipa »Ali je globalno segrevanje?«

Odgovori na prva štiri vprašanja so izstopali, medtem ko je bila večina odgovorov na vprašanja tipa 5 in 6 bolj ali manj pričakovanih. Večinski odgovori so bili: Ženske imajo občutno manjše pokojnine in plače. Programi so seveda lahko rasistični. Donald Trump ima pod- ali povprečen IQ. Na vprašanja kot 5 so bili odgovori v glavnem skladni in na vprašanja tipa 6 so bili praktično vedno skladni s poznanimi trditvami v literaturi. Za prva 4 vprašanja navajamo pravilne odgovore:

1. Povprečna ženska ima večjo pokojnino kot moški v Sloveniji. Razlika je minimalna.
2. Povprečna letna plača moškega v Sloveniji je nekaj večja kot je povprečna plača ženske, vendar je glede na uro dela praktično enaka in glede na večjo prispevno stopnjo in glede na daljšo življenjsko dobo v resnici ženske dobijo precej več izplena iz ure dela. No, iz te razlike ne bi veljajo delati slona, raje bodimo ponosni, da smo ena najbolj spolno izenačenih združb na svetu. Ko pa pogledamo indeks enakosti, ki je za Slovenijo okoli 0.7, je jasno, da so taki indeksi nerealen odraz stanja.
3. Ali so lahko objektivni programi rasistični?
   Progam je seveda lahko rasističen, če npr. naredi odločitev na osnovi barve kože. Ko pa program naredi objektivno analizo, npr. statistiko ali strojno učenje, pa je govorjenje o rasističnih programih napad na znanost zaradi ponorele ideologije. V skrajnem primeru je potem tudi 1 + 1 = 2 tudi rasistično, saj objektivni programi v resnici le izračunavajo neko, resda bolj zapleteno enačbo kot zgornjo. Seveda je možno tudi objektivne programe spremeniti v subjektivne oz. rasistične preko spreminjanja učnih primerov. Tako lahko neko specifično rasno skupino diskriminiramo preko namerno generiranih rasističnih učnih primerov, česar ne more odkriti praktično nobena inšpekcija. Na podoben način so v Googlu izločali neželene pomembne posameznike – namesto »Janezek Starček« so generirali veliko negativnih učnih primerov tako, da so npr. spustili eno črko - »Jnezek Starček« in program se je naučil obravnavati »Janezek Starček« kot nezaželenega ter bil zato izločen iz socialnih omrežij. Program se je korektno naučil, da je »Janezek Starček« nekaj slabega, vendar so bili učni primeri diskriminatorno zbrani.
4. Kakšen IQ ima Donald Trump?
   Praktično vsi ameriški predsedniki so izjemni posamezniki, pametni, sposobni, bogati, pa naj gre za Trumpa ali Obamo ali Busha ali Clintona …. Praktično vsi imajo IQ med 120 in 150, kar jih po IQ uvršča med raziskovalce in profesorje. Postati predsednik je pač izredno težko in le izredni posamezniki v tem tudi uspejo. Če imamo ideološko oprane možgane preko IT gigantov in masovnih medijev ter določene posameznike vidimo kot svetnike in druge kot peklenščke, to ne pomeni, da niso vsi po vrsti pametni. Seveda se lahko osebno strinjamo ali ne z določenimi pogledi in aktivnostmi, ampak zato ne smemo zanikati objektivnih številk.

Kako je torej mogoče, da celo na Institutu »Jožef Stefan« večina, zlasti mlajših, ne pozna objektivnih dejstev oz. informacij, ampak ponavlja ideološko obarvane trditve? Ali je odgovor iskati v smeri IT podjetij?

Kako so IT giganti prišli do izjemnega vpliva in moči, je preprosto pojasniti. Vsi po vrsti prinašajo nove storitve, ki jih z veseljem uporabljamo. Pravzaprav smo že postali odvisni od njih, morda celo preveč. Brez njih nam ni živeti. V resnici prinašajo mnogo pozitivnih novosti v naša življenja. Kdor je kdaj poskušal iskati zanimive novice po spletu in si ogledoval npr. YouTube, je pridobil izredno zanimive posnetke in informacije z vseh virov točno s področij, ki zanimajo individualnega gledalca, medtem ko so poročila v medijih veliko bolj nefleksibilna in za širše mase.

Hkrati pa neodvisnemu opazovalcu hitro postane jasno, kako YouTube in podobni perejo možgane. Če recimo začnete gledati posnetke o kolesarstvu, vam bo sistem predlagal čedalje več zanimivih kolesarskih posnetkov. Če začnete gledati levo usmerjene posnetke, vam sistem sam od sebe predlaga čedalje več tovrstnih in kmalu ste mnenja, da imajo vsi levi vse prav, vsi desni pa vse narobe. Ko pa začnete gledati desno usmerjene posnetke, vas zanese desno. Ko gledate CNN, začnete sovražiti desne. Ko gledate FOX News, začnete sovražiti leve. Kako se otresti tega potenciranja? Potrebno je le pazljivo nekaj časa gledati CNN in nekaj časa FOX, da se informacije uravnotežijo in je lažje videti skozi ideološko retoriko in propagandno navijanje. Vsaj tak je recept oz. način ogledovanja informacij avtorja prispevka.

Ni jasno, v koliki meri je pranje možganov in polariziranje množic stranski produkt, vsaj avtorju tega prispevka ne, in v koliki meri gre za namerno forsiranje določenih pogledov in miselnosti. Je pa nesporno, da čedalje več strokovnjakov opozarja na omenjeni pojav.

Še iz enega razloga se pogled na IT gigante počasi spreminja. Nekaj vodij omenjenih ogromnih podjetij je prišlo v ameriški parlament pojasnjevati delovanje njihovih podjetij. Po koncu njihovih nastopov je bilo celo njihovim zagovornikom jasno, da imajo v rokah izredno močne mehanizme za manipuliranje javnega mnenja, vplivanja na volitve, hote ali nehote vnašanja svojih osebnih pogledov v cenzuro, hkrati pa ni nobenega neodvisnega organa, ki bi bil sposoben nadzirati te gigantske sisteme. Tako, malo po malem, so omenjeni giganti zapravili zaupanje ne samo intelektualcev in politikov, ampak tudi množic.

En vtis je jasen: kljub občasnemu leporečju o etiki, je delovanje IT gigantov daleč od etično korektnega in še bolj pomembno – bolj ali manj se na etiko požvižgajo kot na nekaj nebodigatreba. Denimo Frank Pasquale, avtor »The Black Box Society: The Secret Algorithms That Control Money and Information« [6] piše, da je postalo jasno, da se ti sistemi ne bodo samo-regulirali, da jih politiki v ZDA ali Evropi ne bodo mogli obvladati, ampak da bodo še naprej manipulirali z uporabniki, jih izrabljali in zavajali.

Med drugim Pasquale trdi: "I don't think tech companies can have these discussions until a regulatory framework forces them to do so. They were warned about the perils of lax application of their own guidelines, and they have ignored or marginalized their critics".

Vtis je, da so – tako kot večina despotov oz. politikov na oblasti – IT giganti opijanjeni od svoje moči in pomembnosti, prepričani, da so edinstveni nosilci napredka na svetu (kar po svoje tudi so v tehničnem smislu), da so tudi edini pozvani (od koga?), da usmerjajo ljudske množice v pravo smer, in da so zaradi pomembnosti in sposobnosti kupovanja podpore sposobni na svojo stran pridobiti vsaj politike, če že uporabnikov ne. Ampak njihova »PRAVA SMER« je njihov ideološki pogled in smisel vrednot, ki so daleč od optimalnih, za ljudi in človeško civilizacijo najbolj koristnih. Direktorji in lastniki so večinoma usmerjeni v povečevanje svojega bogastva in moči in imajo prej dokaj čudne poglede kot normalne. Oblast in bogastvo kvarita ljudska srca!

Večina vodstev IT velikanov vidi delovanje demokracije, ljudstev in politike, prav tako tudi etike kot nekaj neumnega, primitivnega, škodljivega. Sebe vidijo kot edine prave svetovne voditelje, kot rešitelje, za katere je etika nepotrebna ovira pri snovanju novih IT rešitev.

Po eni strani so rešitve na dlani: potrebno je vgraditi mehanizme kot so etika, objektivnost, neodvisnost od ideoloških in političnih pritiskov. Potrebno je izločiti vpliv omenjenih posameznikov na delovanje sistema in zagotovoti neodvisen nadzor.

Neodvisni strokovnjaki so glede omenjenega dali vrsto dobrih smernic, taki so recimo »asilomarski principi«, opisani v tem prispevku. V knjigi: Woodrow Hartzog, »Privacy's Blueprint: The Battle to Control the Design of New Technologies« [7], so eksplicitna opozorila, da je preveliko oblast praktično nemogoče nadzorovati in usmerjati. Da je vsaka aplikacija v bistvu tako ali drugače povezana z etiko in vplivom na ljudi. Hartzog pravi: "every aspect of the design of Facebook is bent towards its mission to get you to never stop sharing and to feel good about it in the process". Posledično namenoma oz. posredno nezavedno silijo uporabnike v odvisnost od sistema do nezdravih razmer.

Ena od rešitev je učenje etike [8] med rednim študijem, kot to predlaga ACM [9]. Za umetno inteligenco pa so posebej relevantni t.i. asilomarski principi.

4. ASILOMARSKI AI PRINCIPI

Umetna inteligenca je že proizvedla koristna orodja, ki jih vsak dan uporabljajo ljudje po vsem svetu. AI vsak dan naredi 300 trilijonov odločitev. Nadaljnji razvoj AI, primerno etično voden, bo ponujal neverjetne priložnosti za pomoč in krepitev položaja ljudi v desetletjih in stoletjih, ki so pred nami. Ker je AI med najbolj udarnimi tehnološkimi področji, so se tu postavila prva vprašanja, kako usmeriti raziskave in razvoj AI v pravo smer.

Januarja 2017 je bila konferenca BAI 2017, kjer so strokovnjaki umetne inteligence definirali 23 asilomarskih principov o etični uporabi umetne inteligence (AI). Mnenje skupnosti je bilo precej skladno tedaj in je sedaj (op. prevod je prirejen): "Prihaja do velikih sprememb v neznanih časovnih okvirih, vendar v vseh delih družbe, zato imajo odločujoči veliko odgovornost in priložnost, da ga oblikujejo v dobro ljudi in civilizacije."

Prva naloga organizatorjev je bila sestaviti seznam skupnih mnenj o tem, kaj mora družba storiti, da bi v AI v desetletjih najbolje koristila ljudem. S tega seznama so organizatorji, kolikor so lahko, zbrali mnenja v temeljni sklop principov z veliko stopnjo soglasja. Osnova je bila skupno dogovarjanje in ne preglasovanje. O podrobnih besedilih so nato sodelovale manjše skupine, jih natančno opredelile in komentirale. Ta postopek je ustvaril izboljšane različice osnovnih principov. Na koncu so pregledali celoten nabor principov, da so določili raven podpore za vsako različico in končno izbrali najbolj sprejemljive verzije.

Po končanem postopku se obdržali le principe z visokim soglasjem – pogoj je bil, da se je strinjalo vsaj 90% udeležencev. 23 principov je bilo razvrščenih v raziskovalne strategije, pravice do podatkov in prihodnje zadeve, vključno s potencialno superinteligenco, ki so jo podpisali tisti, ki želijo svoje ime povezati s seznamom. Smoter načel je, da bodo podala nekaj smernic, kako lahko moč AI uporabimo za izboljšanje življenja vsakogar v naslednjih letih.

Na spletnih straneh Future of Life Institute [10] lahko dobite izvirno besedilo.

4.1 Raziskovalna vprašanja

1) Cilj raziskovanja: Cilj raziskav AI bi moral biti ustvarjanje ne kakršne koli inteligence, ampak koristne inteligence.

2) Financiranje raziskav: Naložbe v AI bi morale spremljati financiranje raziskav o zagotavljanju koristne uporabe, vključno z etičnimi vprašanji iz računalništva, ekonomije, prava in socialnih študij, kot so:

• Kako lahko naredimo prihodnje AI sisteme robustne, da bodo delali, kar hočemo, ne da bi pri tem delali nepravilno ali se zlomili?

• Kako lahko z avtomatizacijo izboljšujemo svojo blaginjo, hkrati pa ohranjamo človekove vire in namen?

• Kako lahko posodobimo naše pravne sisteme, da bi bili bolj pravični in učinkoviti, da bi bili v koraku z AI in obvladovali tveganja, povezana z AI?

• S katerimi vrednotami naj se AI uskladi in s kakšnim pravnim in etičnim statusom?

3) Povezava med znanostjo in politiko: obstajati mora konstruktivna in zdrava izmenjava med raziskovalci AI in oblikovalci politike.

4) Raziskovalna kultura: Med raziskovalci in razvijalci AI je treba spodbujati kulturo sodelovanja, zaupanja in preglednosti.

5) Izogibanje tekmovanja za vsako ceno: Skupine, ki razvijajo sisteme AI, bi morale aktivno sodelovati, ne pa v dirki za prevlado kršiti varnostne standarde.

4.2 Etika in vrednote

6) Varnost: AI sistemi morajo biti varni in zaščiteni v celotni življenjski dobi in preverljivi, kadar je to primerno in izvedljivo.

7) Preglednost neuspeha: Če sistem AI povzroči škodo, bi bilo treba ugotoviti, zakaj.

8) Preglednost - pravna: Vsaka udeležba avtonomnega sistema pri odločanju sodišča mora zagotoviti zadovoljivo razlago, ki jo mora pregledati pristojni človeški organ.

9) Odgovornost: Oblikovalci in snovalci naprednih sistemov AI morajo biti odgovorni za moralne posledice njihove uporabe, zlorabe in dejanj, z odgovornostjo in priložnostjo za oblikovanje teh posledic.

10) Prireditev vrednosti: Visoko avtonomni sistemi AI morajo biti zasnovani tako, da se lahko njihovi cilji in vedenja uskladijo s človeškimi vrednotami med njihovim delovanjem.

11) Človeške vrednote: AI bi morali biti zasnovani in upravljani tako, da so združljivi z ideali človekovega dostojanstva, pravic, svoboščin in kulturne raznolikosti.

12) Osebna zasebnost: Ljudje bi morali imeti pravico do dostopa do podatkov, ki jih ustvarijo in nadzirajo AI sistemi, da lahko te podatke analizirajo in uporabljajo.

13) Svoboda in zasebnost: Uporaba AI na osebnih podatkih ne sme neupravičeno omejevati resnične ali zaznane svobode ljudi.

14) Skupne koristi: AI tehnologije bi morale koristiti in opolnomočiti čim več ljudi.

15) Skupna blaginja: Gospodarsko blaginjo, ki jo ustvari AI, je treba širše deliti, da bi koristili celotnemu človeštvu.

16) Človeški nadzor: Ljudje bi morali izbrati, kako in ali bodo delegirali odločitve na sisteme AI, da bi dosegli cilje, ki jih je izbral človek.

17) Ne-subverzija: Moč, ki jo podeljuje nadzor nad zelo naprednimi sistemi AI, bi morala spoštovati in izboljšati družbene in državljanske procese, od katerih je odvisno zdravje družbe.

18) Avtonomna orožja AI: Izogibati se je treba tekmi orožja s smrtonosnim avtonomnim orožjem.

4.3 Dolgoročne dileme

19) Previdnost glede zmogljivosti: Če ni soglasja, bi se morali izogibati trdnim predpostavkam o zgornjih mejah prihodnjih zmogljivosti AI.

20) Pomembnost: Napredni AI sistemi bi lahko pomenili preveliko spremembo v zgodovini življenja na Zemlji, zato bi jih bilo treba načrtovati in z njimi sorazmerno upravljati.

21) Tveganja: Tveganja, ki jih predstavljajo sistemi AI, zlasti katastrofalna ali eksistenčna tveganja, morajo biti predmet načrtovanja in ukrepov za ublažitev, sorazmernih s pričakovanim učinkom.

22) Rekurzivna samopopolnitev: Za sisteme AI, ki so zasnovani za rekurzivno samopopolnjevanje ali samo ponovitev na način, ki bi lahko privedli do hitrega povečanja kakovosti ali količine, morajo veljati strogi varnostni in nadzorni ukrepi.

23) Skupno dobro: Superinteligenco je treba razvijati samo v službi široko razširjenih etičnih idealov in v korist celotnega človeštva, ne pa ene države ali organizacije.

5. DISKUSIJA

V današnjih časih, ko postaja očitno, da so ljudje čedalje bolj zasvojeni in izgubljeni, konfliktni in z opranimi možgani, je potrebno uveljaviti varstvo uporabnikov predvsem s strani IT gigantov in medijev. Pri tem imamo na voljo dobre usmeritve, kot so npr. asilomarski principi.

Pomembno je, da stroka in neodvisni intelektualci opozarjajo na sedanje problematično stanje, ki počasi ogroža celo razvoj zahodne civilizacije. Prav tako je pomembno, da politika sliši glas stroke.

Druga pomembna rešitev je ureditev IT gigantov, kjer ima Evropa škarje in platno v svojih rokah glede varstva podatkov ali zasebnosti, pa vendar se zdi, da ji ne uspeva zaščititi uporabnike. Poglejmo samo izogibanje davkov. Verjetno je precej bolj možna regulacija v ZDA, recimo razbitje podjetij zaradi preveč monopolnega položaja. Seveda pa je take rešitve potrebno previdno uvesti, da ne bomo škodili razvoju najbolj tehnološko naprednih podjetij na svetu, ki so med najbolj zaslužnimi za razvoj človeške civilizacije.

6. ZAHVALA

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Etična uporaba podatkov družbenih medijev
Ethical Social Media Data Use

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POVZETEK
Podatki družbenih medijev so zanimivi za raziskovanje na različnih področjih. S tem pa so povezane možnosti zlorab in različne dileme, tako glede varovanja zasebnosti, percepcije javnosti informacij, ter možnosti objavljanja in deljenja podatkov za druge. Priporočila projekta SERISS ponujajo pregled tovrstnih vprašanj in razmisleke o načinih reševanja.

Ključne besede
Podatki, etika, družbeni mediji, deljenje podatkov, privolitev.

ABSTRACT
Social media data are gaining attention in various fields of research. The dilemmas about privacy protection, public or private perception of information and options for data sharing and publishing are among the threats. Guidelines from SERISS project gives an overview of questions and offers some considerations about how to find solutions to the dilemmas.

Keywords
Data, ethics, social media, data sharing, consent.

1. UVOD
Podatki družbenih medijev so zelo zanimivi za raziskovanje in lahko nadomeščalo ali pa dopolnjujejo druge vire. Nastajajo sproti in tako vsebujejo neprimerljivo podrobno časovno in zaradi velikih količin tudi prostorsko granularnost, iz njih se da izluščiti tako psihološke osebnostne lastnosti kot politične in druge preference, pa tudi neposredno opazovati obnašanje in navade posameznikov ter skupin [1]. S podatki so povezane tudi različne omejitve, kot so vprašanja samoselekcije in nepokritosti populacije, pristranega prikazovanja sebe, tehničnih omejitev pridobivanja in nestrukturiranosti informacij, zaradi česar je težko oceniti kakovost podatkov [2, 3].

Posebnost podatkov družbenih medijev (DM) je, da so to vsebine, ki jih uporabnik DM dajejo sami na lastno pobudo in neodvisno od morebitne naknadne raziskovalne rabe. Raziskovalec te vrste 'organske' podatke, če gre za velike količine, 'najde' in ne 'generira' oz. ustvarja s pomočjo interakcije z opazovanim subjektom kot na primer v anketah [4]. Zaradi tega se za nazaj v kontekstu raziskovalne rabe 'najdenih' podatkov odprejo pravne in etične dileme glede tega, ali smemo te podatke uporabljati in s kakšnimi omejitvami [5].

Pri tem z rabo podatkov razumemo zbiranje, analizo, spravilo, objavljanje rezultatov in spravilo podatkov ter njihovo deljenje za drugo rabo, se pravi celotni življenjski krog podatkov [6]. Primeri spornih rab podatkov družbenih medijev kažejo, kako aktualna je ta tema in kako potrebno je jasno postaviti meje dovoljenega. Ogorčenja je bil deležen Facebookov projekt manipulacije z vsebinami za proučevanje privzemanja čustev brez presoje projekta s strani etične komisije [7] in nazadnje razvpiti primer analize miljonov podatkov Facebookovih uporabnikov brez obvestila in privolitve za sodelovanje s strani Cambridg Analytica za ciljano prikrito oglaševanje.

2. PRIPOROČILA PROJEKTA SERISS
Znotraj EU H2020 projekta št. 654221 Synergies for Europe's Research Infrastructures in the Social Sciences (SERISS) je bil delovni sklop 6 posvečen novim oblikam podatkov in z njimi povzanimi pravnimi, etičnimi in problemi kakovosti.

Rezultati dela na nalogi 6.1 glede pravnih in etičnih izzivov podatkov DM so poročilo [8], vodič [9] in hitra priporočila [10]. Pri tej nalogi sta kot partnerja projekta sodelovala ESS (European Social Survey) in CESSDA (Consortium of European Social Science Data Archives), kot s slednjo povezana enota pa tudi slovenski ADP (Arhiv družboslovnih podatkov) pri Univerzi v Ljubljani in drugi (NSD – Norwegian Centre for Research Data, UK Data Service in ČSDA – Czech Social Science Data Archive).

V prispevku bomo predstavili nekaj izvlečkov na obravnavano tematiko vezanih priporočil in zaključkov projekta SERISS s povabilom, da se slovenska javnost z njimi podrobneje seznani.

3. ETIČNE DILEME UPORABE PODATKOV DRUŽBENIH MEDIJEV
3.1 Privolitev
Seznanjena privolitev je osnovni način, da smemo zbirati osebne podatke. Z nastopom Splošne uredbe o varstvu osebnih podatkov (GDPR) je izpolnjevanje zahtev glede privolitve še strožje določeno kot je bilo do sedaj, saj naj bi bila pridobljena brez pogojevanja z ustreznimi informacijami, podrobna in dokazljiva.

Pri podatkih DM je najprej vprašanje, ali so to sploh osebni podatki. Če gre za javne profile institucij ali organizacij, seveda niso. Tudi objave javnih oseb, kadar nastopajo v svoji javni vlogi, so izvzete iz obveznosti varovanja osebnih podatkov. Drugače pa so podatki, tudi če ne vsebujejo imen ali naslovov, skoraj vedno osebni, saj objavljene slike, psevdonimi ipd. še vedno posredno skozi povezane informacije lahko vodijo do prepoznavnega posameznika. V tem primeru je torej privolitev obvezna. Iz tega sledi tudi, da je podatke SM težko anonimizirati. In nadalje, kadar povezujemo podatke SM s podatki istega posameznika iz anket, se upoštevaje možnost prepoznavanja prvih tudi slednji šteti kot osebni podatki, četudi 'pseudoanonimizirani' [11]. Se pravi, da so oboji podvrženi tako jasno izraženi določni privolitvi, kot posebnemu režimu varovanja pred možnostjo zlorabe.

Izjeme, predvidene v GDPR in implementirane v slovenski osnutek Zakona o varstvu osebnih podatkov, so kadar je zaradi velikih količin podatkov ali podobnih razlogov pridobivanje privolitve praktično neizvedljivo. V teh primerih so še vedno potrebni ukrepi, ki npr. med drugim vključujejo etično presojo s strani pooblaščenih organov kot so etične komisije [510] pomena raziskovalnih ciljev projekta, posebnosti in občutljivosti vsebin (politična in druga prepričanja, spolnost, zdravstveno stanje ipd.) in tveganj glede udeležene populacije (manjšine, bolniki, otroci) [10].

Ločujemo tudi pravne in etične vidike privolitve. Tudi če je osnova za uporabo podatkov druga kot pa privolitev pravnega značaja, je npr. če podatki niso občutljivi, niti ne gre za izpostavljeno populacijo, primerna oblika t.i. izločitvena ('opt-out)' privolitev etične narave, ko posameznike kontaktiramo z obvestilom o zbiranju podatkov in podatke nato uporabljamo v kolikor nismo dobili odklonitve, kar sicer po GDPR ne bi bilo sprejemljivo [12].

3.2 Javna ali zasebna informacija

Poenostavljeno si včasih predstavljamo, da so objave na DM že tako ali tako javne, in jih lahko uporabljamo brez vsakih omejitev [13]. Naravo zasebnosti objav moramo presojati glede na okoliščine, npr. če gre za zaprte forume ali skupine, ali pa občutljivo vsebino [10]. Večina uporabnikov ne pričakuje, da bi lahko njihove objave uporabljali za različne druge analitične namene, pri tem pa so tudi razlike glede uporabe za javne raziskovalne ali pa privatne tržne ipd. namene [14].

3.3 Deljenje podatkov

Priprava podatkov za raziskovalni projekt ali pa kot tematsko zbirko zahteva določena znanja, čas in sredstva [15]. Enkrat pripravljeni podatki bi bili lahko zanimivi še za koga. Omogočanje dostopa do podatkov in programov za njihovo obdelavo je tudi etična obveznost raziskovalcev, ki na ta način dokazujejo integriteto na podatkih temelječih objav v člankih. Pri tem pa je vprašanje tudi, kje in na kakšen način deliti podatke, po možnosti pri usposobljenih podatkovnih centrih [16].

Poleg izzivov varovanja zasebnosti in vprašanja privolitve za arhiviranje in deljenje podatkov je najbolj aktualno vprašanje, kakšni so pogoji in kaj dovolijo zasebna SM podjetja, ki posedujejo podatke. Rešitev, ki se je poslužujejo npr. v primeru zagotavljanja izpolnjevanja omejitev podjetja Twitter, je deljenje ID-jev posameznih objav skupaj s kodo, ki omogoča ponovno generiranje vsebine [17]. Rešitev ima med drugim to pomanjkljivost, da uporabniki DM posamezne objave umaknejo in tako ni mogoče pridobiti podatkovnega seta istovetnega prvotnemu. Obenem pa je seveda na ta način zagotovljeno spoštovanje volje posameznika pri umiku vsebine.

4. ZAKLJUČEK

Vidimo, da so pravne omejitve npr. glede intelektualne lastnine in etična načela raziskovanja lahko v nasprotju. Raziskovalci podatkov družbenih medijev so iz različnih področij, tako tehničnih kot iz družboslovja, humanistike, medicine idr. Z različno usposobljenostjo in priučeno občutljivostjo za etičnost raziskovanja. Zato je toliko pomembneje vzbuditi pozornost do nekaterih dilem in problemov etične rabe tovrstnih podatkov.

Člane etičnih komisij bi bilo potrebno usposobiti za presojo etičnih dilem pri novih vrstah podatkov. Raziskovalci in uporabniki podatkov pa bi morali z lastno presojo in v primeru dilem, z aktivnim posvetovanjem pri pristojnih organih, razreševati dileme na način, da bi zbujali zaupanje javnosti.

5. ZAHVALE

Zahvaljujemo se sodelavcem pri projektu SERISS za prispevke pri posameznih vsebinah, ki smo jih izkoriščali pri pisanju in Evropski komisiji za podporo projektu.

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Etični kodeks strokovnjakov računalništva in informatike
Code of Ethics for IT Professionals

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POVZETEK

Dejanja strokovnjakov za računalništvo in informatiko spreminjajo svet. Da bi ravnali odgovorno, bi morali razmišljati o širših vplivih svojega dela in dosledno podpirati javno dobro. Kodeksi etike in poklicnega ravnanja naj izražajo vest stroke. V tem prispevku bomo obravnavali razvoj kodeksov skozi čas in njihove glavne značilnosti. Hiter razvoj novih tehnologij in njihov prodor v vsa področja človekovega delovanja in infrastrukturne sisteme kot so napr. zdravstvo, promet, energija, itd. zahteva posebno pozornost strokovnjakov, njihovih združenj in vedno bolj tudi uporabnikov teh sistemov.

ABSTRACT

The actions of computer and information science professionals are changing the world. In order to act responsibly, we should think about the broader impacts of our work and consistently support the public good. Codes of ethics and professional conduct should express the conscience of the profession. In this article we will discuss the evolution of codes over time and their main features. Rapid development of new technologies and their penetration into all areas of human activity and infrastructure systems such as healthcare, transport, energy, etc. requires the special attention of professionals, their associations and, increasingly, users of these systems.

1. UVOD

Po drugi svetovni vojni je Norbert Wiener (Wiener 1948) napisal knjigo z naslovom Kibernetika, v kateri je opisal novo vejo uporabne znanosti in opredelil tudi nekatere družbene in etične posledice uporabe računalnikov. Vprašanja, ki jih je opredelil v tej in še dveh naslednjih dveh knjigah so vključevala teme, ki so danes še kako pomembne: računalniki in varnost, računalniki in brezposelnost, odgovornost računalniških strokovnjakov, računalniki za invalide, informacijska omrežja in globalizacija, navidezne skupnosti, delo na daljavo, človeških telesa in stroji, etika robotov, umetna inteligenca, računalniki in religija ter številne druge teme. (Bynum 2000).

Leta 1976, skoraj tri desetletja po izdaji Wienerjeve knjige o kibernetiki, je Walter Maner opazil, da se etična vprašanja in težave, obravnavane v njegovem tečaju Medicinska etika na univerzi Old Dominion, pogosto zapletejo ali bistveno spremenijo, ko vključijo računalnike. Včasih je dodajanje računalnikov, kot se zdi Manerju, dejansko ustvarilo povsem nove težave z etiko, ki ne bi obstajale, če računalnikov ne bi izumili. Zaključil je, da mora obstajati nova veja uporabne etike, podobna že obstoječim področjem, kot sta medicinska etika in poslovna etika. Potem ko je preučil ime "informacijska etika", se je odločil, da bo predlagal novo področje in ga poimenoval "računalniška etika". (V tistem času Maner ni vedel za dela Norberta Wienerja o računalniški etiki). Razvil je eksperimentalni tečaj računalniške etike, namenjen predvsem študentom univerzitetnih programov računalništva. Leta

1978 je napisal "Starter Kit" o poučevanju računalniške etike, ki ga je pripravil za udeležence delavnic, ki jih je vodil, in govorov, ki jih je imel na različnih znanstvenih konferencah v ZDA. Bil je tudi polaga za učne načrte na univerzah. Rezultat tega je, da so se številni znanstveniki, zlasti filozofi in računalničarji, seznanili z računalniško etiko. (Bynum 2000)

2. ETIČNI KODEKSI STROKOVNJAKOV RAČUNALNIŠTVA IN INFORMATIKE

V devetdesetih letih so različna mednarodna in nacionalna strokovna združenja kot so napr. ACM (Association for Computing Machinery) in IEEE (Institute of Electrical and Electronics Engineers)sprejela etične kodekse oziroma načela strokovnega ravnanja računalničarjev. ACM-ov etični kodeks je bil sprejet 1992 in v letu 2018 (ACM 2018) dopolnjen z novimi poudarki zaradi tehnoloških sprememb in njihovega prevladujočega vpliva na ljudi, organizacije in družbo.

Slovensko društvo informatika je prvi kodeks, ki je bil narejen na podlagi ACM-ovega, sprejelo leta 1998 in ga dopolnilo v letu 2010 (SDI 2010).

IFIP (International Federation for Information Processing) je ob koncu devetdesetih analiziral kodeks tridesetih organizacij, svojih članic in prišel do splošne ugotovitve da glede na svojo mednarodno in globalno delovanje ne more sprejeti univerzalnega kodeksa, veljavnega za vse članice. Je pa v analizi predstavil nekatere skupne značilnosti tridesetih analiziranih kodeksov (IFIP 1996):

- Spoštovanje

  To vključuje spoštovanje interesov ali pravic vpletenih, spoštovanje prestiža poklica, spoštovanje interesov ali pravic javnosti ter spoštovanje blaginje in zdravja javnosti ter kakovosti življenja.

- Osebnostne (ali institucionalne) lastnosti

  Sem spadajo vestnost, poštenost, pozitiven odnos, usposobljenost in učinkovitost. V praksi se izraza "vestnost" in "poštenost" pogosto srečujeta pod izrazoma "sprejemanje odgovornosti" in "integriteta. Druge teme, ki se nanašajo na "vestnost" in "poštenost", so: "strokovnost", "zasluge za delo drugih", "dobra vera ali dobra volja", "skrb za doseganje splošnih ciljev" in podobno. Glede "usposobljenosti" in "učinkovitosti" sta pogosta še dva pojma: "poklicni razvoj in usposabljanje" ali "samoomejitev glede na lastne kompetence

- Zasebnost informacij in celovitost podatkov

  "Zaupnost" zahtevajo skoraj vsi splošni kodeksi združenj IFIP. "Zasebnost" in "spoštovanje intelektualne lastnine" se pogosto pojavljata. Druge teme, kot so" računalniški kriminal", " piratstvo ali zloraba informacij", "integriteta podatkov" , so manj pogoste.

- Obdelava in dostop do informacij

  Večina kodeksov zahteva dostop do informacij vpletenih strank ali ljudi in "obveščanje javnosti". Polovica jih zahteva "celovite informacije." Pri tem velja, da lahko "zasebnost informacij" in "prosti pretok informacij" postaneta nasprotujoča . Oba koncepta je treba uravnotežiti.

- Odnos do regulative

  "Regulativa" se v kodeksih ne pojavlja kot glavna tema. Manj od polovice kodeksov zahteva "spoštovanje kodeksa", "spoštovanje zakonov" in "spoštovanje IT in poklicnih standardov."

Še nekatera pomembna etična vprašanja pri uporabi informacijske tehnologije:

- Nepooblaščeni nosilci obdelave in hrambe informacij
- Vprašanje lastništva programske opreme
- Preučitev videnja računalnikov kot razmišljajočih strojev in absolutnih ter nezmotljivih ustvarjalcev resnic
- računalniški kriminal in varnost sistemov

- piratstvo ter pravice intelektualne lastnine
- hekanje in virusi
- pomanjkanje zanesljivosti informacijskih sistemov in težave s kakovostjo
- shranjevanje podatkov in zasebnost
- umetna inteligenca in ekspertni sistemi
- informatizacija delovnega mesta.
- Itd.

2.1 ACM etični kodeks

Za razumevanje vloge in evolucije etičnih kodeksov je zgovoren primer omenjenega prenovljenega etičnega kodeksa ACM. V preambuli kodeksa je napisano:

Kodeks je zasnovan tako, da navdihuje in vodi etično ravnanje vseh računalniških strokovnjakov, vključno s sedanjimi in novimi ambicioznimi izvajalci, inštruktorji, študenti, vplivneži in vsemi, ki računalniško tehnologijo uporabljajo. Poleg tega Kodeks služi kot osnova za sanacijske ukrepe v primeru kršitev. Kodeks vključuje načela, oblikovana kot izjave o odgovornosti, ki temeljijo na razumevanju, da je javnemu dobru potrebno posvetiti glavno pozornost. Vsako načelo je dopolnjeno s smernicami, ki ponujajo razlago za pomoč računalniškim strokovnjakom pri njegovem razumevanju in uporabi. Struktura kodeksa:

1. SPLOŠNA ETIČNA NAČELA

1.1 Prispevajte k družbi in blaginji ljudi, ob priznanju, da so vsi ljudje udeleženi pri uporabi računalnikov.

2 Ne škodujte.

1.3 Bodite pošteni in vredni zaupanja.

1.4 Bodite pošteni in ukrepajte proti diskriminaciji.

1.5 Spoštujte delo, potrebno za ustvarjanje novih idej, izumov in ustvarjalnih del in računalniških sistemov.

1.6 Spoštujte zasebnost.

1.7 Spoštujte zaupnost.

2. STROKOVNE ODGOVORNOSTI.

2.1 Prizadevajte si doseči visoko kakovost tako v procesih kot tudi pri izdelkih strokovnega dela.

2.2 Vzdržujte visoke standarde strokovne usposobljenosti, ravnanja in etične prakse.

2.3 Poznati in spoštovati obstoječa pravila v zvezi s poklicnim delom.

2.4 Sprejmite in zagotovite ustrezen strokovni pregled.

2.5 Podajte celovite in temeljite ocene računalniških sistemov in njihovih vplivov, vključno z analizo možnih tveganj.

2.6 Delo opravljajte samo na področjih, ki so v vaši pristojnosti.

2.7 Spodbujajte ozaveščenost javnosti in razumevanje računalništva, povezanih tehnologij in njihovih posledic.

2.8 Do računalniških in komunikacijskih virov dostopajte le, če se to to ujema z javnim dobrim.

2.9 Oblikujte in izvedite sisteme, ki so zanesljivi in uporabni.

3. NAČELA STROKOVNEGA VODENJA.

3.1 Zagotovite, da je javno dobro v vseh strokovnih dejavnostih glavna skrb.

3.2 Izrazite in spodbujajte, sprejemanje in ocenjevanje izpolnjevanja družbenih odgovornosti članov organizacije ali skupine.

3.3 Upravljajte osebje in vire za izboljšanje kakovosti dela.

3.4 Izpostavljajte, uporabljajte in podpirajte takšne politike in procese, ki odražajo načela kodeksa.

3.5 Ustvarjajte priložnosti, za strokovno rast organizacije.

3.6 Bodite previdni pri spreminjanju ali zamenjavi sistemov.

3.7 Prepoznajte in posvetite posebno skrb sistemom, ki se integrirajo v družbeno infrastrukturo .

4. IZPOLNJEVANJE KODEKSA.

4.1 Podpirajte in spodbujajte spoštovanje načel kodeksa.

2.2 Analiza sprememb ACM kodeksa

Posodobitve so najbolj vidne v treh dopolnitvah: pomen novih nastajajočih sistemov, diskriminacija in zasebnost podatkov (techrepublic 2018):

- Na prvem mestu so novi nastajajoči sistemi kot posledica penetracije računalniške tehnologije na vsa področja delovanja družbe. V oddelku 3.7 Kodeksa članice ACM poziva, naj posvetijo posebno skrb sistemom, ki se vključijo v družbeno infrastrukturo. Ko nove tehnologije prodirajo na področja prometa, zdravstva, energetike itd, bi morali ustvarjalci teh sistemov delovati tako, da zagotovijo pravičen dostop do sistemov in raven integracije upoštevaje potrebe javnosti.
- Vprašanje diskriminacije je posebej obravnavano. Posebej je izpostavljena odgovornost strokovnjakov, da tehnološke sisteme naredijo čim bolj vključujoče in dostopne vsem ljudem. Diskriminacija na podlagi starosti, barve kože, invalidnosti, narodnosti, družinskega statusa, spolne identitete, članstva v sindikatu, vojaškega statusa, državljanstva, rase, vere ali prepričanja, spola, spolne usmerjenosti ali katerega koli drugega neprimernega dejavnika predstavlja izrecno kršitev kodeksa, Nadlegovanje, vključno s spolnim nadlegovanjem, nasiljem in drugimi zlorabami oblasti in avtoritete, je oblika diskriminacije, ki med drugim omejuje dostop do virtualnih in fizičnih prostorov, kjer se to dogaja.
- Končno kodeks, v razdelku 1.6., obravnava pojem zasebnosti in varstva podatkov. Tehnologija omogoča zbiranje množice podatkov. Strokovnjaki bi morali biti dobro seznanjeni z vsemi problemi v zvezi z varstvom zasebnosti. Strokovnjaki za računalništvo bi morali osebne podatke uporabljati samo za zakonite namene in brez kršenja pravic posameznikov in skupin. V kodeksu je zapisano, da je treba v sistemih hraniti le najmanjšo še potrebno količino podatkov in da morajo članice ACM delovati, tako da omogočijo preglednost svojih podatkovnih praks.

3. ZAKLJUČNA BESEDA

Ob analizi etičnih kodeksov v tem prispevku, lahko občudujemo dalekovidnost Norberta Wienerja, ki je že koncem 40 let prejšnjega stoletja predvidel vpliv rabe računalnikov na ljudi in družbo in celo taksativno naštel področja, ki so z vidika etike aktualna še danes. Lahko pričakujemo spremembe kodeksov tudi v bodoče. Nove tehnologije, v zadnjem času najbolj poudarjane umetne inteligence, prav tako množični podatki, množična robotizacija, družbena omrežja, internet stvari, itd,. ob neetični rabi lahko predstavljajo realno grožnjo globalnih razsežnosti. Seveda kodeksi ne bodo dovolj. Potrebna bo tudi ustrezna regulativa, ki je veliko močnejše orožje v boju proti problemom, ki se bodo pojavljali v bodoče, ki pa vedno zamuja.

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Ethics First!
Ethics guidelines for trustworthy AI

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ABSTRACT

In the article we recapitulate the content of Ethic Guidelines for Thrustworthy AI, the AI HLEG (2019) prepared for the European Commission offered for discussion last spring. In the Commentary we give a selection of views on the role of AI, on ethical dimensions of ICT and especially on the importance of AI ethics. We present critical responds on the document, particularly those from the Special interest group for computer ethics of the IFIP. In the conclusion we claim that the actual anecdotical approach toward the evidence of ethical problems and the offered "check-list" for problem solving needs to be complemented with urgent changes in the common ethics, since it hasn't been able to come up forward with the ethics of ICT / AI. For that reason intellectual strenghts of technic and humanistic need to be joined, which has been missed. We suggest trying at home by connecting the Slovenian philosophical society and the Slovenian society Informatika.

/V prispevku smo povzeli vsebino Ethics Guidelines for Trustworthy AI, ki jih je letošnjo pomlad ponudila v razpravo Evropska Komisija oz. v njenem imenu AI HLEG (2019). V Komentarju smo navedli izbor pogledov na vlogo UI, na etične razsežnosti IKT in še posebej na utemeljenost etike UI. Predstavili smo kritične odzive na document, posebej iz posebneinteresne skupine za računalniško etiko IFIP. V Sklepu smo ugotovili, da je treba sedanji anekdotični pristop beleženja etičnih problemov in ponujanje 'ček-liste'rešitev poglobiti s presojo nujnosti sprememb v obči etiki, ki ne dohaja vplivov IKT oz. UI. Za to pa je potrebno združiti intelektualne moči tehnike in humanistike, kar je doslej manjkalo. Lahko bi poizkusili doma, če bi se povezali Slovensko filozofsko društvo in Slovensko društvi 'Informatika'./

Keywords

Ethics Guidelines for Trustworthy AI, computor/information ethics, AI ethics.

1. UVOD

Predlog dokumenta je na osnovi številnih predhodnih posvetov z okoli 500 aktivnimi udeleženci pripravila 50-članska High Level Expert Group on Artificial Intelligence (AI HLEG) in ga objavila 8. aprila 2019, z načrtom, da ga bo Evropska Komisija obravnavala in sprejela v prvi polovici leta 2020. Skupina se je oprla na rezultate dela European Group on Ethics in Science and New Technologies (EGE), ki je stalna svetovalna skupina Evropske Komisije. Izhodišče je, da se kritična izguba zaupanja v letalstvo, nuklearno tehnologijo ali varno hrano tiče tudi umetne inteligence in pri tem ne gre zgolj za kakovost tehnologij, ampak za domišljenost kompleksnejših socio-tehničnih sistemov. Zato morajo o tem razmišljati in ukrepati podjetja, organizacije, raziskovalci, javne službe, vladne agencije, institucije, civilna družba, posamezniki, delavci, potrošniki in drugi.

2. POVZETEK "ETIČNIH SMERNIC ZA ZAUPANJA VREDNO UMETNO INTELIGENCO" V EVROPI

Cilj Smernic je promoviranje zaupanja vredne umetne inteligence (ZVUI), ki zajema tri glavne sestavine: (1) biti mora zakonita, t.j. skladna z veljavno zakonodajo in pravili; (2) biti mora etična – privržena etičnim načelom i vrednotam; (3) biti mora zanesljiva, tako v tehničnem kot v socialnem smislu, da ne bi – čeprav z dobrimi nameni – povzročala poškodb. Vsaka od teh sestavin je nepogrešljiva sama zase, vendar nezadostna za doseganje ZVUI. Potrebno je, da so prisotne vse tri v medsebojni harmoničnosti ter se prekrivajo s svojim delovanjem. Če se pojavijo med njimi razhajanja, si mora skupnost prizadevati za njihovo čim večjo usklajenost.

2.1 Etična načela

1. Razvijajte, upravljajte in uporabljajte sisteme umetne inteligence (SUI) na način, ki je skladen z etičnimi načeli spoštovanja človekove avtonomnosti, varovanja pred poškodbami, poštenosti in nedvoumnosti. prepoznavajte in naslavljajte obstoječa in potencialna razhajanja med temi načeli.
2. Bodite posebej pozorni pri vključevanju ranljivejših skupin kot so otroci, osebe s primanjkljaji in težavami ter drugih, ki so zgodovinsko prikrajšani ali so na robu vključenosti, ali pa živijo razmerah, za katere je značilna asimetrija moči ali informiranosti, npr. odnosi med delodajalci in delojemalci, med trgovci in potrošniki ipd..
3. Upoštevajte, da ob velikih koristih za posameznike in družbo, SUI prinašajo tudi določena tveganja in lahko povzročajo negativne vplive, ki jih je težko predvideti, identificirati ali meriti – npr. za demokracijo, vladavino prava, pravično razdelitev blagostanja ali tudi za način človekovega razmišljanja. Sprejmite ustrezne ukrepe za ublažitev takih tveganj, če je to potrebno glede na razsežnost tveganja.

2.2 Priporočila

1. Zagotovite, da bodo razvoj, upravljanje in uporaba SUI skladni z naslednjimi priporočili za ZVUI: (1) človekovo obvladovanje in nadzor; (2) tehnična zanesljivost in varnost; (3) zasebnost in upravljanje podatkov; (4) transparentnost; (5) različnost,

nediskriminatornost in poštenost; (6) okoljsko in societalno blagostanje; (7) odgovornost.

2. Upoštevajte tehnične in ne-tehnične metode za zagotovitev in implementacijo navedenih priporočil.

3. Povečajte število raziskav ter inovacij, ki podpirajo dostopnost SUI in pospešujejo izpolnjevanje priporočil, spodbujajte odpiranje vprašanj v širšem družbenem okolju ter sistematično usposabljajte nove generacije strokovnjakov za etiko umetne inteligence.

4. Komunicirajte na jasen in proaktiven način z deležniki o zmožnostih in omejitvah SUI, nakazujte realistična pričakovanja ter načine implementacije; bodite transparentni glede dejstev, povezanih s SUI.

5. Podpirajte sledljivost in preglednost SUI, še posebej v kritičnih kontekstih in situacijah.

6. Vključujte deležnike skozi celoten življenjski ciklus SUI; krepite usposabljanje in izobraževanje, da se bodo vsi deležniki zavedli nujnosti ZVUI.

7. Bodite pozorni, da morebiti obstajajo temeljna razhajanja med različnimi načeli in priporočili, zato stalno ugotavljajte, vrednotite, dokumentirajte ter komunicirajte take primere in njihove rešitve.

2.3 Ocenjevanje

1. Sprejmite ocenjevalno listo za ZVUI v vseh primerih, ko razvijate, upravljate ali uporabljate SUI ter jo prilagodite specifičnim razmeram uporabe teh sistemov.

2. Upoštevajte, da takšna ocenjevalna lista ni nikoli dokončna, zato je treba zagotoviti kontinuirano identificiranje ter implementiranje priporočil, evalvacijskih postopkov in vključevanje njihovih rezultatov v življenjski ciklus umetne inteligence, ob obveznem vključevanju deležnikov v ta proces

3. KOMENTAR

3.1 UI za ljudi

Japonska vlada je napovedla "Japonsko družbo 5.0", ki bo maksimalno izrabila zmogljivosti IKT za uresničitev "super pametne" kiber-fizične družbe, osredotočene na človeka, kar bodo omogočili socialni roboti, pametni agenti in entitete UI (Gladen, 2019). Danska vlada se je zavezala, da bo državo pripeljala med prvakinje odgovornega razvoja in uporabe UI (Danish Government, 2019). Podobne strateške dokumente sprejemajo tudi druge države, ob tem pa nastajajo tudi civilnodružbenr organizacije, ker si javnost želi jasne slike o razsežnostih in vplivu UI. Tako poslanstvo ima npr. AI4People, ki hoče usmeriti to izjemno silo v dobrobit družbe, slehernika v njej in okolij, ki so nam vzajemna (Floridi in drugi, 2018). Z njeno pomočjo bomo lažje odkrili, kaj lahko postanemo, kaj lahko naredimo, kaj lahko dosežemo in kako lahko sodelujemo med seboj na celi zemljeski obli. Presenetljivo, večina razmišljanja o UI so dejansko razmišljanja o človeku! "UI nas mora opolnomočiti za globlji razmislek o tem, kdo smo in kaj pomeni biti človek" (Blanco-Perez in drugi, 2019). Sploh ni presenetljivo, da se v tej zvezi čuti pozvano tudi katoliška cerkev (Wichmann, 2019).

3.2 Ko gre za ljudi, gre za etiko

Vsa znanost se zaklinja na človeka, a je vse pogosteje v zadregi, ko mora opravičevati moralne zdrse: izmišljanje, prikrajanje, potvarjanje in izkrivljanje podatkov, plagiatorstvo in parazitstvo, zamolčani konflikti interesov, ipd.. (Klampfer, 2018). Ko gre za kibernetiko, jo je njen oče Norbert Wiener že pri njenem poimenovanju neločljivo povezal z etiko in še več: "Veliko pred Nagasakijem in javnimi svarili o atomski bombi, mi je bilo jasno, da imamo v rokah še drug potencial nezaslišanega pomena za dobro ali zlo" (Taddeo, Miller, 2016, 4). Bolj ali manj splošno je znano, da IKT posega v zdravljenje ljudi, v zasebnost, varnost, avtonomijo, identiteto, v zaupanje med ljudmi itd.. Zaradi nje se spreminjajo: narava družbe, kultura, nadzorovanje, odgovornost, legalnost, tveganja, enakost, lastnina, politična moč, ekologija, razmerje med spoloma in vsakodnevno zaznavamo nove in nove posledice (Stahl, 2011). Problem je, ker etične vidike večinoma zaznavamo posteriorno, nujno pa je proaktivno delovanje, česar pa nam stara deontologija v primeru novih tehnologij ne omogoča. Floridi in Sanders (2003) ugotavljata, da je egopoietica posameznikovih kreposti, nastala v Platonovi Republiki, nezadostna in da globalna omreženost zahteva sociopoietico oz. informacijsko etiko, ki pa jo zavira moralni eskapizem.

3.3 Etika UI

Alan Turing si je leta 1950 zastavil izrecno vprašanje, ali stroj lahko misli, in presodil, da nanj ni mogoče odgovoriti, ker ni jasno, kaj pomeni "misliti", niti kaj je "stroj". Lahko imitira človeka in na tem temelji t.i. Turingov test, ki je eno od izhodišč za etiko UI. Morda lahko na ta način pojasnimo tudi dogotrajno "zimo UI", ko se od 1960 do 2000 ni kaj dosti dogajalo, saj za to ni bilo potrebe, ker so že začetne rešitve zadoščale za računalniško imitacijo neštetih nezahtevnih opravil v družbi? Definicij UI je sicer mnogo, ker je tudi v tem primeru nejasno, kaj je "umetnost" in kaj je "inteligenca", se je pa mogoče zadovoljiti s kartko kompilacijo: "UI je raziskovalno področje, katerega cilj je kreiranje artifaktov kot so računalniški programi ali stroji. Smoter večine aplikacij je reševanje problemov s pomočjo algoritmov – to so imitacije ali nadgradnje človeške intelligence. Poleg tega pa je osredotočena še na učenje iz rešitev kompleksnih problemov ter nadgrajevanje funkcionalnosti obstoječih aplikacij" (Richter in drugi, 2019, 146)

UI od samih začetkov sproža resne skrbi glede svoje etičnoti (Marley in drugi, 2019):

- nepopolnost zapopadenja problema (algoritemsko sklepanje je verjetno, a ne izključuje napak);
- nenatančnost vpogledov (algotitemske sisteme je težko kontrolirati, pregledovati, popravljati in so za uporabnike black-box);
- zavajajoči vpogledi (sklepanja so točna v isti meri kot so točni vhodni podatki);
- nepošteni izvidi (sprožajo diskriminatorna ukrepanja, če se odredotočajo le na nekatere družbene skupine);
- transformativni učinki (splošno razširjeni algoritmi profiliranja ogrožajo avtonomijo osenosti in informacijsko zasebnost);
- sledljivost (škodo, ki jo povzročajo algoritmi je težko izslediti, zato je moralna odgovornost zamegljena – kdo odgovarja za nesreče avtonomnih vozil?).

Tudi v primeru UI se zdijo najpriročnejši etični kodeksi ravnanja, ki vsebujejo bolj ali manj konkretne odgovore na zgoraj navedene moralne skrbi. Kašnih 70 jih je na razpolago in med njimi so tudi tisti, ki jih ponuja industrija: Google, IBM, Mocrosoft, Intel; nadalje akademske institucije, strokovna zdrženja (IEEE, ACM..), vlade in končno tudi EU. Ob njih je vse bolj jasno, da vedeti kaj je etična UI, še ne pomeni tudi vedeti, kako narediti etično UI – prepad med načeli in prakso to stalno kaže.

3.4 Pripombe k Etičnim smernicam

Na Smernice EU se je takoj odzvala posebna interesna skupina za etiko, ki pri IFIP deluje že pol stoletja, od izida programskega dela Jacquesa Berleurja in Klausa Brunnsteina Etika računalništva (Berleur, Brunnstein, 1966). Skupno vodi Dona Goterbarn, ki si posebej prizadeva za interdisciplinarni pristop k računalniški etiki, njegov prvi komentar v korespndenci znotraj skupine (e-mail 20/4 2019) pa je bil: “Videti je, da so končno tudi drugi odkrili pomembnost računalniške etike, a na nesrečo je tudi videti, da bodo prezrli vse dosedanje delo in izumili “novo etiko” ter ponovili tudi vse napake iz preteklosti.” Prva napaka je v tem, da spet potrpežljivo nakladajo problem in ponujajo odgovore nanje, kar zožuje etiko na navadno “ček-listo”. Dejansko pa se moramo odločati med mnogimi alternativami in izbira mora biti odvisna od argumentiranih premislekov o vseh danostih in okoliščinah. “Ček-lista” absolutno ne zadošča. ampak je celo nevarna, ker ne nudi okvira za globljo etično analizo.

Julie Cameron, članica skupine, posebej opozarja na nedorečenost “poštenosti” v dokumentu, saj je neenakopravnost različnih skupin državljanov očitna in če se o UI oglašajo vlade, naj predvsem popravijo, kar je njihova napaka. Treba je vzpostaviti pritožbeni system, kamor se lahko prizadeti obrnejo zaradi zlorab UI, saj so v sedanjih sodnih mlinih brez upa zmage proti multinacionalkam. Spet se je treba vrniti na zočko opredelitve med “opt-in” in “opt-out”, ko gre za naše osebne podatke. Celo same vlade nas veselo silijo v uporabo internet, tudi ko so druge alternative razumnejše, kar kaže na njihovo podpiranje nepoštenih ravnanj z osebnimi podatki, vključno s problematičnim nadziranjem ljudi. Da naj bi na etične dileme odzivali z DA ali NE, je korak nazaj od že dosežene osveščenosti uporabnikov. In še to, EU bi se morala zavzeti za globalne rešitve in zastaviti soj angažman za opolnomočenje OZN na tem področju.

Luciano Floridi, ki ima eno ključnih vlog pri nastajanju Etičnih smernic, ne zanika odprtih vprašanj o tem, kaj naj bila etično dobra UI v Evropi. Najbolj potrebno se mu zdi razčiščevanje naslednjih moralnih klastrov: etična vprašanja digitalne trgovine, etični problem zavajanja ljudi, etični vidik lobiranja, etičnost dumpinga, etični problem izmikanja odgovornosti. Povsod je prisotna tudi UI in njeni ponudniki se ne morejo sklicevati na to, da so zgolj tehniki-programerji in se jih ne tiče nobena etična grdobija, ki jo (menda nehote) podpirajo.

4. SKLEP

Nenavadno je, da se EU najprej loteva etičnosti UI, preden se je opredelila do temeljne ravni etične problematike računalništva oz. informatike. Prevladuje pogled, da klasična etika ponuja povsem zadovoljive paradigme za sedanji proctor in čas, ki pa se je pod vplivom IKT močno spremenil. Če je že treba, naj se pač opredeli obrtniška etika za računalničarje, kakršno so v Aristotelovih časih imeli tesarji ipd.. Vendar to zagotovo ni perspektivna pot, ker UI vpliva v vse smeri in v globino. Anekdotični pristop naštevanja etičnih napak in sestavljanje “ček-liste” njihovih poprav je veliko premalo za odpravo nezaupanja, ki se širi glede uporabe UI. To bo resna ovira prihodnjemu razvoju in če se EU tega zaveda, naj gre pri iskanju prave rešitve do etičnih korenin. 70 obstoječih kodeksov za UI predstavlja nekonsistentno in konfuzno rastišče vseh mogočih prepričanja in navideznih rešitev, k čemur dodajamo še enega s strani pomembnega predlagatelja, od katerega bi pričakovali, da se bo znal poglobiti v temeljna vprašanja obče etike za današnji svet. Za tak korak je potrebno interdisciplinarno sodelovanje tehnike in humanistike, kar je dolej umanjkalo.

Zakaj ne bi česa takega poizkusili doma in za skupno mizo povabili Slovensko filozofsko društvo in Slovensko društvo Informatika?

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Etika naj postane del študija informatike
Ethics should Become Part of the Informatics Curriculum

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POVZETEK

Medicinska izobrazba tipično vključuje seznanjanje študentov z etiko in medicinskimi etičnimi dilemami. Tehniška izobrazba tipično ne vsebuje etiških vsebin. Trdim, da za takšno razlikovanje ni dobrih razlogov. Etiški premisleki so potrebni, kjerkoli kdo deluje in spreminja dobrobit drugih bitij z etično vrednostjo. Mogočnejše so tehnologije, s katerimi upravljamo, močnejši so razlogi, da se ovemo etiških implikacij njene uporabe. Informatika je ena najmogočnejših tehnologij sodobnega časa, vključitev informacijske etike v študij informatike je zato moralno upravičena zahteva.

Ključne besede: inženirska etika, biomedicinska etika, človekove pravice.

ABSTRACT

Medical education typically require that students of medicine get some knowledge of ethics and ethical challenges specific to medicine. On the other hand, technical education typically does not involve any of this. I argue that there are no good reasons for making such a difference. Ethical reasoning is needed wherever someone acts in a way that change the well-being of others than him bearing ethical value. The mightier the technology we use, the stronger are the reasons to become aware of the ethical implications of its usage. Informatics is arguably one of the mightiest technologies of our time; the inclusion of information ethics in the study of informatics is a morally legitimate request.

Keywords: engineering ethics, biomedical ethics, human rights.

1. I.

V enem od treh letošnjih božičnih predavanj Kraljevega inštituta, ki veljajo za najprestižnejša znanstvena predavanja v Veliki Britaniji namenjena širši javnosti, bo letošnja izbranka, da jih izvede, matematičarka Hannah Fry, zagovarjala tezo, da je v študij uporabne matematike in informatike potrebno od njunega začetka vgraditi etiko in da ti poklicni profili potrebujejo dokument, ki bo imel podobno vlogo, kakršno ima v medicini Hipokratova prisega. Prepričana je, da so to področja, na katerih znanstveni in tehnološki razvoj drvi, ne da bi ga spremljalo ustrezno etiško premišljevanje znanstvenih dosežkov in njihovih uporab (Sample).

Strinjati se je mogoče, da je tehnološki razvoj čedalje silnejši in da je prav informatizacija in razvoj infomacijske družbe eno od njegovih najpomembnejših žarišč, verjetno celo njegovo najpomembnejše (Bynum; Castells, 1996, 1998). Biotehnologije, ki so najresnejši konkurent za ta status, so prav tako v silnem razmahu, a se v genskih posegih močno opirajo na računske sposobnosti računalnikov, medtem ko obratno ne velja (Rifkin, 2001). Mogoče je zagovarjati tezo, da z razvojem interneta stvari, robotike in širjenjem pametnih strojev informatika postaja to, kar je bila za razvoj prve industrijske revolucije težka industrija – sektor, katerega proizvodi se vgrajujejo v proizvodne postopke v vseh drugih industrijskih sektorjih in v rastoči delež potrošniških blag, zlasti tistih z daljšo življenjsko dobo. Informatika in uporabna matematika ustvarjata algoritme, ki so jedro dodane vrednosti tako rekoč vseh drugih tehničnih naprav, proizvodnih in potrošniških. Na življenje vseh nas čedalje bolj vplivajo algoritmi, ki so jedro pametnih naprav in določajo relevantne okvire naših izbir.

Pisci teh algoritmov, ki torej kreirajo okvire naših izbir, določajo privzete opcije in razvrščajo odstopanja od njih, so pogosto spodbudno nagrajeni mladi inženirji informatike, ki dobijo dokaj določno opredeljene cilje in naloge. V tržni ekonomiji so ti cilji in naloge določeni z logikami, ki nas navsezadnje privedejo do dobičkonosnosti kot poslednjega razloga nastanka celotnega pogona. Pogosto akterjem v proizvodni verigi funkcionalnost in hierarhija ciljev njihovega dela ni znana in inženirji zato ne morejo predvideti in moralno oceniti posledic svojega dela (Castells 1996, 365 in nasl.).

Ta razmah računalniških programov je doslej potekal v normativnem okolju, ki ga je zaznamovala precejšnja odsotnost ali ohlapnost moralnih in pravnih norm in pravil. Zakonodaja je nepresenetljivo zaostajala za realnim tehnološkim razvojem, vendar je svojo mrežo temeljnih vrednot in človekovih pravic, ki se jih je zavezala spoštovati, kljub neprilagojenim področnim zakonodajam vseeno ponujala podlago za razsodbe sodišč. Te so, zbrane, lahko pomemben orientir pri določanju področnih pravil ravnanja in delovanja tako na pravni kakor na etični ravni. Drugi pomemben vir opore so nastajajoči področni in stanovski etiški kodeksi računalniške in inženirske etike. Uveljavlja se misel, da so Splošna deklaracija o pravicah človeka in drugi podobni dokumenti skupaj z nacionalnimi ustavami normativni vir, ki določa meje sprejemljivega ravnanja zlasti vsem akterjem javnega sektorja, in da so ti viri referenčni tudi za zasebne akterje. (Pribac, 2012)

Področje, na katerem je vse jasneje čutiti manko, je odsotnost širše, kontinuirane in več nivojsko zastavljene javne razprave o moralnih, pravnih in razvojnih dilemah, ki jih ta skokovit tehnološki preboj IKT sproža. Takšna razprava je v družbi pomembna predvsem zato, ker se skoznjo lahko izrišejo kritična področja, na katerih bi kazalo poseči in jih družbeno ustrezno pravno in moralno regulirati, in ker se ta področja v takšni razpravi, v katero se pomembno vključujejo tudi področni strokovnjaki, lahko pokažejo jasneje in prej, kakor če bi jih skušali detektirati in preučiti z ad hoc raziskavami. Razprava, ki bi tematizirala moralno in pravno želene in neželene vidike novih tehnologij, je po moji oceni pri nas pičla. Število družboslovcev in humanistov, ki se ukvarjajo s temi vprašanji je skromno in svoje refleksije novih tehnologij običajno prispevajo s precejšnjim časovnim zamikom glede na njihovo vpeljavo. Pogosto tudi zato, ker sami niso posebno vešči in zahtevni uporabniki naprednih IKT tehnologij in potrebujejo več časa, da pridejo z njimi v stik in jih doumejo. Moralni premisleki rabe novih tehnologij težko shajajo brez tehnološke ekspertnosti, ki je družboslovci in humanisti ne premorejo. A prav tako res je, da inženirji v splošnem ne premorejo sposobnosti, da bi premišljali moralne in socialne implikacije in konsekvence IKT proizvodov, ki jih načrtujejo. V svojem izobraževanju jih večinoma niso pridobili, ker jih v učnih načrtih večinoma ni. Je tako prav? V nadaljevanju bom razvil splošen argument, da bi seznanitev z osnovami etike in osnovnimi dilemami posamezne področne etike morala vstopiti v učne programe vseh inženirskih poklicev podobno, kot je splošno privzeto, da je področna etika del študijskih programov zdravniških poklicev in tudi izobraževanj za zdravstvene tehnike, sestre in babice. Del tega argumenta je tudi teza, da je to tem bolj res, kolikor moralno pomembnejše so posledice delovanja posameznega poklicnega profila – kar informatike in uporabne matematike postavlja v sam vrh inženirskih strok, ki bi nujno potrebovale etiške vsebine v svojih programih (prim. Noorman, Harris in dr., 6-9; Bynum).

K etični presoji svojega strokovnega početja tehniki doslej niso bili spodbujeni. Krepitev IKT tehnologij z utopističnimi obeti, ki jih je ta tehnologija zbujala, na pragmatični ravni teh etiških premislekov dolgo ni potrebovala. Razvoj osebnega računalništva in svetovnega spleta je v osemdesetih in devetdesetih oživel iluzijo zlivanja tehnološkega napredka z moralnim. To iluzijo so spihnila dognanja o kopičenju, analiziranju, profiliranju in posredovanju tretjim osebam osebnih podatkov, najdenih na računih članov in obiskovalcev omrežja. Delodajalci, zavarovalniški agenti in – kot smo lahko spoznali zlasti ob zadnjih volitvah v ZDA – politični strategi se lahko okoristijo z njimi. Vsesplošna dosegljivost, prenosljivost in izsledljivost podatkov je trčila ob varstvo temeljnih svoboščin in pravic, na katerih temelji liberalno demokratični svet, katerega del smo. Naša demokracija je liberalna prav zato, ker kot nezastarljiv namen vsakega političnega delovanja postavlja varstvo temeljnih osebnih svoboščin in človekovih pravic.

2. II.

Splošno sprejeto je, da je del medicinske izobrazbe tudi poznavanje etike. Medicinske fakultete v liberalnih demokracijah v svoje študijske programe zato praviloma vključujejo tudi predmet ali modul, ki se ji posveča. Vsaj del statusa, ki ga uživa etika v medicinski stroki, gre pripisati statusu, ki ga uživa medicinska stroka v družbi. Medicina velja za etični poklic, tj. poklic, ki ima etično poslanstvo vdelano v svoje jedro, saj 'pomaga ljudem'. Sama medicina je ta svoj status utrdila, ko je še pred našim štetjem izdelala svoj stanovski etični kodeks (ti. Hipokratova prisega), si torej zadala moralna načela, ki so se uveljavila onkraj posameznih političnih meja v prostoru in času kot nekakšna moralna ustava, ki so jo zdravniki spoštovali ne glede na politično oblast, pod katero so opravljali svoj poklic. Velika večina drugih poklicev si je takšne kodekse omislila šele nedavno. Poleg tega so prav na področju medicine v drugi polovici 20. stoletja začela nastajati nacionalna in nadnacionalna posvetovalna telesa. Ta so skušala osvetljevati etične in družbene dileme, ki spremljajo razvoj tehnologij in praks na medicinskem področju.

Toda ta tradicionalni in še vedno prevladujoči pogled na poseben status medicine med znanostmi, se zamaje, če medicino preučimo primerjalno in se vprašamo, kaj jo razlikuje od drugih znanosti, zlasti od tehniških. Izhajajoč iz razdelitve vseh znanosti in ved na 4 poglavitne skupine (naravoslovje, tehnika, družboslovje, humanistika), je za nekaj znanosti in ved lahko diskutabilno, v katero skupino jih kaže uvrstiti. A medicine ni med njimi. Razmeroma nedvomno jo lahko uvrstimo med tehniške znanosti, čeprav tradicija takšne uvrstitve ne podpira. Opora za takšno razvrstitev je razlikovanje med naravoslovnimi in tehniškimi vedami. Osnovno razlikovanje med obema skupinama je, da prva vsebuje deskriptivni diskurz o tem, kaj nekaj je, medtem ko so znanosti druge opisni diskurzi o nečem, česar še ni. In dalje: prve načeloma ne posegajo ali čim manj posegajo v to, kar preučujejo (saj bi v nasprotnem primeru njihova lastna dejavnost vstopala v predmet preučevanja, kot vemo od Heisenbergovega načela nedoločljivosti naprej), medtem ko so prizadevanja tehniških ved od samega začetka usmerjena v poseganje v realen svet: tehniška naravnanost je naravnanost v oblikovanje predlogov za transformativne posege v realni svet. Skupno vsem tem predlogom je, da zase trdijo, da bo svet, če bodo predlogi uresničeni, v nekem pomembnem pogledu boljši, kot bi bil, če posega ne uresničimo, in tudi, da bo boljši tudi v primerjavi z drugimi možnimi posegi.

V soju tako opredeljenega razlikovanja med naravoslovjem in tehniko se jasno pokaže, da ima medicina svoj naravoslovni sestavni del (diagnostika) in svoj tehniški sestavni del (terapevtika in preventiva). Oba sta nepogrešljiva in med seboj ne recipročno povezana: brez točne diagnoze stanja posameznika ali populacije ne more biti izbrana uspešna terapija ali preventiva; sama diagnoza brez terapije ali preventive pa je, četudi dobra, jalova. Cilj medicinskega prizadevanja, ki je maksimiranje zdravja, lahko torej doseže le terapevtski poseg ali preventivni ukrep. In oba sta v svojem formalnem jedru inženirska projekta, podobna projektom, ki jih na drugih področjih oblikujejo domiselni strokovnjaki drugačnih znanstvenih kompetenc.

Izboljšava, ki jo ti predlogi ukrepov ali posegov ponujajo, je lahko različna. Doseženi so lahko novi cilji, že doseženi cilji so lahko s predlaganim ukrepom doseženi lažje, ceneje, hitreje, udobneje itn. Vsi cilji tehniškega prizadevanja so v določenem pogledu vsaj za neko skupino ljudi neka korist oz. prednost. Ta prednost ali korist nekaterih pa je lahko družbeno sporna, saj lahko negativno vpliva na dobrobit druge skupine ljudi, ki lahko zato temu ukrepu ali posegu nasprotuje. Previdnostni premislek, ki cilja le na maksimiranje koristi akterja, ne zagotavlja moralne upravičenosti ravnanja, ki ga vodi.

Konflikt dveh vrednotenj nekega tehničnega posega nas privede do nujnosti moralne (v tem besedilu ne razlikujem med moralo in etiko) presoje ukrepov in posegov. Moralna presoja nečesa je v nečem podobna tehnični, saj presoja glede na neko dobro. Tako kot tehnika tudi etika posega in spreminja realnost. Vendar je dobro, na katerega se sklicuje etika drugačno od tistega, na katerega se sklicuje presoja v tehniki, kolikor je zgolj tehnika. Slednja se bo zadovoljila z ugotovitvijo, da predlagan poseg prinaša določeno korist nekaterim. Morala letvico postavi višje in zahteva, da je načrtovana korist nekaterih ne pomeni neupravičenega poslabšanja stanja drugih. Moralna presoja se razlikuje od presoje koristi akterjev ali posameznih skupin, univerzalna je in varuje interese vseh tistih in vsega tistega, kar ugotovi, da ima moralno vrednost (Singer, 36-38). Ta zahtevnejša presoja je seveda nujno omejujoča in selektivna glede na presojo tehnično izvedljivega in koristnega za nekatere.

Ker je vsak odgovoren za posledice svojih dejanj, nosijo tudi inženirji del odgovornosti za moralne vsebine naprav in posegov, ki jih načrtujejo ali z njimi upravljajo (Harris, 91-110) . Poznavanje teh vsebin je nujni pogoj sposobnosti moralne presoje teh tehnologij in njihove rabe, njihovo nepoznavanje pa je odločen korak k opustitvi vsakega etičnega pomisleka povezanega z njimi. Poznavanje osnov etiških teorij, praktičnega silogizma in moralne argumentacije v kontekstu priznavanja človekovih pravic kot moralnega temelja sodobnih družb je zato skupaj z razvojem sposobnosti prepoznavanja moralno relevantnih lastnosti načrtovanih ali obstoječih posegov in naprav (ti. *disclosive ethics*) nujni pogoj dejavnega prevzemanja moralne odgovornosti inženirjev na njihovih področjih delovanja. S tem bi tudi ti izobrazbeni profili lahko obveljali kot zaznamovani z moralnostjo, nič manj kakor medicina. Primarni cilj vpeljevanja etiških vsebin v tehniške študije tako ni dogmatičen, ampak je glede odgovorov odprt. Prizadeva si pri študentih okrepiti sposobnost zaznavanja moralnih vprašanj in jih opremiti za njihovo reševanje. Začne se z ugotovitvijo, da etika ni del nobene tehniške stroke, da je iz znanosti neizpeljiva in nanjo nezvedljiva in da mora zato svoja oporišča oblikovati sama (Singer, 21-34; Johnson, 609).

Poleg tega moralnega argumenta za uvedbo etike v poklicno izobraževanje informatikov in drugih inženirjev, je mogoče oblikovati še previdnostnega, ki se ozira le po koristih za akterja samega (Karoof). Mogoče je trditi, da v svetu, ki ga oblikuje čedalje gostejša in vplivnejša mreža pravnih in moralnih, formalnih in neformalnih pravil delovanja, v katerem je beseda tudi o etični zasnovi izdelkov (*ethical design*), sposobnost ravnanja v skladu z njihovim duhom pomeni primerjalno prednost za akterja. In obratno: njihovo nepoznavanje lahko velja za primerjalni zaostanek. Poznavanje področne etike in sposobnost razreševanja etičnih izzivov ima poleg intrinzične torej tudi instrumentalno vrednost.

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Zbornik 22. mednarodne multikonference

INFORMACIJSKA DRUŽBA – IS 2019

Zvezek E

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Volume E

Kognitonika
International Conference on Cognitonics

Uredila / Edited by

Vladimir A. Fomichov, Olga S. Fomichova

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Ljubljana, Slovenia

Preface/Predgovor

Sixth International Conference on Cognitonics (Cognit 2019)

Since October 2009, the biannual international scientific conference on Cognitonics ("Kognitonika" in Slovenian) is a part of the international scientific multiconferences "Information Society" (Slovenia, Ljubljana, Jozef Stefan Institute).

Cognitonics may be very shortly characterized as the science about the human being in the digital world. More exactly, Cognitonics is the science about the trajectories of raising the human being to such level of intellectual and spiritual height, where the scale of his/her personality becomes proportional to the scale of the digital world.

The first aim of Cognitonics is to explicate the distortions in the perception of the world, in the development of the personality caused by the peculiarities of knowledge society (or smart society) and globalization processes. The second, principal aim is to join the efforts of the scholars and educators from various fields for coping with these distortions by means of elaborating systemic solutions for compensating the negative implications of the kind for the personality and society, in particular, for creating cognitive-cultural preconditions of the harmonic development of the personality in the information society (transforming into knowledge society) and for ensuring the successful development of national cultures and national languages.

The birth of Cognitonics was stimulated by the ideas of Philosophy, Cognitive Linguistics, Artificial Intelligence theory, Web Science, Applied Linguistics, Art theory, Cognitive Psychology, and Cognitive Biology.

Two factors seem to be especially important from the standpoint of achieving the goals of Cognitonics:
- information and communication technologies (ICT) have been developing extremely quickly and have been expanding unusually broadly, they penetrate not only into every office and laboratory but also into every school class and every family;
- it is necessary and promising to use the power of modern ICT in order to very quickly and broadly disseminate the found effective methods of compensating the negative distortions in the development of the personality and of national cultures in information society and knowledge society.

The goal of the conference is to combine the efforts of the scholars from numerous scientific fields and educators in order to establish a new synergy aimed at ensuring the harmonic, well-balanced development of the personality, national cultures, and national languages in the modern information society and knowledge society and, as a consequence, to compensate a number of broadly observed negative distortions.

From the standpoint of educational practice, Cognitonics proposes an answer to the following question: what precious ideas and images accumulated by the mankind, at what age, and in what a way are to be inscribed into the conceptual picture of the world of a person in order to harmonize his/her intellectual and spiritually-coloured emotional development and to contribute to the successful development of national cultures and national languages?

Cognitonics formulates a new, large-scale goal for the software industry and Web science: to develop a new generation of culture-oriented computer programs and online courses (in the collaboration with educators, linguists, art historians, psychologists) - the computer programs and online courses intended for supporting and developing positively-oriented creativity, emotional intelligence (cognitive-emotional sphere), mindfulness, the appreciation of the roots of the national cultures, the awareness of the integrity of the cultural space in the information society and knowledge society, and for supporting and developing symbolic information processing and linguistic skills, associative and reasoning abilities, social responsibility of young children, adolescents, and university students.

The Program Committee has accepted for the conference the papers of 22 researchers from 10 countries of two parts of the world: Asia (Japan, Lebanon) and Europe (Croatia, Cyprus, Finland, Greece, Italy, Poland, Russia, Slovenia).

The editors would like to thank the authors of the papers for their contributions and the members of the Program Committee for their precious comments ensuring the high quality of the accepted papers and making the reading as well the editing of this volume a rewarding activity.

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ABSTRACT
A brief excursus analyses the process of the education to an environmental and human culture in the last fifty years, through reflections on personal experiences and the thoughts expressed by different Authors. The little awareness of the **gift of nature** for human life hasn't helped prevent previously speculated scenarios, throughout three generations. Will the school be able, within the next twenty years, to stop the fast realization of the scientific forecasts? Time is up, concrete and immediate actions can be done only by governments, will the power be able to act "wise"?

Keywords
Human Ecology, interactive education, dualism, individualism, ,bio and cultural diversities.

1. INTRODUCTION
Will school change the wisdom of the world or will the world change the school?
Facing the problems linked to the present time and to the forecasts for the future starting from data might help (or can discourage), it will most definitely help those who are already discouraged because they will verify that almost nothing has changed since the seventies through the XX century. We hope to choose a path that won't lead to resignation, but will encourage everyone towards a prospective of possible changes. Why have we mentioned school as the maker of change? For many reasons it is the best place for relations and communications in almost all the world, at least between the ages of three and fourteen and more, secondly because it is the place where many ecosystems connect. We are keeping our simplified but global definition of ecosystem as the *PLACE OF INTERACTIONS* childhood ↔ adulthood, social world ↔ familiar world, the world of imaginative freedom ↔ the world of rules, the world of cognitive development ↔ the world of social dimension, world of reality ↔ world of artificiality.

Where, in all of this, stands the knowledge of the world and the reflections on it? Each ↔ represents the two ways flow of elements between one side and the other and which, ultimately, stands for the Ecotone between Man and Environment (natural, social, political, economic). Let's try, then, to analyze and reflect, following a time line.

2 "TIME IS OFF-AXIS"

In 1978, Gregory Bateson [1] in the appendix to Mind and Nature, addressed to the Regents of the University of California, wrote that "time is off-axis". This is because the two components that rule the evolutionary process don't go to the same pace. If one part of the cultural system is late it means that the other one has developed too fast. The inner evolution hasn't kept the pace with the outer one, imagination has overtaken strictness. This analysis was really referred to the obsolescence of the contents and of the teaching methods of the universities that proposed dualisms and cultural itineraries of deterministic type, that were already out of the reality of the time. In 1993 Professor Sandro Pignatti[1] said, in a conference for Natural Sciences teachers, that "many of the unsolved problems of our time actually depend on the deterministic vision that has accompanied the western scientific research since Galileo". He continued by reminding that the linearity of processes to which we have been accustomed is not applicable to living systems because these are not systems that we can isolate in order to study them, but they are complex systems the organization of which is self-organizing and the processes that rule their existence have a cyclical trend [7].

If we stop and think about the situation today in the western world, we find out that dualisms are far from being overcome, they persist in the vision of the world, or we might better say that they persist in that specific part of society, of economy, of finance that have no interest to leave old cultural paradigms, uncertain because the outcomes are unpredictable. Professor Giaccone writes: "Ecologists have gathered, in this century, experimental scientific evidences that assert that for specie's population the goal of using resources in nature is to reach the fitness; this is to be able to persist with the future generations in the biosphere, developed in ecological niches" [3].

Some modern economists, heirs of the marginalist revolution (that one century ago reduced the economic paradigm to an individualistic, static and a short time matter) have transformed

[1] Ecologist at the University La Sapienza in Rome

economy from a science that studies development, richness of the populations, growth, happiness of populations, in a science that concentrates on the distribution of the scarce resources on an individual level.

3 METHODOLOGICAL INDIVIDUALISM

The methodological individualism of the modern economy and the liberalistic capitalism that apply its principles have promoted in the last two centuries a socio-economic development process that has contributed to transforming humans from an included species, even though rationally, in the biosphere, to a species that, though it appeared in the evolutionary process more than one hundred thousand years ago, in a short period of time it is destroying a biodiversity that is the outcome of an evolution about four billion years old.

4. ECOLOGICAL ALTERNATIVES

If the political, social and economic world has refused to take awareness of what was going on in the ecological environment of men in the past fifty years, what can we deduce from it? For example we can understand that all that was functional to the gain of an ever growing "power" (political and economic) has stopped human social evolution. Giaccone [3] also writes: "Each generation, in fact, needs to know how to invent or at least redefine its niche; this is its lifestyle, in order to use new resources or at least to exploit in a new way the existing ones. If this does not happen or if the previous generation don't allow the new ones to have a cultural evolution, the only way to have a generational change or a change in the socio-political regime is through a revolution […] that in ecological terms means an extreme competition of a generation that kicks out the previous one from a niche that was conquered before by the elder generation: without evolution there is revolution!

The change in lifestyle, in the vision of the world, if we don't want it to be revolutionary and fierce, it has to take place with the solidarity between generations and populations. At the base of economy, from the ecological point of view, what is really important is the interests of the spices and not of the single individual, therefore of the whole mankind. The differences in the polis cannot become a rigid distinction between social classes, ethnicities, otherwise exclusive competition takes place (riots, civil wars like in the Balkan's or in Africa). It is necessary to break the barriers and make information and resources flow in order for the different lifestyles to undergo a process of reciprocal cultural influences, so to allow the evolution in the cultural niche of mankind.

Promote inter-generational responsibilities, accept the new and promote it, include the needs of the environment in the socio-economical process, obtain reciprocity in the relationships, these are all parameters of niche that will allow evolution in the third millennium".

5 WHERE DOES SCHOOL STAND IN ALL OF THIS?

We think that remarkable initiatives done based on these analysis throughout the 70's, 80's and 90's in the world of cultural agencies, ONG, school, that had as a goal the ecological training of teachers in order to reach the students and the public opinion, have essentially failed. The term Environmental Education itself postulated the transmission of knowledge that are not easily digested by those that are not insiders. Talking to who didn't have the necessary bases in ecology and in the functioning of complex systems has reduced the safeguard of the niche to pure dexterity. Today we assist to the protraction of this misunderstanding when we approach the different groups that use the web through the social networks. We are sorry to say that in education nobody understood that the term implied a continuous process between family, school, socio-economical context and the elected trainers in the school already existed and they were those teachers of Natural Science that had already introduced the study of economy through innovative methods. We'll talk about these later on. Now we need to reflect on how easy it is to kill in the school also those initiatives that are useful to the social development if who manages the *Res Public* doesn't have the necessary competences (or the necessary interest).

But the purpose was antinomical compared to the primary goal of the school that is to form the citizens of the future; it was, in fact, calibrated on the needs of the industry and the economy of the time. In fact, in those segments of the Italian school where more than elsewhere it appeared to be essential a transversal and complex teaching of the ecological sciences, the Industrial and Professional Institutes, we have assisted to a reduction or an exclusion of this cultural field. What are the consequences? That exactly where it would have been necessary to form citizens that often do not go on with their studies a path that served to form citizens at least partially aware of the choices that they would have had to do in their life was eliminate. Therefore, now it is useful to propose again a reflection by Bateson that was made forty years ago for the American socio-economical world, that now perfectly fits also the Italian one. Today, we, too, can recognize the considerations that Bateson does on the thought sphere where he writes that we are "teared between the denial of feelings and the strong current of anti-intellectual fanaticism" . Was it predictable? Yes, if we share the thought that social and ecological evolution has been "...off axis".

The learning environments have widened, new scenarios have been opened by the new technologies, we hope these will be ***ruled*** in order to avoid passing from a partially unknowable reality to the impossibility to understand the world ahead of us. During a lecture at the University of Trieste, Giuseppe O. Longo [5] said that already technology has overcome scientific knowledge and through these changes also the mind is modified. "Today, through informatics and computers, we are witnessing the overcoming of technology on science. While science is trying to show the complexity of the world, technology simply ignores it, showing only the friendly and endearing aspects of the functionalities that it is able to produce. From an original blissful unawareness, man has passed, through science, to a phase of consciousness of problems. Today, though, through technology, man tends to go back to unawareness, and all that it comes with it. At a cognitive level, what will the effects of this change be? We don't know, nobody today is able to give an answer. Maybe those who will live in this new artificial environment won't care about the answer.

The analysis continues through an intervention in 2014 at the Convention Frascati Scienza [6], where he said:

"It (...technology) not only modifies the quantity but also the quality of information. Man, relying on technological systems, delegates a lot when it comes to choices. But the technological systems are very fragile, because they are organized following a very low level of redundancy. A small problem can block the system, sending high wire, as chain reaction, a huge number of other activities that are indirectly connected to it. Therefore, relaying totally on technological systems is a hazard. This brings to inevitable negative psychological consequences for man, such as uncontrolled emotional reactions, continuous anxiety, permanent insecurity, fear and panic. This consequence appears to be inevitable, because man rely often on irrational projects that go on the sole choice of immediate opportunism and arbitrariness".

6. HUMAN ECOLOGY, A NEW WAY FOR LEARNING AND TEACHING

We certainly do not want this to happen and even then it should be the school that should have the task of conjugating the separations that are part of the time culture fragmentation in order to create new areas of learning such as the ecological and informatics ones that aim to make the modern man better.

We have postponed the reflections on the new learning paths on which the Italian school was experiencing since the years 2000 at least in the scientific disciplines.

A new method to introduce ecology as a study was the one to propose and start a European Project that would train teachers (Socrates, Comenius), exactly in the program of the year 2000.

The active participation of many European countries had raised hopes, as well as the sharing of new methods. The exceptional thing was that a project had been accepted that swiveled on the teaching of ecological disciplines. The produced materials had been asked to many, but apparently the timing wasn't right.

The starting point was that the modern school had to change methods and had to analyze the scientific contexts in the social/cultural meta contexts of the time. It was important to give students a new learning method, the self-learning one, through skills structured with multimedia products which allowed them, as a group, to be included in a context of research-study directly or virtually *in situation*. The term indicates three modalities to use and make other use daily:

- ✓ The study-research in a natural and man-made environment,
- ✓ The production of original multimedia products,
- ✓ The use of lab both in class and in field.

This experience, transferred to the local realities has given tangible results, students and their teachers trained to train students have excellent results in national and international evaluative contexts, but this obviously isn't enough if the involvement is fragmented in the local realities. It is not time anymore to *"think globally and act locally*".

For the methodological approach that had been used, a new definition had been introduced, the **ecological-evolutive approach** in which the concept of historicity of the living being in the environment was introduced and following the appearance of mankind.

The didactic instruments and the innovative methods had some priority goals:

- help to overcome the limits imposed to knowledge by the compartmentation of the disciplines, since the ecological-evolutional path emphasizes the interconnection between the different areas of knowledge;
- introduce the student to a new concept, often not considered, such as the historicity inherent in phenomena and the natural processes;
- Create the presupposition for a reflection on the relation between science and ethical values;
- Value the new area of knowledge and of production and comparison offered by the web. A correct use of the new technological instruments allows, thanks to the multimedia reworking, to highlight the system characteristics of ecology and society.

The typology of "reticular" reasoning today is considered to be essential in order to face a new way of "producing", in research, but also in the medium-high profile work activities. It is the student himself that gets used to reorder "his own way" in the whole of the old and new knowledge, as the new concepts are always an autonomous product of the one who is learning and therefore he himself has to build them relying on his own cognitive needs.

It is known to teachers that what is learned as a consequence of a strong motivation is most likely to become "significative learning" to the student, who in such way feels capable of building his own "new knowledge". It is also to be highlighted that from the activity done in natural environment it is easier to reach another goal: nature's biodiversity shows us that the interactions that produces different organisms also acts in the social systems. The ecosystem "orientates" and can make one understand that the relations that are at the base of adaptations and of the differentiations in nature, also act in each one's culture and life.

At this point we know that the time we have for the changes is almost up. It took three generations for the world of the scientific culture and of the most innovative school to spread new knowledge and awareness of the importance of the actions to be taken for ecology to be transformed in Human Ecology, that is for man. The target has been centered, but only for the more acculturated and open to the change part of the population, will scientists and school be able in twenty years, last deadline at the moment to stop irreversible processes of environmental destruction, to make the entire human society aware?

Figure 1: the Green Schooner, Mediterranean Environmental Sentinel

6. CONCLUSIONS

For those who still today keep denying the evidence of human responsibility, we remind them that we have knowledge that since at least one hundred years man has been acting on the environment by simplifying natural biodiversity and by accelerating natural processes. We already have preoccupying signs of climate changes and their inevitable consequences: extreme wheter events, disappearance of entire ecosystems that involve also the man-made world in which migrations are forecasted that involve forty million persons searching for water and food. Maybe the cultural transformation of lifestyles operated by the school, that involves at least one generation is not enough, it is time to strongly ask for quick interventions at a global level. Can we hope that those who rule the world, governments and political powers, rethink the socio-economic models and take action?

Let's conclude again with Bateson when, highlighting the danger of the myth of power more than power itself, he says "are we wise?"

7. ACKNOWLEDGMENTS

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Cognitonics in Plato’s Cave.

The responsibility of the creative writer

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ABSTRACT

In Plato’s cave modern creative writers type the words that refer to the shadows of ideas on the screen of the computer. The eye grasps the words in links and research tools, but the mind does not grasp the birth of the idea. As the writer types, hyperlinks change the route of thought, while grammar checkers guide the mind via syntax suggestions. The subject is being revised by collective interactive media and word processing is altering the sense of the text, that is displaying the story on the screen while its reflection is not the inner narration in the cognitive sphere of the intellect. Outside the cave Marcel Proust and Dostoevsky and Victor Hugo decrypt the depths of the human soul. The missing bright sunlight does not only reflect the light of knowledge and insight but also the lack of the light of the joy of genuine creation and beyond that, outside the cave, shedding its irreplaceable light, lies democracy.

Keywords

Plato's Cave, creative writer, cybernerics, literature, education, serendipity

1. INTRODUCTION

The path that led humanity into a contemporary Plato’s Cave was full of technological innovation and accomplishments. Citizens from all countries and origins followed the path without any hesitation and without any planning made by the social structures. They were not ready for the vertiginous speed of the technological changes that is leading to the fourth industrial revolution and Globalization 4.0 but they follow the path that has no guiding instructions. Inside Plato’s Cave, they find themselves facing a screen. In the screen their face can be instantly located, each instant at any location in the world. The location applications have no way of spotting the individual’s identity, though. Existential anxiety, irrationality and aesthetic poverty is the constant echo of the inexhaustible flow of information that fills the screen. The words on the screen touch the senses but make no contact with the intellect, the modern cave inhabitants do not grasp the birth of the ideas and words. Education systems do not provide the cave’s citizens with the ability to critically view what is projected in front of them, for the goal of modern education is to prepare the student for his/her admission in the cave, forgetting the goal of creating the ideal man, able to criticize what is outside the self. The democratization of information replaces the democratization of knowledge and does not seek good, justice and beauty. Socrates had warned about this development at Plato’s Allegory of the Cave, when he argues that “the instrument of knowledge can only by the movement of the whole soul be turned from the world of becoming into that of being, and learn by degrees to endure the sight of being, and of the brightest and best of being, or in other words, of the good.”.

Constant information flow is the ground on which the modern citizen is called to stand and participate in the democratic process. The ruled citizens passively absorb the flow that appears to create a reality and have no defences against manipulation and propaganda. The rulers of the state are no others than some of the cave’s inhabitants that have managed to use the flow of images and information and the advertising communication channels in order to reach the ruling state, by satisfying the needs and preferences of the average consumer. But do they rule? They follow the rules of the market, they use the same communication and advertising tricks, even after their election, while the giants of this mighty cyber market find their ruling work an easy task.

Of this global population blossom the modern creative writers. many of which find themselves spending their talent in order to please, who else, the average consumer, deprived from the joy of creation.

The creative writer has an obligation to escape the cave, find the light of true knowledge and then go back and tell his/her story to the prisoners.

2. THE ALLEGORY OF PLATO’S CAVE. A SCREEN ON THE WALL OF THE CAVE

In the Allegory of the Cave, a dialogue between Socrates and his disciple Glaucon, humans are prisoners in a cave, facing its wall, unable to turn to see the opening of the cave. They can see only the shadows of objects, projected on the wall. One must get free and find the light of knowledge outside the cave and return in order to free the intellect of the other prisoners [1]. In Plato’s contemporary cave, a flow of data and information is projected on a screen placed on the wall of the cave. The flow is fast and is often interrupted by other streams of flow. The words pass rapidly before the modern human's eyes. The modern human once too often interrupts the flow and casts a warm look on a familiar face, his/her own, projected in several locations. Checked in. The face is found. The identity is still lost in the inexplicable flow of data, shaping a stream of thoughts that were never born in the human's soul.

In a contemporary cave, a contemporary Narcissus, the son of the Nymph and the River – a river that is fluid, in a constant flow - is trying to reassure his lost ego that he/she exists by seeking him/her self not in the waters of the river but in the media [2] in the constant flow of data on the screen he/she faces.

2.1 Cybernetics in the Ocean

Plato first used the expression cybernetics to describe the steering of a ship and Aristotle later to describe the steering of a community. Norbert Wiener, the creator of modern cybernetics has described the world as a ship in the ocean destined to wreck. Wiener reflected deeply on the consequences of the by then second industrial revolution, "Long before Nagasaki and the public awareness of the atomic bomb, it had occurred to me that we were here in the presence of another social potentiality of unheard-of importance for good and for evil" [3] .The accelerating rhythm of the speed by which humanity has reached the fourth industrial revolution left no space for any harmonious adjustment. For political and economic reasons, the rulers responsible for the development of social structures and the planning of the societies designed no strategy to guide humanity in the one way that led from revolution to revolution. The boundaries between the biological, the physical and the digital realities are no longer distinct [4]. Beauty and joy are not part of the algorithm's game. However, the aesthetical poverty is proving its most powerful need for existence by the ethical and aesthetical flattening that have brought the ontological flattening in the new landscape [5], for the need to exist is the fate for existing and fate, as ancient Greek tragedies narrate, is not to be ignored.

2.2 Thoughts, Words, Meanings and Means

Reversing the question *Is thought without language possible* we may ask *what kind of language without the esoteric vibrations of thought is possible*. Language is born in the depths of one's secret places, an inner private movement in the path where it connects and synthesizes, it thrives and is becoming [6], while thought moves in the path of words – for Velimir Klebnikov "the living eyes of secrecy" - formed in codes that store and transmit collected memories and reflections of a person, his/her family, the community, to enter the big avenues of the world sharing its adventures in the course of time [7]. Words follow the thought while at the same time they push it towards the goal. Descartes four hundred years ago added thought in the equation that positioned language beyond the boundaries of mechanism [8], while the screen on the wall of the cave is adding a new component in the equation. A mediator, a facilitator, an inexhaustible source of information and memories. The text is not solid on a paper now, the text is fluid, it is copy pasted, it is grammatically corrected, word processing is guiding the thought in a constant flow of interaction.

Nietzsche points out that "Our writing instruments are also working on our thoughts". A contemporary literary critic, Hugh Kenner, in the context of his book *The Mechanic Muse*, develops the view that T.S. Eliot, James Joyce, Ezra Pound and Samuel Beckett evolved their creating writing, not in the choosing of the thematic but the actual writing itself - directly and indirectly influenced by the technological changes of their time [9]. Word processing allows the text to be flexible, open to changes, ready to expand [10]. In the context of her research Christina Haas argues that word processing and computers actually change the cognitive processes of writing, by altering the ways language is produced, distributed and consumed [11]. Word processing had developed for the organizing and restructuring of the office by automating the composition, transcription, reproduction and distribution of the printed word, highlights Matthew Kirschenbaum [12].

Words, syntax, grammar, connotations and connections appear ready and interconnected on the screen. The actions on the screen influence the train of thought and guide creation. A stream of interactive input and output that is constantly on the move via the social media, runs into the paths of syllogism and its impact sheds its collective shadow. Of this equation is missing a component that is essential for the genuine creation: the moments of solitude in the context of which the creator strives for the discovery of the truth, in the depths of the soul.

2.3 Cybernetics and Literature. Serendipity

Cybernetics as "the unit of measuring organization", delivers a predetermined result, saving energy, keeping what is necessary to avoid driftlessness. Literature in its best form lavishly offers the unexpected, while in its consistency it unfolds the myth to its inevitable conclusion [13]. Artistic creation is the proud proof that what is necessary is not enough. The restless artistic spirit will keep exploring fantasy and the sphere of beauty and good.

Quite unexpectedly the difference between finding and exploring has created a space for serendipity in the modern online search process. One cannot avoid reflecting on the word serendipity, invented by Horace Walpole, inspired by "The Three Princes of Serendip", in fact an early detective story and we do know that in detective stories the capable writer leaves traces of the unexpected end along the path of narration proving that the unexpected end was inevitable.

The thirst for exploration has driven humans to seek the great truths of knowledge in the external environment as much as in the internal landscape of their inner self, in the cognitive sphere of the intellect.

The development of the skill of exploration, the sense of devotion for the discovery of the truth, free spirit, discipline, critical thinking, are just some of the essential components that progress is made of. The same components are essential for a successful educational system, the foundation stone of democracy.

2.4 Education and Democracy

Any educational system ought to have as its primary goal to nurture the citizen who will combine the characteristics that will bring him/her to a state of being where in addition to knowledge and critical thinking, he/she will acquire the love for the Form, the passion for free expression, "the awareness that beyond what is necessary there is something that is not biologically useful but is humanly essential" [14].

"No political theory is adequate unless it is applicable to children as well as to men and women.", argues Russel, adding that the educator ought to give the child the tools and the inner strength to find the path not to an external goal that a social structure may propose, but the goals that are at the end of the child's inner paths in the depths of the soul [15]. And there, private and personal, carrying the truths of one's collective history in the course of time, the light of knowledge lies, in a soil that waits to be fertilized by the truths of the rest of the world.

In full contrast, a student that has been admitted to the cave, will passively accept what is being projected on the screen, unable to consult the inner foundations of critical thinking in order to stand in a distant from information and judge it. The student will grow up to become the citizen that is being manipulated by economic and political rulers. And the rulers who will emerge from such a crowd will be manipulated by the faceless giants that rule the world.

Creative writers live in the same era, facing the same challenges as the rest of the citizens.

3. CREATIVE WRITING, A TRADE ORDER RUNNING IN A VICIOUS CIRCLE OR A FRAGRANCE OF A MYTH BLOSSOMING IN THE LANDSCAPE OF OUR POETRY?

3.1 Creative Writing a la Cart

The bad news is that writers will no longer be able to survive financially as professional writers. The worse news is that if they do, it will be because they will offer their talent in order to please the needs of our good old average consumer, namely they will write a la cart without any satisfaction or joy. To make bad things even worse, as any other industry that enters the digital market, creative writing industry ends up free production and consumption. Content, talent, creation, free of charge. What the cyber giants truly sell is the consumer. The consumer is the product [16] and the consumer has developed a "textual attention deficit disorder", skimming text [17] in the course of his/her constant reading the constant flow of nothings on the screen. Creative writers had always had to face difficulties in financially surviving on their talent as a profession. The challenge now is that it is extremely difficult for creators to find the political support and will to design protective statutes, in an increasingly hostile and complicated environment.

3.2 In the Cave They Like and They Write

All the inhabitants in the cave are consumers. And they are not the victims of the ones that manipulate the stream of symbols projected on the screen. In fact, they are the victimizers, for their preferences dictate the choices of the ones that serve them back to them [18] - in the same manner that voters get the rulers they deserve - and they are no longer able to distinguish between a symbol that reflects an archetypal myth of the soul and a symbol that is created in order to provoke a reaction. Even some creative writers cannot make this distinction, the cave writers that lack the esoteric reflection of the meanings they are narrating, for the roots in the landscape of their cultural and earthly identity, their comprehension of their social structure and the historical sequence of events that gave birth to their individuality are floating together with the flow of data, the impressions and the messages that are constantly being poured in their minds.

The democratic base of creative writing also is missing, since the consumers passively absorb the servings of their own preferences, they accept what is offered to them without actively criticize and possibly reject it. This is evident not only in the thematic of their writings but also in the writing itself. "Language is the main tool of a human being, in his/her denial to accept the world as it is", wrote George Steiner [19]. Resistance is the responsibility of the writer.

Some creative writers do resist, and they explore the depths of the human soul. They have a powerful idea that is complete. Under the idea lies reflection that has the weight of conceptualisation and it is not an occasional game of the mind. They have something new to say to the world [20]. They find the poetry of their myths and spare no effort in their strive to narrate it to the world, in language that speaks to the soul directly, leaving the lucky reader thunder struck and joyful and a better human being ready to change skin and heart and mind.

"I think of mythology as the homeland of the muses, the inspirers of art, the inspirers of poetry", said Campbell to Moyers [21]. For without Myth rooted in the poetry of our being, we have nothing to tell the world.

The obligation belongs to the creative writer who escapes the cave, where he must return to share his story.

3.3 Roots

"Through the endless steppes in Russia, the vast fertile land of millions of people and the fierce social contradictions, the deeply rooted passions and the abyssal souls, in the context of great opportunities and the radical changes, the long endless winter nights that never saw the light of the dawn, the need for story telling, the need of the conscience to relive and narrate its experiences to itself, deep in the solitude of its being"[22], gave birth to the masterpieces of Fyodor Mikhailovich Dostoevsky and Leo Tolstoy and so many others that offered to the world some of the best novels in human history. The spirit of the French revolution and the deeply rooted demand for Liberty and Human Rights gave birth to Victor Hugo's masterpiece *Les Misérables*. Deeply rooted in the soil of their land, absorbing the fertile climate or the bad weather, the vibrations of the struggles for progress and justice, the dark dreams and the desperate thoughts, the hopes and the future plans, the greatest writers of all times were deeply rooted in the myths of their land and had offered universal truths in their novels that are read in all lands.

"Homer, ancient Greek drama, Don Quixote, Shakespeare, Faust, Dostoevsky, Proust, with strongly national features, gave the universal measure, and engraved the myths of the soul that constitute our civilisation" [23].

4. A SCREEN AND A PASSION. A NEW COMPANION

The writer escapes the cave. He/she walks out of the opening and follows the path to his/her land. Like Raskolnikov, he/she bends down and touch with his/her lips the purified soil. Like Anastassya Filippovna, he/she throws Rogozin's packet of money in the blazing fire. Like Prince Myshkin, he strokes the murderer's hair, while sitting next to the victim and like Jean Valjean, he walks in the dark forest and lifts the heavy bucket from the little hand of Cosette, replacing it with his hand and then he carries Mario through the trenches of the French revolution. Like Antigone, he/she buries the beloved brother. Like Prometheus, he steals the fire from the Gods and goes back to the cave and offers it to humanity.

The writer returns and sits among the cave inhabitants and starts the narration. He/she is using a computer devise. The screen projects his/her passion. Decoding the depths of the human soul, he/she narrates the archetypal myths of human race, offering drop by drop the distillation of a human being's hypostasis, a wonderful blossom in the colours of his/her landscape, full of symbols and memories.

Next to him/her, listening with great interest sits Al.

5. ACKNOWLEDGMENTS

Zeno of Citium, founder of the Stoic school of Philosophy was born in Kition, Cyprus. Stoicism taught goodness and peace of mind that one can gain by living in harmony with Nature and Virtue. He survived a shipwreck near Pereus and he went to Athens where he went to a bookseller and started reading Xenophon's Memorabilia. "I had a good trip with my shipwreck" he said, for the shipwreck gave him the chance to start a dialectic journey, conversing with the dead, reading their writings. His cybernetics in steering his ship into wrecking in order to find the writings of the dead was successful.

My journey and the steering of this ship in my endeavour of writing this paper, would never be possible without my conversing with my dead father, reading his own writings, the ones used dated in 1965 – 1970, where in the small land of Cyprus, he wrote about cybernetics, and the Modern Narcissus, and the Space communication, art, education and more. I wish to thank him for cooperating with me with such a generous and rich manner. I also thank him for coming at home one summer when I was fourteen years old with a huge box, where he offered me as a gift all that Freud and Dostoevsky had ever written, actuating me in a journey with no end.

It doesn't matter if the ship has reached its destination. As in Ithaca, the journey is wonderful.

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The Pillars of Higher Personality Development of Net Generation in Smart Society

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ABSTRACT

Firstly, the paper suggests a new look at little "C" and big "C" creativity (LCC and BCC) under the framework of cognitonics, its essence is the challenge of LCC and BCC convergence in knowledge society. Secondly, the paper proclaims a new focus of education in smart society, characterized by rapid technological changes and predictable shift in the list of professions - the focus on higher personality development. The maps of cognitive transformations of conceptual world's picture and the spectrum of cognitive skills into a new configuration ordered by smart society are proposed. As a whole, the paper suggests a strategic way to achieving a new stage of smart society corresponding to the expectations of the technologies users with higher personality development.

Keywords

Higher personality development, emotional intelligence, creativity development, little "C" and big "C" creativity convergence, development of figurative reasoning, art cognitonics, thought producing self, value of thought, early socialization of children, system of emotional-imaginative teaching, cognitive engagement, serendipity.

1. INTRODUCTION

The notion "net generation" (the generation which is born with a finger on the button) which is called "multitaskers" (ready to perform simultaneously various activities: to do home work, to listen to music, to talk on phone, to consult social networks, which can hardly distinguish private talk, private space from social networks and public life as a result they are given the new characteristic. They easily give away everything they know, trespassing onto private space of another person.

Net generation roams in the cyberspace, picking up information and exchanging it with a second thought. They are digitally enlightened and can't do without smart devices (we can't do without them either). The question is how to teach if they are sure that they can find everything in cyberspace and can be encouraged by their smart devices in all cases? Which way is it possible to achieve cognitive engagement, to increase their curiosity, to make them believe that getting information is not enough for being intellectually and spiritually mature?

2. THE RETURN OF THE NOTION "VALUE OF THOUGHT" TO THE WORLD'S CONCEPTUAL PICTURE AND COMMUNICATIVE PRACTICE

Thought-Producing Self (TPS) is the awareness of the preciousness of the thought, its social significance, appreciation of the thought on the part of the authorities of different levels. Let's consider the main steps of our original complex method of realizing the TPS of the child, it is a part of our System of Emotional-Imaginative Teaching [3-5]. At the first stage five-six year old children are taught to understand what a thought is. They are asked to give an example of a thought. They start to speak about their wishes but no one mentions the wishes of mother, father, grandparents. Then they are given the examples of a thought which reveals another way of viewing something. For instance,

"The year is to midwinter moving ,

The roofs are dripping, roads are soak,

And on the ice the sun is brooding (Boris Pasternak).

Children give their own examples.

Example 1. "In early spring, when the snow is melting, there are puddles under every tree and bush. They look like the mirrors scatted by spring to help nature with a morning toilet after the long winter hibernation".

Then children are asked to remember the moments of happiness in their life experience. One of the most touching examples was given by a six year old girl who said that near her country house there lived a dog. The girl and her friends were sure that the dog was an orphan. But then her mother told her that in her childhood she knew the mother of that dog. And it made the girl really happy.

Example 2. "I woke up earlier as usual and saw the morning sun raising up above the deep forest. The sun was cristal clear and in good humour. I guessed that the water in the forest lake had already become warm, because the sun had already bathed in it, and I was happy".

Example 3. "Once upon at Christmastime I looked out of the window. It was a heavy snowfall. Suddenly, I saw a Santa Clause, he didn't walk to my house, he was carrying to somebody else. But I became happy, because I had seen a miracle. It was much more precious than a present".

Then we asked children to share their thoughts. Once of the boys asked: "If he shared his thought, whose thought it would be?". We explained to the children that it was happiness when one had an opportunity to share one's thought, that there were people who were interested in your thoughts.

The first experience of sharing thoughts showed that children wanted to share their troubles and their pain. As a result, children came to understanding that the thought is a value, it is precious. It is the starting point of their strong interest towards the cognitive processes and of deep respect towards the thought of another person. It evokes the ability to admire the thought.

Then we start considering on the notion "shyness of thought", when people are shy to ask the questions, because they are not ready to listen to the answer.

Then we speak about the "shyness of soul", when we are shy to start up something being sure that can't cope with the task. This state of mind can be overcome with the help of consideration and clear understanding that it has nothing to do with some one's ability to cope with but it is just shyness of soul. Be brave and confident, trust yourself.

The last step but not the least is the idea that a thought is a deed. If you don't agree with something, you should oppose another thought but not power, because thought is powerful itself and can work wonders. People should take responsibility for their thoughts, and that is why they can dare (in this case, your responsibility is increasing).

The strongest enchantment is the enchantment of thought, because the thought can transfigure the world and it reveals revelation.

3. PUTTING TOGETHER BIG "C" AND LITTLE"C' CREATIVITY AS A NEW APPROACH TO IMPROVING OUT OF BOX THINKING AND THE ABILITY OF MULTIFACET WORLD'S VIEWING

One of the principal aims of this paper is to represent a new look at little "C" and big "C" creativity. Big "C" creativity (BCC) [7] is regarded in connection with the creative ability of outstanding scientists, musicians, painters, writers, poets [6]. Smart society demands little "C" creativity (LCC). It reveals the smart society's necessity of creative thinking [1] and creative approach to solving the every-day tasks. LCC improves problem solving skill, which is one of most important skills.

BCC is defined by two main characteristics. It is regarded as original and highly significant creative activity for big groups of people. Creativity of children (LCC) usually is subjective and is defined by their previous knowledge. The main characteristics of LCC is their imagination [2]. Smart society demands the necessity of supporting and improving LCC in order to create the preconditions for increasing the proportion of the specialists in significant application domains who possess BCC.

In order to solve that problem and achieve the significant results in increasing LCC in order to have BCC in future, we have found the way how to combine as early as possible LCC and BCC in the process of realizing the Thought-Producing Self of the child.

The first step suggests the understanding by the children of the significance of thought. It helps to return the notion "value of thought" to the world's conceptual picture of the school children.

The second step suggests the awareness of the school children of the fact that their ideas, metaphors, way of viewing nature , communicative situations, the pictures, etc. may be highly significant for relatively big groups of people in case of sharing their ideas with the others. The reason is that they have given a sophisticated look at something and have revealed an example of serendipity (the ability to make pleasant and unexpected discoveries entirely by chance). It happens due to their natural ability to see out of the way things in usulal things and usual things in out of the way things. It might be thought provoking for grown-up people.

Example (one of the examples of nature inspired behaviour).

The crown is sitting on the twig. The crown is heavy and big, the twig is thin. But the crown is no nervous. It is not afraid of the fact that the twig may break, because the bird doesn't think about the twig, it trusts its swings (Anne, a seven year girl).

Example. Nine year old children are taught the language of painting. Then they are asked to paint with the help of the words natural language) the portait of their mother and describe what they have depicted. One of the nine year old boys described his mother s, sitting in an arm chair in the garden in spring. He said that she was blond and she had a long plaid. In fact, his mother had short black hair. To the question why he had said that his mother was blond he answered that he had depicted her inner world, the essence of her personality in order to create the right image of hers, because all kind princesses in Russian fairy-tales are fair-haired.

The third step is to make children aware of the beauty and wisdom they have discovered, because in most cases they do it without a second thought, intuitively. It just donned upon them. They need encouragement to continue mental and spiritual work on that level. Their efforts and their inspiration should be discussed and appreciated by the community.

Example. "To dig out of the ground all its treasures, whether it is the goal of life?" (Angelina, 14 years old).

Example. "Do we love the Volga river only because it provides us with fish?" (Marina, 15 years old).

Example. "All good deeds are reflected on the palm of the Time" (Mary, 15 years old).

Example. "We are not planting the flowers, we are introducing beauty into the world" (Anton, 15 years old).

The fourth step is to show te examples of BCC revealing the same idea to make children believe that the value of thought doesn't depend on age and experience, but age and experience help us to penetrate the very essence of the thought, to comprehend it.

Example (a fragment from a poem by the world known poet Boris Pasternak).

"In everything I seek to grasp

the fundamental:

The daily choice, the daily task,

The sentimental

... And puzzling out the wave of fate,

Events observer,

To live, feel, love, and meditate

And to discover".

The awareness of the value of thought, the ability to see many aspects of reality, creativity as a thought provoking process being able to transfigure the world lead to improving out of box thinking, problem solving skills and reveal nature inspired behavior.

4. HIGHER PERSONALITY DEVELOPMENT

Knowledge society and digital space in general cause the endless processes of challenges and answers. The digital space is created by the most gifted people, who dare to create another world with much more opportunities for humans. On the other hand, that intellectual challenge and application of information and communication technologies in all spheres of human activity and even, in some cases, substitution by robots or androids reveal new demands to the Personality. In order to correspond to the created digital reality, we need to make the focus of education (face-to-face and e-learning) on the higher personality development in order to be successful in smart society. It means that the personality is able to regard thought as a value, understand (not only know which is equal to having information) and be thrilled by the processes of thinking, being able to dare and to take responsibility for it. It suggests that he/she is a socially and intellectually mature person and has improved emotional intelligence and is a spiritually mature person.

Higher personality development includes the ability to put unpredictable questions (out of box thinking), to be ready to make a breakthrough on any level, strong interest in cognition (self-cognition, meta-cognition), nature inspired behaviour, sociability, sense of belonging, awareness of the necessity to be grateful to other people [4, 5].

Modern reality teaches us that modern technological solutions which underpin he creation of new products are hidden. The companies don't want us to get the students acquainted with those technical solutions. They just teach us how to use their products (Google Educational Platform, for example). That is why the focus of education must be shifted to higher personality development (see the figures 1 and 2), and the main object is to train students to think and discover TWO WORLDS: the world inside and the world outside (the second is easier).

In this case we'll have the equilibrium (or balance) between the created digital space and the humans with higher personality development being able to appreciate and correctly use the new digital reality. It will be an initial stage for a new level of digital space development , much more humanized one, because it would be started up by the gifted humans reached the level of higher personality development (see the figures 1 and 2), and aimed at humans with higher personality development.

The new approach is putting together BCC and LCCC through using Student-Self Oriented Learning Model [3, 4] in educational process (see the figures 3- 5), suggesting cognitive engagement.

5. CONCLUSION

The creation can't be better and stronger than the creator. If the mankind creates a digital world (like a Creator creates World and a human being as a topmost creation), it means that the demands to a human being are increasing. The idea of robot (computational technologies) domination in the future and, as a result, decrease of the human role in general due the substitution of humans by the robots shouldn't be allowed to enter the brains of people, because it was already rejected and proved to be the wrong one in the 19th century by F. Dostoevsky. In his world-known novel "Crime and Punishment" he proved that the idea of God-Man shouldn't be substituted by the idea of Man-God, when the human regards himself higher than his Creator. Dostoevsky proves that in case of substitution a human being will suffer the consequences. In the 21st century we shouldn't repeat the mistake. It's better reread the novel lest we should suffer the consequences.

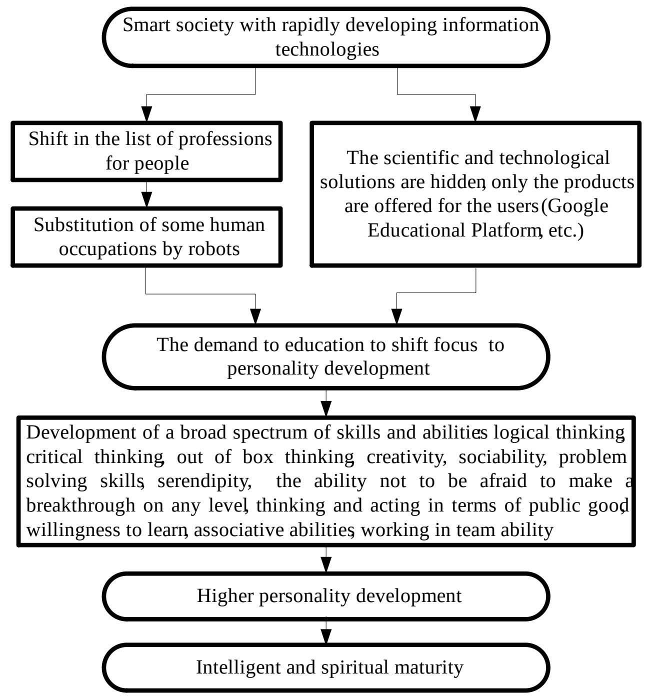

Figure 1: A challenge of smart society for education

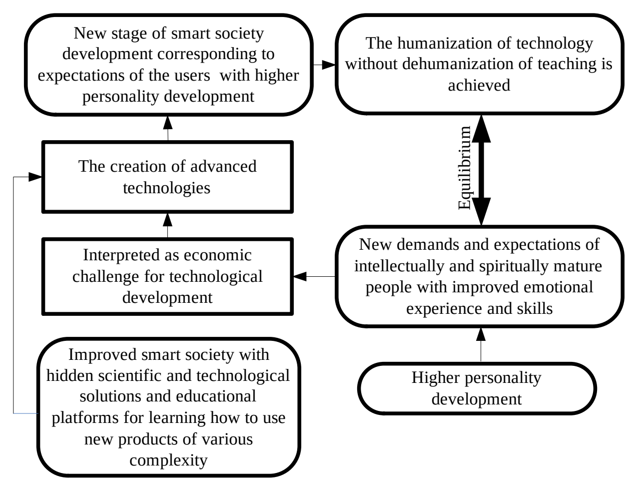

Figure 2: A cognitive leverage for moving to a new stage of smart society development

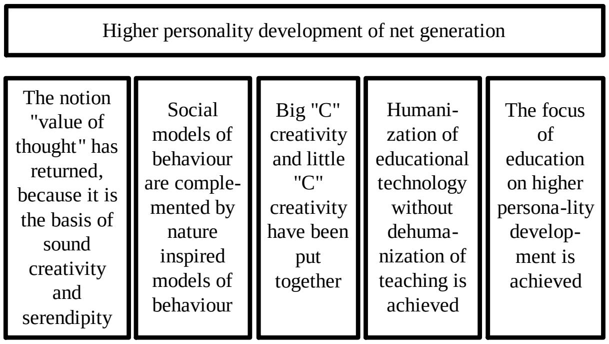

Figure 3: The pillars of higher personality development of net generation

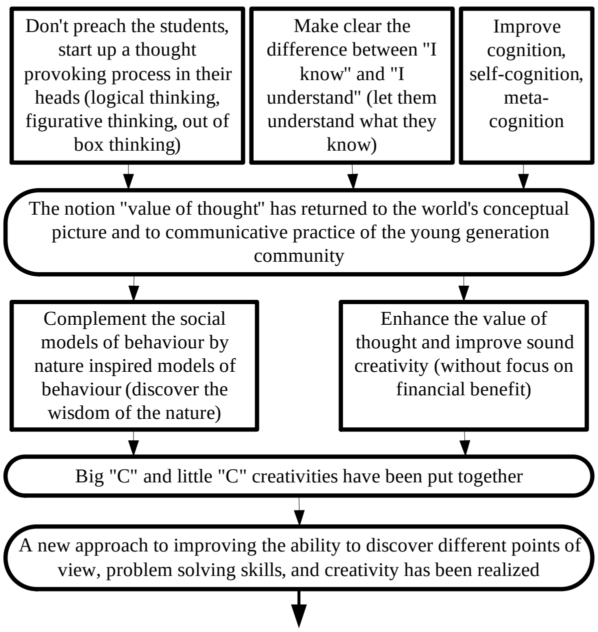

Figure 4: A map of cognitive transformations for building the pillars. Part 1

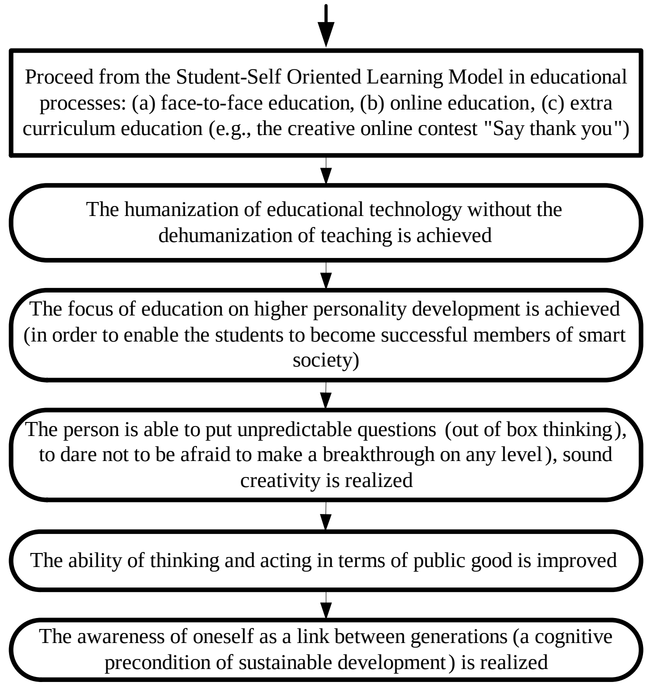

Figure 5: A map of cognitive transformations for building the pillars. Part 2

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Towards Harmonic Existence of Green Computing in Knowledge Society

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ABSTRACT
The upsurge in global warming and release of greenhouse gases is a major issue that intensified over the past years due to the increasing usage of technological resources in our daily routines. That is why a call for going green in the technological field is hardly recommended. This paper reviews various approaches of green computing in five main models - software engineering model, cloud computing, mobile computing, data centers, and educational sector.

Keywords
Green computing, Sustainable development, Models, Cloud computing, Mobile development, Education, Cognitonics, Data centers.

1. INTRODUCTION
Global warming and climate change are causing the increase of global temperature and the rise of sea levels. The main cause of environmental impacts is people and their harmful behavior. An example for such behaviors is the huge amount of CO2 emissions from the industries and vehicles, cutting trees, and the exhaustive use of resources by technology. Studies have showed that the amount of CO2 emissions have been increasing in the past few years [1]. Efforts for reducing harm on the environment must start from changing peoples' behaviors. Citizens of the planet Earth are responsible for thinking "Green" in all aspects of their lives in order to save and protect their future on their planet. Nowadays, technology has entered people's lives deeply, until it reached their jobs, homes, and education. As a contribution to achieving environmental sustainability, people can start from changing the way they deal with technology. Most efforts addressed the hardware perspective of green computing with little attention to the importance of the software perspective. Efficient software reduces the use of hardware resources; therefore, reducing energy consumption. In this study, we examine different green computing approaches in the literature in various domains of software development. In particular, we study green approaches in software engineering models, cloud computing, mobile development, data centers. In addition, we highlight the importance of introducing green computing principles in the educational sector.

The remainder of this paper is organized as follows. Section 2: literature review of the topic addressed.. Section 3: Models for sustainable software engineering. Section 4: Green cloud computing. Section 5: Green mobile development. Section 6: Green data centers. Section 7: Green computing in education. Section 8 concludes the paper.

2. LITERATURE REVIEW
Many efforts were done in the literature with the aim of achieving green computing in different domains and reducing the negative impacts of ICT on the environmental sustainability. Naumann et al. [2] presented a reference model for sustainable software engineering (GREENSOFT) that supports different stakeholders in the whole lifecycle of software production. Berkhout and Hertin [3] defined three levels of ICT impacts on the environment and highlighted the importance of studying their rebound effect in which negative impacts over compensates positive ones. Mahmoud and Ahmad [4] defined green metrics in the stages of software production and stressed on the importance of two stages: requirements definition and testing. The model also discusses the role of software itself in achieving green computing. Capra et al. [5] studied the impacts of software on sustainability and proved that achieving a better performance does not guarantee better energy efficiency.

Atrey et al. [6] studied how the cost of the unlimited services of cloud computing leads to overcompensating the benefits and increases energy consumption and CO2 emissions. Dougherty et al. [7] described a model-driven green technique to avoid over-provisioning of idle virtual resources in cloud servers. The aim of this model is to provide a green auto-scaling technique, for allocating VM configurations, that preserves a satisfactory QoS. The problem is solved as a feature selection problem. Gai et al. [8] presented an energy-aware mobile cloud computing model that takes advantage of cloudlets to reduce energy consumption of wireless communications. Xu et al. [9] described an energy efficient algorithm for VM scheduling inspired by physical principles. Zhao-Hui and Qin-Ming [10] proposed a virtual machine scheduling algorithm that deploys VMs on data nodes with the least growth of energy consumption. Mukhtar et al. [11] presented a green strategy for determining the least energy consuming fog device to offload client application modules. Verma S. et al. [12] presented an energy efficient, but costly, algorithm that integrates load balancing and data replication for Fog-Cloud computing. Previous researches acknowledge that using virtualization CC (cloud computing) is itself energy efficient technology [13]. A.J. Younge and his colleagues proposed a green cloud framework a few years ago, but it covered only virtualization and data center operations [14].

Mobile devices are becoming an important and irreplaceable resource in our daily life. According to the International Telecommunication Union, the number of registers in the worldwide mobile network operators has already reached more than 4 billion of users [16]. Moreover, based on the International

Data Corporation's statistics, 494 million smartphones were soldworldwide in 2011. The sales of smartphones reached an annual growth of 62% from 2010 till 2011, expecting this increase to continue furthermore [17]. With this huge number of mobiles and mobile users, and taking into consideration their effect on the environment, regardingtheir energy consumption and the toxiccomputational operations on the cloud rather than executing them on mobile devices. For example, CloneCloud [18] is a system that allows partial offloading from smartphones to the phone's clone in the cloud. A similar idea was also investigated by Satyanarayanan et al. [19] and Cuervo et al. [20]. Another example from Chen et al. [21] who introduces a framework allowing heavy tasks on an Android phone to be offloaded to an Android virtual machine in the cloud.

When talking about going green in an environment that encounters rapid ongoing changes in the technological fields, the need of a business to "Go Green" is much needed. Green data centers view a great aspect into offering an energy efficient and ecofriendly computing environment. The burst of data centers began from 1946 where data centers where created by U.S. army to serve the military [22]. A green data center differs from a normal data center through the mechanical, electrical, and computer infrastructure is designed in a way to obtain maximum energy efficiency and minimum environmental damages [23]. Nada and Elgelany [24] mentioned in their article that data center consumes a huge amount of energy as the same time it plays a major role in producing large amount of carbon dioxide due to a fact that data centers are mainly composed of thousands of servers. Uddin et al. [25] mentioned in their study that a data center is composed of thousands of servers and is equal of the amount of a small city.

The topic of green computing in the education sector has been studied intensively in the literature. Many studies were conducted to assess the awareness and knowledge levels of green computing in educational institutions [26, 27]. In [28], German software users were surveyed for a study that addressed the environmental issues of software. The integration of sustainability into computing education was studied in [29], where three different strategies were presented. In [30], different techniques for practicing green computing in universities were proposed.

3. MODELS FOR SUSTAINABLE SOFTWARE ENGINEERING

Berkhout and Hertin [3] studied the impacts caused by Information and Communication Technologies (ICTs) on the environment. They presented a summary of the literature on the topic and classified the environmental impacts of ICTs into 3 categories. *First-order impacts,* the most obvious environmental impacts: resource use, pollution, electronic waste. *Second-order impact:* indirect environmental impacts of using ICT.*Third-order impacts:*indirect environmental impacts of using ICT that appear on the long term and may overcompensate the energy savings by ICT (rebound effects).

The authors identify that ICTs have both positive and negative impacts, and that each order effects appear based on the previous order effects. A major issue stressed in relation to the third order effects is the ***rebound effect*** of the use of ICT. The first and second order effects show that ICTs have the potential to reduce resources usages and energy consumption. However, a critical question is whether the long-term consumption of ICTs will overcompensate the conserved resources.

Naumann et al. [2] presented a reference model for Green and Sustainable software named *GREENSOFT* and gave definitions for *Green and Sustainable Software* and *Green and Sustainable Software Engineering*. The model also performs a refinement for the environmental impacts of ICT, defined in [3], to cover human and social sustainability issues instead of limiting them to environmental issues. The effects were identified as:effects of ICT supply (representing *first-order* effects), effects of ICT usage (representing *second-order* effects) and systemic effects of ICT (representing *third-order* effects). Naumann et al. [2] claimed that a sustainable software product should have a low impact on *Sustainable Development*, and that the development process of the software product should be environment-friendly. This is reflected in the definitions of *Green and Sustainable Software* and *Green and Sustainable Software Engineering* that were provided. Green and Sustainable Software:is software that leaves a small footprint on the environment.Green and Sustainable Software Engineering is the art of defining and developing software products in a way, so that the negative and positive impacts on sustainable development that result and/or are expected to result from the software product over its whole life cycle are continuously assessed, documented, and used for a further optimization of the software product. The *GREENSOFT* model also supports different stakeholders of a software product in developing, maintaining, and using it in a sustainable manner. The model comprises four parts:*Life Cycle of Software Products, Sustainability Criteria and Metrics, Procedure Models, Recommendations and Tools*. Mahmoud and Ahmad [4] proposed a model for a green software engineering process consisting of two levels (described below). The first level comprises metrics for the green assessment of every stage in the software engineering process. The second level addresses the role of software itself in sustainable development and green computing. The model followed the definitions of Green and Sustainable Software and Green and Sustainable Software Engineering presented by Naumann et al. [2] and their definition of ICT impacts because they consider human and social sustainability issues. [4] also included an additional definition which is Green and Sustainable Software Process because their aim is to provide green instructions for the whole lifecycle of software production.

3.1 First Level

The first level defines a software engineering process to mitigate the negative impacts of ICT on the environment. The process consists of seven stages of the software lifecycle: requirements, design andimplementation, testing, green analysis, usage, maintenance, and disposal. In [2], the part of *Life Cycle of Software Products* discusses impacts of ICT on sustainable development in stages of the product's lifecycle. However, they do not include the requirements and testing stages. These two stages were considered in [3] in contrast to many green software models. In addition, a green analysis stage was added to measure the greenness of the output of every stage.

3.2 Second Level

Another idea missing from the *GREENSOFT* model [2] is the software's role in reducing the negative impacts of ICT and improving sustainable development. The second level of the model presented by [3] describes how software can act as a tool to monitor efficient use of resources

4. GREEN CLOUD COMPUTING

Cloud computing reduces power consumption by providing cloud applications with virtualized computational resources dynamically upon request such as virtual OS instances. This technique requires keeping idle VM instances in a queue as standby for any request. Consequently, 70-80% of power consumption in data centers is wasted [33-36]. In order to avoid over-provisioning of idle resources, auto-scaling technique was introduced to improve server utilization of resources and support greener cloud computing by allocating virtualized computational resources, dynamically and accurately, to cloud applications based on their current loads. The objective is to maintain the auto-scaling queue in a green manner while preserving QoS. However, determining the number of VMs to fill the queue and their configurations would be very challenging.

Dougherty et al. [7] describes a model-driven green technique for sustainable *auto-scaling* cloud computing infrastructures called *Smart Cloud Optimization for Resource Configuration Handling* (SCORCH). The authors mention three main challenges of configuring VMs:The need for recognizing the VM configuration options of cloud applications and their constraints, the choice of VM configurations to be kept in the auto-scaling queue that can warrant a satisfactory QoS and the optimal auto-scaling queue size.

SCORCH addresses these challenges based on the following four functionalities: (1) Feature models [32] are used to represent VM configurations, implementation details. (2) Cloud applications are requested to inform *SCORCH* about the VM configurations that it will ask for. (3) Feature configuration problems are transformed into constraint satisfaction problems (*CSPs*) and an objective function is defined, to aid in deciding on the appropriate settings of the *auto-scaling queue*. (4) Optimizing the objective function yields an optimized the *auto-scaling queue*.

The greenness of *mobile cloud computing* is linked directly to the stability and efficiency of the wireless communications. Gai et al. [8] introduced a dynamic energy-aware cloudlet-based mobile cloud computing model (*DECM*) that takes advantage of cloudlets to reduce the amount of energy consumed by wireless communications. The main objective of the model is to providegreen computing on mobile devices without affecting the *QoS* in cloud services. The nearest cloudlets receive requests from mobiles through the virtual machines corresponding to client applications. A cloudlet may switch a client's connections to another one if it can provide better and greener service. Cloudlets are coupled with dynamic programming algorithms that enable them to find the most convenient cloud servers to connect with. The *DECM* algorithm is a minimizing algorithm for the cost of the wireless communications in *mobile cloud computing*.

Xu et al. [9] addressed the issue of VM scheduling algorithms that affect the efficient migration of virtual machines between nodes of the cloud. The authors presented a VM scheduling algorithm, *VMSAGE*, inspired by the physical gravitational effect, as an improvement of the simple scheduling algorithms. According to the physical concept of gravitation, the algorithm shuts down data nodes having a low utilization rate and migrates its VMs to other nodes with good heat dissipation in order to avoid overheating. The system decides which VMs will migrate before others based on initial speeds of migration. VMs with very high utilization rates, having large amounts of resources, or placed in servers with very high temperatures are assigned higher values of initial VMs than others. VMs are migrated to other servers that are selected based on lower costs of migration and heat dissipation. The *Cloud of Things* paradigm *(CoT)* was introduced to overcome the problems of limited storage capacities and computational capabilities in *IoT* devices. However, *CoT* was shown to be inefficient for applications that require high latency. *Fog Computing* was introduced by *Cisco* to support the provisioning of *IoT* applications by bringing computations towards the edge of the network. This technique has various benefits such as reduced energy consumption in data centers and improved latency and network bandwidth.

Mukhtar et al. [11] presents a green strategy for allocation of application modules in fog devices. Its objective is to determine the best suitable place for offloading, in the Fog or the Cloud, taking into consideration energy consumption, CPU capacity, and desired response requirements (or tolerable delays). This approach was assessed by measuring energy efficiency in a remote patient monitoring system (RPM) and comparing the results with those of two other approaches. The results show that the proposed approach reduces energy consumption.

5. GREEN MOBILE DEVELOPMENT

In [16] different perspectives to study energy consumption on mobile devices were discussed. A first approach is from the perspective of instructions processed by the Central Processing Unit (CPU). Whenever the amount of code or data the system needs to fetch from the cache increase, the energy consumption will eventually increase as well. Another approach is from the network perspective. For example, using 3G network connection consumes more energy than using 2G network connection. The last approach discussed was from the application perspective. Two factors were addressed in this section: (1) Bluetooth usage and (2) the SMS message size. It was proven that using the mobile with Bluetooth enabled consume much more energy than using it with Bluetooth turned off. Regarding the SMS message size, sending multiple SMS messages of smaller size will consume more energy than concatenating these messages into fewer SMS messages but of larger size.

In [17] some actions were recommended to save energy. The first recommendation was for mobile applications to operate in networks that offer best-cost benefit rate. For applications that are used to send data (e.g. email applications), consider the alternative of delaying the sending of data, so that the maximum number or requests can be triggered at once. Moreover, applications must make use of parallel connections to transfer data, a strategy that would save a lot of energy. In [17] a mobile computing prototype called GMECloud that utilizes energy efficient mobile devices (e.g., smartphones and tablets) as computing resources is proposed. The mobile client's application checks the status of the device, if the device is ready, it connects to the server. The status of the device is defined in terms of different characteristics, for example, the CPU usage, the device battery level, etc. The server splits the job into smaller tasks; these tasks are then distributed to multiple clients. If the number of active clients is high, the server will assign to each client fewer tasks. This means that the time required by each client to finish the assigned tasks will be less.

In [15], a novel approach is proposed where Middleware is coordinating between mobile and cloud computing techniques to achieve green computing for next generation.The major approaches of the Green Computing are Product longevity, Software and deployment optimization, Power management, Materials recycling, Telecommuting and Low performance computing. A middleware is a software infrastructure, it binds together the applications, operating systems, network hardware, and network stacks. Its major task in this proposed architecture is to evaluate Data center power, Operating system support, Power supply, Storage, Video card, and Display.Green Cloud Computing System Architecture Technologies consist of five core technologies: Scalable Network Architecture, Energy-efficient, Cooling and Power Efficient System, Modular Cloud, Computing

System, Scalable Virtual Internet Appliance and Flash Memory Based Cloud Storage System. In [37], the main concern is to highlight the energy related issues as early as possible in the software development life cycle (SDLC) of an application making it more energy efficient and reducing the cost regarding energy consumption. This paper divides the green technology, as mentioned before, on all the stages of the software development life cycle (SDLC) of a given application. It starts with **Green software requirement specification**, means that there may be additional software requirements to maintain the developed software. Next, **Green Software design**; the main concern of the software developers is always the software structure, the modules needed, the software architecture, etc. While energy efficiency is a main part for a good software design, it's rarely taken into consideration by software developers at this stage. Moving forward, **Green Software Implementation** focuses on reducing the application CPU consumption, the number of parameters used, and many other factors that affect the energy consumption. Regarding the testing phase, a **Green Software Testing** takes into consideration the number of people and the amount of equipment allocated to test the energy used by the application, of course based on predefined test cases related to energy consumption. Finally, **Green Software Maintenance** tends to perform regular maintenance tasks that will keep data transmission at optimal efficiency.

6. GREEN DATA CENTERS

6.1 How Green Is a Data Center

Before taking a risk, an industry must first study the level of energy efficiency which is the level of energy consumed by the industry. Based on the quantitative results that issued from energy efficient measures we can decide what suitable techniques we can use in order to turn the data centers to become ecofriendly. In [23], Mata-Toledo and Gupta mentioned two important metrics which are, the Power Usage Effectiveness (PUE) and Data Center Efficiency (DCE). They mentioned too an aid to the following analysis such as tools known as the "The Green Report". However, Siso et al. [38] focused on metrics technique called CoolEmAll that focuses not only on Energy consumption but also on Heat-aware metrics. They pointed out, that the reason they introduced CoolEmAll metrics is because of the reason that standard metrics such as, CFD, PUE doesn't allow any space for predication of energy performance to enhance the energy efficiency. CoolEmAll provides analysis tools for data centers efficiency according to IT equipment. Moreover, Wang, Khan [39] presented in their study more metrics in order to measure the consumption of energy performance in data centers. The aim of their study is to know how green a data center is through different matrices and measurements and according to that information possible techniques can be taken for a data center to go green. They pointed out that there are two methods for going green either to involve green requirements into building the infrastructure of the process or to green up the process of a working data center in every day usage.

6.2 Optimization Methodologies

Moreover, after measuring the efficiency of a data center in an industry, there must be certain measures taken in order to come up with an ecofriendly data center. In their study, Sari and Akkaya [40] mentioned that one of the greatest threats that affect green data centers can be divided into two groups. First threat, consists of the in ability to manage the cost crises that is born due to the divergence in determining the efficiency performance technique from one hand and the calculating the performance of the server. Another threat relates to data centers is the release of carbon dioxide that results from data centers to the atmosphere. The authors presented two methods of techniques into data centers to handle these threats. They first presented cooling method know as liquid cooling approach that is put into action its only limitation is that it is geographically dependent which means it must be located in cold areas so that cold water is formed that will reduce temperature and hence reduce the consumption of energy. Another cooling approach is known as direct cooling that is responsible for reducing energy consumption. In addition, another technique is presented that relates to using energy efficiency servers which are achieved by using renewable energy resources to power up the data centers. Another way to produce efficient energy that was provided in this study is either to use of virtualization software through virtual machine. Furthermore, Ghani, Nikejad, Jeong [22] presented in their paper a series of techniques that enables a data center to go green by saving the consumption of energy. They managed to divide their field of work into four fields by presenting energy saving techniques for servers, energy saving techniques for networks, energy saving techniques for a combined environment of servers and networks, and finally by energy saving techniques by using renewable energy. As for servers, it's known that server is the main consumer of energy in data center so establishing power saving environment is vital in this area and it is covered through methodologies such as, server virtualization that tends to minimize the number of hardware in use and decrease the amount of functioning servers through making more than one virtual machine on server. Another technique known as dynamic power management that handles to puts down the computing servers when they are not. Yet a third technique known as dynamic voltage scaling that sets the CPU power according the level of load. Ghani et al. managed also to cover techniques that help to reduce energy consumption in networking fields due to that fact that networks infrastructure is the second consumer of energy after servers by utilizing 30% of energy used for powering data centers. One of the techniques is known as sleep mode that manages to switching of the networks resources or putting them to sleep mode whenever they are not in use.

7. GREEN COMPUTING IN EDUCATION

Many work and studies have been made in order to improve the green computing awareness and practices in the education sector.

7.1 Awareness on Green Computing in Education Sector

The awareness and knowledge of green computing have been addressed by different surveys and studies where different target groups were surveyed [42, 43, 46, 28]. Many studies were conducted in the literature to comprehend the level of knowledge and awareness of green computing among university students [27, 44, 30]. In [27], Dookhitran et al.conducted a study to check thelevel of awareness of green computing among students in the University of Technology in Mauritius. The survey was designed for students of the School of Innovative Technologies and Engineering. The main goal of the study was to check and analyze the level of awareness of green computing focusing on student's computing related activities and their computer literacy. The survey questions focused on the hardware aspects. Findings showed thatstudents, in majority, are computer literate but they lack knowledge of some major green computing practices (e.g. screen savers.) In [44], Selyamani and Ahmad conducted a study that addressed the student's awareness of green computing issues in higher education institutes focusing mainly on hardware aspects. The survey was undertaken by students from Higher education institutes in Malaysia. The study findings indicated that students, mainly non-ICT, lack the green computing knowledge. In [30], students and academic staff at Botho College in Botswana were surveyed in order to check and measure the levels of awareness regarding green computing and the negative influences of IT on environment. The study was also conducted to check if any green computing policies are established in the institution. Interviews with staff of the IT department were also prepared and organized. The results showed that the level of awareness regarding green computing is low, and that no green computing policies are set in the institution. Furthermore, findings indicated that changes in behaviors and use of technology and IT can be reached by exalted education.

7.2 Approaches to Creating and Raising Awareness

The topic of creating and raising awareness in the education sector has been studied in the literature where different and many ideas have been published. According to [30], creating a website that contains different green computing information, procedures, policies and tips is one solution to create awareness among students in a university. Pang et al. called for the extending the aspects of green computing in the educational programs [41]. Dookhitram et al. proposed that environmental IT information can be spread by the information channels that are mainly used by the students [27]. Haraty et al. suggested engaging students in educational activities and including awareness campaigns in the educational curriculum [26]. In [45], Suryawanshi presented a number of techniques that raise the awareness of Green ICT such as: Including an obligatory green ICT program course in all universities, to train learners about the importance of implementing green practices by starting Green Computing Certification course, to present rewards for educational institutions and educators (Green Institute, Green Teacher) that best embrace green practices efficiently as a motivation, effective promotion of green ICT practices, and encouraging faculty and students to choose webinars instead of traveling and adopting online education mechanisms in universities that will lead to less carbon footprint [45].

7.3 Green Computing Techniques to be used by Educational Institutes

A lot of studies have been conducted and ideas have been published in the literature about the measures that needs to be taken by educational institutions in order to improve the practicing of green computing [46, 47, 48]. An overview of some measures is provided in Figure 1. Many work and studies have been made in order to improve the green computing awareness and practices in the education sector. However, more green awareness should be raised among students. Educators and educational institutions have a crucial role to play in order to promote and spread green computing awareness among students. Moreover, many measures should be taken and many techniques should be used in order to practice real green computing in educational institutes.

8. CONCLUSION

Technology has become a major cause for global warming whenever treated inefficiently. A huge urge is needed to save our environment before it's too late. In this paper, we went over different approaches to "GO GREEN".We also addressed the software engineering models for green computing, and the four different perspectives for this topic: Green cloud computing, Green mobile development, Green datacenters and the importance of greencomputing in educational sector .The usage of green computing by normal people contributes to their harmonic existence in knowledge society, and this corresponds quite well to basic objectives of cognitonics [49,50].To sum up, this paper is intended to be part of the research that have been ongoing to increase the awareness of people towards this topic and presents different approaches that will help whenever applied in software development.

Measure/Technique	Source
Online Learning: reduce the pollution that results from students and faculty travels by adopting online learning techniques such as video conferencing and web conferencing. **Implementing Green Computing in administration and in sharing information:** use of online examination systems instead of paper-based exams, using software application to submit student information such as grades and attendance, reduce the use of papers by introducing online applications, forms and petitions, introducing online system for fees payment, use of online brochures thus saving papers and conserving power. **Saving electricity:** educational institutes should consider the huge power consumption that result from the use of computers on its different offices and classes. ENERGY STAR labeled computer equipment should be purchased and should replace energy inefficient equipment (e.g. LCD monitor instead of CRT one)	[46]
Upgrading Computers: upgrading specific components (CPU, system memory) in the computer in order to prolong the lifecycle computers and improve performance. **Power saving modes:** computer power consumption can be managed in an efficient way by using the most "green" and efficient computer power saving mode. Different modes include sleep mode, hibernate mode, system standby mode and hard disk sleep mode. The Hibernate mode proved to be the most effective among other as it power off the computer completely. **Eliminate Phantom Loads:** by using of power strip devices that power off in an automatic way powered off devices that are plugged into the strip.	[47]
Virtual Desktop Infrastructure (VDI): exploiting the green benefits of virtualization (operation efficiency, compatibility, ease of management, simplicity of deployment, low carbon emissions etc.) by implementing VDI in educational institutes. The implementation of VDI has proved to be power efficient as it saves power and consumes low energy compared to non-virtual infrastructure.	[48]

Figure 1: An overview of some green computing measures to be used by educational institutes

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Art and Culture as a Mirror, Testimony and Testament of Their Times

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ABSTRACT
Art and culture reflects the time in which it was created. They seem to be a mirror but also testimony and testament of their times and as such should be protected for our identity, memory and development. The ephemeral or experimental nature of some modern materials and new technologies used in contemporary art and the nature of the works themselves determine their future when subjected to the process of ageing. In contemporary art, the work of art has ceased to be merely a physical object, but has become a hybrid incorporating different meanings, relations and processes in addition to its material substance (traditional materials, new technologies, ready made etc.). This creates new challenges in conservation-restoration in the field of theory and practice and it is necessary to rethink paradigms and educational profile.

Keywords
Contemporary art and culture, liquid modernity, Baumann, new paradigm of conservation-restoration of contemporary art, new materials and technologies, synergy in analysis, care and conservation-restoration, education

1. ART REFLECTS THE TIMES IN WHICH IT IS CREATED
The creation of art has always been accompanied by a desire to protect and preserve it for future generations. The form in which it survived was determined not only by the interpretation of the work, but also by the times, people and culture that it reflected. Throughout the centuries, the development of European art has been largely based on producing enduring and valuable objects through the use of the highest quality materials and the maintenance of the correctness of the techniques and technology by which they were created, according to principles developed for generations. From the end of the 19th century, the situation began to alter, to change dramatically in the early 20th century.

New times have generated new needs; this also applies to the art that reflects their diversity and dynamics. The Polish philosopher Zygmunt Bauman created the notion of the civilization of the twentieth and twenty-first century as a “liquid modernity”, resulting from advances in technology, telecommunication and transport. The core of liquid modernity is the absence of anchoring features (identity, values, capital) and the absence of borders (in consumption, geopolitics, commerce and communication). It is defined by three categories: variability, relativity and pluralism. In a liquid modernity, culture and art are constantly undergoing deconstruction of meanings.

New times have put new, modern materials and technologies into the hands of artists. New forms of art have emerged that extended beyond traditional artistic disciplines both in the sphere of ideas and in the materials used in their creation. The selection of materials began to reflect the randomness of everyday life, so the material used could be unstable, worn out, of low quality, or used in an experimental way. Issues related to authorship and reproduction were also re-evaluated.

2. CHANGE OF PARADIGMS IN THE PROTECTION AND PRESERVATION OF CONTEMPORARY ART
Globalization, new technologies, dynamism of today’s life have huge influence on culture and art. The wealth of ideas and means of artistic expression employed in contemporary art raises the question of preserving the authenticity of the work, and the answer implies careful decision-making in terms of its protection and conservation. The body of conservation-restoration theory and practice related to traditional art must be a necessary base, but at times it proves to be inadequate to cover all issues. For centuries, there have been a variety of manners in which the authenticity of a work of art was understood, and theories about this were at times contradictory. As a result of the debates on the conceptual suggestions of Emanuelle Viollet-le-Duc (the idea of stylistic unity), John Ruskin (the doctrine of non-intervention), Camillo Boito (the use of minimal intervention and the principle of distinguishability of added elements), Georgio Dehio (respect for the whole history of changes affecting the historical object) and others led to the establishment of the main dogmas of the ethics and practice of conservation-restoration in the Venice Charter (1964). The broadening of the scope of the preservation of the heritage by taking into account cultural diversity (Document on Authenticity, Nara 1994) and intangible heritage (Convention for the Safeguarding of the Intangible Cultural Heritage, UNESCO, Paris 2003) led to a realignment of the dogmas of the imperative of the preservation of the material within the object, the principle of minimum intervention, the impermissibility of the exchange of original elements, and the postulate of reversibility of conservation-restoration treatments. This is close to the concept of the preservation of the ideas and material of contemporary art.

In the light of that, in digital world, in what way must the approach to the care of a collection of contemporary art differ from the practices and principles determined for the preservation and exhibition of traditional art? In the case of traditional art, principles were established according to which the original material had an absolute value. Conservation was aimed at prolonging the life of the unique physical object. New approaches that influence conservation-restoration decisions are the result of the unique character of contemporary works of art. They integrate different media and objects, space and place, contexts, new technologies and sensual elements to form a whole. The material sphere becomes the carrier of a certain idea. Additionally the physical and psychological involvement of the viewer should be treated as an integral part of the work.

In the case of the preservation of contemporary art, one might almost say that we are dealing with "post-conservation". Similar to the concept of "postmodernism" – this is the space of confrontation of different tendencies and concepts, the common denominator of which is critical thinking based on the extremely individual assessment of each case. Here however we encounter a certain threat, the „lack of boundaries", the deficit of rules and a stable anchor point in values, the relativity, mutability and the excess of pluralism about which Bauman wrote. The sense of freedom which, in the case of postmodernism, manifests itself in the eclectic selections from various conventions, styles and languages in art, carries the risk of destroying the values established over the centuries by conservators-restorers and curators of works of art.

3. DILEMMAS ABOUT MATERIAL

The variety of artistic attitudes does not allow the adoption of clear solutions for the preservation of a work of art. The traditional approach to keeping the work in the best possible condition by slowing down the degradation process, in many cases will be a rejection of the sense of some objects of contemporary art which involves the spheres of change, destruction, the activities of the viewer, and the survival, not of the original substance, but its remains. "This is not to suggest that the treatments are more difficult but that the decisions of what or whether to treat can be more complex and are often without precedent". For example, according to the principles of conservation-restoration ethics established with reference to traditional art, it would be unacceptable to replace certain elements of the work with new ones, their reconstruction, emulation or re-installing. For works of contemporary art, however, the lack of such operations could lead to a negation of their nature. One example might be the picture of Jan Tarasin *Przedmioty policzone* [Counted objects], (1970), with elements of colored plastic stuck to its surface that had, as a result of incorrect storage methods, lost about half of these elements. The missing elements were recreated as a result of the decision of the conservators-restorers and the owner (the son of the artist, who stated that, because the object's expression as a three-dimensional character would have been lost and the picture could not be displayed without them, his father would certainly have wished that). As an aside, as a long-time lecturer at the Faculty of Conservation and Restoration of Fine Art of the Academy of Fine Arts in Warsaw, as well as an active conservator-restorer of works of art of the past and present, I have noticed a certain tendency; young conservators-restorers show much more humility and caution in making difficult decisions about contemporary art (in, for example, reconstruction, emulation, replacement of new elements) than those conservators-restorers who remember the times in which a given artist lived and created.

4. NEW APPROACH IN THE EDUCATION

In this „post-„ period (when we are faced with post-truth, postmodernism, post-politics etc. – in other words concepts which are in opposition to the basic ones formerly in existence), there exists the risk that the lack of well established conservation doctrines resulting from the open nature of modern and contemporary works can introduce confusion and an excess of subjectivity in the field of the ethics and practice of conservation-restoration. The remedy for this is the professionalism and synergy of activities and attitudes in the creation of conservation-restoration strategies for active and preventive conservation of a work of art, through careful analysis of its constituent appearance, materials and concepts, as well as the dichotomous nature of its material and non-material layers.

Education is of prime importance. It is easy to cross boundaries if you are unaware of their existence. Polish experiences show that the multi-aspectual training of conservators-restorers is important, and this is achieved through a six-year multi-disciplinary course of studies in the conservation-restoration of traditional art conducted in an institute of higher education, in the course of which in the last year of studies there is a parallel specialization for students showing a predisposition to undertake studies in the field in the conservation of contemporary art. Knowing the ethical and technical rules that they will sometimes go beyond, the young conservators-restorers know how and why they must do so. They have thus an awareness, backed by a basic but already relatively broad knowledge and experience. And it is worth mentioning that, due to a cruel history, many works in Poland have been preserved in poor condition, so that the conservator-restorer is able to gain experience during their studies with objects that are connected with many different problems of active and preventive conservation. In practice it turns out that this comprehensive education, openness to new experiences and the ability to cooperate are a good basis for the training of conservators-restorers who are able to cope with every situation, including working in contemporary art museums. I noticed this being a member of the commission of the Ministry of Culture and National Heritage that allocated resources for national and regional collections of contemporary art, for which applications had to be supported by the opinions of conservators-restorers. It turned out that even in the case of small cultural institutions, even a conservator educated and practicing in the field of the protection of the traditional arts was well aware of the problems of contemporary art collections.

The education of conservators-restorers who have the most direct influence on the work is one thing. The preparation and appropriate approach of all other people who have to deal with an art object during its lifespan is another. As far as the shape of the work and its state of preservation are concerned, this is determined not only by the artist (who selects the specific artistic means, materials and technology at the time of creation), but also all the stakeholders from acquisition to a collection - through packaging, storage, transport, together with the both active and preventive conservation measures applied, also those connected with the sphere of interpretation and display of the exhibited works. And over-interpretation is not difficult. Another condition of the adequate protection of contemporary art is thus the degree of the co-operation between its carers, which is based on collaboration with various specialists (curators, conservators-restorers, archivists, registrars, audiovisual technicians etc.). For a conservator-restorer of contemporary art, such interdisciplinarity is an obvious consequence of the complex character of the works. For example, the preservation of the work *Dokumentacja Galerii Foksal* [Documentation of Foksal Gallery] by Tadeusz Kantor (1970), which is a roll of cotton canvas 17 metres long with silver gelatine prints depicting the history of one of the most important Polish contemporary galleries printed on it, required consultations with photographers, fabric technicians, art historians, archivists and the work's owner.

It is also obvious that it is necessary to directly consult the artists or their collaborators to obtain information "from the source" about the creation process, the material and artist's own assumptions concerning the preservation of individual elements and the whole object. Interviewing the artists facilitates the identification of materials and, above all, justifies their selection, binding them to the message carried by the work.

The role of science in the process of preserving and conservation-restoration of works of contemporary art is also undisputable. Undertaking analyses and research to identify materials and techniques, identifying causes of damage and determining preventive methods is important here because of the often unconventional and experimental nature of the work, affecting holistic conservation-restoration practices. In Poland, because only the most important museums have their own research laboratories, these needs are fulfilled to some extent through co-operation in research projects between museums and scientists working in universities, academies of fine arts and research institutions.

5. PROBLEMS WITH NEW MATERIALS, TECHNOLOGIES AND APPROACHES

New forms of artistic expression appeared together with the rise of modern art, and they force us to incorporate in the strategies of curatorship and conservation-restoration such aspects as ephemerality, processuality, performativity. But concomitantly, the material of the work is a carrier of the artist's ideas and creative thoughts. Problems arise from the limitless combinations of materials that can be used to create a work: artistic and non-artistic materials, readymade objects, technology applied experimentally, and the use sometimes of substances that are dramatically unstable (such as some plastics) or time-based media. We also increasingly find ourselves dealing with materials whose instability was not intended by the artist. Examples include fragile polyester sculptures by Alina Szapocznikow or the color-changing polyvinylchloride (PVC) mannequins from the performance of Tadeusz Kantor's *The Dead Class*. While plastic is generally regarded as durable and unchangeable, in some cases we can observe their chemical and physical degradation to destruction. This is a burning issue, especially as the process, once it has been initiated may continue, even though the original stimuli that gave rise to the problem are removed. Preventive conservation may be able to slow down these processes. Problems include the use by artists of new materials and technologies. An example of this is the use of certain plastics that should be stored in an anaerobic environment - anoxic chambers, airtight containers or envelopes equipped with appropriate absorbers, while others require constant air circulation. Other problems involve the complex character or size of some works (e.g. installations) that require the introduction of new procedures and changes in museum practice. Sometimes the use of new materials, often from outside the usual repertoire of artistic media, which are used in various combinations and sometimes act on one another destructively (e.g., the combination of some plastics with metal), can result in the production of undesirable effects during ageing. It is therefore vital for all those who have museum collections in their care to be aware of the risks resulting from the nature of modern art objects (such as through inadequate packaging, storage and transport), as it is rarely possible to rely on routine resolutions to these problems.

Should we really take such care of the future of this strange, unconventional art? As the British economist John Keynes said, "in the long run we're all dead", so who cares? Conservators-restorers do. And their decisions determine whether the identity of contemporary art and culture will survive.

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Technology and the Socio-Human Transformation in the World Structure

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ABSTRACT

Technology has been the base of human civilization. But contemporary technology began to exceed human being. The alienation of human being by technology defines the condition of human existence. This paper tries to suggest a basic idea to overcome this absurdity.

Keywords

technology, world structure, Faustian bargain, human alienation
globalism, socio-human transformation.

1. INTRODUCTION: IGO MATCH

In 2017 a big event between human being and AI was held: a Go match between Lee Sedol, a Korean Go master and Alpha Go, an AI which was developed by Deep Learning.

Until then it had been believed that AI cannot win the first class professional human Go player, because it needs an astronomical calculation to analyze the complicated situation on the Go board, which composed of 19 lines by 19 lines, all 361 dots, and select the best strategy and tactic in the situation. Theoretically it has 361! (factorial) options of move, and actually 2.08 x 10^170 moves are possible, which is more than the number of the whole atoms in the universe. But the result was 4 to 1 victory of Alpha Go over Lee Sedol.

At the end of the previous century, there had been already the awareness of the status of human being in rapidly changing environment of technology, predicting the time when computers exceed human intelligence.

> Before the next century is over, human beings will no longer be the most intelligent or capable type of entity on the planet [6].

It seems to have been realized much earlier than had been predicted. Man succeeded in making a machine whose intelligence is far beyond man itself. Man made a monster which may not be controlled by man. Or did human being create a god, whom he cannot win?

2. HUMAN BEING AND TECHNOLOGY IN WORLD STRUCTURE

2.1 World Structure

The world consists of three elements: nature (N), society (S) and human being (H). Society is set of a kind, human being is the whole as an individual as well as a part of a society, and nature is its environment.

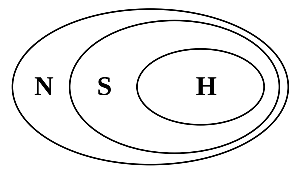

Figure 1: World Image

Figure 1 shows this structure. Human being constitutes society with the same kind. Society is not a single entity, but a very flexible concept. There are various kinds of society according to the degree of similarity of the same kind.

Human beings compose a society and respond to the nature. And the technology is the way how human being and society respond to the nature.

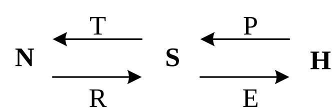

Figure 2: World Mechanism

This relation is depicted in Figure 2, which represents a simplified system of the world. H organizes S by politics (P), and S contacts with nature by technology (T). Nature feeds back resources (R) to S, responding to the intensity of technology. S distributes this R to H through the economic system (E).

Here technology functions

> as a particular way of 'experiencing' or 'disclosing' the natural world, which is transformed into exploitable resources and practical opportunities…([4], p.27).

Usually human beings respond to the nature as a society. Robinson Crusoe should and could make instruments to respond to nature[1], because he was exposed alone to nature apart from society. In ordinary world situation, human being is better able to respond to nature, socially. Social brain is

[1] Recent study shows that Robinson Crusoe was a novel based upon real episodes in Daniel Defoe's era.

more efficient than individual brain.

2.2 Transformation of Human Society by Technology

Human beings as society face technologically with nature. They functionalize their lives. Technology as the responses to nature transforms society and changes human being. Therefore the history of technological development means the history of human development in the nature.

> …technology, which is itself shaped by society, actively shapes society by influencing the way in which people behave, the way in which social roles, relations and institutions are constructed, and the manner in which culture manifests itself [1, p.39].

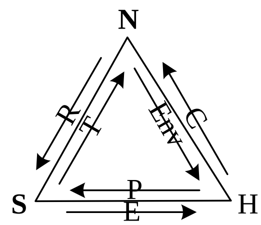

Figure 3: World Structure

The mechanism of the world is expanded to the Figure 3 World Structure from Figure 1. Here human being cultivates nature, which results in culture (C) and nature provides environment (Env) to human being.

Technology defines society, civilization and human being itself. Society, not human being, decides whether to accept the technology or not. Technology comes into the society with its own logic. Human society is transformed on the technological base as a predefined condition. Technology, not only politics, directly changes the society[2].

Civilization is based upon technology. The development of civilization means the development of technology.

Agricultural Revolution ten thousand years ago, Industrial Revolution some 300 years ago had resulted in civilizations specific to the technology systems, and the transformation of human society. And now the 3rd revolution[3], IT Revolution, has just begun.

Alvin Toffler developed his socio-evolution theory based upon this macro view on civilization: the first wave (Agricultural Revolution), the second wave (Industrial Revolution) and the third wave (Information Revolution).

> Technologies,…,are embedded within 'forms of life' which simultaneously 'provide structure for human activity' and 'reshape' it, thereby transforming the meanings of those activities [9, p.58] quoted in [4, p. 28].

A great leap of technology transforms a society as a whole.

Industrial Revolution changed the agricultural society into modern, industrial civilization. IT revolution changed industrial society into cyber civilization. The base of life, and the framework of the society changed. Paradigm shift had taken place, and the new IT generation couldn't understand the life style of the old generation when people had not smart phones, because technology is a mode of being, a way of life or a kind of thinking [8, p. 94].

In Figure 2, technology acts on nature, and nature feeds back resources to society. If technology increases its efficiency, then resources increase. If there is a great leap of technology, then there appears a great growth of resources, which act as the stimulus to change sociology.

The development of productivity leads to the change of social structure. Historical development of productivity defines human society. When capital and labor are equal, productivity depends upon technology. Therefore the development of technology changes social structure. Table 1 shows the 3 stages of transformation in human history, according to the Figure 2 schema.

In individual human level, we can adapt this schema to the development of musical instrument. T leads to the deepening and expanding of R (musical resources). When H cultivates N based upon a new T (Figure 3), R is an artistic result, which is the creation of unlimited production of sound color. This stimulates human intelligence and even spirituality, transforms human existence through elevated aestheticism.

Table 1: Technology and the Social Transformation

	Technology	Resources	Society
1st Revolution	T1: Agricultural	R1: Accumulation of crops	S1: Tribe, birth of social classes
2nd Revolution	T2: Industrial	R2: Steel, chemistry and electricity	S2: Nation state
3rd Revolution	T3: Informational	R3: IT	S3: Global society

3. FAUSTIAN BARGAIN AND THE ALIENATION OF HUMAN BEING

3.1 Convenience and Faustian Bargain

Technology provides convenience to society, but it does not guarantee happiness. If convenience means happiness, contemporary men should be

2 A business man told his success story: "I had wished to be a politician, but having seen that tech moves faster than the politics and changes everything, I decided to start up. At first I tried to change health care law, but I changed my mind, when I saw one of my friends make mobile app and linked tens of thousands of doctors and patients". (http://biz.chosun.com/site/data/html_dir/2019/08/26/2019082600279.html)

3 Recently we often hear of 4th Revolution. This is the result of dividing the 2nd revolution in detail. In this paper, this 4th Revolution belongs to the 3rd Revolution, in Table 1, from the long term historical point of view.

thousand times happier than Stone Age men. But those who are living in the 21st century seem to be less contented than those who had been living in any other age.

Convenience is a function, and happiness is essentially related to human existence. Convenience can be a necessary condition for happiness but it is not the sufficient condition for it.

Technology has two-sided coin: bright side and dark side. Functionality without valuable purpose, with wrong direction, is dangerous.

I suggest the formula of happiness as below [5]:

$$H = \frac{R}{D}$$

Here H =happiness, R =Resources and D =human desire.

In this formula the technological development provides human society the increase of R , the physical condition of human happiness. But if the speed of D growth is faster than that of R , H decreases. So technology is not the absolute condition for the happiness. T gives some level of convenience for H , but market stimulates D more than R . Therefore H keeps on decreasing.

Technology compels human beings to make a Faustian bargain. It tries to exchange human identity with physical convenience, which is extra condition to human existence[4].

Human beings give up the essence of human existence through this bargain. Convenience of network or smart phone changes the meaning of life. Human beings seem to be happy to get some convenience by providing his ID (identity) to the internet. Is this a good bargain for human?

3.2 Human Alienation in Technocentric Society

Now nobody can live without smart phone. Preconditions of human lives became complicated and multi-layered. Human beings cannot stand alone as a natural being. He can exist only on technology. As the object of technology, human being is an atom with smart phone, which dedicates every kind of personal information to the huge network system, and various kinds of organizations are social molecules

In Figure 4, technology is centralized. It is at the center of world structure. Now every element of the world structure is linked only through technology. Functionality stands above the entity. Now is the time of technological sovereignty. Humanity gave away its entity to the functionality and has fallen to the status of second class being.

Technology has been the liberator of human being from the nature, the mediator between nature and human society, but now it tries to take the central position of the world and is becoming the controller and the oppressor of human being. The anthropocene era was thought to have just begun, compared to the beginning of the universe or the birth of the earth,

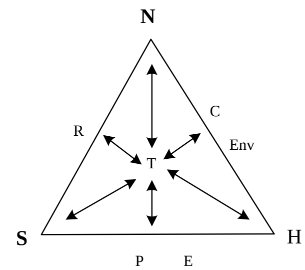

Figure 4: Technocentric World View

but almost at the same time we are now entering in the technocene era. Technology defines human beings. Now the concept of humankind became to include not only human being, but also humanoid, in other words, not only carbon human but also silicon human [2, p. .237]. Here the new era of alienation comes, which is different from that of Industrial Revolution era: alienation of human being by IT. Someday in the near future the silicon humanoid will assume the position of carbon human being.

A rapid and profound technological change is called Singularity [7]. Here transition from human being to humanoid will take place and technology becomes humanized so that the society will have to include more intelligent humankind, as the same kind equal to human being. Since then human being loses its sovereignty over itself and becomes alien and subordinate to what he himself created.

3.3 Human Value and the Logic of Technology

The logic of technology is different from human value system. The former has its own logic of development and it confronts with the latter.

Technological change seems to be value-neutral, but it is not. Various kinds of human value are attached to it. It is often biased to negative value, linked to market-oriented human activity, not sufficiently reflecting the general will and value of human kind. When internet was introduced globally, it was welcomed worldwide. But it should have been introduced on global consensus, because it was not the absolute good. It has dark sides as well as bright sides. Several years after we began to enjoy it, we suffer the computer virus and many other non-ethical, anti-values which are parts of our daily lives now.

The reason why technology cannot be controlled according to general will of human kind is that it is used as a method to overcome others between mega competitors such as states or big companies which possess their own R&D facilities. This absolute necessity of technological development by big organizations dwarfs individual human beings and the society.

The competition between nations is mainly political, and that between companies is economic. This politico-economic reason of technological development leads to the human alienation by the subordination of human

[4] Oswald Spengler says in a different nuance that Faustian man is he who strides forward in an ever-increasing alienation from Nature ([4, p.26].

being to the technology, in other words, self-negation of human being by man-made technology. Human society creates the situation which it cannot control because of its internal disunity, even though it is aware of that.

The world operates on similar technological standards. Technology is globalized and made the world globalized. Technology has been commercialized and expanded worldwide. Technology has its own logic, which might be antagonistic to human value and under the globalization it might cause the global crisis. The evidence of the fact that the world had completed the globalization technologically includes the ironical case of Y2K or recurring global financial crisis, which reflects bad aspects of computer modelling of financial commodity.

The historical stage that links every part of the world through network, based upon the same technological standard, routinize the global crisis.

Contribution to the development of technology has been a kind of patriotism for scientists and engineers. They worked for their nation, not for human society. A country has been the absolute society they belonge.

So that competition between states justifies unlimited technological development. Technological development is summum bonum to each and every state. Especially since the Industrial Revolution, it contributed to the ideology of the strong nations.

Industrial Revolution was developed rather inside the national borderline, using coal and steel. But the IT Revolution directly influences on global citizen which is human being, on the borderless global space, not confined to nation.

AI will be limitlessly developed by countries or companies, to win over the opponents. The problem is that during this development process, AI will eventually confront with and win over human being.

Confrontation between nations is being transformed to human-technology confrontation. Under the international competitive society, it seems almost impossible to confine the technology within the range of human value system.

But there is a serious reason why we, as human beings,, should make a fundamental social transformation at this point of human history.

> …the increasing technical control of the social and natural world could be challenged and perhaps, made to accommodate the needs of repoliticized public realm ([8], p.96).

4. CONCLUSION: FOR THE GLOBAL, HUMAN TECHNOLOGY

Since Lee Sedol was defeated by Alpha Go, there have been great changes in Go world. The highest level of Go play was not fought between professional human Go players but between AI softwares. Therefore AI Go players have become more powerful. What is striking is that now professional human Go players are learning correct moves from AIs.

Human role has been changed to the developer of stronger AI Go players to win over the other AIs.

The liberation of human being from humanoid depends upon how to get rid of the competition between mega organizations like states or big companies and to go from this international society to global society. It means the restructuring or the recomposition of human society to respond to technology.

If human being fails to well organize the society, then the society fails to control technology. Therefore if we don't try a fundamental change to humanize the society through right politics, human society will be replaced by humanoid society.

Global society, which is not divided by national sovereignty, revives man to a human being, not confined to a national. Global human technology, not national technology, will overcome the alienation of human being caused by high technology.

At the end of 19th century it was declared that "God is dead" by man which was created by God Himself. It won't be long before "human is dead" will be declared by silicon humanoid which was created by man, unless human beings build a society on the global consensus.

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Simultaneous Teaching Through Video Call and Providing Mentorship Remotely – Challenges for Laboratory Classes in Higher Education

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ABSTRACT

In the context of virtual learning environments, education consists of several factors that make up human resources and technological capabilities. Reduced sharing of non-verbal communication as a result of the physical distance has a significant impact on the educational processes. Laboratory and practical classes with currently available software and hardware solutions at universities make distance learning possible but limited due to the level of automation and Quality of Service (QoS) network parameters impacting the videoconferencing technology as well.

For the purpose of this paper, research was conducted through experimental teaching, in the online environment, within the laboratory exercises in higher education of IT departments. The results of the students who participated as well as the professor who held the tuition will show the advantages and disadvantages of distance learning in higher education institutions. The research results will also demonstrate opportunities to improve IT systems management as a key element of automation. The main research objectives of this paper are to explore how the factors of education should adapt to virtual learning conditions in order to achieve a complete technological process of automation. In addition, the paper aims to discern which cognitive processes and structures should be adjusted for teaching and learning in a virtual environment. Our final aim and conclusion were to highlight how automated processes and technology can be meaningful only when society is ready for its acceptance.

Keywords

Distance Education, Virtual Learning Environments, Computer Science, Higher Education, Automation, IT management systems, Cognitive Processes

1. INTRODUCTION

Over the last decade, video conferences, like everything else, migrated to the Internet. Online video conferences are becoming ever more important in the area of service occupations, whose business processes mainly consist of various forms of communication. Undoubtedly, such a form of real-time communication saves time and money to both providers and service recipients. Thus, for example, it is not necessary to go to the bank to get some information because this is possible to achieve through a single video call from anywhere. Although, if we move this business communication to the context of education, there is no longer an emphasis on saving time and money. Even though distance education brings a whole range of benefits compared to traditional teaching, it is imperative to define and adapt the methods and methodologies of teaching, testing and assessment to an online educational platform. Existing virtual learning environments already have diverse solutions for knowledge acquisition and testing which are in accordance with educational methodologies, however many of them still use only the written form of communication. The reasons lie primarily in technological achievements. Above all, forthcoming implementation of a faster data transfer technology over the internet, like 5G which will reduce the signal latency, achieve high speeds and a short response time, in stable connection, will provide appropriate standards for educational purposes. This article will describe a practical example of a two-location teaching lesson in which all forms of communication are combined as in classroom teaching.

2. RESEARCH METHODOLOGY

This research sought to find out how complex it is to teach practical work in computer technology through video conferencing, which in this case is used only for communication, and at the same time, by using the remote access tool to demonstrate tasks, as well as accessing any student computer that needs it at a given time, enabling the explanation of a practical task in more detail within the exact application that needs to be used to solve the task.

2.1 Experimental Study

Experimental teaching classes are chosen for the main research methodology. For the purpose of this research, exercises were held within the Computer Networks Course in an online environment. The professor holding the lecture was at the University of Lisbon and students were at the Polytechnic of Rijeka. Basic hardware requirements for this experiment in addition to the computer included: speakers, microphone, camera and the router for Internet access. Internet speed was 100Mbps in both institutions. The software solutions used for this experiment were the existing free tools: Chrome extension which enables remote computer control and Skype for video call. In addition to software for the online environment, software for learning content of the course Computer Networks was also used. This included: Oracle VM VirtualBox and GNS3. For the purpose of this research, we also considered the presentations of projects held by the students through the video conference. Hardware specifications were the same as those mentioned above but chosen software was different. Since in this part of the experiment students were required to present their work only the video conferencing software was needed. At the Moodle education platform, a webinar plugin was used for this purpose. The experimental studies were held on several occasions during 2018.

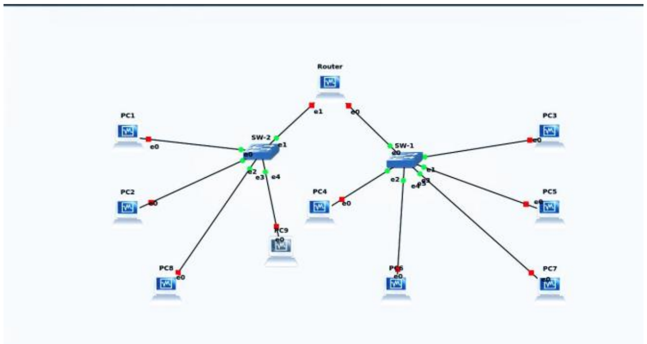

Figure 1: Network topology in GNS3 environment

2.2 Survey

In addition to experimental classes, other research methodology included a survey that explores user experience, and in this case the student's perception of experimental teaching and learning.

3. ONLINE TEACHING PROCESS

3.1 Video Collaboration

Video collaborations have its technical progress which couldn't move forward without the user's influence. Considering this, we can state that when Skype became a worldwide accepted tool, video calling became the usual way of communication. Meanwhile, the progress of video collaboration has evolved into browser-based platforms for video conferencing. According to its technical specifications and browser-to-browser environment, Moodle's webinar platform offers a virtual classroom experience similar to the one described above. The reason for testing the two different platforms were the technical features, like sound quality, video quality and delays in data transmission. Although a lot of security and privacy is invested in its development process, the user's experience is still not equal to the in-person communication experience. However, given these two experimental studies, the fact that the students were physically located in the classroom of an institution could certainly have influenced the teaching experience through video calling.

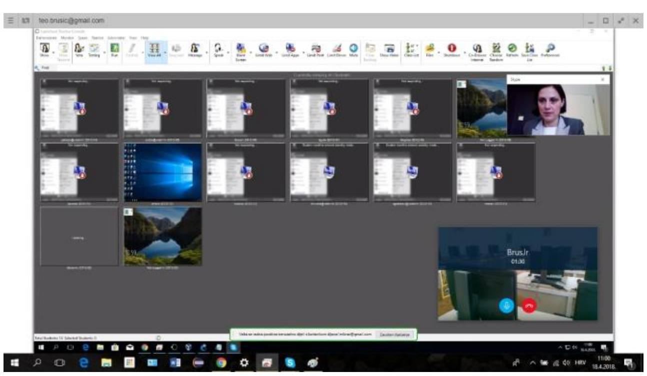

Figure 2: LanSchool in practical training course

3.2 Remote Desktop Services

Practical work from computer network courses refers to the creation of a network topology consisting of virtual computers, virtual switches and virtual routers created within the GNS3 (Graphical Network Simulator 3) application. When emulating a topology, GNS3 emulates the hardware of a device and you run actual images on the virtual device. When covering the specific tasks that refer to GNS3 performance and capabilities, students usually require assistance to successfully grasp these concepts. With this in consideration, it was necessary to be able to access the students' computers throughout the classroom, during this segment of the class. The most effective way to achieve this was to connect online to the teacher's computer and then access the student computers on the local network. In other words, to manage teacher's computer remotely using Chrome remote desktop. Furthermore, classroom management software - LanSchool was used for faster and easier management in local network of computers throughout the classroom. Therefore, remote access to student computers is created through the Virtual Local Area Network (VLAN) and Local Area Network (LAN).

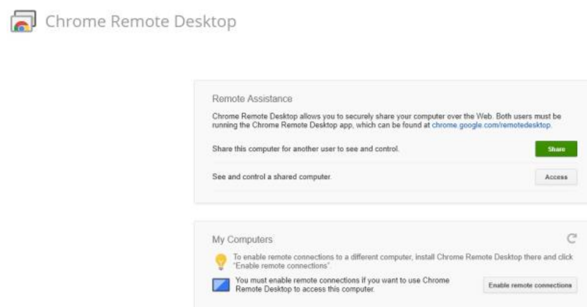

Figure 3: Chrome Remote Desktop

3.3 Blended Learning

The term blended learning is generally applied to the practice of using both online and in-person learning experiences when teaching students. In a blended-learning course, for example, students might attend a class taught by a teacher in a traditional classroom setting, while also independently completing online components of the course outside of the classroom [1]. Online learning management systems like the Moodle platform provide distance learning through various educational methods. Those methods can mimic actual classrooms, with required attendance at specific times, can be self-paced, or blended, and use a variety of tools to engage students and support learning by making the most flexible learning environment possible. Lectures place students in a passive role. An example of this is hybrid learning, where connection between online and in-class instruction increase students' activity and brings flexibility into the process, contributing to different verticals of education. However, IT students, in most cases, handle content where the environment requires special software tools to work. Moreover, some professors are increasingly introducing, for example, the well-known GitHub platform for joint project work. With all of the above in mind, the online learning environment for IT technologies is becoming an area in need of standardization.

4. RESULTS OF THE RESEARCH

The purpose of this research was to explore how learning through practical examples in the context of IT technology affects the learning process itself. Can online and in-class instruction be the same in terms of transferring knowledge and skills? To what extent the professor's physical absence affects the classroom atmosphere? The first experiment involved students from the field of Information Science and Technology who were alone in the classroom, and the professor was present by video conferencing and they demonstrated the creation of a network topology using virtual machines. Following the demonstration of the assignment, which students followed through the transmission (via projector), they were given a similar assignment. For such a task, students need an average of 15-20 minutes. 45% of students needed help in completing the task or had some other problems with software in use. In this case, the professor must be ready to communicate with all students in the classroom by video conference which has been put on the classroom's wall through projector and simultaneously manage student's computers remotely to assist them. The second experiment involved the students from the field of Information Science and Technology and students from the field of Telematics. In this experiment, which took place in four different terms, students were tasked with presenting their project through a webinar, from their home. The presentation of Information Technology students consisted of a practical presentation of system implementation within virtual network topology using virtual machines for various needs, such as creating a network topology configuration using the DHCP (Dynamic Host Configuration Protocol) server, creating a DNS server or creating web server within a network topology and so on. Students of Telematics have presented their applications mainly in the area of IoT (Internet of Things), which refers to an explanation of their own source-code. For the examples above, students were required to organize a webinar by using several software tools to present their work to the audience. In addition, it was necessary to enable video communication with the professor and other students in the classroom, in order to open a discussion on the topic presented. The entire survey was attended by 132 students. 58% of students were male, 42% female. Regarding age, 79% of respondents belong to the age group of 18-25 years while the other 31% belong to the group older than 25 years. After the whole research, the students have solved a questionnaire that examines their perception of this method of learning and teaching. For the first statement in the survey, as the fundamental statement of this research, "Online education should be introduced as a support to traditional teaching", 48% of students responded with the affirmative.

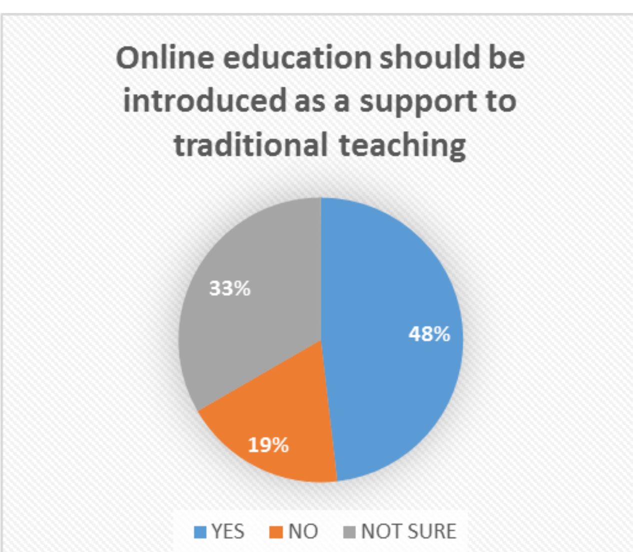

Figure 4: Online learning as part of the overall education

Almost a third of students are unsure if they want to make the virtual environment part of their education. However, despite the above, 78% of students responded with the negative to the statement: "Video conferencing for virtual learning makes me feel uncomfortable."

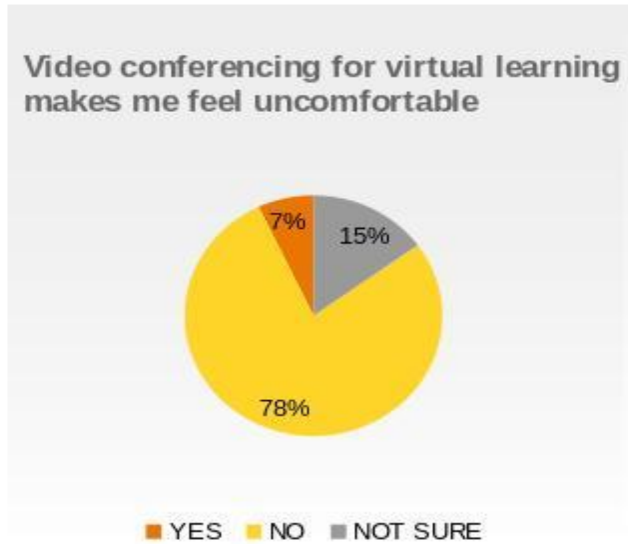

Figure 5: Videoconferencing - the impact of psychological factors

One reason for these results can certainly be deduced from the following statement: "I think that this kind of work has limited my options for presentation" where 46% of respondents stated they are not sure, 15% students responded affirmative and only 38% believe that they could have their own future project presentations without any problem in an online environment. Since the online environment is part of the course content, as well as the learning outcomes, the following statement was also included in the questionnaire: "This type of work within the Computer Network courses contributes to a better understanding of the content of the course". The results are the following: Strongly disagree – 4%, Disagree – 7%, Neither agree nor disagree – 67%, Agree – 22%, Strongly agree – 0. The answers to this claim support the fact that students do not see, to a greater extent, a link to the course. The reasons may be different, from the fact that it is completely natural for present generations to communicate in this way without considering the history of network architecture to the ignorance of learning outcomes and content of course in its entirety.

5. IMPLICATIONS/LIMITATIONS

The process of teaching in the field of computer technology is mainly carried out using electronic devices. Although not disproving the importance of theoretical knowledge, and especially in the context of purposeful understanding of designing applications or network topologies, practical results in computer technologies are what makes some business more or less successful. Although the online environment has many advantages, in the context of practical learning and teaching, it also has some disadvantages like performance limits that significantly affect the performance of the system software or programming software.

5.1 Bandwidth and Quality of Service (QoS)

The definition of QoS dimensions has received a lot of attention during recent years, mostly in the networking and the middleware communities, but few studies deal with end-to-end application QoS requirements or propose dimension taxonomies. Among the others, an integrated framework is also proposed characterizing the production, transmission and consumption of data through a single media [2]. The variety of services is especially noticeable in network congestion cases and results in different levels of network performance for individual packets. Some of the basic parameters defining the quality of data transfer such as packet loss, bit rate, throughput, transmission delay, availability, jitter, etc. are key factors that affect the subject of this research.

Furthermore, bandwidth management, incorporating an end-to-end Quality of Service (QoS) architecture, have numerous challenges when faced with traditional on-premise solutions, that can be overcome by moving to the cloud and become the responsibility of the service provider.

5.2 Psychological Impact

In addition to the technical background above, the online teaching process is also influenced by participants' psychological factors during communication. Non-verbal information is an important component of the conversation. By definition, therefore, a message may be a word, a group of words, a complete sentence, or several sentences. Since source and seeker could talk at the same time in the voice and communication-rich modes, messages could overlap [3]. In such situations, non-verbal communication can significantly contribute to overcome this.

5.2.1 Lack of Body Language

In the communication-rich mode, subjects could, and did, use non-verbal forms of communication. They gestured, nodded, grimaced, and used other expressive movements of the body [3]. The ability to read the body language of other participants, which makes it possible to recognize you need to change direction during the meeting, in an online environment is possible to a much lesser extent.

5.2.2 Lack of Eye Contact

Eye contact is another benefit of non-verbal communication, the disadvantage of which significantly diminishes the quality of conversation during videoconferencing. To preserve eye contact a user would need to look simultaneously at the monitor and into the camera. However, the camera and monitor cannot be physically in the same location. One solution is to place a half-mirror oriented 45 degrees to the gaze direction [4].

6. CONCLUSION

Today's technologies provide a whole spectrum of cloud-based development including integrated programming environments, code repositories, software modeling, documentation tools and application management. The existing cloud development ecosystem based on a wide number of characteristics allow remote teaching and learning. On the other hand, there are demands on the part of educational institutions that face barriers and seek change in access to education. All this requires a completely different approach to education, grading and certainly a special virtual environment.

If we consider that the quality improvement and productivity optimization are the keys to success in any industry, this might be the case when it comes to the area of higher education for software development and progress of development of information technologies in its entirety.

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The Approach of Human Ecology in Digital Society

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ABSTRACT

In this paper we present an epistemological framework on a case of Democracy of Learning developed through the promotion of cognitive processes addressed through Human Ecology's criteria.

Here we want to develop the theme of Cognitive Democracy and social Learning in contemporary society. This article deals with the themes of Human Ecology and Action Research as fundamental elements of new possible lifestyles practicable in harmony with the Evolution of Mind and Nature. We present a case of possible Action Research to be developed within an ecosystem Man / Society / Environment of the Apuan / Apennine Mountain in northern Tuscany "*Participatory learning process in the context of the Mediterranean mountain called Civic Mountain University"* (Giorgio Pizziolo and Rita Micarelli).

Key words

Human Ecology, Learning processes, Research-Action Human Societies, Digital Technologies, Informational/real world

1. INTRODUCTION

In the contemporary condition all the human societies of the evolving world are experiencing a paradoxical condition in which the *societies of the rich world*, having plundered their own living environments, *impoverished themselves* creating at the same time deep crises in all other human, social and environmental conditions. Really all the ternary systems M/S/E have been equally impoverished and deprived of their original autonomies while all the people, societies and living environments of our Planet, live in the illusion of independence, autonomy and civil rights, *as citizens of the world* actually dominated by the *technocratic digital powers* of the globalized world.

At the same time the natural living environments are transformed into technologized and controllable contexts, while human persons and societies live in illusion of conquering independence, autonomy and civil rights, as citizens of the world in reality dominated by the globalized technocratic digital powers.

The coexistence of different human societies and the coexistence of each of them with their own living environments are both compromised in the absence of *appropriate approaches and adequate environmental and social practices to cope with this new contemporary condition*.

The complex problems encountered in this unprecedented situation cannot be solved in the traditional terms of disciplinary separation (scientific, economic, political, cultural, etc.). They must be assumed in the wider dimension of Human Ecology that includes the living world in its entirety and in its dynamic evolution natural, cultural, technological and digital. In it all the people, the societies to which they belong and the living environments to which human societies refer, interact with each other, each in full autonomy, and all together as a ternary ecosystem M / S / E.

On this basis a *multiplicity of learning processes* can be stimulated and developed for the creation of a series of dynamic evolutionary Equilibria, achieved through learning processes and progressive experiences, which can lead people and societies to a consequent political maturity towards a *cognitive democracy*.

The *ambits* in which people, societies and living environments interact become *fields of events* and of relational dynamics in which knowledge is *produced, experienced and experimentally verified in its becoming*.

2. HUMAN KNOWLEDGE IN THE COMPLEXITY OF THE LIVING PLANET

From the crises that pervaded western culture in the last century a new epistemology was born and changed our approach to the world. Science, art and philosophy have progressively overcome the crises of the classical sciences to interpret the phenomena of nature in their entirety and in their mutual relations, towards a renewed style of knowledge of the world.

Many scientists, artists and philosophers have been involved in this epistemological revolution, producing their scientific / philosophical thinking and their artistic masterpieces working in mutual resonance.[1]

The world is all that happens [and] ... *All the things that happen* [... are ...] *Events!*

The first proposition of *Tractatus Logico Philosophicus* (L. Wittgenstein, 1922) [2] has been verified by contemporary scientists (in particular astrophysicists) who explored the secrets of the Universe recognizing in it a stormy ocean, where waves, resonances and particles play chaotically, giving rise to stationary

[1] As pioneers of these innovative approaches, H. Poincaré, P. Klee, W. Benjamin, L. Wittgenstein, A. Schoenberg, A. Webern, A. Einstein and many others explored the complexity of the evolving world, developing and propagating the epistemology of the contemporary age

States of Matter / Energy or to unexpected Events in which the macro realities of Space and the micro realities of the Biological World are equally and continuously involved.

The recent acquisitions of contemporary science suggest a new vision of the living world that can now be recognized as an indissoluble interweaving of fields in which networks of relationships, resonant waves and living entities meet and relate to each other in the circularity of evolutionary dynamics that bring it towards ever increasing complexity.

In this epistemological context the ecological approach developed, initially addressed to Nature, later extended to humans and their societies overcoming the reductionist separation between Humanity and Nature. All this encouraged a broader ecological vision recognising all living entities as *equal* components of hyper-complex Ecosystems Man / Society / Environment.[2]

In this condition all the evolutionary phenomena of the planet could be understood as intrinsic to the ternary system (M / S / E), in which natural and human dynamics interact enriching each other, exchanging Matter, Energy and Information through their ambits of contact (ecotones). These interactions are joined by new "artificial" components progressively produced by men (such as art, science, classic and digital technologies, artificial intelligence, etc.) that could stimulate, accelerate many spontaneous processes of nature, transforming and creating unexpected conditions and new life environments.

2.1 The UNESCO Project Man and Biosphere (MAB)

A relational approach to ternary ecosystems has been officially promoted by UNESCO as M.A.B. Project (60 s, XX Century) which has been propagated and strongly emphasised as innovative approach, but has been scarcely practice at the concrete levels of reality.

2.2 The Approach of Human Ecology

Human Ecology can still be considered in all aspects as an innovative *suitable approach* to our contemporary jeopardised situations and planetary crises.

In these dynamics also the technological and digital components are directly involved that, on their turn, can evolve as coherent parts of evolutionary processes.

Then we can conceive the ternary ecosystems as hyper complex structures endowed with their own ecotones (ambits where the natural exchanges matter/ energy/information among the different ecosystems are encouraged and intensified) and further made more complex by new kind of Ecotones

These new dynamics established among the original ecosystem (human and environmental) and among the new ecotones in mutual interaction give rise to unexpected configurations of natural/artificial components mutually combined as Human/Social/Environmental *Ecotones of Ecotones.*

In this view we can assume the Human Ecology as a Field on which the *Evolutionary Play of Knowledge and Experience* can be practiced.

This is a Play[3] that we can all experience together, in our *Life Environments* the same environments that we have co-created and that we are continuously transforming.

A *Play* which does not obey preconceived external rules since it is continually unexpectedly renewed through the interactions Man/Society/Environment. The mental abstractions, intrinsic to Individuals and Societies as Art, Science, Communication, Desire and Participation take part in this *Play*, that could more properly understood the *Play of Mind and Nature*[4]

2.3 The Contemporary Crises Hit the Complexity of Living Systems

The crises of the western world have renewed the epistemology but have also stimulated technological, economic and digital growth in contradiction to the epistemological principles on which contemporary ecology is founded. The contemporary world, its evolution and its ecological re-composition are now risking the destruction of their complexity. . The relationships, their circularity and their interaction between all the components of ecosystems are impeded, dominated and provoked by the alterations of the components of ternary ecosystems and of Human Ecology itself.

Nature is altered by the feed-backs of Climate crises, Humanity is deformed by digital/technological changes, and Learning has lost its peculiar evolutionary character in favour of a linear trend.

Despite these crises Nature and Humanity have not been annihilated and still live. Among the fragments and interstices of this contemporary world new vital manifestations are constantly emerging and Human Ecology can still encourage their development.

In coherence with the contemporary science, now we can recognize ourselves as active parts of the world, as responsible members of the human societies to which we belong and as *citizens of nature in evolution* of our planet.

2.4 The Ecological Reconstruction for a new Citizenship of contemporary world

In such a perspective we can reconstruct ourselves, the societies to which we belong and our living environments as a wholeness by following the approach of Human Ecology and developing learning and relational structures, that *we* can create *ex novo*, building unexpected *Ecotones of Ecotones*

Like the Ecotones in nature, that work as relational ambits where different ecosystems meet, exchange and learn in mutual interactive relationships, these new *Ecotones of Ecotones* created among human, natural and social systems, can develop again as very experiential *Ambits of Learning*, as the name of this *Cognitonics* Conference suggests.

On these conceptual criteria a *multiplicity of learning processes* can be stimulated and developed for the creation of a series of dynamic evolutionary Stationary Equilibria, achieved throughout progressive involving experiences, which can lead People and Societies to a consequent political maturity towards multiple opportunities of *Cognitive Democracy*.

[2] These hyper complex systems are homologous to the ones prophesied by G. Bateson in *Mind and Nature* (1980s, 20th century) [1].

[3] G. Bateson, 1960’s

[4] As G.Bateson suggested in his homonymous book

All the *ambits* in which people, societies and living environments interact can become *fields of events* and *relational dynamics,* in which a lot of *adequate knowledge's* processes are *produced, experienced and experimentally verified in their becoming*.

2.5 New Ecosystems, new Ecotones

On the bases above described a number of new Ecotones (*Eco-Cognitones*) can be created and developed, in coherence with the principles and prerogatives of Human Ecology.

The *Eco-Cognitones* can be structured and addressed as participatory learning processes towards Environmental Transformation, Territorial Crises, self-manageable Life Environments, Micro economies, Solidarity Action-Researches, etc. The configuration of such kinds of *Eco-Cognitonics* needs adequate instruments for a suitable and *interactive elaboration, description and self-verification* that can be *only* experientially and chorally developed as mutual friendly learning, spontaneous representations, social perception, which remains intrinsic to all learning processes.

Among our recent experiences and proposals we illustrate the Civic University of Mountain now in course of realization in Tuscany –North Apennine- Apuan Alps.

Figure 1: The *Pania Forata* Mountain in Apuan Alps, Tuscany, photographer A.Lunardi

3. THE CIVIC UNIVERSITY OF MOUNTAIN (CUM)

This Civic University has been conceived as a Structure of experiential of Action/Research as a very **Eco-tone of Learning**, able to interact with the ternary Human Ecology Systems, supplying multiple interactive harbours to exchange, renewing and producing unexpected mutual Relationships.

In this concrete case the University is a structure of research dedicated to experimentation and dissemination of the contemporary problems, and of the general and local conditions of the North Apennine, Apuan Alps' Mountain, Valleys and Rivers in Tuscany.

3.1 The Role of Human Ecology

It is conducted in terms of participatory, active and civic knowledge, by the interested populations, researchers and promoters of the *meaning and value* of each Individual, of the Places and in general of the Mountain Common Good. All these Common Values are promoted in terms of Relational Ecological procedure, close to the contemporary issues of the world, and the climate and environmental crisis, and the socio-economic problems of mountain populations, youth in particular.

In the specific case we intend to deal with that particular complex of Mountain consisting of the northern Apennine / Apuan Alps node, and of the valleys and rivers that are involved, up to the Tyrrhenian and Mediterranean seas.

It is a very varied complex, with phenomena differentiated within it, but also highly homogeneous in terms of geographical location, and the complex of environmental, historical and human relations that characterize it.

3.2 On which contexts the CUM operates

They range from areas that are still highly natural, to industrial areas that require a profound ecological re-conversion with respect to their improper uses in progress, involving both abandoned areas and intensely inhabited areas, with piedmont Cities, and abandoned industrialized areas, and the wider Alpine subsystems.

Precisely their extraordinary naturalistic richness and complexity, and at the same time their problematic and contradictory uses, seem to require the attention of a structure such as the CUM capable of deepening both the great values and the great local problems but also of providing a relational Ecosystemic interpretation to overcome closures and limitations, nowadays widespread, and look for more organic and systemic ESITI outcomes, precisely by referring to the Research / Action practices of Human Ecology (ternary ecosystem Man / Society / Environment, - Unesco MAB project)

3.3 How the CUM works

With reference to this approach, the following Research and Action guidelines could be STRUCTURED

3.3.1- The research on the Relational Ecosystem "The Mountains of the Sea".

This Ecosystem is *evaluated* in the different Apennine and Apuan Subsystems and in their Ecosystemic complexity, *considered* in their relationship between Man / Society / Environment- going to find, nature, history and complementary economies, starting from the positive cases in progress, in particular the Community Cooperatives, and the residual Civic Aggregations, up to the unexpressed and latent potentialities of the Nature and the Communities

3.4 The Deepening of the Specific MAB Issues of the Great Ecosystem.

"Mountains of the Sea", in its essence as an Relational Environment between Europe and the Mediterranean Sea, between continental Italy and Mediterranean peninsular Italy, as a land and hinge between Flows and Relationships, in history and in the contemporary condition, almost an Eco-tonal System, between wider Continental Systems and Mediterranean Sea. These elements that underlie the MAB Recognition of Succiso's Community experience and that were the basis of the formation of the Apuan Alps Park must become also the basis for the future developments of the area for an ecological evolution of those

territories and of those populations, also through Research-Actions hypothesised for this context as avant-garde experiences [5]
Thus a general territorial and ecological strategy could be developed to move from a phase of Resilience to that of Protagonism, beyond the marginal role of current economies and official Policies.

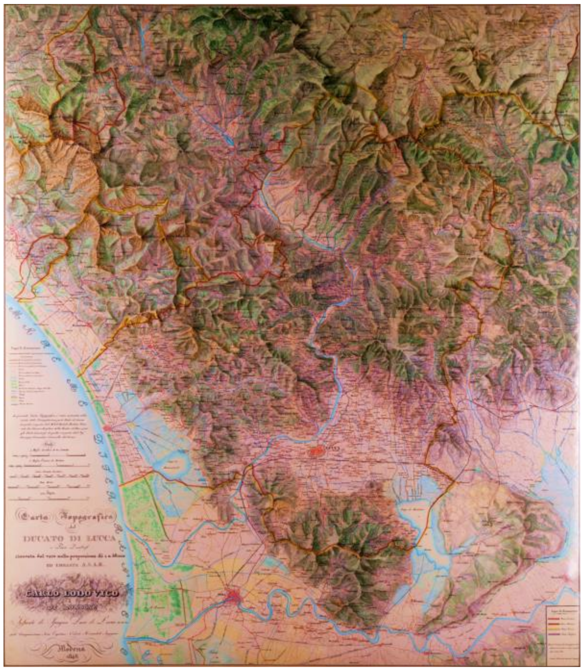

Figure 2: The ecosystem of Apuan Alps, Coastal Area on Tyrrenian Sea, North Tuscany, represented by a Map in the year 1846

3.5 The contribution of CUM to Civil Society.

It is to play a key role of self-promoted Observatory of the great climatic, environmental transformations developed at the level of Natural/ Environmental/ Human Relationships and its mutations, observed throughout the great flows of change, and also from the Core of one of the vortexes of transformations that could unexpectedly appear. This theme - apparently more abstract and distant is instead incumbent and of great actuality and – could instead be directly observed from the Observatory, the chosen Place “at the margins of chaos".

3.6- The working method

The *Laboratory Projects*.
On the basis of the results of the three research / action themes described above, the CUM will be able to promote the following Action Research Steps
-*Ecological Projects* in the form of a *Participatory Laboratory* to activate, according to the current Italian Laws,
-*Acknowledgment of the existent and potential Ecosystems*
-*New economic and environmental Relations* between widest Landscape Ecosystems, giving rise to Eco-Services whose profits must be managed and enjoyed by the Mountain Communities..
Formation of new *Eco Cognitonics (Learning Structures)*

[5] See the Presentations of *City/Landscape/Versilian.River* and various *Landscape Contracts* on **www.graspthefuture.eu**

Figure 3: New Communities at work. Photo by R. Micarelli

New Communities will be Guarantors of the Eco Services above mentioned, of their ecological relevance and evolutionary maintenance.
The Communities will be recognized as Managers of such Eco-Services in terms of *Common Civic Goods*. All this could be concretised through open Procedures shared and ratified by all the involved subjects.
In this way it could be organized self-produced and self-funded Programs and Projects for the renaissance and promotion of the Mountain and its Populations, in all their Relational Values in terms of Human Ecology.

The Research Actions carried out on the themes highlighted are proposed by Giorgio Pizziolo and Rita Micarelli with the European Association **GRASP** the future (**G**roups of **R**esearch and **A**ction for **S**olidarity and **P**articipation , www.graspthefuture.eu)

4 . CONCLUSIONS

The **Civic Mountain University** is open to the participation of all those who share its guidelines and operating procedures and are committed to developing its activities in the areas of the Apuan Mountain / Northern Apennines.

5. ACKNOWLEDGMENTS

We renew our gratitude to Vladimir Fomichov and Olga Fomichova who, with the foundation of Cognitonics, have stimulated an extraordinary epistemological debate on the themes of learning and the crises of contemporary computerized technology companies.

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The Conceptual Architecture of Intentional Human Action

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ABSTRACT

The aim of this paper is to present key definitions of intentional action fulfilled with respect to the interests of other people. First, intentional ethics, moral and legislation are considered. Secondly intentional teleology, performance and production are discussed. This all is made in order to improve the dialogue between theory and practice in conscious action. Examples are mainly drawn from architecture, which has served as a good reference in action theory.

Keywords

Architecture, action, cognition, cognitonics, collective, conflict resolution, individual, intention, thinking and acting in terms of public good.

1. INTRODUCTION

People influence the world by means of intentional actions. Obviously, everyone dreams about harmonic existence in modern knowledge society (KS), or smart society. Cognitonics, or the science about the human being in the digital world, is a relatively new scientific discipline. It was formally born in the first decade of the XXIst century. Its prenatal stage of development covered the 1990s. The principal objective of cognitonics is to elaborate systemic solutions for compensating the negative implications of the broad use of computers and internet for the personality and society. In particular, the aim is to create cognitive-cultural preconditions of the harmonic development of the personality in KS and for ensuring the successful development of national cultures and national languages [5, 7].

A precondition of harmonic existence of a person in KS is acting with respect to interests of other people. That is why cognitonics pays a special attention to developing educational methods and to motivating the learners to think and act in terms of public goods [6].

The paper analyses the conceptual architecture of intentional human action fulfilled with respect to the interests of other people, even future generations.

Intentionality or its high degree is often considered as sign of human action (Marx/ [29]). In classical theory intentionality is discussed under the idea of teleology (> Aristotle) and practical conduct related to it. We extend here this idea and postulate human action to be based on ethics and related ideas behind. We have problems of intentional action, like:

Intentional ethics, moral, legislation

Intentional teleology, performance, product (-ion)

This idea is natural because Aristotle presents many good examples concerning human action in his Nikomakhian ethics [2]. After him also Cicero [3] underlines the human directionality toward future world.

In modern philosophy intentionality has many interpretations starting from directedness toward the world or being a key aspect in the possible world semantics (Brentano, Husserl > [10]). In analytical philosophy the turn from explanation to understanding of human action via intentions was a milestone (> Anscombe, von Wright > [15]).

Architecture has served since far as archetype of intentional action [2, 17, 29, 20, 21]. The trans-modern view here means that we consider the problem in question noticing its roots besides the recent discussion. Methodologically we present a conceptual, systemic analysis of human action and thinking [18].

2. BACGROUND IN INTENTIONAL ACTION

2.1 Intentional ethics

Ethics has as its main intention to give rules for better living in the world [24]. It is trough-out intentional in the sense that ethics gives the main goals for (future) life. We have problems [22]:

Intentional virtues, idols, avoiding of sin

Intentional happiness (utility), duty, avoiding of suffering

In antique ethical virtues gave the model of right action. Among them wisdom is the key tool to control goals setting. In collective level symbols of good life were enlarged to contain idols. It is evident that for example health (> salus) is an important factor in happiness. Health is a very practical intent in life. Autonomous ethics has an alternative in revealed ethics and humans consider themselves as responsible to avoid sin. This attitude was the main intent propagated in medieval Christian life.

In utilitarianism the best action produces maximal happiness for the greatest amount of emotional beings [11, 14]. This is clearly a meta-intent to be interpreted in various situations of life. The counter part of utilitarianism in modern world was full-filling of duty (Kant). Duty typically forms an umbrella for some intent-collective. The common point of all ethics can be seen in Pan-ethics in the sense that humans have to avoid suffering.

We have shown that the basic forms of ethical attitudes are intentional or better said meta-intentional. Then forms of ethics mentioned are creations of human cognition, but also potentially related to religious beliefs.

2.2 Intentional Moral

The intent of moral is to guide the application of ethics in our life-way. We have problems:

Intentional task, situation, way

Intentional interaction, attitude, emotion state

In our action and especially in our duties we have clear task, which is some concrete intent "par excellance" [17]. In all action it is important to note the situation, it is our relation or position to the world toward we are Brentano intended [15]. Way of action is an allegory taken from traffic and movement and it is evident that we then have in our mind the idea of goal.

Personal intents are important, but clever persons understand that most of our goals can be realized in groups and co-operation or collaboration [1]. Our intent may then be to negotiate with others about goal setting. From social study we know, how hard it is to find out common collective goals in principle [28]. Intentions are strongly attitude laden and the will is decisive correlate for intent. Other attitudes are of course influencing and the second key idea is emotion (> conscience).

In the study of basic actions as movements of body the dimension of moral is often forgotten and vice versa, but there are of course exceptions [25].

2.3 Intentional Legality

Reasonable intentions are limited by laws, but some of us fight even against laws in order to find out better ones. In normal case reasonable persons obey the laws of nature, but even they can be improved in theory. We have problems:

Intention/ natural, logical and Gestalt, societal laws

Intention/ obligatory, plausible, forbidden cases

As said natural laws tell us what is necessary to obey in practice. Logical laws express, what is necessary in cognitive sense. We perceive in certain culture things under relatively similar Gestalt-laws, but they are developing in the long run. Art can influence also revolutionary new ways to see (> Le Corbusier). The most typical way of collective guidance of personal action is expressed in societal laws. In some societies the legislation may fail (The Frescoes of Sienna/ [4]) and in this sense civil courage can be considered as a virtue (see above).

The contradictions of collective legal intentions and personal ones can be discussed in Deontology as a subspecies of modal theories [30], [9]. The firmness of intention is expressed with the idea of obligatory. Acceptance is considered in a qualitative sense under the choice between yes or no. In fact, a practical agent considers also what is more preferable than something else (obligatory situation). In order to save lives, it is allowed to break some laws like traffic rules. In this sense what is allowed and forbidden may be considered as relative. The general respect of law is however important as a maxim (Categorical imperative).

3. CONCRETIZATION OF INTENTIONAL ACTION

3.1 Intentional Teleology

We have discussed rule-atmosphere behind intentional human action. This may be very wide area and forgotten as too evident phenomenon in discussion and even in education. Now we are able to continue and discuss the intentionality of normal action. It is based on goal setting. In advanced practice we have intentional key goal-families like:

Intentional "epistemics", aesthetics, ethics

Intentional "ecologics", ergonomics, economics

As Cicero [3] has told the passion to see truth is typical for man. Whether it is possible, is another problem. Truth is thus a goal, independent of achieving it (> truthfulness). For man it is evidently clear that we consider aesthetics more – valuable than lack of it (> sensual death). In certain sense aesthetics may be seen more fundamental than epistemology [24]. After that it is possible to prefer pleasure and avoid suffering. In setting intentions, it is often important to sacrifice something in order to get something more valuable. Such contradictions are typical challenges in ethical life. The intentionality of ethics is discussed already above.

To save (own) life is by nature the key principle of beings. Then contradictions of groups and species in the competition of life should be solved in ethically sustainable manner. Humans have great responsibility in respect of the destiny of Earth and biodiversity [13]. Sometimes ecology has been under-estimated (> industrialism). Today humans have awaked, which is good, but we have to avoid vulgar proposals. Humans have the right to develop ergonomics in the sense of creating facilities for more honest economy. Economy is often seen too much as the question of efficiency wrongly understood. If we see the efficiency depending on both quality and saving of resources, we are mainly on right road. The key idea of economy is that economic agent has the freedom of activity if he/ she does not violate the rights of others (A. Chydenius). Then it may be considered also the rights of animals, plants and microbes somehow.

3.2 Intentional Performance

In action there may be separated clear goal setting and soft goal setting during production as typical for example in creative action (> improvisation) [16]. There are also differences in knowledge-based goal setting and the tacit way [26]. In this sense the dynamic production of art serves as good model also for the performance of action in general. We have cases (Ingarden/ [19]):

Intentional idea, notation, concretization (of action)

Intentional realization, materialization, actualization (of action)

In intentional action we need a guiding idea as in art. A normal agent can utilize notations as inspired by art (> note book). A lot of action is concretized in the normal sense of the word, when we gather concrete tools to facilitate the act.

Intentional realization of action refers to the logical conduct plan in order to realize the act [27]. Acts are materialized in body movement, when the body is considered as matter. This is of course very limited view but possible as abstraction (> Behavioralism). The realization in human reality means that we actualize action in mind and are able to give cognitive explanations for it (> Cognitonics).

3.3 Intentional Product (-ion)

The idea of producing actions of living persons is related to complex reality of human body and mind. In most cases people abstract and simplify the production of material things and artifacts. In systems methodology there has been developed formal tools of production of all kinds of expressions. We have problems (Chomsky > [20]):

Intentional start symbol, non-terminal, terminal

Intentional meta-rule, production rule, outcome

In order to make abstracted intentional acts of acting or producing we need some knowledge about when and how to start. This sub-goal is typically symbolized by start symbol like base-stony in building. A huge amount of Gestalt-aid is needed in production. Some of them can never be seen directly in the product and they are called non-terminals. The other part of symbolic tools is called terminal.

A standard agent often does not know exactly his/ her meta-rules in action and this part is introduced from the sub-conscious. One other explanation is that a collective can own this wisdom, but a single agent can't in a clear way. In intentional action we suppose that the agent sets some production rules in order to get intended products [16]. This refers to the right performance as expected for example in sport and techniques. In practice the outcomes are acceptable, wrong or simply emergently new ones to be accepted after special consideration.

4. DISCUSSION A: THE WORLD OF INTENTION

One basic meaning of intention is to be directed toward world. The then the idea of possible worlds [10] becomes close, because we do not know exactly our targets. Under collective knowledge it is possible to speak about:

Physical, biological, psychological world

Sociological, semiological, anthropological world

Physical and biological worlds as targets of science are supposed to exist independent of the existence of man. In certain sense even they are man-related [8]. The study of intentions starts from biology but culminates in psychology.

The development of human mind is bound to the surrounding society and the theory of intention has to be enlarged to collective dimensions [28]. Intentions are language- and thus intension related as well [10]. Finally, highly developed goals and value systems are typical for man especially if we expect a linguistic representation of them.

Today humans have access to knowledge via Internet and the world may be related with knowledge listed above. The world-concepts then vary a lot between individuals and collectives and the idea of world is both intensional and intentional also in this sense [10].

Intentional action in planning aims to improve the world and search not only certain possible world but in practice we search the best possible world (> Plato, Bonaventura, Leibniz).

5. DISCUSSION B: INTENTIONAL ACTION AND THERAPY

In order to improve our action and via it our world we have to know what intentional action is in its directedness toward the world. Secondly, it is essential to know what therapy is. Intentional Action Therapy consists of [12], [23]:

Intentional action/ health ideal, diagnosis, improvement plan

Intentional action/ operation, test, metabolism/ meta-noesis

We have discussed what health intentional action is. Ideally it is subordinated to ethics and conscience and thus not only on short cut goal setting (> quartal economy). Human action is self-diagnostic. Intentionality as a tool to consider alternatives renders it possible to compare ideals and realism. Then it is possible to make improvement plans. The skill to plan things manifested first of all in architecture is a natural reason why architecture is the standard example in action theory. Other good example is medical therapy of course.

Man should all the time be prepared to cut away non-healthy features and worse parts of our action. In this sense human action should be critical and self-correcting (> know yourself better and better). Intentions should be tested and the totality of action as well. In scientific explanation of bodily movements and standard reasons we expect metabolism even in the brain whereas in more developed analysis and synthesis the concern is cognitonic meta-noesis

6. CONCLUSIONS

We have shown what intentional action is when we open the idea of human action to contain more or less subconscious levels of control behind the rational concentration guiding our acts. Consciousness can be partial due to lack of knowledge or for memory reasons in the sense that the basis of action is deep in our mind and actions are made as based on intuition and emotion.

It is important to make a difference between body movement and causality dependent basic action theory and deeper action theory noticing collectively created traditional frames of action starting from ethics. Among causal theories there is also difference depending on the interpretation of causality as real or teleological.

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The Effects of Yoga on Quality of Life Perception

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ABSTRACT

Each individual strives to achieve high quality of her/his life. In a fast modern world there is a high degree of stress which often decreases different aspects of life quality, such as physical and psychological health and social relations. Relaxation and meditation techniques such as yoga have been shown to have positive effects on quality of life for several groups suffering from different illnesses, including mental health issues. In the present study we examined the effect of yoga on perception of quality of life in general. The comparison was made between groups of people who practice yoga and those who don't on the quality of life aspects, using World Health Organization quality of life scale (WHOQOL). Results showed that yoga practitioners evaluated their quality of life better than test group on all the facets. There were no significant differences according to gender or age. This study confirms that yoga practice improves the people's perception of the quality of their lives.

Keywords

yoga, quality of life, WHO, WHOQOL.

1. INTRODUCTION

Quality of Life (QOL) is the degree of well-being felt by an individual or group of people. Unlike standard of living, quality of life is not a tangible concept, and therefore cannot be measured directly [20]. Quality of life is a subjective construct which varies with the population studied. It is generally conceptualized as a multi-dimensional construct made up of a number of independent domains including physical health, psychological well-being, social relationships, functional roles and subjective sense of life satisfaction [8]. According to WHO, quality of life is defined as "individuals' perceptions of their position in life in the context of the culture and value systems where they lived and in relation to their goals, expectations, standards and concerns. It is colored by physical health, psychological state, level of independence, social relationships, environmental factors and personal beliefs [33]. Quality of life, by its very natures, is idiosyncratic to the individual, but intuitively meaningful and understandable to most people [25].

1.1 Normal or Body Text

Quality of life (QOL) is a latent variable that cannot be directly measured. It needs to be converted to indicators of its component dimensions and domains to be quantified. To serve the purpose, the indicators must be valid, important, representative and adequate. A QOL measure presents the indicators as items that can be rated on response scales, which are then presented as a profile domain scores or a composite index of quality of life [16]. The essential concepts of QOL measures are subjectivity, multi-dimensionality and well-being.

There are several measurements of quality of life. Most of the measurements were developed for medical field as Quality of life (QoL) is fast becoming a standard measure of outcomes in clinical trials, cost effectiveness analysis and clinical practice. Some of them are:

1) The Wisconsin Quality of Life Index [8]. It is a comprehensive multi-dimensional measurement tool that reflects the personal priorities and goals of individual mental health clients. It measures eight dimensions: General Life Satisfaction, Occupational Activities, Activities of Daily Living, Psychological Well-Being, Symptoms/Outlook, Physical Health, Social Relations / Support and Money.

2) The Anamnestic Comparative Self-Assessment (ACSA) uses a self-anchoring rating scale to measure subjective well-being. ACSA was originally developed by Jan Bernheim [3] as a simple method to measure quality of life consecutively in the patient-physician relationship in cancer patients. It differs from the conventional single-item scales of subjective wellbeing (SWB) because it uses biographical experiential scale anchors: the best and the worst periods in the respondent's life experience. Because of its internal frame of reference, ACSA is argued to be less influenced by cultural relativities and psychological traits [31].

3) The Quality of Life Scale (QOLS), created originally by American psychologist John Flanagan in the 1970's, has been adapted for use in chronic illness groups.

4) Short-Form Health Survey (SF-36/12). This multidimensional instrument was developed in 1992 by Ware and Sherbourne and validated in Brazil by Ciconelli et al. [6]. Eight dimension scores were extracted from studies including physical functioning, bodily pain, physical role function, general health, mental health, emotional role function, social function, and vitality.

5) WHOQOL-100 and WHOQOL-BREF developed by the WHO [33] assess four major domains: physical, psychological, social relationships and environment. The WHOQOL instruments are focusing on individuals' own views of their wellbeing. The WHOQOL-BREF is one of the best known instruments that has been developed for cross-cultural comparisons of quality of life and is available in more than 40 languages.

2. YOGA

Yoga is an ancient Indian system of philosophy designed to bring balance and health to the physical, mental and emotional dimensions of the individual. The practice consists of a set of physical postures (''asanas''), which are maintained for a certain time [22, 27].

Since its introduction into the Western culture, yoga has becoming more popular as a complementary way to achieve healthy living [13]. Several researches have shown positive effects of yoga techniques on physical and mental health [10, 12, 27]. Moreover, investigations have shown the beneficial effects of yoga on cognition [4]. Rangan, Nagendra, and Bhat [24], verified that the Gurukula Education System School, based on a yoga way of life, was more effective in increasing performance on visual and verbal memory in students when compared with students of the Modern Education System. Another study showed that yoga-based relaxation techniques improved memory scores in volunteers immediately after the practice [30]. Research of Rocha et al. [26], has shown positive effects of yoga on memory performance in healthy men. They also found that yoga decreases anxiety, depression and stress-related measures. On the basic of their research they suggest an application of yoga in preventive health care. Khalasa et al. [14] showed that 11 weeks of yoga sessions had significant benefit on anger control and fatigue/inertia thus suggesting to use yoga as a preventive tool for maintaining mental health. Klatte et al. [15] performed a metaanalysis on the effects of yoga on mental health issues. They have included 25 studies with a total of 1339 patients in the analysis. A large and significant effect of yoga was seen with respect to the primary endpoint (symptom severity) compared to untreated control groups. Small but significant effects of yoga were also seen in comparison with attention control and physical exercise. No difference in efficacy was found between yoga and standard psychotherapy. Preliminary but encouraging results were also found in meta-analysis of 13 reviews examined 185 distinct studies showing yoga as an intervention for the effects of trauma as well as the mental health symptoms and illnesses often associated with trauma [17]. Sharma et al. [28] showed that from the 17 studies, 12 demonstrated positive changes in psychological or physiological outcomes related to stress. Rakhshani et al. [23] showed that yoga interventions are generally effective in reducing anxiety and depression in pregnant women.

2.1 Effects of Yoga on Quality of Life

Yoga is commonly being adopted and prescribed with the intent to increase a participant's health-related quality of life. Several studies showed positive effects of yoga on patients with cancer [18, 9, 5, 21, 19], which included: reducing cancer-related symptoms, improvements in quality of life, social functioning, as well as spiritual and emotional well-being [9, 18]. Studies have found that yoga may reduce fatigue, pain, nausea, mood disturbance, depression, and anxiety in early-stage of breast cancer patients [21]; increase invigoration, acceptance, and relaxation in women with metastatic breast cancer [5]; and help decrease stress and pain while increasing energy, sleep, and sense of well-being in a variety of patients with cancer [19]. Yagli and Ulger [34] performed eight sessions of a classical yoga program including warming and breathing exercises, asanas, relaxation in supine position, and meditation and 8 sessions of classical exercise program were applied to cancer patients. They found that all patients' quality of life scores (measured with Nottingham Health Profile (NHP), Beck Depression Inventory and visual analog scale (VAS)) after the yoga and exercise program were better than scores obtained before the yoga and exercise program ($p<0.05$). It was concluded that yoga is valuable in helping to diminish depression, pain, fatigue and helps cancer patients to perform daily and routine activities, and increases the quality of life in elderly patients with breast cancer. The meta-analytic evidence of Bandevidez and Hart [2] clearly supports the small-to-medium positive effects of yoga on health-related quality of life, as measured by the SF-36/12 assessments. Research of Agnihotri et al. showed that yoga can be used as an adjuvant therapy in the management of asthma [1].

Not many studies have been made on the effects of yoga on quality of life among healthy individuals. Goncalves, et al. [11] showed benefits of yoga practice on quality of life with elderly people.

3. AIM

Our aim was to discover weather practicing yoga affects the individuals' perception of his/her quality of life regardless previous health status. Our referential study was the one of Singh et al., who conducted similar research in India [29]. They have found that yoga exercise practitioners reported comparatively sound sleep, enhanced energy level, and overall general health wellness. We wanted to check if the results would be similar for western country such as Slovenia.

4. METHODOLOGY

4.1 Sample

We used stratified sampling within the individuals in Slovenia who practice yoga (yoga group). There were 50 individuals in the sample from five different groups practicing yoga, of which 41 completed questionnaires. In addition, we used a test group of 50 individuals who did not practice yoga, 42 of them adequately fulfilled the questionnaire. In the first group, there were 80% of women (32 persons), in the second 73% (30 persons). The majority of participants were between 25 and 45 years old (21 in yoga group and 25 in test group). 11 participants from yoga group and 10 from experimental group were younger than 25 years. The lowest number was in the age group of 45 to 65 years (8 in yoga group and 6 in the test group). None of the respondents was older than 65 years.

4.2 Instruments and Procedure

WHOQOL questionnaire has been used as a base for our research. WHOQOL covers four domains of mental health: physical, psychological, social and environmental. The psychological health in the research covers various aspects, such as: positive/negative feelings, self-image, body image and appearance, self-esteem, spirituality /religion /personal beliefs, thinking, learning, memory and concentration. The assessment of physical health has aspects such as activities of daily living, dependence on medicinal substances and medical aids, energy and fatigue, mobility, pain and discomfort, energy and fatigue, sleep and rest and work capacity. Social aspect includes social and personal relationships, social support and sexual activity. Environmental dimension includes financial resources, freedom, physical safety and security, health and social care: accessibility and quality, home environment, opportunities for acquiring new information and skills, participation in and opportunities for recreation / leisure activities, physical environment (pollution/noise/climate) and transport. For the measurement of the intensity, the Likert scale of five points (from 1 to 5) was used. Instructions included the statement to evaluate the individual's life in the last 14 days.

5. RESULTS

Some of the most interesting results according to 4 different aspects of quality of life are presented. Comparisons between yoga and test group were made using Mann-Whitney U-test and are presented for all the facets in the following chapters.

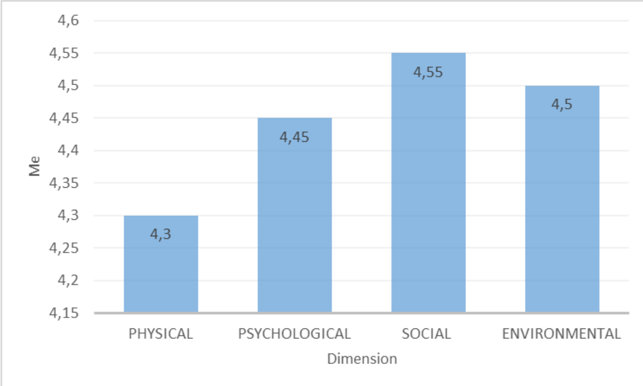

Figure 1: Median values of the evaluations of different aspects of quality of life for yoga group participants

Figure 1 shows, that people who train yoga have a high level of satisfaction with their quality of life. They rated all aspects of life above 4 on the scale from 1-5. The most satisfactory is evaluated social aspect, followed by environmental, psychological and physical being the least satisfactory. Among psychological aspect, the lowest rated were the facets about acceptance of the physical appearance (M=4,1, SD=0,55), the highest enjoyment in life (M=4,6, SD=0,55). Among the lowest rated in the social field was the evaluation of participant’s sex life (M=4,4, SD=0,6).

We tested gender and age differences within yoga group, and there were no statistically significant differences between the average ranges. We can therefore assert that there are no gender or age differences of the yoga effects on all aspects of quality of life. Even though the differences were not statistically significant, on average, men showed better perception of quality of their lives than woman. They are abler to relax, are more satisfied with the amount of daily activities they can perform and the quality of their home. Even though not statistically significant, there is a tendency that younger respondents are more satisfied with the extent to which they can relax and enjoy. Respondents between 25 and 45 years most strongly agree with the statement that they can count on their friends when they need it, while the oldest group of 45 to 65 years has the highest ratings about the quality of their home that suits their needs.

The differences between yoga and test group in the evaluation of most aspects of quality of life were statistically significant (see Table 1).

The biggest difference between the groups is for the indicators "Do you have enough money to meet your needs?", "How are you able to relax and enjoy?" And "How much are you able to enjoy and relax?" in favor of yoga group. Yoga group members are also more satisfied with their sleep than test group members.

Table 1: Comparison of different aspects of quality of life assessment between yoga and test group

	Practice yoga?	Average rank	Sum of ranks	Mann–Whitney U- test	P (2-tailed)
HOW SATISFIED ARE YOU WITH THE QUALITY OF YOUR LIFE?	yes no	53,00 29,29	2120,00 1201,00	340,000	0,000
PHYSICAL DIMENSION					
How satisfied are you with your ability to perform your daily living activities?	yes no	56,05 26,32	2242,00 1079,00	376,000	0,000
How well do you sleep?	yes no	56,05 26,32	2242,00 1079,00	218,000	0,000
How satisfied are you with your health?	yes no	50,34 31,89	2013,50 1307,50	446,500	0,000
Do you have enough energy for everyday life?	yes no	49,40 31,60	1967,00 1264,00	444,000	0,000
How satisfied are you with your ability to perform your daily living activities?	yes no	47,16 34,99	1886,50 1434,50	573,500	0,008
How much do you need any medical treatment to function in your daily life?	yes no	36,34 45,55	1453,50 1867,50	633,500	0,020
PSYCHOLOGICAL DIMENSION					
How satisfied are you with your abilities?	yes no	50,98 31,27	2039,00 1282,00	421,000	0,000
Are you able to accept your bodily appearance?	yes no	49,70 32,51	1988,00 1333,00	472,000	0,000
How would you rate your memory?	yes no	54,28 28,05	2171,00 1150,00	289,000	0,000
How much do you enjoy life?	yes no	55,45 26,90	2218,00 1103,00	242,000	0,000
How satisfied are you with your ability to learn new information?	yes no	50,74 31,50	2029,50 1291,50	430,500	0,000
How satisfied are you with yourself?	yes no	52,73 29,56	2109,00 1212,00	351,000	0,000
SOCIAL DIMENSION					
How satisfied are you with the support you get from your friends?	yes no	53,96 28,35	2158,50 1162,50	301,500	0,000
How satisfied are you with your sex life?	yes no	48,63 32,38	1945,00 1295,00	475,000	0,001
How satisfied are you with your personal relationships?	yes no	50,39 31,84	2015,50 1305,50	444,500	0,000
How satisfied are you with your ability to provide for or support others?	yes no	50,00 31,46	1950,00 1290,00	429,000	0,000
Do you feel happy about your relationship with your family members?	yes no	53,78 28,54	2151,00 1170,00	309,000	0,000
ENVIRONMENTAL DIMENSION					
Have you enough money to meet your needs?	yes no	57,50 24,33	2242,50 997,50	136,500	0,000
How satisfied are you with the conditions of your living place?	yes no	50,08 31,39	1953,00 1287,00	426,000	0,000
How available to you is the information that you need in your day-to-day life?	yes no	50,83 31,41	2033,00 1288,00	427,000	0,000
How satisfied are you with the social care services?	yes no	54,37 27,30	2120,50 1119,50	258,500	0,000
How satisfied are you with the way you spend your spare time?	yes no	54,06 26,94	2162,50 1077,50	257,500	0,000

Legend: N=81

6. CONCLUSION

Quality of living does not always correlates with technological development. Today’s stressful and multitasking life environment in highly sophisticated technological work environments demands the relief of tension and stress and organization of life to enable high living quality. Our study confirmed and extended the results of Singh and Sharme [29] on Slovenian population, showing positive effects of practicing yoga on all aspects of quality of life. Yoga practitioners were more satisfied with the quality of their lives on physical, psychological, social and environmental asset. Therefore, we can agree with the statement of some previous studies [7, 17] who recommended yoga as an alternative method of retaining mental health and prevention of different mental issues. The quality of life and mental health is definitely something that should be working on and not taken for granted. We can also see in the study that mind and body work together. It was shown that non-practitioners were not as good as yoga practitioners on the physical health domain. We may also say that yoga affects one perception of social relations and environmental facts, such as amount of money that a person would need to live a quality life. In this regard we see the limitation of our study, since we have not gathered data about participant’s economic status. Although we have no reason to believe that yoga group would have higher income than test group. Our research also showed the importance of yoga practice for male and females of all ages. The results support the effort of United Nations Organization to declare the international yoga day on 21st June of every year is significant towards awareness for benefits of yoga to secure good health of mankind [32].

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Creating Multimedia Systems According to Principles of Cognitonics

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ABSTRACT
Cognitonics is a scientific discipline developed with the aim of studying the human being in the digital world. The aim of this paper is to analyse how to create a *Multimedia system* according to principles of Cognitonics.

Keywords
Cognitonics, ICT, multimedia, multimedia system, personality development, creativity development, socialization, social responsibility

1. INTRODUCTION
Cognitonics is a scientific discipline developed with the aim of studying the human being in the digital world and creating cognitive-cultural foundations of the personality's harmonic existence in modern information society, quickly transforming into knowledge society. It is based on research results that point to the gap between intellectual and spiritual development of individuals in a modern information society [2]. One of the goals of Cognitonics is to create theoretical basis that will enable development of different advanced systems within ICT. This paper will be focused on *multimedia systems.*

A *multimedia system* is a communication and information system that enables the processing, management, transmission and presentation of multimedia data.

Multimedia systems, as any other ICT systems, must have a positive impact on development of individual's creativity, its sense of harmony and beauty, awareness of belonging to a particular national culture, a positive impact on the development of individual language skills, ethical behaviour, self-regulation and other values that represent some of the principles of Cognitonics. The application of these principles in developing a multimedia system should be encouraged for the purpose of harmonious development of individuals.

2. ABOUT MULTIMEDIA SYSTEMS
Multimedia means the simultaneous combination of two or more media for the simultaneous transmission of different types of information. In the IT Encyclopedia Dictionary, multimedia is defined as the use of a computer to display text, graphics, videos, animation and sound [8]. The purpose of multimedia is to make it as interesting, attractive and real as possible to present and convey information, an appearance, a scene, an atmosphere or an event. The goal of multimedia is to capture as many of our senses as possible so that the experience of the transmitted message is more complete. Some advantages of using multimedia systems are: accessibility, mobility, interactivity, lower price, distance learning, etc.

Multimedia literacy consists of information literacy, visual and media literacy. It is reflected in the individual's understanding of how multimedia works, how it produces information, how information is created and merged into a meaningful and purposeful whole with the help of multimedia tools. It is also reflected in the individual's understanding how multimedia is used. Multimedia literacy also means the ability to critically understand the nature of multimedia and the impact of multimedia [9] and the ability to think critically for the good use of information. In the context of Cognitonics, multimedia literacy can also mean understanding how to create multimedia systems according to principles of Cognitonics.

One of applications of multimedia is for educational purposes. *Multimedia educational material* is a simultaneous combination of two or more media in one digitized system with the aim of presenting information and encouraging better educational success of students. The main purpose of multimedia educational material is instructiveness, and the goal of any multimedia educational material must be to facilitate the process of remembering and understanding the content presented. An instructive message is a message that aims to teach. A *multimedia instructional message* aims to encourage the remembering and understanding of multimedia content, and consists of words, images and other multimedia elements in appropriate formats [6].

Each multimedia system is made up of multiple media and has its own structure that defines how these media are interconnected. The media that the multimedia system consists of is created and processed independently of the design of the system itself. In other words, to create a multimedia system, first it is necessary to design and create it's elements, and then to carefully connect them to a useful multimedia system.

The *elements of multimedia* are: text, graphics, animation, sound and video. Text and graphics are static elements of multimedia. Sound, animation and video are dynamic elements of multimedia. Appropriately chosen elements for multimedia system can be a motivating factor for encouraging and maintaining interest in subject.

2.1 Text
Most multimedia applications include *text*, even if graphics are heavily used. Text is the most flexible way of presenting information on screen. It is often more useful to consider how to

present the text appropriately than to try to replace it with speech or image. The text in multimedia system should be as simple as possible and the sentences should be short and precise. Abbreviations should be used as little as possible and only if they are widely known, and their use should be consistent throughout.

Text has the advantage that it is: easily manipulated (requires little time to create), easily stored (requires little memory), easily transmitted (requires small bandwidth). On the other hand, the text itself is usually not enough (it takes a lot of text to explain the simple concept).

2.2 Graphics and Infographics

The term *graphics* (computer graphics) refers to a number of different elements created using a computer, such as diagrams, graphs, pictures, photographs or drawings displayed on the screen, all with the aim of visualizing information.

An image can convey information very effectively ("One picture is worth a thousand words"). The fundamental difference between an image and a graphic is that the image is captured and the graphic is created. It is usually much easier to generate an image (capture) than graphics (creation).

Research has shown that humans are visual beings and that they remember visuals better than textual information. Because of that, the term *Infographics* is very important when speaking about multimedia systems. *Infographics* is a visual presentation (display) of facts, information, data or knowledge. It is used when complex information is to be explained quickly and clearly, because it provides the reader with visual content that is simple and interesting to process, understand and remember. Infographics is a visual representation of facts, information, data or knowledge presented in the form of graphics and intended to present information quickly and clearly. It makes it easy to understand and remember information that may seem difficult to remember in large blocks of ordinary data. Simply put, infographics are graphics that provide information - explanatory graphics. Effective infographics convey the essence of the message without individual having to read the related text thoroughly. An individual can determine the subject of the infographic just on view. Nowadays, in an era of information overload, followed by shortened individuals' attention, infographics is used to easily and quickly enable understanding of information. Each infographics should be created in accordance with *Emotional-Imaginative Teaching System (EIT - system)* which, among other, aims at developing in individual emotional intelligence, creativity, the ability to process symbolic information and suggests the educational methods contributing to early socialization of children (preschool and elementary school ages). The EIT-system belongs to the constructive core of Cognitonics [3].

2.3 Animation and Video

The human being has the instinctive ability to detect movement, so *animation* is used to draw attention to the information within multimedia system. The *purpose of animation* is to imitate reality by the appearance of movement, and it is possible because of the laziness of the human eye. Animation gives the viewer an illusion of movement by quickly changing the frame. It is used for: highlighting an object (moving text, the appearance of a character in rhythm as it is written, text pulsing, text changing color, etc.), “humanizing” an object, explaining a concept or action. Animation should be used only when there is a clearly defined goal to be achieved with it. The various effects of multimedia application development tools should be carefully used for animations. For example, scrolling text is difficult to read and should be avoided, or at least, once stopped, it should be left enough time for the user to read it.

Video (moving image) can include all of the elements of multimedia. Video is usually much easier to make than animation, but it is also less useful on a regular basis.

The duration of the video or animation (for the sake of attention) should in most applications be limited to:

• video - no more than 60 seconds,

• animation - no more than 30 seconds.

Passive video leaves the user as a passive observer, while *interactive video* engages him / her with the interaction that makes him / her an active participant. Interactive video enables the engagement, participation, control, response and active involvement of the viewer, it is very important for his / her intellectual and spiritual development.

2.4 Sound

The term *sound* in multimedia represents: speech, sound effects and music. *Music* is used as a background, usually to a video, and in that sense represents the whole with the video. It makes a mood in presentation. *Sound effects* are most commonly used to provide the user with system status information (for example: "beep" for an error) or to provide additional information about the object being displayed visually (for example: stream noise). Both music and sound effects have relatively little information value but can significantly contribute to the comfort of work. *Speech* can be used for both inputting information (for example: speech recognition in an application management function) and output from a multimedia application (for example: description of the image being displayed). In doing so, care must be taken that listening to speech is slower than reading, so that at the same time the user can accept less information by listening than reading.

3. DESIGNING MULTIMEDIA SYSTEM ACCORDING TO PRINCIPLES OF COGNITONICS

3.1 The tasks to be solved by a multimedia system

Each multimedia system is made up of multiple media and has its own structure that defines how these media are interconnected. The media that the multimedia system consists of is created and processed independently of the design of the system itself. After creating all multimedia elements, they need to be combined into one meaningful whole.

Creating a multimedia system is a process by which individual media are combined and their flow is combined and controlled. The multimedia system should be: *useful* (to give the user what she/he wants), *simple* (not having a need for too much effort when using), *interesting* (to result in a positive feeling and desire to be reused).

When creating a multimedia system, it is necessary to take into account its effect on the levels of the subconscious: in order to develop intellectual and emotional spheres harmoniously, it is necessary to include feelings, and not only ideas. Individuals form associations with the messages displayed, but they will not necessarily make a conscious connection between the aesthetic elements and the information. Knowledge must not only be transmitted but also inscribed into the mind of users during the process of active learning [2].

When creating a multimedia system, one should fulfill the tasks of communication with users through multimedia system at the levels of consciousness and subconsciousness. This tasks are:

• to increase audience awareness and attention to presented multimedia material;

• to increase and channel excitement and enthusiasm when using multimedia system;

• to successfully explain through multimedia system abstract ideas and themes, and complex ideas and themes;

• to be able to communicate through multimedia system with people with different knowledge, needs, capabilities, and with different levels of intellectual development;

• to successfully create simulations and explanations of complex contents;

• to encourage individuals to focus their actions on achieving the desired goals;

• to achieve positive feelings about the multimedia system and the messages themselves.

According to Bearden [1], the goal is to integrate technology and to create a space open to demands of society with the aim of building a sense of belonging to society. In such way a smart, sustainable and inclusive growth of an individual can be achieved.

The technology of multimedia systems should not be integrated only in education, but also for business purposes, in public administration, for fun, for communication etc. Multimedia systems should be created in a way to represent a cognitive learning resource that enables development of more complex and richer thoughts among individuals.

Using the multimedia systems is changing the way users access information, collect them, analyze them, present them, etc. Also, by transforming situations from static to dynamic, users are enabled to develop the skills of socialization, social responsibility, creativity and cooperation skills [7].

3.2 Media Selection Guidelines

When creating a multimedia system it is important to carefully analyze and select the right media for transmitting a message in a successful way.

Reasons for selecting *Text and Speech* for transmitting a message in multimedia systems:

• Written words are descriptive, detailed and straightforward.

• Words can be literal or just remind the user about the topic.

• The correct use of words is critical because words can easily be misinterpreted.

• If speech is used, it must be informative and expressive.

Reasons for selecting *Graphics and Illustrations* for transmitting a message in multimedia systems:

• Designs, drawings and images can be used thematically or symbolically.

• Graphics can be explanatory, conceptual or suggestive.

• Graphic can be adapted to the information being transmitted or it can be aimed directly to the audience.

• Graphic design connects separate elements of multimedia to one functional system.

Reasons for selecting *Still photos (Pictures)* for transmitting a message in multimedia systems:

• Pictures are visually very rich, detailed and attention - grabbing.

• Pictures can show real photos as detailed information for subject describing.

• Pictures can be suggestive or even symbolic.

Reasons for selecting *Video and Animation* for transmitting a message in multimedia systems:

• Video is largely realistic and descriptive in a detail.

• Video is used to transmit time - based information.

• Animations can also be descriptive in detail or even suggestive.

• Video and animations are good to be used when there is a need for clarifying things.

Reasons for selecting *Sound* for transmitting a message in multimedia systems:

• Sound adds an audio element to visual information.

• Sound (in a way of music) makes a mood of multimedia system.

• Sound (in a way of music) promotes the development of emotions.

• Sound is the most subconscious of all the media, but it must be used moderately.

There are reasons to believe that the formulated guidelines would be very appropriate for implementing the script of a multimedia intelligent tutoring system (MITS) introduced in [4, 5]. This script is based on the world-known fairy-tale "Sleeping Beauty". It is a script of an MITS for acquainting young children (5-6-7 year old) with the basic ideas of social etiquette.

4. CONCLUSION

Multimedia systems are broadely used in all sorts of fields. Some of them are education, business or communication. To reduce a proven gap between intellectual and spiritual development of individuals in a modern information society, multimedia systems must be designed in accordance with the principles of Cognitonics. To do so, principles of Cognitonics must be added as *multimedia literacy* items. In such way one can use multimedia elements in right way to make complete multimedia system which fulfils its purpose and in parallel respects the principles of Cognitonics.

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Application of Robotics in High Schools

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ABSTRACT

In this paper it will be spoken about programming languages, how to program Micro:bit and Arduino. The peculiarity of our approach is that the lessons of programming are interpreted as a good tool of developing the skill of planning complex sequences of actions, in particular, conditional actions. This skill is very important in order to be successful in knowledge society. Arduino and Micro:bit are open source hardware. Arduino and Micro:bit program can be written in any programming language. Application of Arduino and Microbit is enormous. This paper presents the results of research conducted in high schools. The students answered some questions concerning programming Microbit and Arduino application.

Keywords

Application of robotics, Arduino, Micro:bit, high school, the skill of planning complex sequences of actions, research.

1. INTRODUCTION

The complexity of life in knowledge society (KS) is quickly increasing. In particular, this complexity is caused by the situation when the major part of people encounter the necessity to change the profession several times during the life. That is why a highly significant skill in KS is the skill of planning complex sequences of actions, in particular, conditional actions. A person should think over not only his/her actions in case any condition is satisfied but also a reaction in case a condition is not satisfied (is false).

This paper discusses programming languages, robots, how to program robots Micro:bitand Arduino. Arduino is open-source hardware. Arduino program can be written in any programming language. Application of Arduino and Micro:bit is enormous. Research results are also presented in this paper. The research was conducted in a secondary school. The students answered some questions concerning programming robots and the application of Arduino and Micro:bit.In order to use Arduino or Micro:bit it is necessary to know the basics of electronics, logic circuits and programming.

2. PROGRAMMING LANGUAGES TODAY

Computer is a digital device that can perform a large number of operations based on instructions it is given in the form of programming commands [1].

It performs a certain number of operations whereby all complex operations have to be broken down into a sequence of simple operations and adjusted to the syntax of the programming language. For each of these simple operations there is a sequence of commands expressed as binary numbers, zeros and ones, that computer can understand and perform, and translate into language understandable to humans.[1]

2.1 Types of programming languages

There are several groups of programming languages; some of them include machine languages, low-level symbolic programming languages, high-level symbolic programming languages and object-oriented programming languages [1].

The most user-friendly programming languages are high-level symbolic languages, which based on their purpose can be classified as follows:

- LOGO is a language intended for entry level programming and drawing.
- BASIC is a universal general-purpose language, suitable for beginners in programming, useful for solvingall problem tasks.
- COBOL is intended for use in bookkeeping and accounting, as well as in business and commercial dealings.
- FORTRAN is a language suitable for solving technical, physical and mathematical problems.
- C is a general-purpose language, one of the most widely used languages for professional purposes; it provides a wide range of options and is adaptable to any platform.
- PASCAL is a general-purpose language, very popular in academic environments. It enables a logical program organisation that best follows thought process. It can be used for professional purposes as well.
- HTML, XHTML, CSS are program languages used for website creation and design.
- SQL is a language used to search databases.
- JAVA, JavaScript, DELPHI, ASP, PHP are relatively new programming languages, mostly intended for work on the Internet, web design, developing web and mobile applications [1].

3. Arduino and Microbit programming

The first thing to focus on when programming an Arduino microcontroller is the understanding of the term algorithm as a basis of all logical reasoning when solving a problem or writing a program code [2]. Algorithm is a sequence of interrelated commands used to perform a certain task or solve a logical problem. Arduino algorithm's commands have to be organized so that they follow the hardware platform's work, as well as to perform the assigned task as quickly, simply and effectively as possible [2]. Every Arduino program code contains two parts, which include: **setup()**(input-output) involves setting up Arduino controller, and **loop()** or part of the program performed several times [2].

Setup() command is actually the part of the code that sets up the Arduino controller, i.e. the input and output of the data, the communication with computer or another device is established. **Loop()** is the part of the code that Arduino constantly repeats enabling itself to behave as a smart device, navigating its surroundings and executing commands like a little robot [2].

3.1 Arduino programming software

Regarding hardware, the most essential part necessary to build a little robot is the Arduino microcontroller. There are several such microcontrollers, and according to one's needs, one can choose between Arduino Uno SMD R3, Arduino Ethernet, Arduino Mega, Arduino Due, Arduino Pro and other [3]. For its functionality and program command execution **Arduino IDE** is recommended as specialfreeware program that can be downloaded from this link:

https://www.arduino.cc/en/Main/Software [3]. The image below shows the program interface. The interface consists of the area for code writing, main menu with code checking commands; it includes sending the program to Arduino controller, the communication with Arduino, and the area at the bottom of the page where notifications about the code translation process (compiling) are received (Figure 1) [3].

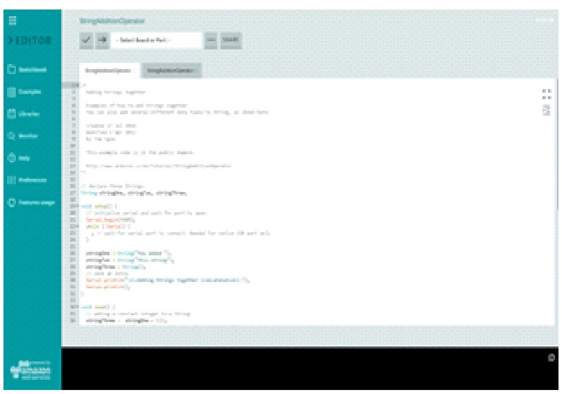

Figure 1: Programinterface of Arduino IDE

When starting the program in the Arduino environment it is necessary to prepare hardware, by using USB cable to connect Arduino microcontroller with the computer or some other device (Figure 2) [3].

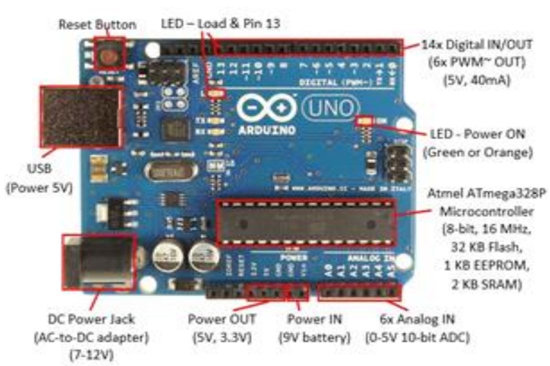

Figure 2: Arduino microcontroller

After connecting Arduino hardware, the procedure is as follows:

- turn on Arduino via USB cable, or Bluetooth,
- click onTools - Boardand check whether the Arduino microcontroller we are working with has been recognized,
- then click on Tools - Serial Port and select the suitable COM port. In order to know which COM port to select, open Devices and Printers option on Start menu in Windows and find the Arduino microcontroller on the list. The COM port will also be listed here [3].

When the first code (program) is written click on the icon Verify, which initiates code check, and if there are any errors in code the result will be displayed at the bottom of the interface, i.e. window. If the code is correct the icon Upload is selected [3].

After uploading, the program is on Arduino and can be tested. Each new program being written and each new command transferred to microcontroller is executed in the same manner [3].

3.2 Micro:bit programming software

Similar to the Arduino microcontroller we have a Micro:bit microcontroller. Micro:bit is small programmable device, designed to make learning and teaching easy, interesting and fun. Lots of information about, how to program Micro:bit and how to create code we can find on this web site https://microbit.org/.

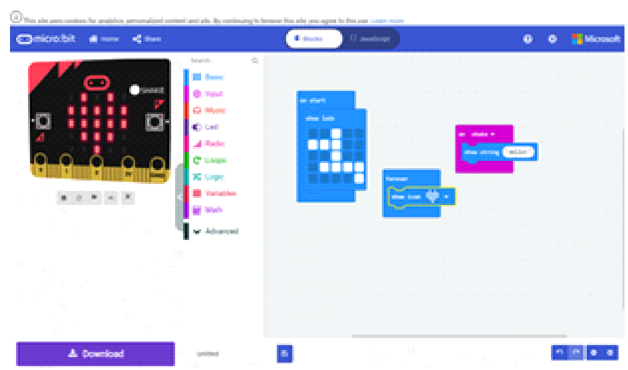

Figure 3: Create code for Micro:bit device

4. Research results

The research was conducted on a sample of 45 participants. There were 12 female and 33 male participants. Participants were on average between the ages of 15 and 30 years (Table 1).

4.1 Results and methodology

The research was conducted in two groups. The first group involved students, and the second involved adults. There were 30 participants in the first group and 15 participants in the second group. Both groups completed the questionnaire. The data interpreted in the text was obtained thorough a questionnaire. The questionnaire consisted of 12 differently formed questions.

Table 1: Overview of the number of participants assigned to groups based on age and gender

	Men	Women	Total
Students	18	12	30

Adults	15	0	15
Total	33	12	45

The research objective was to explore in what ways and to which extent programming in general, Micro:bitand Arduino programming is present in the teaching process.

Each group answered questions on the use of programming languages, familiarity with Micro:bit and Arduino controller and programming in Arduino. The questions aimed at identifying attitudes of both groups. In this way we tried to collect the necessary information about the opinion of the participants on the functionality and application of Micro:bit and Arduino programming.

Questions were:

1. Have you ever programmed before?
2. What programming languages have you programmed in?
3. What did you program?
4. Do you know how to program in Java?
5. Do you know what Arduino is?
6. Have you ever programmed in Arduino?
7. Do you know what Micro:bit is?
8. Have you ever programmed in Micro:bit?
9. Do you have Arduino robots in your school?
10. If you are attending a Robotics class, what do you learn in that class?
11. In your opinion, what is the most interesting part of Arduino or Micro:bit programming?
12. What do you think of using robots in the classroom?

    1 It is interesting to learn how to program robots

    2 I believe Robotics is our future

    3 I think it is only for pastime, I do not see it utilized on a large scale in the classes.

Several significant answer examples from the Questionnaire are mentioned in the rest of the text in this chapter, which are also represented in numbers and chart values.

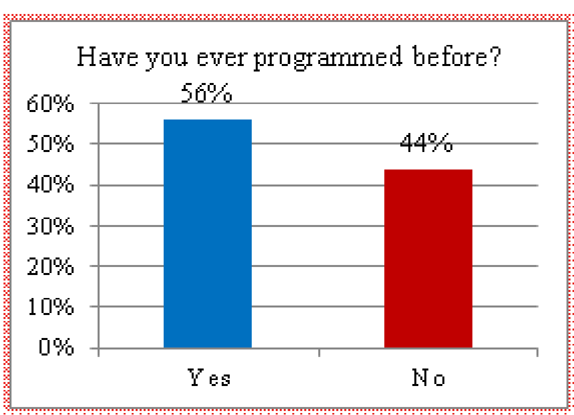

Figure 4: Overview of the research results

The overall analysis shows that a larger number of participants used at least one programming language throughout their education. According to the research results the programming languages the participants most frequently encountered are Qbasic and C++. To the first question: "Have you ever programmed before?" 56% of participants answered affirmatively, and 44% answered negatively (Figure 4).

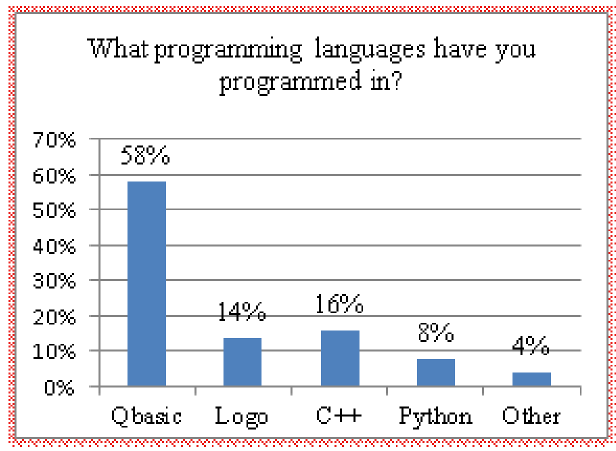

Figure 5: Research results overview

To the second question: "What programming languages have you programmed in?", 58% of the participants said Qbasic, 16% C++, 14% Logo, 8% Python and around 4% used other languages (Java, C#) (Figure 5).

Regarding questions referring to the application of Arduino robots in the classroom, e.g. to the question no. 12: "What do you think of using robots in the classroom?", around 64% participants said they believed that robotics is our future, 24% found it interesting to learn about and know how to program robots, and 12% participants saw it only as a pastime, without recognizing any big application possibilities for robotics in the classroom (Figure 6).

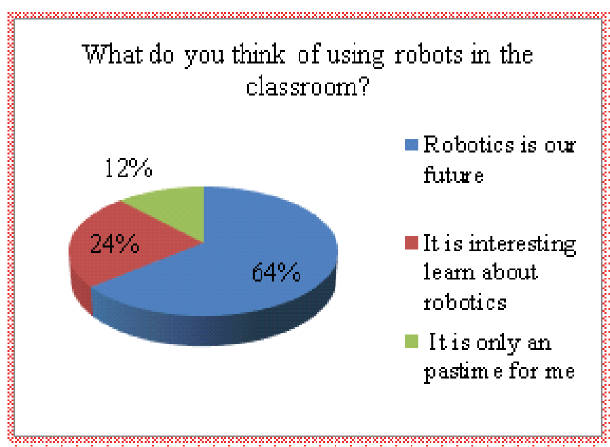

Figure 6: Robotics in the classroom

Regarding the questions about the use of Arduinoand Micro:bit in the classroom, some participants who worked with Arduino and Micro:bit said they had learned how to instruct a robot to move, avoid obstacles, move in chosen direction, emit light signals, etc.

5. CONCLUSION

By using and programming digital devices, as well as taking all opportunities the modern age gives us, it is easier for us to learn and create new contents and then present those new contents as final products on the market.

The modern, contemporary age offers free and fast communication, availability and networking. It is observable from the research presented in the paper that programming attracts more individuals each day who are striving for new realizations. Arduino itself awoke and encouraged individuals interested in the possibilities technology has to offer to further explore and progress. The application of programming and creating something better encouraged young people who see the future in technology to come up with some new ideas.

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Transforming Teaching History in a Smart Learning Environment with Open Educational Resources

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ABSTRACT
This paper analyzes the steps to be taken to design a blended learning environment which develops into a Smart Learning Environment and a Mobile Learning Environment based on Open Educational Recourses and free and easy-to-use online tools for the teaching of History in Secondary Education. This learning environment is based on learner-centered teaching theories, strategies and methods to stimulate motivation, study skills, learning skills, thinking skills, critical thinking. All the Information and Communication Technologies' tools are combined with interactive and collaborative activities.

Keywords
Historical Thinking, Learner-Centered Teaching Theories, Strategies, and Methods, Critical Thinking Skills, Smart Learning Environment, Blended Learning Environment, Open Educational Recourses, Collaborative and Flexible Learning

1. INTRODUCTION
The teaching of History is defined as the students' cultivation of skills and abilities which a historian has, such as historical understanding, adaptation, analysis, synthesizing [1-3]. In teaching History, a crucial role is played by: a) Comprehensive History (New History, Microhistory, Oral History, etc.); b) the experiential relationship with the past through meaningful communication, collaboration, common reflection and pursuit, interaction, cognitive conflict within existing knowledge and knowledge which is being acquired; c) a critical approach to sources and historiographical works; d) historical interpretation which is based on logic and facts [1-4]. Information and Communication Technologies (ICT) as a tool for teaching History can substantially alter the way that students access, gather, analyse, reconstruct, present and convey information. There are at least five main reasons that advocate the integration of ICT in the learning process and they relate to the support and reinforcement of: a) learning; b) teaching; c) the socialization of the student; d) the social inclusion of students with learning difficulties; e) the creativity and effectiveness of the educators [1-3, 5-7]. When we refer to the *mobile learning* and smart learning implementation in the teaching of History, we mean that the teaching is implemented in a learning environment that combines real-world contexts and digital-world resources with the use of ICT to provide students with direct experiences of the real world with sufficient learning support [5-13]. The basic precept of constructivism is that learning is achieved via the mediation of tools and interaction. In particular, ICT can substantially contribute to the teaching of History because: a) it can provide access to primary and secondary sources; b) it can cultivate a kind of experience in students, with audio visual material, simulations, etc., which makes the understanding of historical terms, concepts and facts feasible; c) it favors the creation of an exploratory and collaborative learning environment; d) it offers rich material to the teacher to transform learning into a social process, collaborative, evolving and informed by a process of self-paced development that happens at a time and place of the learner's choosing [3, 13-17].

2. THEORETICAL FRAMEWORK
Contemporary teaching highlights, as the primary objective of History, historical understanding which is based on knowledge of the content of history, the methods of approaching historical facts and the understanding of concepts (evidence, cause, explanation, empathy, etc.) that seem to play a crucial role in historical understanding [1, 2, 13, 17-19].

The most important task in teaching and learning History is the study of primary and secondary source documents because it significantly enhances school students' understanding of content. When working with sources students need to be both cognitively active and emotionally engaged. In particular, some of the things that students need to do are: a) closely observe the documents' features, b) bring prior knowledge to bear, c) speculate about causes and consequences, d) make personal connections, and e) use evidence to support their speculations. Indeed, the centrality of these skills is a key reason why digital archives of primary sources have important roles to play in improving elementary, middle, and secondary teaching and learning across the curriculum [13, 20].

Moreover, teaching should be based on the learning theories of *constructivism* and the *socio-cultural dimensions of knowledge*, in effect *socio-cultural constructivism,* that allow the students to interface with the digital teaching environment and determine the issues of investigation according to their needs and potential [13, 21, 22]. Students have to manage, in a variety of ways, the mobile devices, smart phones and the ICT in general, as well as interactively participate in the learning process in an "open-ended software program" (Internet). The teaching and learning activities must be combined with free and easy-to-use ICT tools needed to bring open educational resources (teaching, learning and research materials in any medium that reside in the public domain or have been released under an open license) into the classroom, to facilitate a student-centered learning environment (promoting problem solving, knowledge construction, critical thinking evaluation, interactivity, and collaborative, flexible learning). The use of the aforementioned ICT tools suggests that learning is affected and modified by these tools, and that reciprocally the learning tools are modified by the ways that they are used for learning. This type of learning complies with learning as a tool-mediated socio-cultural activity and with mobile learning. Mobile learning refers to the use of mobile or wireless devices for the purpose of learning. A central task in the design of technology for mobile learning is to promote enriching conversations within and across contexts. The design of mobile learning activities should be driven by specific learning objectives. The use of (mobile) technology is not the target but rather a means to enable activities that were otherwise not possible, or to increase the benefits for the learners. Thus it must support learners to reach personal understanding through conversation and exploration; support learners' collaboration in order to construct common knowledge; use technology to enrich learners' collaborative knowledge building with other learners and teachers; support learners' transitions across learning contexts. Mobile learning is not just about the use of portable devices but also about learning across contexts, that is technology that makes it possible for learners to work at unique activities in ways that were previously impossible. Recent innovations in program applications and social software using Web 2.0 technologies (e.g., blogs, wikis, Twitter, YouTube, etc.) or social networking sites have made mobile devices more dynamic and pervasive and also promise more educational potential [3, 16, 17, 22-27].

2.1 The integration of Lerner-Centered Teaching Strategies

If we want to achieve the essential understanding of the content of History teaching must contain various teaching strategies to stimulate motivation, study skills, learning skills, thinking skills, critical thinking to secondary school students. The strategy of "teaching history through inquiry" helps students move toward knowledge by engaging with the primary documents of the past. Crafting the right questions is the key step that ensures students learn to critically evaluate information. Teachers provide primary and secondary sources that confirm students' viewpoint and ask students to develop a new point of view based on the evidence. By forcing students to engage with all evidence, teachers can help them gain greater insight into History. The greatest challenge in teaching with the inquiry approach is taking the time to find the right sources. Students need the tools to distinguish the truth, to evaluate the information they encounter, based on where it comes from, who is producing it and when, its use of evidence, and its intended audience [13, 28].

Another significant strategy for teaching History is the strategy of "historical empathy" in order to succeed students' cognitive and affective engagement with historical figures to better understand and contextualize their lived experiences, decisions, or actions. Historical empathy involves understanding how people from the past thought, felt, made decisions, acted, and faced consequences within a specific historical and social context [13, 29, 30]. The process of forming affective connections to the past enables students to view historical figures as human beings who faced very human experiences and leads to a richer understanding than perspective taking alone [13, 29-33]. When we teach History, it is helpful to structure lesson plans aiming not only to educate students about particular topics such as global mass atrocities but to help them prevent possible future atrocities. Through the historical analysis we should be engaged to the moral and anti-racist education [13, 30].

Another useful teaching strategy is "project-based learning," (PBL) an overall approach to the design of learning environments. PBL is a model that organizes learning around projects. According to the definitions found in PBL handbooks for teachers, projects are complex tasks, based on challenging questions or problems, that involve students in design, problem-solving, decision making, or investigative activities; give students the opportunity to work relatively autonomously over extended periods of time; and culminate in realistic products or presentations. Other defining features found in the literature include authentic content, authentic assessment, teacher facilitation but not direction, explicit educational goals, cooperative learning, reflection, and incorporation of adult skills [13, 34].

Finally, for analyzing visual sources, the integration of teaching strategies such as "visual literacy", "multimodal literacy", and "analyzing visual images and stereotyping" is necessary in order to lead students in a critical analysis of an image, and to help students develop and enhance observational, interpretive, and critical thinking skills. The exploration of visual sources and their multimodal messages enables students to deal constructively with complex modes of delivering information, and technology-based art forms. Students benefit doubly when they study traditional literary contexts and multimedia sources. Their understanding of the literary text is enriched and enhanced and they are encouraged to become more informed about the content [13, 35].

2.2 The integration of Information and Communication Technologies (ICT)

The integration of Information and Communication Technologies (ICT) is another very important factor for successfully teaching History. The teaching process consists of the handling of objects and tools, both material (e.g. devices, hardware, software, Internet, technology tools, worksheets) and symbolic (language, communication, interaction, cooperation of educators – students, and students amongst themselves). The students are divided into groups, with the teachers' guidance. Collaboration, as a role-playing game, engages the imagination and empathy of the students [3, 13, 22]. Students have to manage, in a variety of ways, the mobile devices and the ICT in general, as well as interactively participate in the learning process in an "open-ended software program" (Internet). The teaching and learning activities are combined with free and easy-to-use ICT tools needed to bring open educational resources into the classroom, to support a blended learning environment which combines face-to-face instruction with technology-mediated instruction and to enhance students' perceived technological competencies, while promoting their active engagement. A blended learning environment encourages active learning through the use of authentic instructional activities, interactive communities of learners and online learning tools and develops into a smart learning environment and a mobile learning environment as it combines cyber synchronous learning, mobile learning, social learning, and ubiquitous learning [3, 13, 16, 17, 22-24, 36-38].

Students interact with the content, resulting in a change in their cognitive structure, with the instructor, who guides and motivates learning, and with one another, motivating and helping one another to learn. In more detail, videos (moving images and sound) are used as an instructor in communicating facts but they also enable students to acquire research skills, collaborative working, problem solving, technology, and organizational skills [13, 39, 40]. Students combine information from a variety of sources to create multimedia presentations; they use online discussion groups/lists, to exchange opinions about historical themes; they also use Wikis to write essays sharing and collaborating with others. Wikis also permit both interaction and simultaneous work on the conjoined result, thereby removing the boundaries between the active author and the passive user of content [13, 41, 42]. Students use Blogs where they discuss and comment various topics. Educational blogging is an effective tool for user centered, participatory learning [13, 43]. Students are also assigned to create a digital journal using online tools. In the case of History, the purpose of journal writing is to provide a space where students can connect their personal experiences and opinions to the concepts and events they are studying in the classroom. Teachers evaluate the journals based on criteria such as effort, thoughtfulness, completion, creativity, curiosity, and making connections between the past and the present [13, 44]. All the aforementioned free technology tools enable the groups of students to work together to complete their tasks. They have the advantage that anyone can contribute anytime, anywhere. Thus collaborative skills, skills in negotiation and organization, critical writing skills, and a sense of responsibility and ownership are developed. This way students are helped to reach Bloom's higher order skills: knowledge, comprehension, application, analysis, synthesis, and evaluation [13].

3. CONCLUSION

The evaluation of the learning process and results takes place in the end with the evaluative reports from the participants about the achievement of the lesson's objectives and the success of the activities (based on how well the students have incorporated the concepts discussed in class). Teachers evaluate students' understanding of the content; ability to relate and analyze primary and secondary sources; ability to situate the sources and their messages within the context of the historical events; ability to determine the central ideas or information of a primary or secondary source and provide an accurate summary that makes clear the relationships among the key details and ideas; ability to evaluate various explanations for actions or events; ability to determine the meaning of words and images as they are used in sources. Also teachers check for the: clarity with which the argument is presented; ability of the students to cite specific examples to support their analysis; active participation of all students (as group members and individually) [13].

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PREDGOVOR

Konferenca je sestavljena iz dveh:

- demografske, predsednik prof. dr. Janez Malačič, letos dvanajstič
- okolijske, predsednik mag. Tomaž Ogrin, letos prvič.

Izrazu »evropska demografska zima« se pridružujejo izrazi kot »civilizacijski propad Evrope«, brezbrižnosti se nasproti postavlja panika, črni scenariji. Tudi Slovenija se srečuje s podobnimi demografskimi izzivi. Med trenutno najbolj perečimi tematikami sta begunska problematika in skoraj pol stoletja premajhna rodnost Slovenije, ki preti z dolgoročnimi uničujočimi posledicami. Demografske odločitve bodo pomembno krojile kakovost življenja ljudi v prihodnjih desetletjih tako v Sloveniji kot Evropi. Če Japoncev s sedanjo rodnostjo po napovedih leta 3000 ne bo več, pa bo Slovencev po narodnosti leta 2500 med 5.000 in 10.000.

Podobno travmatične so napovedi glede okolja. Medtem ko zavedanje o pomenu okolja narašča, mirno gradimo nova in nova veletrgovska središča na najboljši kmetijski zemlji, pa smo jo v letih od osamosvojitve izgubili 70.000 ha, tako da je ostalo še cca 180.000 ha obdelovalnih (njivskih) zemljišč, v občinskih prostorskih načrtih je predvidenih za pozidavo še 57.000 ha. Ni čudno, da imamo le 30 odstotno samozadostnost. Od leta 2000 smo izgubili 10 odstotkov zemljiških površin. Ob izgradnji novih 100 km avtoceste je povzročeno toliko segrevanja ozračja, da bi morala za kompenzacijo vsa slovenska gospodinjstva za tretjino zmanjšati potrošnjo slovenske energije, pa jih še kar naprej intenzivno gradimo, tudi veletrgovine, račun zaradi uničevanja okolja pa neodgovorno prelagamo na bodoče rodove.

Želimo podpreti usmeritev Slovenije v varno, prijazno, zdravo in kakovostno okolje za vse državljane in državljanke Slovenije. S kakšnimi usmeritvami, s kakšnimi konkretnimi ukrepi za zaščito vodnih virov, tal, zraka, slovenske krajine in narave? Ali prehitro uničujemo okolje, kmetijske površine, nepotrebno gradimo nove in nove trgovske centre, avtoceste in energetske objekte na najboljših zemljiških površinah? Imate o tem strokovno mnenje?

Je mogoče hkrati spodbujati tehnološki razvoj, uporabo obnovljivih virov in preprečevati negativne vplive na okolje? Razvoj je lahko pozitiven, lahko pa tudi negativen. Za oba imamo veliko primerov. Smo sposobni preusmeriti antropocentrični razvoj v ekocentričnega? Potrebujemo na primer strožji nadzor varstva na ožjih, širših in vplivnih vodnih območjih za zaščito podtalnice in pitne vode, vključno z ekonomskimi in lastniškimi načeli? Imajo mesta dovolj zelenih površin v mestih, imajo podjetja in inštitucije vse pozidano, v asfaltu in betonu? Kdaj bomo sanirali degradirana območja, na primer Celjsko kotlino?

Konferenca in posvet v Državnem svetu sta dve zgodbi istega dogodka - zbrali bomo strokovna mnenja o varovanju okolja in ljudi, predloge za izboljšanje in zbrali protestne izjave za najbolj eklatantne primere uničevanja okolja. V skladu s pravili posveta v Državnem svetu bomo vprašanje oziroma pobudo posredovali Vladi RS in predsedniku RS.

Janez Malačič in Tomaž Ogrin

Ideje za belo knjigo o varovanju okolja
Proposals for scientific approach to environmental problems

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ABSTRACT

This paper is a follow-up from the previous paper »Scientific environmental care« and the National Council environmental event. Ideas for the national proposals are here gathered in an informal way as a first draft leading to actual proposals that will be sent to the Slovenian leadership.

Ključne besede:

okolijske ideje, trajnostni razvoj, varovanje okolja

1. UVOD

Prispevek je nadaljevanje referata »Znanstveno o varovanju okolja«, sestoji pa iz idejnih predlogov kot osnove za Belo knjigo o varovanju okolja, ki jo nameravamo poslati vodstvu Slovenije. Osnova teh idej je posvet “Znanost o okolju”, ki je bil izveden 10.9.2019 na Institutu “Jožef Stefan” (IJS). Posvet [1] je bil del aktivnosti Državnega sveta [2]. Na osnovi predstavitve na posvetu je avtor napisal prispevek »Znanstveno o varovanju okolja«, ki je obravnaval teme [3..10], zbranih pa je bilo tudi nekaj predlogov za izboljšavo okolja v Sloveniji. V tem prispevku na hitro zberemo predloge avtorjev posveta v Državnem svetu v kratki, neformalni obliki. Smisel tega spiska predlogov je, da spodbudi oblikovanje kvalitetnega seznama predlogov v roku meseca ali dveh po konferenci.

2. SPISEK NEFORMALNIH PREDLOGOV

Reklamni panoji

Predlog1: Predlagamo, da se z zakonom prepove reklame v vidnem polju avtocest. V roku 4 let se odstranijo obstoječe na stroške reklamiranih podjetij oz. postavitelja. Takoj se prepove postavljanje novih.

Predlog 2: Dosledno naj se uveljavi prepoved postavljanja reklamnih panojev na vseh kmetijskih zemljiščih, kot to zakon že določa.

Utemeljitev: Sedanje reklame ob avtocestah so velikosti 10-20m, kvarijo estetiko naravne pokrajine, obremenjujejo okolje, zmanjšujejo varnost v prometu, nekatere so celo osvetljene in dodatno svetlobno onesnažujejo krajino.

Svetlobno onesnaženje

Predlog: Potrebno je zaostriti zakonodajo na področju svetlobnega onesnaževanja in strožje regulirati namestitve novih svetlobnih virov.

Utemeljitev: Slovenija se hitro razvija in postavlja nove in nove vire svetlobnega onesnaževanja, kar povzroča veliko škodo okolju zlasti ponoči. Zakonodaja na tem področju je izredno ohlapna.

Zmanjšati število prebivalcev Slovenije

Predlog: Odgovorna demografska politika naj poskrbi, da se pri nas število prebivalstev ne poveča. Istočasno s povečanjem domače rodnosti na primeren nivo je potrebno tudi omejiti pretiran priliv dodatnih ljudi in skupno rast prebivalstva.

Utemeljitev: Največji problem pri varovanju okolja je število ljudi krat standard. Potrebno je zmanjšati število prebivalcev – najlažje z omejitvijo pretirane imigracije in skrbeti za trajnostno rast, ne pa za poveličevanje pretiranega potrošništva Opomba: s sedanjo rodnostjo bo Slovencev po narodnosti leta 2500 le še okoli 7.000. Za primerjavo: Japoncev leta 3000 ne bo več, če se bo njihova premajhna rodnost nespremenjeno nadaljevala.

Povečati mestno prebivalstvo

Predlog: Potrebno je stimulirati tako normalno življenje na podeželju kot normalno selitev v mesta.

Utemeljitev: Selitev mestnih in urbanih storitev na podeželje spremeni koncentracijo iz mest v razpršenost po vsej državi, kar je slabo za okolje.

Povečati sredstva za znanost

Predlog: Potrebno je povečati sredstva za znanost, v tem kontekstu za raziskovanje varovanja okolja, saj se problema lotevamo preveč stihijsko.

Utemeljitev: V Sloveniji raste okolijska osveščenost, žal pa se pogosto zaletavamo v dokaj nepomembne ali celo nekoristne usmeritve, medtem ko so ključne kot kurjava ali promet največkrat izločene iz debate.

Povečati okolijsko osveščenost/izobraženost občin in občanov

Predlog: Sprejme se zakon, da mora vsaj en posameznik v občini opraviti okoljevarstveni tečaj v trajanju najmanj enega tedna, kjer se seznani s problematiko.

Utemeljitev: Občine so točka, kjer se občani najbolj seznanjajo s problemi v okolju. Če pa pogledamo samo ambrozijo, vidimo, da v približno polovici občin ne izvajajo nobenih ukrepov proti tej izredno invazivni in alergeni vrsti. Ankete občanov kažejo, da večina ne pozna npr. ambrozije ali drugih alergenih in invazivnih vrst. Z izobrazbo vsaj enega na občini se bodo tudi drugi občani seznanili s temi vprašanji.

Invazivne rastlinske vrste

Predlog: Popraviti zakonodajo za odstranjevanje invazivnih vrst, tako da je ob prijavi s strani občanov avtomatsko izdano opozorilo in ob ponovitvi čez primeren čas avtomatska kazen. Poleg akcij za čiščenje Slovenije je potrebno izpeljati tudi akcije za odstranitve invazivnih vrst. Pozvati je treba inšpektorje/ravnatelje/občane, naj bodo šole, vrtci, javni zavodi brez strupenih, alergenih, invazivnih rastlin.

Utemeljitev: Varstvo okolja med nekaj največjimi škodami okolju navaja invazivne vrste in nujnost borbe proti njim. Medtem ko uspešno občasno izvedemo čiščenje smeti po Sloveniji, se daleč nevarnejših invazivnih vrst še ne lotevamo, niti nismo z njimi seznanjeni. Opomba: Po poročanju International Union for Conservation of Nature (IUCN) je polovica vseh rastlinskih endemičnih vrst v Evropi ogroženih oz. jim grozi izumrtje. Med razlogi je tudi vnos invazivnih rastlin.

Invazivne živalske vrste

Predlog: Za vse invazivne živalske vrste se dovoli izvzem z lovom ali na druge humane načine brez lovopusta in na varen način.

Utemeljitev: Tako imajo urejeno najbolj ekološko razvite in osveščene države na svetu. Ena največjih nevarnosti okolju so invazivne vrste, ki so soodgovorne za 100x hitrejše izumiranje vrst v zadnjih 100 letih, v 50 letih pa se je število živali (osebkov kot kg) zmanjšalo za polovico.

Alergene rastline v javnem sektorju

Predlog 1: Vse alergene rastline iz zgornje tretjine spiska alergenih rastlin je potrebno odstraniti iz javnega sektorja – za drevesa v roku 2 let, za vse ostalo v roku pol leta in nato stalno izvajati redno izločanje.

Predlog 2: Vse alergene rastline iz zgornje polovice spiska alergenih rastlin je potrebno odstraniti iz površin vrtcev in šol – za drevesa v roku 2 let, za vse ostalo v roku pol leta in nato stalno izvajati redno izločanje.

Utemeljitev: Danes lahko opazimo vrsto močno alergenih vrst ne samo na površinah javnega sektorja, ampak tudi vrtcev in šol. S tem delamo veliko škodo ljudem, zlasti mladim.

Genetsko spremenjene rastline

Predlog: Pri uvajanju genetsko modificiranih rastlin, ki vsebujejo snovi proti insektom, je potrebno biti negativno nastrojen.

Utemeljitev: Čeprav na spletu najdemo trditve, da je potrebno uporabiti manj insekticidov, če uporabljamo genetsko spremenjene rastline, ker imajo tovrstne obrambne snovi že vgrajene, tako uničimo dobršen del insektov in s tem negativno vplivamo na okolje. Primer študije je:

https://arstechnica.com/science/2018/03/planting-gmos-kills-so-many-bugs-that-it-helps-non-gmo-crops/

Agresivne živali

Predlog: Vse individualne agresivne živali – individualno ali v tropu, se avtomatsko umakne ali izloči ob pojavu treh agresivnih napadov na živali ali premoženje.

Utemeljitev: Za živalsko vrsto je najslabše, če pustimo neprilagojenim posameznikom, da stalno napadajo in ogrožajo živali, ljudi, premoženje. Najkasneje po treh konfliktih se tako individualno žival odstrani in s tem se živali prilagodijo na sobivanje z ljudmi.

Problemi raziskav, rodnosti oz. naravnosti državljanov

Predlog: Več sredstev nameniti raziskavam za konkretne dileme – vsaj najbolj pereče, recimo ugotoviti, zakaj je tako padla rodnost, število semenčic, zakaj je tako velika pogostost raka, kaj uničuje ljudi.

Utemeljitev: Približno vsaka peta Slovenka je brez otrok, število semenčic je padlo pri mladih moških na polovico v 50 letih, pa se teh problemov nihče intenzivno ne loteva. Morda je razlog v hormonih v vodi ali hrani, potrebno pa je razpisati znanstvene projekte na to temo.

Oddaljena hrana

Predlog: Potrebno je uvesti ekološki davek na oddaljeno hrano proporcionalno z oddaljenostjo.

Utemeljitev: Ko kupujete hrano, skrbno poglejte poreklo in raje kupujte hrano iz bližine. Zlasti bodite skrbni pri nakupovanju hrane iz Afrike ali Južne Amerike, ker je velika verjetnost, da s tem podpirate uničevanje pragozdov. Poleg tega je za vsako hrano iz daljave potreben prevoz, to pa pomeni neposredno dodatno potrošnjo fosilnih goriv. Najbolje je problem urediti z zakonom, če ne pa z navodili uporabnikom in davki trgovinam, ki uvažajo enako hrano iz oddaljenih krajev. Samozadostnost Slovenije je pri 30%, tako da bomo večino pridelkov kupovali iz tujine, ni pa vseeno, ali je iz sosednjih držav ali iz držav, ki intenzivno uničujejo naravo.

Oddaljeni izdelki

Predlog: uvede se dodaten davek na predmete iz oddaljenih krajev, premo sorazmerno z razdaljo.

Utemeljitev: ko kupujete predmete iz oddaljenih krajev, se za potrebe prometa troši fosilna goriva, prispeva se h globalnemu segrevanju, promet pa ubija tako živali v morju kot na kopnem od insektov do kitov.

Prodaja kmetijskih površin

Predlog: Z zakonom je potrebno uvesti dodatne davke za prodajo kmetijskih površin za namene gradnje proporcionalno s kvaliteto zemljišča: 1. kategorija 100% dodatnih davkov, 2. kategorija 50% davkov, 3 kategorija 30%. Sredstva gredo v sklad za okolijske raziskave.

Utemeljitev: Gradnja npr. cest ali objektov je cenejša na najbolj kvalitetni zemlji kot pa recimo skozi gozd, zato Slovenija izgublja najboljšo zemljo na izredno hiter način. Ob že tako nizki samopreskrbi se postavi predvsem vprašanje okolja. v zadnjih 25 letih smo izgubili 85 tisoč hektarjev kmetijskih zemljišč, zadnje čase po 10 hektarov na dan. Od leta 2000 smo izgubili 10% kmetijskih površin.

Klimatske naprave-inverterji

Predlog: Uvesti olajšave za moderne klimatske naprave – inverterje in seznaniti medije z njihovo učinkovitostjo.

Utemeljitev: Do temperatur okoli ničle je segrevanje stanovanj s klimatskimi napravami – inverterji najučinkovitejše. Zato bi jih bilo smotrno dodatno stimulirati namesto nekaterih spornih kot npr. peletov.

Financiranje obnovljivih virov

Predlog: Potrebno je ponovno analizirati, katere vire energije je smotrno sofinancirati. Za vsako konkretno instalacijo, npr. solarno streho, je potrebno predložiti prikaz, ali se nahaja na primernem področju in ali je brez sence.

Utemeljitev: Pri pregledu virov energije, ki se financirajo, je možno opaziti velika odstopanja od optimalne strategije. Poleg tega lahko vidimo npr. solarne strehe, ki so dobršen del dneva v senci itd. Čemu sofinanciramo tovrstne izvedbe?

Termoelektrarne na premog

Predlog: V doglednem času je potrebno zapreti predvsem starejše termoelektrarne na premog.

Utemeljitev: Termoelektrarne so eden glavnih virov onesnaženja zraka v Sloveniji, zlasti starejše.

Nove veletrgovine

Predlog: Dodatno se obdavči vse veletrgovine in gradnjo novih.

Utemeljitev: Po kvadratnih metrih veletrgovin na prebivalca smo na enem izmed prvih mest v svetu, pa se intenzivno gradi nove, ker dobivajo stimulacije oz. se izogibajo davkom s »spretnimi« prijemi, medtem ko naša politika ne najde primernih ukrepov za ureditev stanja.

Jedrska energija

Predlog: Slovenija naj zgradi nov blok jedrske elektrarne in ukine stare termoelektrarne.

Utemeljitev: V primerjavi s starimi elektrarnami je jedrska elektrarna praktično čista energija, saj ne proizvaja izjemnih količin toplogrednih plinov. V boju proti podnebnim spremembam je potrebno najti najboljše rešitve, čeprav vsaka zahteva svoje pristope in potrpežljivost. Za zamenjavo enega bloka jedrske elektrarne bi potrebovali več 10.000 vetrnic, kar bi bolj ogrozilo slovensko okolje.

Varčevanje z energijo

Predlog: Vsaka stavba (v javnem sektorju), ki ima odprta vrata ali okna za več kot 30 minut in ima notranjo temperaturo za več kot 2 stopinji
- poleti nižjo znotraj kot zunaj in je zunaj več kot 25 stopinj
- pozimi višjo znotraj kot zunaj in je zunaj manj kot 15 stopinj

se kaznuje z denarno kaznijo, razen če gre za izredne dogodke.

Utemeljitev: V najhujši vročini in najhujšem mrazu je občasno na stavbah opaziti odprta vrata in okna, kar nepotrebno povečuje obremenjevanje okolja. Za zračenje pa 30 min več kot zadošča.

Prehitra vožnja

Predlog 1: Potrebno je zmanjšati hitrost na avtocestah, kjer je le možno.

Predlog 2: Potrebno je dosledno izvajati preverjanje omejitve hitrosti.

Utemeljitev: Za vsakih 10 km/h nad 110 km/h se nekaj časa onesnaževanje poveča za 10%, pri še večjih hitrostih pa za še več. Promet je eden glavnih onesnaževalcev okolja v Sloveniji.

Tranzitni tovornjaki

Predlog: Z vrsto ukrepov je potrebno otežiti tranzitni prevoz tovornjakov čez Slovenijo: z večjimi kaznimi, z večjimi cestninami, z dodatnimi ekološkimi davki itd.

Utemeljitev: En velik tovornjak uniči toliko avtoceste kot 10.000 osebnih avtomobilov in še na druge načine zelo škodi okolju. Za popravilo avtocest seveda plačamo državljani, ker iz zbranih cestnin niti slučajno ne zberemo dovolj.

Davki na ceste

Predlog: Potrebno je uvesti davke na ceste proporcionalno z velikostjo cest in zlasti na gradnjo novih cest. Ti davki naj se namenijo za okolijske raziskave in akcije.

Utemeljitev: Ceste so eden največjih posrednih škod okolju. Po njih prihaja masa avtomobilov, onesnaženja, turistov, ljudi … Ena ključnih točk pri varstvu okolja je omejitev cest in dostopa po njih, da vsaj deli narave ostanejo brez masovnega izumiranja.

Omejitev prometa z vozili

Predlog: vožnjo s terenskimi vozili, motornimi sanmi, kolesi itd. je potrebno bistveno strožje omejiti samo na dovoljene trase. Potrebno je zaostriti zakonodajo na tem področju.

Utemeljitev: Po Sloveniji lahko vidimo terence, ki divjajo po stranskih poteh, poljih, travnikih in gozdu plašijo divjad itd. Podobno velja za gorske kolesarje.

Uvedba hitrih vlakov

Predlog: Modernizira se potniški in tovorni promet v smeri hitrih vlakov. Sistemsko se preusmeri promet s cest na železnice.

Utemeljitev: Železnice bistveno manj škodijo okolju kot avtomobili, zato bi bilo smotrno preseliti dobršen del prometa s prezasedenih cest na železnice za varstvo okolja in večjo propustnost prometa.

3. DISKUSIJA

Tu zbran spisek predlogov je nadaljevanje prvega referata v tej konferenci in posveta v Državnem svetu. Seznam predlogov udeležence posveta bomo v naslednjem koraku prečistili, dodali nove, preoblikovali in pripravili za pošiljanje v zakonodajne postopke.

4. ZAHVALA

Zahvalil bi se Državnemu svetu Slovenije in Institutu »Jožef Stefan«, ki sta omogočila izvajanje posveta »Znanost o okolju« in konference »Ljudje in okolje« na Institutu »Jožef Stefan«.

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Znanstveno o varovanju okolja
Environmental movement through scientific approach

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ABSTRACT
In this paper, several essential environmental problems in Slovenia are presented coupled with the proposals how to resolve them through the proposal mechanism of the National Council.

Ključne besede: znanost, varovanje okolja

1. UVOD
V času pisanja tega prispevka so se dogajale zadnje organizacijske priprave za posvet "Znanost o okolju" 10.9.2019 na Institutu "Jožef Stefan" (IJS). Posvet [1] je del aktivnosti Državnega sveta[2].

Osnovno poslanstvo avtorja tega prispevka je prinesti čim več stroke v odločanje in čim manj politike v stroko, predvsem pa povečati pomen raziskovanja, stroke, razvoja in podpore v smislu upoštevanja in financiranja. Slovenija še vedno ostaja na repu Evrope, tretja najslabša po financiranju akademske znanosti.

Slika 1: Zadnja leta se povečuje delež ljudi, ki ne verjamejo v preprosto dokazljive argumente, recimo da je zemlja okrogla.

Zadnjih nekaj let se razkorak med znanjem, spoznanji in javnostjo oz. mediji poslabšuje – primer so tako imenovane lažne resnice, ki jih mrgoli. Mediji so – tako levi kot desni – postali glasila političnih strank in ideologij (politokracija), to pa pomeni, da se znanstveno dokazani argumenti čedalje manj cenijo, pa naj gre za cepljenje, globalno segrevanje ali vprašanje, ali je zemlja okrogla ali ploščata (Slika 1). To poneumljanje je doseglo že neverjeten nivo, saj je s preprostim pogledom mogoče ugotoviti, da jadrnica izgine za obzorjem v primerni razdalji, iz spremembe pa je mogoče še kar dobro oceniti zakrivljenost oz. radij zemlje. Tovrstna miselnost se pojavlja hkrati z zniževanjem pomena znanosti, raziskovanja in razvoja ter zmanjšanim financiranjem le-teh.

Naštejmo še nekaj nenavadnih primerov:

1. Sveče (plastične vrečke, plastične slamice) so med največjimi ekološkimi onesnaževalci.

   Preprost izračun pokaže, da vse sveče v Sloveniji naredijo toliko škode okolju kot 1 velik tovornjak (poškoduje cesto kot 10.000 osebnih avtov), ki se vozi po avtocesti.

   In dodatno: Študije WHO (https://www.theguardian.com/environment/2019/aug/22/microplastics-in-water-not-harmful-to-humans-says-who-report) so pokazale, da so običajne koncentracije plastike, mikro in nano, prisotne v ljudeh in živalih daleč pod kritično oz. nevarno ravnijo.

2. Avtocesto v vsako slovensko vas, saj zmanjša onesnaženje.

   Zopet izračun pokaže, da 100 km avtoceste s sprejemanjem sončne toplote tako segreje ozračje, da bi za kompenzacijo tega morala vsa slovenska gospodinjstva potrošiti 1/3 elektrike manj – manj pranja, hlajenja, segrevanja itd. Pri tem nismo upoštevali povečanih izpuhov zaradi večjih hitrosti – s hitrostmi nad 100 km nad uro se hitro povečuje potrošnja avtomobilov, tako goriv kot elektrike, še posebej pa se poveča onesnaževanje. Poglejte Sliko 5. Avtoceste in ceste so v resnici eden največjih onesnaževalcev okolja po raznolikih kriterijih. So tudi cone smrti, saj tu življenja ni. Po njih prihajajo množice v zadnji kotiček Slovenije in sveta. Po njih prihajajo divji lovci v Afriki in iztrebljajo zadnje živalske vrste. Trditev, da je zaradi manj vzponov in ovinkov tudi manj škodi okolju, bi veljala le pri pogoju, da bi bila omejitev hitrosti na cca 100 km/h. Ker pa je običajno 130 km/h, je onesnaževanje v resnici za cca tretjino večje.

3. Čim več mest preseliti na deželo (decentralizacija).

   S tem potenciramo negativni vpliv ljudi na okolje. Čim več krajev poselimo, tem večja je škoda okolju. V urbanih okoljih je nekajkrat manj (po poročanju nekaterih cca 3x) živali in rastlin. Neokrnjena narava v parkih naj bo brez dostopa (cest), brez turistov, ljudje naj se naselijo predvsem v nekaj mestih in naj ne preobremenjujejo krajine.

Ni pa vse slabo. Dobro je, da se javnost, mediji, tako levi kot desni, čedalje bolj zavedajo, da postajajo vprašanja varovanja okolja izredno pomembna za kvalitetno življenje. Čedalje več ljudi tudi aktivno sodeluje, čedalje več društev in civilnih iniciativ. Problemi varovanja okolja bodo dokaj nesporno iz sedanje precejšnje škodljivosti prej ko slej prišli do nivoja ogrožanja razvoja človeške civilizacije. V [3] smo pokazali, da bo človeška tehnološka civilizacija najverjetneje propadla v tisoč do deset tisoč letih. Ne vemo sicer zakaj, možnih je cela vrsta razlogov od jedrske vojne naprej, a med potencialnimi kandidati so tudi globalno segrevanje (ne v sto, ampak tisočih letih), vsekakor pa so praktično vse trenutno največje grožnje človeštvu povzročene s strani ljudi. Tudi analize Rimskega kluba opozarjajo na prihajajoče probleme [4].

Ker pa je v svetovnem merilu Slovenija majhna in njena populacija maloštevilna (za primerjavo - Etiopija ima 110 milijonov prebivalcev), je naš vpliv npr. na globalno segrevanje zanemarljiv. Hkrati pa so problemi okolja praktično identični. Če kurimo, prispevamo tako h globalnemu segrevanju kot škodimo lokalnemu prebivalstvu. Zato so splošne usmeritve enake, samo reševati jih moramo predvsem z lokalno optimizacijo in v lokalnem okolju, kjer se naš glas vsaj nekaj sliši.

Pri poskusih varovanja okolja v svetu in še bolj v Sloveniji je opaziti določeno neurejenost, kampanjskost, stihijskost, tudi zaletavanje v dokaj ali skoraj povsem nepomembne tematike. Posamezniki, določene skupine so prepričani, da je ta ali oni problem najpomembnejši, pa čeprav so strokovnjaki drugačnega mnenja. Ravno stroka je ključna, da sedaj to energijo pravilno usmeri, da nekaj dejansko spremenimo, nekaj pomembnega naredimo za varovanje okolja, prizadevanja kvalitetno oplemenitimo.

To je ključna ideja posveta in konference »Ljudje in okolje«. Konferenca je približno en mesec za posvetom, torej v začetku oktobra 2019. Iz posveta, kjer se je slišal glas ljudstva in stroke, bo zbranih od deset do dvajset problemov in konkretnih predlogov. Nato jih bomo ustrezno preoblikovali in poslali slovenskemu vodstvu z željo, da čim več predlogov ali v izvirni obliki ali primerno preoblikovane tudi realizirajo.

V nadaljevanju je ključno naslednje poglavje, kjer so predstavljeni nekateri pomembni problemi varovanja okolja in predlagane rešitve.

2. PROBLEMI VAROVANJA OKOLJA IN PREDLAGANE REŠITVE

2.1 Reklamni panoji

Stanje: V Sloveniji je predpis, da ne sme biti reklam 40m stran od avtocest. Verjetno je bilo teh 40 m v davnih časih dovolj, da se reklam ne bi postavljajo, saj se na tej razdalji običajne reklame ne vidijo več, oziroma bodo predrage. Razmere pa se spreminjajo in ob avtocestah vidimo čedalje več reklamnih panojev, sicer res primerno oddaljenih, vendar tako velikih, da so dobro vidne in berljive.

Nekatere države v Evropi reklame na dovolj veliki razdalji ob avtocestah dovoljujejo, druge ne, npr. VB. Npr. Češka je pred kratkim prepovedala reklame ob avtocestah (The total number of billboards in the country is estimated at 25,000. By removing the billboards from motorways, the Czech Republic will follow the example of countries such as Belgium, Denmark, Germany and Spain, Neusar added. http://praguemonitor.com/2017/07/27/operators-protest-law-banning-billboards-along-motorways).

Torej je vse odvisno od odločitve vodstva Slovenije, ki na dosedanje pobude še ni odreagiralo.

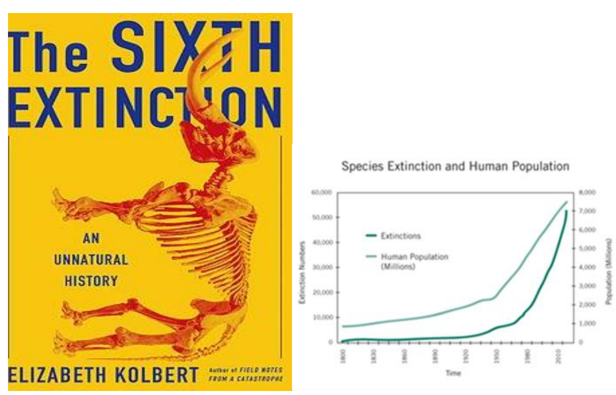
Predlog1: Predlagamo, da se z zakonom prepove reklame v vidnem polju avtocest. V roku 2 let se odstranijo obstoječe na stroške reklamiranih podjetij.

Predlog 2: Dosledno naj se uveljavi prepoved postavljanja reklamnih panojev na vseh kmetijskih zemljiščih, kot to zakon že določa.

Utemeljitev: Sedanje reklame ob avtocestah so velikosti 10-20m, kvarijo estetiko naravne pokrajine, obremenjujejo okolje, zmanjšujejo varnost v prometu, nekatere so celo osvetljene in dodatno svetlobno onesnažujejo krajino. Čedalje več držav jih odstranjuje. Pri tem imamo tudi zakon, ki prepoveduje postavljanje reklam na kmetijskih cestiščih ob avtocesti, da ga nihče ne izvaja. Čas je, da državni organi oz. inšpektorji začnejo izvajati zakon in da ne bomo več poslušali pripomb začudenih turistov, ki gledajo orjaške panoje na kmetijski površini – eklatanten znak ekološke zaostalosti Slovenije.

2.2 Izumiranje živali in rastlin zaradi ljudi in standarda

Stanje: Eden poglavitnih problemov našega planeta je hitra rast števila ljudi in rast standarda. Z rodnostjo 5 (število otrok na žensko v življenjski dobi), kot je bila prejšnje stoletje, bi v 13 generacijah prišel en človek na 1 m2 površine, v 40 generacijah pa 1 na kg našega planeta. Preoblikovali smo že polovico kopnega, pokurili smo pol fosilnih goriv. Letos poročajo o obsežnih požiganjih amazonskih gozdov, povezano s krčenjem zaradi pridelovanja izdelkov za potrebe Kitajske, Evrope. S tem, ko si želimo čedalje več eksotičnih produktov iz Brazilije, smo ljudje sami povzročitelji uničevanja svetovnih gozdov. Posledično je izumiranje vrst živali in rastlin 100x hitreje kot bi bilo normalno (Slika 2), v 40 letih je 50% živali manj na svetu, v 27 letih je v Nemčiji 75% manj letečih žuželk. Nemčija je za varovanje žuželk namenila 100 M € preko ohranjanja potokov, živih mej, neobdelanih površin in podobno. Manj naj bo tudi zlasti nevarnih insekticidov. Glede živalstva in tudi rastlinstva grozi 6. veliko svetovno izumiranje (Slika 2) [5].



Slika 2: Levo: prelomna knjiga o šestem velikem izumiranju v zgodovini našega planeta; desno: krivulja rasti števila ljudi sovpada s krivuljo izumiranja živalskih vrst [6].

Ali Slovenija prispeva k temu uničevanju planeta in izumiranju živali in rastlin? Po nekaterih podatkih v enem letu potrošimo 2x toliko, kot sami pridelamo (energentov, elektrike, hrane …). Zato je zavedanje o pomenu varovanja okolja lokalno za Slovenijo pomembno tako kot je globalno za cel planet. Ker pa se moramo koncentrirati samo na en konkreten napotek, je največji problem pri uničevanju slovenskega okolja na dlani:

Po podatkih Statističnega urada RS se je v letu 2018 število prebivalcev Slovenije povečalo za 14.028, število državljanov Slovenije zmanjšalo za skoraj 2.300, število tujih državljanov pa se je povečalo za več kot 16.300 (13,4 %).

Največje poslabšanje okolja Slovenije je v 2018 zaradi rasti prebivalstva, tj. povečanje zaradi premalo restriktivne priseljevalske politike!

Pri tem pa ima Slovenija cca 10.000 novorojenčkov premalo s strani domorodnega prebivalstva (Slovenci, Hrvati, …) [7] podobno kot cela Evropa in se rast svetovnega prebivalstva umirja [8].

Predlog: Odgovorna demografska politika naj poskrbi, da se pri nas število prebivalstev ne poveča. Istočasno s povečanjem domače rodnosti na primeren nivo je potrebno tudi omejiti pretiran priliv dodatnih ljudi in skupno rast prebivalstva.

2.3 Prodor invazivnih vrst

Stroka je že davno odkrila, da globalni prodor invazivnih vrst pomeni masaker lokalne biodiverzitete, zmanjšanje števila lokalnih, endemnih vrst in prevlada tistih vrst, ki so se bolj prilagodile globalnemu okolju (svet postaja globalna vas), zlasti človeku oz. njegovim virom hrane. Primer so podgane ali mačke v Avstraliji, ki intenzivno uničujejo domorodne živali. Hitro se množijo in širijo ter izrivajo domače avtohtone vrste, ki niso prilagojene agresivnim prišlekom.

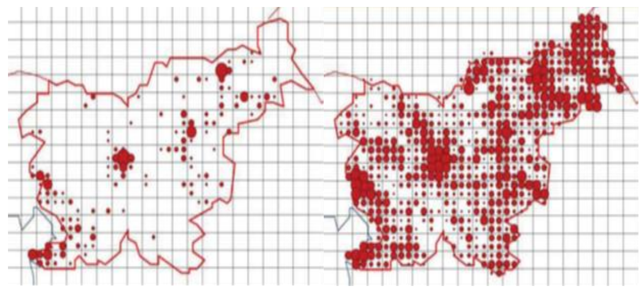
Slika 3: Levo: ljudje hranijo in preprečujejo lovcem, da bi odstranili nutrije v raznih okoljih Slovenije, ne zavedajoč se, da s tem delajo grozljivo škodo okolju. Desno: Poznate najbolj alergeno in invazivno rastlinsko vrsto – ambrozijo? Koliko ste jih že odstranili? Vir: Wikipedija.

Na sliki 3 levo so prikazane nutrije in kako lepo so jih sprejeli v Sloveniji. S tem so pokazali svoj zelo pozitiven odnos do živali, žal pa tudi popolno nepoznavanje varovanja okolja – nutrije so med 100 najbolj škodljivimi živalskimi vrstami. Ekološko osveščeni prebivalci bi prosili lovce, da jih odstranijo in bi jih sami obveščali o videnjih. Zakaj? Ker se z vsakim pojavom invazivne vrste radikalno zmanjša številčnost lokalnih vrst od lokalnih glodalcev do vodnih živali.

Med invazivnimi rastlinami v Sloveniji je med najbolj alergenimi in najbolj invazivnimi ambrozija. Ena sama rastlina lahko na leto proizvede milijardo semen (cvetni prah) [9]. Na sliki 3 je desno, značilna so »kosmata« stebla, v resnici pokrita s strupenimi dlačicami. Na sliki 4 pa je širjenje ambrozije glede na število javljenih opažanj prebivalcev. Zakonodaja o ambroziji niti ni tako slaba – predvideva primerne kazni s strani inšpektorjev, a kaj ko še nobena kazen ni bila izdana, pa so desetine in celo stotine kilometrov ob cestah polne ambrozij, tudi polj in obronkov gozdov.

Delno podobna zgodba je s šolami in vrtci. Ne samo da smo do pred kratkim lahko na področju šol, vrtcev in javnih zavodov našli strupene rastline, vodstva so se na opozorila izgovarjala, da nočejo posegati v okolje – kot da ne bi teh rastlin posadil človek. Sedaj pogosto srečamo nekoliko bolj blago varianto – alergene vrste kot brezo vidimo praktično povsod, pa čeprav povzroča vrsto srednjih in celo hujših težav. Zakaj jih ne odstranijo?

Predlog: Popraviti zakonodajo za odstranjevanje invazivnih vrst, tako da je ob prijavi s strani občanov avtomatsko izdano opozorilo in ob ponovitvi čez primeren čas avtomatska kazen. Poleg akcij za čiščenje Slovenije je potrebno izpeljati tudi akcije za odstranitve invazivnih vrst. Pozvati je treba inšpektorje/ravnatelje/občane, naj bodo šole, vrtci, javni zavodi brez strupenih, alergenih, invazivnih rastlin.



Slika 4: V nekaj desetletjih se je ambrozija, najbolj alergena rastlinska vrsta, razširila po vsej Sloveniji. Povzroča vrsto sekundarnih alergij, vendar ni bila narejena nobena študija povezave med čedalje več alergijami pri otrocih in pojavom ambrozije. Vir: ARSO.

Druga čudna usmeritev, ki je opazna v Sloveniji, je odnos do agresivnih živali. Danes lahko živali dobro živijo le, če se prilagodijo spremenjenim razmeram v okolju, če niso agresivne do ljudi in njihovih živali. Zato je potrebno agresivne primerke čimprej odstraniti, pa naj bo to medved, volk ali vrana, ki se zapodi otroku v obraz. Marsikdo se nestrokovno postavlja na stališče, da je potrebno ščititi enakovredno vse primerke, čeprav s tem škodijo tako ljudem kot živalim, s tem slabšajo odnos ljudi do živali in okolja. Živalskim vrstam najbolj pomagamo tako, da čimprej izločimo preveč agresivne posameznika. Živali so pametne in se hitro naučijo, kakšno ravnanje se ne splača! Zato je okolijsko osveščeno in za živali koristno, da lovci čimprej odstranijo vse preveč agresivne živali, ne pa da prepuščamo birokratom, sodiščem in okolijsko neizobraženim neskončne debate.

2.4 Povečati sredstva za raziskave

Neodgovorno ravnanje z odpadki in okoljem se nam vsem maščuje. V eni generaciji se je število spermijev pri mladih moških zmanjšalo za 50% [10]. Cca 17% slovenskih žensk nima otrok, veliko jih ima težave z zanositvijo. Po pogostosti raka (vpliv okolja!) smo med najslabšimi v Evropi.

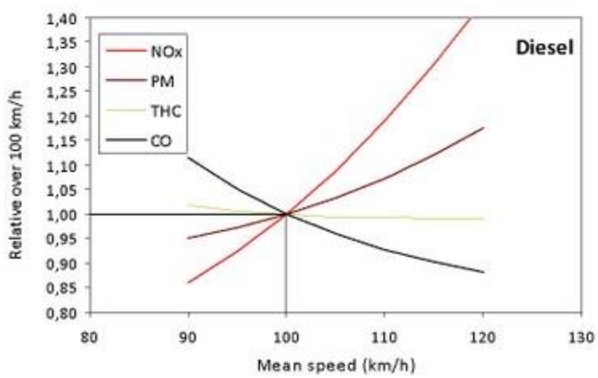
Predlog: Več sredstev nameniti raziskavam, za konkretne dileme – vsaj najbolj pereče, zmanjšati rakotvornost slovenskega okolja (promet, kurjava, hrana …), ugotoviti, zakaj je tako padla rodnost, število semenčic, kaj uničuje ljudi.

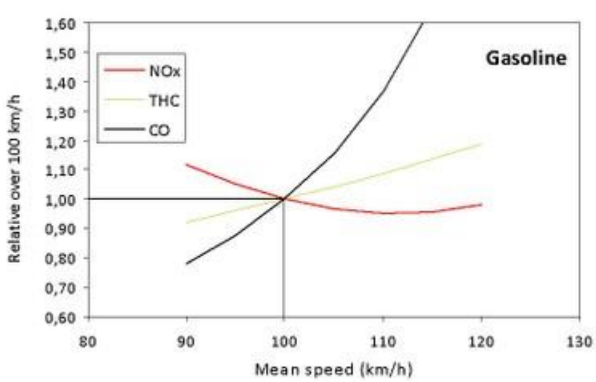
Zgornji primer pokaže, kako interdisciplinarno je varstvo okolja in kako pomembna je objektivna strokovna analiza. Nujno potrebujemo več raziskav, več idej, več odprtih diskusij, da se tako javnost kot mediji in politika zavedo problematike in izvedejo strokovne, ustrezne in učinkovite rešitve. V tej debati je nujna vključitev vseh strokovnih kapacitet, predvsem SAZU, IAS idr.

2.5 Promet

Promet najbolj prispeva k segrevanju ozračja. Nove ceste, slaba prepustnost, zastoji, prevelika hitrost (primer kako s hitrostjo narašča onesnaženje je na Sliki 5). Če bi zmanjšali hitrost na avtocestah za 10 km/h, ali pa bi bolj striktno izvajali nadzor hitrosti, bi približno za vsakih 10 km/h zmanjšali onesnaževanje za 5-20% (do kakšnih 100 km/h, potem se učinki zmanjšujejo).

Vsi ploskajo ob odprtju novih cest, a smo po kilometrih cest na prebivalca med prvimi v svetu, za 100 km novih avtocest pa toliko prispevamo k segrevanju ozračja, da bi morali za to zmanjšati potrošnjo električne energije vseh gospodinjstvih za tretjino. Tovornjaki uničijo cesto kot 5-10.000 osebnih vozil, večino popravil zato namenimo za tuje tovornjake. Kitajska ima več kot pol vseh prog za hitre vlake, Evropa pa ne začne programa hitrih vlakov čez vso Evropo kot prednostno nalogo, ampak se ukvarja s centralizacijo bank. Ko kakšna država poveča davke na tovornjake, ji pogosto grozi kazen EU. Boljša vizija je na dlani. Jo javnost, politiki zagovarjajo?





Slika 5: Rast onesnaževanja s hitrostjo avtomobilskega prometa – zgoraj dizel, spodaj bencin. Zaradi večjih hitrosti so avtoceste poglavitni vir onesnaževanja in uničevanja okolja. Vir: European Environmental Agency.

Pri tem obstaja izredno dobra alternativa cestnemu prometu ljudi in blaga - hitre železnice. Evropa je bila pionir pri njihovi uvedbi, danes ima Kitajska več kot 60% vseh hitrih prog na svetu. Maroko in Savdska Arabija imata hitri vlak, Slovenija niti načrtov ne. EU bi morala vse države povezati z omrežjem hitrih vlakov, pa se ukvarja z globalnimi sporazumi z državami, ki masovno uničujejo okolje, recimo kurijo tropske gozdove za nove kmetijske proizvode, ki jih prepeljejo v EU tisoče km daleč. Ekološko sporno!

2.6 Gradnja na najboljši zemlji

Naslednji velik problem so nove gradnje zlasti na najboljših kmetijskih površinah, kar poslabšuje samopreskrbo, ki se v Sloveniji v zadnjih letih suče okoli 35-40%.

Res imamo zakon, ki za večje posege zahteva pridobitev toliko kmetijske površine, kot jo je bilo izgubljene. V praksi to pomeni izsekavanje gozda in prevoz zemlje. Glavni problem pa ostane - ponovno se izgubi del narave in pridobi veliko betona, asfalta, področja brez življenja, ki zaradi vsrkavanja sončne energije dodatno segreva ozračje Avtocesta je cona smrti, kjer ne preživi nobeno živo bitje, pa vendar se od politikov do medijev vsi samo veselijo novih in novih povečanj onesnaževanja in segrevanja ozračja. Primeri predlogov za nove ceste se vrstijo drugo za drugim, ljudje celo protestirajo v želji za novimi cestami, župani si s tem povečajo možnosti za ponovno izvolitev, namesto da bi ekološka združenja protestirala in prenesla argumente v javnost, da bi bilo slehernemu jasno, kakšna škoda je bila v resnici povzročena. Tudi po m2 (vele)trgovin na prebivalca smo med prvimi ali celo prvi na svetu. Veletrgovci ponujajo vse mogočo robo, vlečejo cca 20% marže, davkov pa skoraj ne plačujejo. Zakaj? Ker so oproščeni, če zgradijo še eno trgovino, investicijo. Tako naša zakonodaja stimulira noro potrošništvo in noro uničevanje okolja. Trgovine so zaradi prezračevalnih, grelnih in hladilnih sistemov ogromen porabnik električne energije in povzročitelj segrevanja. Mediji pa o tem ne pišejo. Ko povabimo tuji kapital, da postavi okolju škodljivo novo tovarno na najboljši zemlji, se hvalimo z novimi delovnimi mesti. Ne povemo pa, da bo večina delovne sile tujih manualnih delavcev, da bo večina dobička zaobšla vse državljane in se vrnila v izvorno deželo, nam in zanamcem pa bo ostalo poslabšano okolje.

2.7 Kurjava in barva površin

Kurjava je eden največjih onesnaževalcev. Najbolj učinkovita grelna naprava je inverter - klima. Moderne dosegajo sezonske faktorje do 9, tj. zadržujejo primerno temperaturo skozi celo leto 9x bolj učinkovito kot neposredna električna naprava (npr. radiator na elektriko – vendar pozor – samo pri segrevanju je faktor »le« 4). Šibka točka je izkoristek v najbolj mrzlih dneh, kjer se toplotne črpalke bolje obnesejo. Slednje pa znajo biti neprijetno glasne. Zakaj torej niso posebej stimulirane napredne klime - inverterji, čeprav so ekološko in finančno najbolj učinkoviti? Podobno dilemo opazimo pri pridobivanju elektrike - je bolj problematična jedrska elektrarna Krško, ali 20.000 vetrnic, katerih investicija je nekajkrat večja? O vseh teh dilemah se je potrebno strokovno in poglobljeno pogovoriti, ne pa se ideološko slepo zaletavati.

Izračun pokaže, da bi v Sloveniji ogromno prispevali k zmanjšanju segrevanja ozračja s preprosto obdavčitvijo temnih fasad in streh.

Na svetlih površinah se svetloba bistveno bolj odbije in zato manj segreva okolico skladno s Stefanovim zakonom.

3. DISKUSIJA

Lepo je videti, kako iz leta v leto raste zavest o nujnosti varovanja okolja. Malo manj lepo je opazovati, kako se javnost in mediji zaletavajo v posamezne probleme, ki so relativno nepomembni, medtem ko so nekateri drugi ključni, recimo nove ceste ali gradnje masovnih alternativnih trajnostnih virov, kot recimo 10.000 vetrnic namesto ene jedrske elektrarne, ljudem bolj sprejemljivi, ali ko ljudje protestirajo in zahtevajo nove in nove ceste in s tem masovno uničevanje okolja, pa o tem ni niti črke v medijih. Ko delamo akcije »Očistimo Slovenijo«, smo lahko zelo zadovoljni, kje pa je akcija »Odstranimo invazivne vrste rastlin in živali«? Ko se prebivalci Ljubljane zavzemajo za nutrije, je po eni strani lepo, da se zavzemajo za živa bitja, vsebinsko in v resnici pa je grozljivo opaziti tako navijanje za globalizacijo in uničevanje - izumiranje avtohtonih vrst. V principu ni bistvene razlike med divjim lovcem v Afriki, ki pobije ogroženega nosoroga, in med razširjanjem nutrij po Ljubljani.

Ključno je, da damo stroki možnost pojasniti, katere aktivnosti so izjemno koristne in dobrodošle, katere relativno nepomembne in katere celo izrazito škodljive. Šele na ta način bomo usmerili pozitivno energijo v pravo smer.

Organizirati konferenco in posvet v Državnem svetu je vse prej kot lahek zalogaj, pogosto doživiš več pritiskov in kritik kot pohval, vendar je to moja osebna vizija in ideal: vpeljati stroko v vse pore slovenskega življenja in odločanja – za dobro okolja, slovenske, evropske in človeške civilizacije.

4. ZAHVALA

Zahvalil bi se Državnemu svetu Slovenije in Instititu »Jožef Stefan«, ki sta omogočila izvajanje posveta »Znanost o okolju« in konference »Ljudje in okolje« na Institutu »Jožef Stefan«.

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Dolgoročne posledice spolnega nasilja
Long-term consequences of sexual violence

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ABSTRACT
Long-term consequences of sexual violence are reviewed, analyzed and presented.

POVZETEK[1]
Spolno nasilje je grozodejna oblika nasilja, ki pušča dolgoročne posledice v vseh porah življenja. Znanstvene in klinične raziskave so pokazale, da poseže v posameznikovo telesno in duševno zdravje ter partnerske in družinske odnose. Individualne posledice imajo relacijsko razsežnost in vplivajo na celotno družbo. Posledic spolnega nasilja se je potrebno zavedati, jih zgodaj prepoznati in pričeti ustrezno odpravljati. Prispevek predstavljamo na podlagi znanstvenih raziskav z željo po celovitejšem razumevanju posledic spolnega nasilja in posledično učinkovitejšemu ukrepanju, ki bo pripomoglo k dobrostanju vseh.

Ključne besede
Spolno nasilje, individualne posledice, posledice v medosebnih odnosih.

1. UVOD

Posledice, ki jih doživljajo posamezniki, ki so doživeli spolno nasilje, se lahko zelo razlikujejo, saj se zloraba zgodi v različnem kontekstu, načinu in okoliščinah. Raziskave so pokazale, da so le-te odvisne od različnih dejavnikov, ki so pogosto povezani med seboj: starost otroka ob zlorabi, odnos s storilcem [1], število storilcev [2], način zlorabe [3], trajanje zlorabe [4], odziv na razkritje zlorabe [5], oz. materina podpora [6]. Če povzamemo navedene razskave, le-te kažejo, da mlajši, kot je otrok ob zlorabi, bližji kot ima odnos s storilcem, več kot ima storilcev, dlje časa kot traja zloraba, hujše in bolj škodljive so dolgoročne posledice. Enako velja za otroka, ki mu ne verjamejo, ko pove za zlorabo, ga obtožujejo ali ga ne vzamejo resno ali pa za otroka, ki nima podpore matere [7]. Zato je za odpravo posledic še toliko bolj pomembno, da se posamezniku verjame in se mu nudi ustrezna podpora. Določene posledice spolnega nasilja se lahko pojavijo že takoj po zlorabi, nekatere pa kasneje v odrasli dobi, je pa nabor posledic zelo širok in so združene v različne dimenzije [8]. Na podlagi raziskav so jih avtorji razdelili na več glavnih področij [9]. Ker je spolno nasiljeu travmatična izkušnja, se ponavlja v čustvih, mislih in vedenju. Ekstremna čustva se pojavijo takrat, ko so spodbujeni spomini iz preteklosti, preko katerih posameznik lahko doživlja intenzivne izbruhe besa, panične napade, depresivne epizode, poplave solz zaradi neznatnega razloga. Osebo lahko preplavljajo močna čustva od gledanju filma ali ob na videz trivialnih razlogih, ob doživljanju krivice neki drugi osebi, pogosto pa prihajajo na dan v partnerskih odnosih in osebo presenetijo [10]. V nadaljevanju prestavljamo posledice na individualni in medosebni ravni.

2. INDIVIDUALNE POSLEDICE

2.1 Razdrobljen občutek jaza

Žrtve spolnega nasilja se pogosto čutijo razcepljene oz. razdrobljene z uničenim občutkom lastne vrednosti oz. nevredne [11]. Lahko izgubijo stik s seboj, oslabljena pa je lahko tudi sposobnost regulacije afektov, kar se je v klinični praksi močno izrazilo pri delovanju v medosebnih odnosih.

2.2 Regulacija afektov

Močni občutki in čustva, ki jih je doživela oseba pri spolnem nasilju se lahko dolgoročno kažejo kot anksioznost, jeza, obup, zmeda, teror ali depresivno razpoloženje. Nekateri se počutijo preplavljene in prestrašene zaradi svojih občutkov, drugi pa nasprotno, čustveno otopijo. Pri oslabljeni regulaciji se kažejo težave povezane s strpnostjo in izražanjem čustev [10]. Če si predstavljamo otroka, ki ob zlorabi ni pomirjen in je prepuščen sam sebi, ko mora upravljati s paleto močnih, pogosto protislovnih in zmedenih občutkov, ki mu jih nihče ne ubesedi, se sam ne more izraziti, pomanjkanje afektivne regulacije pa vodi do nihanja, ko ne morejo kasneje v odraslosti nadzorovati besed ali vedenja, še posebno v za njih zastrašujočih situacijah, ko ne morejo nadzorovati besed ali vedenja in izrazijo jezo na nekontroliran način [8].

2.2.3 Jeza in bes

V raziskavaj je jeza pogosto opisana kot jeza na storilca ali jeza nase. Pogosta čustvena posledica je kronična razdražljivost, ki se kaže kot nepričakovana in neobvladljiva jeza. Če jeze ne morejo

[1] Doseženi rezultati so delno nastali v okviru projekta št. J5-9349, ki ga je financirala Javna agencija za raziskovalno dejavnost Republike Slovenije iz državnega proračuna.

izraziti, jo lahko ponotranjijo kot sovraštvo do samega samega sebe in kot depresijo ali pa jo usmerijo navzven, proti drugim.eksternalizirajo, kar se lahko kaže kot posledica zlorabe drugih, kar se lahko kaže v nasilnem vedenju kot uničevanju lastnine in drugih kriminalnih dejanjih. Ponotranjena jeza, obrnjena vase, se lahko manifestira kot škodovalno vedenje do telesa, kot je npr. samopoškodovanje ali motnje hranjenja. Sem sodijo tudi zlorabe substance. Ker se na eni strani jeze bojijo, jo nezavedno tlačijo, to pa se izraža v pretirani uslužnosti drugim, s katero jim želijo ugajati in niso zmožni reči ne. Mnoge je strah intenzivnosti svoje jeze. Čutijo, da če bi dopustili izbruh svoje jeze, da bi bila ta tako močna, da bi uničila njih same in druge, kar pa v njih bolj spodbuja pasivno agresivno naravnanost namesto direktnega izražanja jeze. Slednje se kaže v pretirani uslužnosti, saj želijo ugajati drugim in niso zmožni reči ne [8]. V raziskavah se je pokazalo tudi, da se jeza kot posledica spolnega nasilja izraža tui v spolnosti [7]. V eni izmed raziskav, kjer so bile udeleženke žrtve incesta, so komentirale: »Utrujena sem od pretvarjanja, da se čutim kot spolno bitje, jezi me, da sem kot ženska pogorela, jezna sem, ker ne bom nikoli normalna v spolnosti in ker bo vedno nekaj narobe z mano« [8].

2.2.4 Strah in tesnoba

Tesnoba je pogosto povezana s spolnim nasiljem. Izraža se lahko zelo nespecifično ali pa kot občutek, da je svet nevaren kraj, ker ga je takega doživel posameznik ob zlorabi. Tesnoba lahko vodi v panične napade [8], ki odraslega naredijo bolj ranljivega za depresijo in razmišljanje o samomoru Posamezniki pogosto doživljajo veliko strahu [14]. Strah je lahko povezan z varnostjo v nepredvidljivem in nevarnem svetu, zaupanjem samemu sebi in intimnostjo z drugimi. Strah jih je, da bi bili ponovno izdani in ranjeni oz. se znašli v zlorabljajočem ciklu. Zaradi navedenega jih je lahko strah imeti otroke, čeprav si le-teh želijo, obenem pa ne morejo verjeti v svoje starševske sposobnosti [8]. Zato pogosto doživljajo veliko tesnobe in strahu v medosebnih in bližnjih odnosih. Lahko je osebo strah pred ocenjevanjem drugih ali pa doživljajo močan strah pred avtoriteto [15]. Pogosto pa je prisotna tudi žalost.

2.2.1 Žalost

Žalost je močno povezana z dejanskimi in simbolnimi izgubami: izguba jaza, izguba zaupanja v sebe in druge, izguba nedolžnosti, otroštva, varnosti, potrebe po varnosti, avtonomije, moči, kontrole, čutenj, idealiziranih staršev, veselja do življenja … [8]. Kadar žalost ni izražena in je »zakopana«, takrat posameznika zastruplja in mu onemogoča, da bi bil lahko v polnosti veselil oz. se počutil živega [15].

2.2.2 Krivda in sram

Pri spolnem nasilju je najbolj pogosto, neprijetno in boleče občutje sram. Oseba se čuti osramočeno, razvednoteno, slabo in neprimerno [7]. Najraje bi se skrilaa in izoliral, kar pa ji prinese občutek odtujitve in ustvarja težave v nadaljnjih odnosih, saj se zaradi sramu umika od drugih [8]. Kako se počutijo v povezavi s sramom odrasli, ki so kot otroci doživeli spolno zlorabo je zajeto v opisu dveh besednih zvez besednih zvez in sicer sindrom »pokvarjenega blaga« (ang. damaged goods) [17]. Oseba se počuti osramočeno zaradi same zlorabe in tudi sebe osebno, kar vodi k preziru do samega sebe, občutku, da je osega slaba in »kužna«. Sram pogosto spremlja kronični občutek krivde, ki med drugim pušča občutek prekomerne odgovornosti zase in za druge. To se kaže v načinu, da osebe, ki so doživele spolno nasilje, pogosto nase prevzemajo ogromno odgovornosti za druge, ki jim težko rečejo ne, obenem pa stalno zavračajo sebe in svoje potrebe [8]. Sram in krivda sta tako v številnih kliničnih raziskavah navedena kot dolgoročni simptom pri posameznikih, ki so doživeli spolno nasilje [18]. Krivda je povezana s preteklostjo, ko se je otrok krivil za zlorabo, ki se mu je zgodila, se spraševal, zakaj je ni preprečil, zaustavil, se ji izognil. Strašljivi občutek samoobtoževanja posameznika še globje povezuje s travmo in onemogoča, da bi lahko razvil samozaupanje [10].

2.2 Slaba samopodoba in nizka samozavest

Raziskave, ki so povezane s spolnim nasiljem in doživljanja samega sebe ter o tem koliko posameznik verjame in misli, da zmore, kažejo negativno povezanost [19]. Posamezniki sebe doživljajo kot manj uspešne, manjvredne, manj privlačne, z nizko stopnjo zaupanja vase in malo samospoštovanja, obenem pa se počutijo nezaželene, doživljajo občutke krivde in sramu [20]. Doživljanje sebe prispeva tudi k drugim simptomom, ki so močno izraziti v intimnih partnerskih odnosih [7].

2.3 Posledica na telesu in zdravju

V literaturi je moč zaslediti povezanost spolnega nasilja z duševnim in telesnim zdravjem [21]. Raziskave kažejo, da je spolno nasilje velik dejavnik tveganja za razvoj psihopatologije, pogosto se lahko razvijejo razpoloženjske motnje [22], lahko se pojavijo različne oblike motenj hranjenja in samopoškodovanja [23], nagnjenost k zlorabam substance v najstništvu [24], samomorilnosti [25]. Raziskave navajajo povezanost spolne zlorabe s kasnejšimi težavami zlorabe substanc, obenem pa naj bi bila le-ta pri ženskah dvakrat višja od splošne populacije [26]. Akohol in opojne substance služijo kot beg pred nakopičenim stresom, občutkom nemoči in izgubo kontrole nad svojim življenjem, slednje pa lahko privede do zasvojenosti, ki tako postane način samozdravljenja posttravmatske stresne motnje [27], ki je ena izmed najpogostejših duševnih motenj. Longitudinalna raziskava spolne zlorabe znotraj družine v povezavi z ženskim razvojem je pokazala številne zdravstvene težave, med drugim zgodnejši vstop v puberteto, disociativne simptome, visoko stopnjo debelosti [28]. Spolno nasilje pa je tudi napovedovalec več bolezni, med drugim gastroenteroloških [29] in ginekoloških težav, povezanih z reproduktivnim zdravjem [30] mišično-skeletnih bolečin, glavobolov [31,32] ter sladkorno boleznijo tipa II [33]. Raziskave so tudi pokazale, da so pri spolno zlorabljenih pogostejši tudi obiski pri zdravniku [34]. Bolečine se lahko pri posamezniku pojavijo takrat, ko zloraba ni bila integrirana v spomin in se ob mislih in občutkih zgodi, da posameznik ponovno podoživlja tako fizične kot tudi čustvene bolečine [35].

2.4 Posledice na kognitivni in vedenjski ravni

Vplivna prepričanja, ki si jih posameznik ustvari o sebi, drugih, okolici in prihodnosti temeljijo na tem, kar se je naučil na podlagi izkušenj, pridobljenih v otroštvu. Glede na to, da so izkušnje v povezavi s spolnim nasiljem negativne, se ta prepričanja in doživljanja samega sebe izražajo v precenjevanju nevarnosti v svetu in podcenjevanju samoučinkovitosti in lastne vrednosti. Sebe pogosto doživajo kot nemočne in brezupne, z oslabljenim zaupanjem in obtoževanjem samega sebe ter nizko samopodobo [35]. Otrok, ki je spolno zlorabljen, mora prehitro odrasti. Tako deluje zrelo, razumno in preveč odgovorno. Vse njegove moči so bile usmerjene v iskanje pomena, razumevanja in nadzorovanja čustev. Občutek prekomerne odgovornosti s prevelikim poudarkom na kognitivnih veščinah in pomanjkanju čustvene pismenosti se lahko nadaljuje tudi v odraslem življenju. Čustvom se skušajo izogniti tako da jih nadzorujejo, zato pogosto iščejo tolažbo in zatočišče v kognitivni sferi, ki jo lažje nadzorujejo. Njihov kognitivni razvoj je bil pospešen, kar pa je v škodo njihovemu čustvenemu razvoju. Pogosto doživljajo tudi močne občutke neuspeha. Da bi jih osebe nadomestile lahko stremijo k popolnosti. Cilje si lahko postavijo previsoko in ko jim ne uspe, se občutek neuspeha še dodatno utrdi, zaradi česar se lahko umaknejo in izolirajo. Nasprotno pa lahko na drugi strani visoko funkcionalne odrasle osebe, ki prevzemajo izzive in se ves čas ženejo naprej. Imajo visoke standarde zase in za druge in stremijo k temu, da bi se dokazale. Te osebe so pogosto uspešne v svoji karieri, vendar ne zmorejo delovati v svojih intimnih odnosih. Raje so v varnem svetu »delati« kot »biti«. [8].

3.POSLEDICE V MEDOSEBNIH ODNOSIH

Številne raziskave kažejo, da travma prizadene intimnost s partnerji [37] npr. oslabi sposobnost zaupanja in oteži čustveno izražanje. Izraža se v obliki težav na področju spolnosti. Raziskave tudi kažejo, da spolna zloraba v otroštvu predstavlja večjo verjetnost za pojav težav v zakonskih odnosih [38] oz. se kaže kot nezadovoljstvo v zakonskem odnosu [39]. Ena izmed raziskav ugotavlja, da se posamezniki, ki so doživeli TSZO, skušajo izogniti negativnim mislim, občutkom in spominom, kar se odraža v mehanizmih spoprijemanja, kot so disociacija, zlorabe substanc, priložnostna spolnost in izogibanje medosebnim odnosom. Medtem ko ti mehanizmi lajšajo bolečino na kratki rok, imajo negativne dolgoročne posledice, kot so občutki izolacije, nezadovoljstvo z odnosi in spolne disfunkcije. Osebe z izkušnjo spolnega nasilja poročajo o težavah s čustveno komunikacijo, intimnostjo, močjo, nadzorom in težavami v spolnosti v intimnih odnosih [37]. V nadaljevanju predstavljamo posledice, ki se pomembno povezujejo z ugotovitvami v zgoraj navedenih raziskavah.

3.1 Medosebne posledice na čustveni ravni

Moški in ženske, ki so doživeli TSZO, v primerjavi s tistimi, ki je niso doživeli, poročajo o več medosebnih težavah na področju zaupanja, kontrole, odgovornosti, asertivnosti in občutku odtujenosti od svojega partnerja [41]

3.1.1 Izdano zaupanje

Izdano zaupanje je eno izmed najpomembnejših travmatogenih dinamik z vidika delovanja v medosebnih odnosih. Oseba, ki je doživela spolno nasilje, se ji je porušil občutek varnosti in zaupanja, hkrati pa je doživela še izdajstvo. To nezaupanje in izdajstvo pa se prenese v vse ostale odnose in je še posebej vidno v intimnih partnerskih odnosih [42]. Zaradi izdanega zaupanja lahko pride do dveh skrajnosti. Na eni strani težko zaupajo svojemu partnerju. Želijo si ljubečega in pozornega odnosa, istočasno pa se ga bojijo, in sicer prav zaradi strahu pred izdajstvom. Na drugi strani pa nekateri posamezniki, ki so doživeli spolno nasilje partnerju preveč zaupajo, potem pa, ko je njihovo zaupanje izdano, so močno razočarani, saj je tako bolečina dvojna – povezana s sedanjim odnosom in prebujajoča se iz pretekle zlorabe. Partnerju tudi težko zaupajo, da se jim je zgodila krivica spolnega nasilja. Ker so že kot otroci navadili ohranjati skrivnost in ker se bojijo zavrnitve ali obtožbe, ostajajo tiho. Nekateri odrasli povedo partnerju v upanju, da jih bo razumel in da bodo sprejeti, vendar pa žal vsi partnerji niso vedno razumevajoči in preteklo spolno nasilje lahko uporabijo kot orožje med konflikti v partnerskem odnosu [8].

3.1.2 Čustveno doživljanje

O čustvenem doživljanju je bilo več povedanega v prejšnjem poglavju, kjer smo se dotaknili individualnih posledic, ki pa se prav tako odražajo v odraslih intimnih partnerskih odnosih.

Osebe, ki so doživele zlorabo, pogosto doživljajo občutke krivde, ker se jim je spolno nasilje sploh zgodilo. Ti občutki negativno vplivajo na medosebne partnerske odnose kar se kaže v občutku, da si ne zaslužijo odnosa; strahu pred intimnostjo, ker jih je strah, da bo partner izvedel za travmo in odšel; zaradi občutka nevrednosti dovolijo partnerju, da jih izkorišča; so preveč zaščitniški ali pa bi radi v odnosu preveč dajali; so premalo asertivni in ne poskrbijo za svoje potrebe ter menijo da so drugi pomembnejši; ko postane odnos bolj intimen, ga zaključijo [43].

3.2 Medosebne posledice na vedenjski ravni

3.2.1 Dinamika moči in kontrole

Dinamika spolnega nasilja se kot dinamika moči in kontrole pogosto odigrava v intimnih odnosih. V naključnem vzorcu 2250 oseb, ki so doživete spolno nasilje, so le-te navajale nizko raven zadovoljstva ter nizko raven dojemanja ljubeče skrbi in visoko raven nadzora s strani svojih partnerjev [44]. Dinamika se tako odraža v številnih medzakonskih konfliktih. Povežemo jo lahko z dinamiko zlorabe, pri kateri je storilec zlorabljal otroka, le-ta ni imel nobene moči in se je počutil nemočnega. Občutki nemoči lahko vodijo do težav glede uporabe in zlorabe moči in kontrole. V odraslosti lahko oseba izkusi občutke nemoči na vseh področjih svojega življenja in ne dostopa do svojih notranjih rezerv moči zaradi strahu pred zlorabo le-teh ali strahu, da bi postali podobni storilcu. Nasprotno pa nekateri preveč kompenzirajo svoj občutek nemoči s tem, ko verjamejo, da so sami vsemogočni in nepremagljivi, na tak način pa tudi regulirajo tesnobo. Tako postanejo v partnerskih odnosih preveč nadzorovalni in rigidni, saj jih je strah izgube kontrole, dinamika moči in kontrole pa je obremenjujoča za oba partnerja [44]. Posamezniki, ki so doživeli spolno nasilje, pa imajo več težav na področju spolnosti v primerjavi s posamezniki, ki spolnega nasilja niso doživeli.TSZO niso doživli [7].

3.1.3 Medosebne posledice na področju spolnosti

Raziskave kažejo, da imajo posamezniki, ki so doživeli spolno nasilje, poleg težav v vzpostavljanju in ohranjanju partnerskih odnosov, težave tudi na področju doživljanja spolnosti [45]. Na eni strani se lahko spolno vedenje kaže kot umik in disfunkcionalnost, na drugi strani pa hiperseksualnost in kompulzivnost. [46]. Številne raziskave poročajo o povezavi TSZO in izkrivljeni spolnosti kot promiskuitetnosti in prostituciji [47].

4. ZAKLJUČEK

Posamezniki, ki so doživeli spolno nasilje doživljajo dolgoročne posledice, ki jim otežujejo zdravo funkcioniranje. Individualno težave se kažeju tudi na medosebni ravni, še posebno v partnerskih in drugih interpersonalnih odnosih, kar se odraža tudi v (ne)kakovosti bivanja celotne družbe. V Sloveniji se premalo posvečamo vzrokom telesnega in duševnega zdravja ter zapletom v medosebnih odnosih. Ni dovolj samo blažiti simptomov, temveč je potrebno ugotoviti vzroke ter jih pričeti ustrezno odpravljati.

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In-Group Social Learning Method: Educational Method for Overcoming the Demographic Imbalances

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ABSTRACT
In this paper, a method of in-group social learning is presented in the light of its efficiency in overcoming one of the most important challenges of current demographic situation – sustainability of long-term care. The method was developed by Jože Ramovš and his team at the Anton Trstenjak Institute of Gerontology and Intergenerational Relations primary for the fields of holistic health prevention and ageing; later on, special attention has been given to its development for training of informal carers as the latter often carry the most significant part of the long-term care burden. The need for such a method will be discussed through a review of current demographic and long-term care situations. Its efficiency will be presented on empirical data – comparative study of two samples of informal carers. One is the representative sample of Slovenian informal carers (N = 200) and the other is the sample of informal carers that participated on training for informal care based on in-group social learning method (N = 453). The results show that the method of in-group social learning has a great potential for quality care empowerment of informal carers and solving one of the most important demographic tasks.

Keywords
In-group social learning, informal care, informal carers training, long-term care, demographic solutions

POVZETEK
V prispevku bomo predstavili metodo skupinskega socialnega učenja ter njeno učinkovitost pri reševanju ene izmed najpomembnejših nalog demografske situacije – dosegnja vzdržnosti dolgotrajne oskrbe. Metodo je razvil prof. dr. Jože Ramovš s sodelavci Inštituta Antona Trstenjaka za gerontologijo in medgeneracijsko sožitje za namene preventive na področju ohranjanja holističnega zdravja ob staranju. Eno izmed poglavitnih področij aplikacije metode je usposabljanje za neformalne oskrbovalce. V prvem delu prispevka bomo predstavili potrebo po aplikaciji metode na področju usposabljanja za neformalno oskrbo v luči sodobnih demografskih trendov, v drugem delu pa bomo predstavili samo metodo ter prikazali njeno učinkovitost s pomočjo empiričnih podatkov – komparativne študije dveh vzorcev, neformalnih oskrbovalcev populacije iz reprezentativnega slovenskega vzorca (N = 200) ter evalvacijske razsikave neformalnih oskrbovalcev (N = 453), ki so bili udeleženih na usposabljanjih za neformalne oskrbovalce po metodi skupinskega socialnega učenja. Rezultati so pokazali, da ima metoda skupinskega socialnega učenja velik potencial za opolnomočenje oskrbovalcev za kakovostno oskrbovanje ter s tem za reševanje problematike dolgotrajne oskrbe ob demografskem staranju slovenske populacije.

Ključne besede
Skupinsko socialno učenje, neformalna oskrba, usposabljanje družinskih oskrbovalcev, dolgotrajna oskrba, demografske rešitve

1. DEMOGRAPHIC SITUATION AND INFORMAL CARE
Long-term care refers to services designed to support old, disabled or ill people who cannot perform some of the instrumental or basic daily activities on their own. In the 21st century, two essential phenomena have made a significant impact on the field of care for disabled members of the community. The first phenomena is the demographic changes leading to an ageing population, which have severe effects on requirements and provision of long-term care. Second is the need for new social models of solidarity between generations, due to the radically changed domestic situations compared to traditional models of coexistence.

In the transition from the 20th to the 21st century, the fertility rate in developed countries decreased to below the replacement level of its population, which is 2.1 children/woman. Together with prolongation of life expectancy and the large 'baby boom' generation, this has resulted in accelerated ageing of the population. It is becoming more and more evident that the need for informal carers support for quality care is increasing. Therefore, informal care has become the focus of many international research studies, e.g. EUROFAMCARE – Services for Supporting Family Carers of Elderly People in Europe: Characteristics, Coverage and Usage (Mestheneos & Triantafillou, 2005) and SHARE - Survey of Health, Ageing, and Retirement in Europe. Research showed that informal carers of disabled older persons are predominantly family members or, to a lesser extent, their neighbors, volunteers, and friends (Mestheneos & Triantafillou, 2005). As Stecy Yghemonos, an executive director of Eurocarers pointed out, informal carers represent 20% of the European population (nearly 100 million people) and provide 70 to 90% of long-term care (Yghemonos et al., 2018). Needless to say, European long-term systems would not be sustainable without their contribution. However, this crucial resource is under pressure. Many people find themselves placed in the role of carer overnight and face extreme challenges: a lack of skills and knowledge about how to provide care, about the diseases, and about the communication with disabled people; a lack of time for rest; and the inability to cope with their own personal physical and mental health, including sense of helplessness and fear of care receiver's health deterioration (Ramovš, 2013).

In Slovenia, a nationally representative field study was carried out among older persons aged 50+ on their needs, potentials, and standpoints; this research also provided in-depth data about care (Ramovš, 2013). According to this data, long-term care in Slovenia is provided by 220,000 informal carers (approximately 11% of Slovenian population) who provide care regularly, from a few hours per week to 24 hours per day. Among them, there are ~200.000 family carers (relatives) and ~20,000 other informal carers (neighbors, volunteers, or friends), and they provide care to 75% of persons in need of care. For the remaining quarter of this group, to whom the care is provided in institutions, a coordinated inclusion of relatives and volunteers can also significantly improve their quality of life.

Since a long-term care system has not yet been adopted in Slovenia, informal carers are left unsupported, despite politicians declaring they recognize the need for respite care and training of informal carers.

2. IN-GROUP SOCIAL LEARNING METHOD FOR INFORMAL CARERS TRAINING

The method of in-group social learning was developed as a response to the needs of informal carers for quality training. It covers the topics recognized as most pressing for this group and takes into consideration their individual capabilities and limitations. As stated by many sources (e.g., Turner and Street, 1999), quality training is one of the best ways to empower informal carers.

The informal carers trainig by in-group social learning is done in goups of 20 participants. Each of the ten sessions lasts for 2.5 hours, each session is themed to one of the challenging themes of informal care - understanding older persons, enhancing positive communication, nursing skills, stress relief, age-related diseases, grieving and others.

For successful training, it is very important to actively involve all participants to share their respective experiences and to provide a positive atmosphere for emotional relaxation and mutual support among the group members.

In-group social learning is based on the narration of personal experience and personal knowledge of each participant of the group, moderated by a group leader. The method focuses on sharing the positive experiences and efficient processing of negative experiences. It builds on the human ability for empathy and solidarity towards others and enables their further development. One of the methods main advantages is a bidirectional association between theoretical and practical knowledge. It aims at strengthening quality intergenerational relations and encouraging the positive communication (Ramovš 2000, Ramovš 2017).

Experiences are the primary determinant of our current view on life, the actions we take, and our orientation for the future. But experiences are subjective and their impact on individual's behavior depends on the way how are experiences processed in our brains, through communication and social interactions (Laing, 1969; Ramovš 1990). In-group social learning method facilitates positive and efficient establishment of experiences.

Of great relevance for in-group social learning method is enthusiasm. Enthusiasm has become one of the focuses in current neuroscience. Gerald Hüther calls it "doping for mind and brain" (Hüther, 2016). The reward system, a collection of brain structures and neural pathways that are responsible for reward-related cognition, are crucial for the feelings of happiness, energy and motivation, needed for working and learning. A pleasant experience is likely to be repeated, resulting in a formation of new neuronal connections in the brain, enabling the preservation of newly acquired skill or knowledge. Such neuroscientific findings can explain the motivational power of good experiences and the enthusiasm about the positive actions of others for the successful learning (Rizzolatti in Craighero, 2005).

Another neurological aspect, related to in-group social learning method's theory, are the findings on the mirror neurons and their impact on empathic behavior development (Iacoboni, 2005). The mirror neurons are brain cells, which facilitate empathy towards other persons, which an individual is observing. While observing another person, our brain reacts similarly as if we were enthusiastically performing the act ourselves. Therefore, the relationships that make us feel enthusiastic, result in spontaneous imitation of other person's behavior and internalization of his/her experiences. Abilities to sympathize, empathize, and identify with another are crucial for the development of high-quality interpersonal relations (Ryff, 1995).

3. EMPIRICAL RESEARCH

To evaluate the in-group social learning method used for informal carers training, a combination of objective and subjective data analysis was performed. For some aspects, evaluation study data were compared with the corresponding data from the national representative research: Ageing in Slovenia – Survey on the needs, abilities, and standpoints of the Slovene population aged 50 years and over (Ramovš et al., 2013). This was done for the following areas: analysis of demographic variables, health, personal experience with care receiving, opinion on informal carers training necessity, and desired way of care receiving.

3.1 Participants

The sample consists of the informal carers that took part in one of the 28 Trainings for Family and Other Informal Carers which took place between the years 2010 and 2018 in various towns and boroughs of Slovenia. The sum totaled in 453 individuals (age 23-83; M=56.00; SD=10.77; 92% female).

National representative research of ageing in Slovenia originally included 1047 participants (age 50-98; M=66.08; SD=10.59; 59% female) who were determined by Statistical Office of the Republic of Slovenia. As our aim was to compare the data of informal carers that underwent the in-group social learning method used for informal carers training, to non-trained informal carers, all the informal carers among the participants of representative study were selected, resulting in a sample of 200 individuals (age 50-98; M=67.37; SD=10.95; 55.4% female) (Ramovš et al., 2013).

3.2 Study procedure

Paper and pencil survey approach was used for data collection. Quantitative data analysis (Chi-square estimations, t-test, and descriptive statistics) was done using Excel software. For qualitative data analysis thematic analysis was used following the steps identified by Braun and Clarke (Braun and Clarke, 2006): data familiarization through reading and re-reading; systematically generating initial codes across the whole data set; identifying themes within identified codes; reviewing themes for internal and external validity; and defining and naming themes.

Table 1. ***Training participants perceived personal benefits.***

Category	Prevalent content	Frequencies
Knowledge and skills		296 (37.7%)
	Positive communication	
	Nursing	
	Understanding diseases and dementia	
	Palliative care	
	Passing away and grieving	
	Understanding old age	
Experiences exchange		179 (22.5%)
	Sharing own experiences	
	Comprehending experiences of others	
	Relating to others' experiences	
	Collective group experiences	
Inner strength		168 (21.2%)
	Self-confidence	
	Self-confirmation	
	Social support	
	Social inclusion	
	Stress relief	
	Health strengthening	
Approval of training		151 (19.0%)
	Contentment with the training	
	Praise of training's quality	
	Praise of training's guidance	
	Gratitude for training participation	
	Appreciation of themes	
	TOTAL	794 00.0%)

3.3 Results

3.3.1 Demographic variables

In the training participants sample of informal carers the female domination is evident, while in the Slovenian representative sample, the proportion of female and male informal carers are more equally distributed. The difference is significant [$X^2(1, N=646) = 141.13, p<.01$)].

For employment results, the differentiation was made between full-time employed and not employed (unemployed, retired, occasional, or part-time job). This type of differentiation is appropriate for the distinction between informal carers, who are mostly experiencing an intensive lack of time for quality caregiving and informal carers, who usually have enough time for caregiving, but often experience lack of financial income. The results show significant differences between both samples – among training participants informal carers there is a much higher percentage of full time working carers [$X^2(1, N=594) = 9.30, p<.01$].

Informal carers that participated in the training have significantly higher education compared to the carers in a national representative sample, that did not participate in training for quality informal care and this difference is important [$X^2(4, N=639) = 49.75, p<.01$].

3.3.3 Desired way of care receiving

Compared to the Slovenian representative sample, more carers in the training participants sample would choose informal care rather than institutionalized when given a choice [$X^2(1, N=575) = 4.66, p<.05$].

3.3.4 General evaluation of the training

The general evaluation of the in-group social learning method-based training by informal carers was very positive. The participants mostly responded with the subjective general evaluation answer "very good," the majority of others viewed the training as excellent.

3.3.5 Expressing themselves on the training

Next evaluation result is summing the training participants' feedback on how much they felt they could express their experiences and suggestions during the training, which is a very important part of the in-group social learning methodology. The majority agreed that they could express themselves. The negative evaluation was rare.

3.3.6 Perceived personal benefits of the training participation

In Table 1, the categories of perceived personal benefits are presented. Most of the participants stated more than one category in their answers. The first three categories are the most relevant for the evaluation of the in-group social learning method, and their contribution will be further presented in the discussion.

3.4 Discussion

Regarding gender distribution, the results showed a considerable difference in the presence of males between training participants and representative sample. A relatively high percentage of male carers in Slovenian representative sample of informal carers in comparison with other studies (Arber and Ginn, 1995; Dahlberg et al., 2007) and data (Central Statistics Office, 2019) could be an outcome of the fact that men, unlike women, are more aware of their caregiving. In Slovenia, the patriarchal social patterns are still very present, and women caring for the family members in need is often self-evident. On the other hand, due to these patterns, men might also find it harder to admit that they need help with providing care, which could explain their significantly lower participation rate in training. Given the fact that there is a substantial amount of male carers, it is evident that we should aim to find a way to include them in training for informal carers.

The results showed that full time employed carers more often participate in the training compared to unemployed carers. Employed carers are likely to be more socially included, more informed about the possibilities in their community as well as are likely to be better organized, which helps them to better manage their time. Despite the ratio difference, the percentage of full-time employment among both samples of carers is still very low, which is consistent with other research results. Informal carers often find themselves in a situation, where they are forced to leave their jobs to be able to care for their family member properly. Even though those carers have more time, they are potentially experiencing a lack of financial income (Pitsenberger, 2006).

Furthermore, the training participants usually have a higher level of education, as higher education often indicates greater awareness of the importance of educating, training, schooling, learning, and obtaining new knowledge and skills. Furthermore, higher educated persons may be better at finding information about the training. The area should be further explored; however, given the fact that there is a substantial amount of less-educated carers, we should aim to find a way to include them in training for informal carers.

Although the number of informal carers that perceived training as strongly needed was high in both samples, it was significantly higher in the sample of training participants. Taking into consideration that the latter have actively decided to participate in the training and mostly had very good experience with it (as can be seen from the results of the evaluation study), such difference is not surprising. More important is a finding that comparing the data, informal carers participating in the training had in significantly higher percent previous personal experience of being a care receiver. It seems likely that carers who know how it is to be a care receiver more often decide for training participation because they are more aware of the importance of quality care and are therefore willing to invest more effort into achieving it.

General evaluation of the training was very positive and in the qualitative analysis, a positive attitude toward a holistic experience of the training appeared as one of the four relevant categories.

Another point of view on the efficiency of the training was positive feedback of participants about being able to express and share their experiences with others. Experience exchange also appeared as one of the four relevant categories in the qualitative analysis of the last item. This was also reflected in the inner strength section of qualitative data analysis, where participants highlighted self-confirmation and self-confidence as perceived benefits of the training.

As previously indicated, qualitative data analysis provided the biggest insight into the efficiency of the in-group social learning methodology for this type of training. Participants' perceived personal benefits were divided into four categories. Three of these categories were in close relation to the expected benefits of the in-group social learning method – knowledge and skills, experiences exchange, and personal development in the form of inner-strength.

To conclude, the evaluation study shows that the in-group social learning method used for the informal carers training has great potential for quality care empowerment of carers. The limitations of this study are foremost the lack of the usage of standardized instruments, which could offer more objective evaluation results, the lack of the information about the situation of each individual carer before the beginning of the training and absence of information on carer-care receiver relationship which could give us further insight into effectiveness of this method. For further research, the potential positive and negative effect of the in-group social learning method-based informal carer's training on the care receivers' health, wellbeing, satisfaction with life or other emotional and personality aspects examination would be beneficial.

4. CONCLUSIONS

Informal carers provide 70 to 90% of all care in today's Europe. Training for carers who provide care to frail, chronically ill or disabled old persons, is prerequisite for sustainable and humane long-term care in the time of ageing population. As shown by the evaluation study, in-group social learning method used for informal carers training is effective and has, therefore, the potential to be used by educational and long-term care systems as part of the holistic demographic solution.

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Sprememba prehranskih navad je najučinkovitejši kmetijsko-živilsko-prehranski ukrep za blaženje podnebnih sprememb

Plant-based diet is one of the most efficient measures to fight climate change

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ABSTRACT
Plant-based diet is proposed as the most efficient action to fight climate change.

POVZETEK
Slovenija namerava do leta 2050 doseči ogljično nevtralnost. Da bi to dosegli, so tudi v kmetijsko-živilsko-prehranskem sektorju potrebne velike spremembe. Da bi lahko država izbrala primerne ukrepe, so različne raziskovalne ekipe kvantificirale učinkovitost različnih možnih ukrepov v kmetijsko-živilsko-prehranskem sektorju. Sprememba prehranskih navad je najučinkovitejši posamezen kmetijsko-živilsko-prehranski ukrep za blaženje podnebnih sprememb, še bolj znatno pa je ta ukrep učinkovit v kombinaciji s pogozdovanjem neuporabljenih kmetijskih površin. V Sloveniji bi bilo smiselno razpoloviti povprečen vnos živil živalskega izvora do leta 2030. Prav tako bi bilo do leta 2030 živinorejo smiselno zmanjšati za 2-krat.

Ključne besede
kmetijstvo, živinoreja, prehrana, veganstvo, vsejedstvo, veganska prehrana, sprememba prehranskih navad, reducetarijanstvo, pogozdovanje, blaženje podnebnih sprememb, ogljična nevtralnost, okoljevarstvo, trajnostnost

1. UVOD
Slovenija namerava do leta 2050 doseči ogljično nevtralnost [1]. Da bi to dosegli, so tudi v kmetijsko-živilsko-prehranskem sektorju potrebne velike spremembe. V Operativnem programu ukrepov zmanjšanja emisij toplogrednih plinov je priporočeno, naj kmetijski sektor do leta 2050 emisije toplogrednih plinov zmanjša za -42 do -49 % [2]. Ker je za več kot 75 % prehranskega ogljičnega odtisa Slovencev odgovorna živinoreja [3], je priporočeno, naj v Sloveniji živinorejski sektor do leta 2050 emisije toplogrednih plinov zmanjša za -77 % [4].

2. NAMEN DELA
Da bi lahko država izbrala primerne ukrepe, s pomočjo katerih lahko dosežemo cilje iz uvoda, so različne raziskovalne ekipe kvantificirale učinkovitost različnih možnih ukrepov v kmetijsko-živilsko-prehranskem sektorju. V tem delu bomo predstavili ukrep, ki se je v slovenskih in v tujih študijah izkazal za najučinkovitejšega: prehod iz vsejede na vegansko prehrano. Predstavili bomo pragmatična priporočila, ki najučinkovitejši ukrep v veliki meri jemljejo v ozir, hkrati pa se ljudem in kmetom predvidoma ne zdijo ekstremna.

3. METODE DELA
Predstavili bomo rezultate treh študij, ki so preučile, kako bi prehod Slovencev iz vsejede na vegansko prehrano vplival na zmanjšanje prehranskega ogljičnega odtisa. Metode dela so bile pri vsaki od treh študij drugačne in so opisane drugje: Novak, 2017 [5]; Jeran, 2018 [6]; Springmann in sod., 2018 [7]. Rezultate teh treh študij bomo primerjali z rezultati dveh meta-analiz, ki povzameta več podobno zasnovanih študij iz razvitih držav [8,9]. Učinkovitost spremembe prehranskih navad bomo primerjali z učinkovitostjo drugih predlaganih ukrepov v kmetijsko-živilsko-prehranskem sektorju [3,7,8,9,10,11,12,13,14,15,16].

4. REZULTATI
Novak, 2017: Prehod Slovenk/Slovencev iz vsejede na vegansko prehrano bi prehranski ogljični odtis posameznice/posameznika zmanjšal za -1.01 t CO2-eq/leto oz. za -70 % [5].

Jeran, 2018: Pri mladih Slovenkah bi prehod iz vsejede na vegansko prehrano prehranski ogljični odtis posameznice zmanjšal za -0.77 t CO2-eq/leto oz. za -21 %, pri mladih Slovencih pa bi se prehranski ogljični odtis posameznika zmanjšal za -1.72 t CO2-eq/leto oz. za -33 % [6].

Springmann in sod., 2018: Prehod Slovencev/Slovenk iz vsejede na vegansko prehrano bi prehranski ogljični odtis posameznika/posameznice zmanjšal za -0.83 t CO2-eq/leto oz. za -92 % [7].

Povzetek vseh treh študij: Prehod Slovencev/Slovenk iz vsejede na vegansko prehrano bi prehranski ogljični odtis posameznika/posameznice predvidoma zmanjšal za približno -1.08 t CO2-eq/leto (0.77-1.72) oz. za -54 % (21-92). Povprečni vrednosti in intervala vrednosti so podobni rezultatom dveh meta-analiz, ki povzameta več podobno zasnovanih študij iz razvitih držav. Wynes in Nicholas, 2017; Aleksandrowicz in sod., 2016: Prehod iz vsejede na vegansko prehrano bi prehranski ogljični odtis posameznika/posameznice v razviti državi predvidoma zmanjšal za približno -0.91 t CO2-eq/leto (0.55-1.57) oz. za -45 % (23-72) [8,9].

Če bi vsi prebivalci Slovenije postali vegani, bi teoretično torej že samo ta ukrep zadostoval za doseganje kmetijskih ciljev za leto 2050 iz uvoda.

Ostali predlagani ukrepi v kmetijsko-živilsko-prehranskem sektorju so manj učinkoviti. Prehod iz vsejede na vegetarijansko prehrano bi prehranski ogljični odtis posameznika/posameznice v razviti državi predvidoma zmanjšal za približno -0.8 t CO2-eq/leto oz. za -33 % [8,9]. Razpolovitev vnosa živil živalskega izvora bi prehranski ogljični odtis posameznika/posameznice v Evropi predvidoma zmanjšala za približno -25 do -40 % [10], prehod na mediteransko prehrano pa bi ga zmanjšal za približno -10 % [9]. Vsak od naslednjih ukrepov bi prehranski ogljični odtis posameznika/posameznice predvidoma zmanjšal za manj kot -10 %: Kupovanje izključno lokalne hrane [3], razpolovitev količine užitne odpadne hrane [11,12], zmanjšanje vnosa hrane za -100 kcal/dan [7], vsak posamezen kmetijski tehnološki napredek v prihodnosti [13].

Zelo učinkovita ukrepa v kmetijsko-živilsko-prehranskem sektorju bi bila samo še preprečevanje s kmetijstvom povezane deforestacije in pogozdovanje neuporabljenih kmetijskih površin, a teh dveh ukrepov ne moremo obravnavati ločeno od spremembe prehranskih navad, saj veganska prehrana zahteva -40 do -80 % manj kmetijskih površin od povprečne prehrane in ima posledično v primerjavi z drugimi načini prehranjevanja močno povečan potencial za pogozdovanje neuporabljenih kmetijskih površin. Kombinacija spremembe prehranskih navad in pogozdovanja poveča potencial za doseganje ogljične nevtralnosti v kmetijsko-živilsko-prehranskem sektorju [3,9,11,13,14,15,16].

5. ZAKLJUČEK IN PRIPOROČILA

Sprememba prehranskih navad je najučinkovitejši posamezen kmetijsko-živilsko-prehranski ukrep za blaženje podnebnih sprememb, še bolj znatno pa je ta ukrep učinkovit v kombinaciji s pogozdovanjem neuporabljenih kmetijskih površin.

V Sloveniji bi bilo smiselno razpoloviti povprečen vnos živil živalskega izvora do leta 2030. Prav tako bi bilo do leta 2030 živinorejo smiselno zmanjšati za 2-krat. To bi ogljični odtis slovenskega kmetijstva in prehranski ogljični odtis Slovencev in Slovenk predvidoma zmanjšalo za približno -25 do -40 %. Da bi to lahko dosegli, bi bilo smiselno razpoloviti priporočen vnos živil živalskega izvora do leta 2020, kmetijska politika po letu 2021 pa naj postane skladna z novimi prehranskimi smernicami, kar v praksi pomeni postopno preusmerjanje kmetijskih subvencij iz živinoreje in pridelave živinorejske krme v pridelavo rastlinske hrane za ljudi.

Živila živalskega izvora v slovenskih prehranskih priporočilih ("*Zdrav krožnik*") zavzemajo približno 18 % krožnika, živila rastlinskega izvora pa približno 82 % krožnika [17]. Če bi slovenska prehranska priporočila upoštevala poleg zdravstvenega vidika še trajnostni vidik prehrane, bi živila živalskega izvora zavzemala približno 7-10 % krožnika, živila rastlinskega izvora pa približno 90-93 % krožnika [18,19]. Kmetijske subvencije se trenutno dodeljujejo v nasprotju s starimi prehranskimi smernicami, še bolj pa v nasprotju s prihajajočimi trajnostnimi prehranskimi smernicami [20].

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Prebivalstvo Prekmurja v zadnjih sto letih: depopulacija, deagrarizacija in okolje

The Population of Prekmurje in the Last Century: General and Agricultural Population Decline and Environment

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POVZETEK

Prebivalstvo Prekmurja se je v zadnjih 100 letih zelo spremenilo in moderniziralo. Demografski prehod je omogočil nastanek modernega demografskega režima. Demografski razvoj po 2. svetovni vojni je določalo zmanjševanje števila prebivalstva, še posebej zaradi odseljevanja in staranja prebivalstva. Vsi ti procesi pa so bili še intenzivnejši pri kmetijskem prebivalstvu, kar je pustilo trajne posledice na kmetijski kulturni krajini.

ABSTRACT

The population of Prekmurje has changed tremendously since the end of WW I. Modernization and demographic transition have produced modern demographic regime. The population decline, emigration and population ageing have been most important demographic processes after WW II. All these processes have determined even more strongly agricultural population in the region.

1 UVOD

Današnje slovensko Prekmurje ima že sto let dobro določene meje, ki so rezultat Trianonske mirovne pogodbe, pa tudi ime se je v slovenskem prostoru dobro uveljavilo. Če pa se vrnemo za 150 let v preteklost, hitro ugotovimo, da je bilo ozemlje poseljeno s Slovenci severovzhodno od Reke Mure brez uveljavljenega slovenskega imena, vključeno v ogrski del tedanje Avstro-Ogrske in zelo slabo gospodarsko, prometno in kulturno povezano s Slovenci poseljenimi pokrajinami na desnem bregu Mure. Prekmurski Slovenci so imeli slabo razvito kulturno življenje in so bili politično povsem neorganizirani. Še več, uradne oblasti so zagovarjale vendsko teorijo, ki je trdila, da so prekmurski Slovenci v resnici Vendi. Takšne razmere so trajale do konca 1. svetovne vojne in so se le počasi spreminjale še v 1920ih letih. V zadnjih desetletjih ogrske oblasti je bila prisotna močna madžarizacija, ki ni dovoljevala nobenega pouka slovenščine v šolah. Zato je bila raba slovenščine omejena na družinsko in ožje lokalno okolje ter na cerkveno življenje. Hkrati pa so ogrske oblasti tudi s prometno in carinsko politiko onemogočale sodelovanje s Slovenci, ki so živeli v avstrijskem delu monarhije. Trianonska mirovna pogodba je določila mejo, po kateri je osem pretežno slovenskih vasi ostalo v Avstriji, porabski Slovenci so ostali na Madžarskem, del madžarskega prebivalstva pa je bil vključen v takratno Kraljevino SHS.

S Slovenci poseljeno območje na levem bregu reke Mure je bilo gospodarsko slabo razvito celo v primerjavi s sosednjimi ogrskimi pokrajinami. Bilo je izrazito agrarno prenaseljeno, brez vsakršne industrije, s tremi železniškimi progami povezano z notranjostjo Ogrske ter brez vsakega mostu čez reko Muro na območju, kjer so živeli Slovenci na obeh bregovih reke Mure. Obrtna dejavnost je bila pretežno omejena na obrti, ki so bile povezane s kmetijstvom. Trgovina in skromno bančništvo sta bili slabo razviti in večinoma v rokah Judov. Po zadnjem popisu prebivalstva v Avstro-Ogrski leta 1910 je bilo kar 89 %[1] za delo sposobnega prebivalstva zaposlenega v kmetijstvu.

Gospodarski in družbeni razvoj Prekmurja je bil počasen vse do 1960ih let, ko se je začela pokrajina nekoliko bolj industrializirati po klasični poti. To pomeni, da se je začela širiti tekstilna industrija in deli industrije povezani s kmetijstvom. Hkrati pa se je začela tudi hitrejša deagrarizacija ter hitrejši razvoj komunalne, energetske in prometne infrastrukture. Zelo pomembno je bilo širjenje izobraževanja na vseh ravneh.

Demografski razvoj je bil do konca 1950ih let pod izrazitim vplivom demografskega prehoda, ko stopnje rodnosti in smrtnosti padajo od visokih na nizke ravni. Proces v normalnih razmerah vodi do hitre rasti prebivalstva. V Prekmurju pa je bil v 20. stoletju pod izrazitim vplivom dveh svetovnih vojn in intenzivnega odseljevanja. Zato prav velike rasti prebivalstva ni bilo. Od 1960ih let naprej pa je v pokrajini prisoten podobno kot drugod po Sloveniji in Evropi moderni demografski režim z nizko rodnostjo in smrtnostjo, zavestnim odločanjem o rojstvih otrok, hitrim staranjem prebivalstva in posledično tudi upadom števila prebivalstva.

V nadaljevanju tega besedila nas bo predvsem zanimalo padanje števila prebivalstva v Prekmurju in nekateri vidiki tega procesa v povezavi z deagrarizacijo, strukturnimi spremembami v kmetijstvu in okoljskimi spremembami. Druga točka bo obravnavala gibanje števila prebivalstva na območju današnjega Prekmurja vse od prvega zanesljivejšega popisa prebivalstva v Avstro-Ogrski leta 1869 do danes in njegovo strukturo po spolu in starosti. Tretja točka bo posvečena prikazu kmetijskih gospodarstev in prebivalstva družinskih kmetij po popisih kmetijstva. Četrta točka bo prikazala kmetijska gospodarstva, kmetijska zemljišča in njihove povezave z okoljem. Sledila bosta pa sklepni del in seznam literature in virov.

2 RAST, SPOL IN STAROST PREBIVALSTVA PREKMURJA

Število prebivalstva in njegova rast sta tesno povezana z geografskimi in drugimi razmerami v naravnem okolju. Statistični podatki o tem so na voljo odkar države organizirajo moderne popise prebivalstva. Na našem ozemlju je to od leta 1869, če zanemarimo popis leta 1857, ki še ni dosegel zadostne ravni kakovosti podatkov. V tem besedilu si bomo zato ogledali podrobnejše podatke o številu prebivalstva ter izbrane podatke o njegovi strukturi po spolu in starosti v Prekmurju za zadnjih 150 let. Prekmurje bomo razdelili na dva dela, kar omogoča razdelitev na okraje, občine in upravne enote v različnih delih tega dolgega časovnega obdobja. Novejše slovenske občine, ki so nastale večinoma sredi 1990ih let smo združili v omenjena dva dela, ki sta Lendava in Murska Sobota. Pri razdelitvi podatkov Prekmurja na dva dela za začetna prikazana leta si bomo pomagali z delom Ž. Šifrerja, ki je opravil potrebno statistično delo.[2] V 150 let dolgem obdobju se srečujemo s številnimi metodološkimi težavami. Zato moramo upoštevati, da statistični podatki med seboj niso čisto primerljivi in da prikazujejo le okvirno sliko razmer in gibanj. Če to konkretiziramo, lahko vzamemo za primer kategorijo prebivalstva. Ta kategorija se je v tem dolgem obdobju in v različnih državah, v katere je bilo vključeno Prekmurje, večkrat spreminjala. Uporabljale so se različne definicije prebivalstva, od prisotnega do stalnega in običajnega prebivalstva. Slovenija je uvedla definicijo običajnega prebivalstva sredi 1990ih let, vendar je pri tem vse do začetka 2009. leta uporabljala le tri mesečno referenčno obdobje za selitve. Zato imamo v Sloveniji podatke o prebivalstvu na osnovi mednarodne statistične

[1] Malačič, 2019, str. 4.

[2] Šifrer, neobjavljeni rokopis.

definicije prebivalstva, ki zahteva enoletno referenčno obdobje za selitve, na voljo šele od začetka leta 2009 naprej, pa še to zaradi izrecne zahteve Evropske unije.

Na kratko omenimo še problem spreminjanja lokalne in upravne ureditve v Prekmurju, ki v tako dolgem obdobju in v več različnih državah gotovo ni enostaven. Kljub vsemu pa tudi ni tako velik, da ga ne bi mogli rešiti in vzpostaviti zadostno primerljivost za dve enoti, Lendavo in Mursko Soboto, na kateri delimo Prekmurje. To nam omogoča srečna okoliščina, da sta okraja in občini, ki jima lahko sledimo od 1931. leta do sredine 1990ih let praktično v enakih mejah. Za ostala leta pa si pomagamo z združevanjem občin v upravni enoti za novejše obdobje in z združevanjem podatkov po naseljih za starejše obdobje vključeno v prikaz. Pri tem pa je še zmeraj lahko prišlo do manjših odstopanj. Zato so tudi tako prikazane dolge časovne vrste le okvirne.

Tabela 1: Število prebivalstva v UE Lendava in Murska Sobota v izbranih letih od 1869 do 2019 po spolu in izbranih starostnih razredih. Vir: Popisi prebivalstva in register prebivalstva, SURS, Ljubljana in Šifrer, neobjavljeni podatki.

Leto/UE	Lendava				Murska Sobota			
	P	% M	P_{0-14} (%)	P_{65+} (%)	P	%M	P_{0-14} (%)	P_{65+} (%)
1	2	3	4	5	6	7	8	9
1869	17.915	-	-	-	46.696	-	-	-
1910	27.262	-	-	-	63.251	-	-	-
1921[x]	27.910	48,1	31,1	6,1	64.506	48,1	31,1	6,1
1948	29.643	48,1	-	-	65.271	48,7	-	-
1981	26.717	48,9	21,6	14,1	64.299	49,3	21,7	13,7
1991	26.143	47,8	20,0	14,0	63.744	48,0	18,8	13,6
2006	24.521	48,6	12,9	15,7	58.572	48,1	13,3	16,1
2019	22.437	49,4	13,0	21,9	54.654	48,9	13,2	22,2

[x] Za leto 1921 smo predpostavili, da sta deleža Lendave in Murske Sobote v prebivalstvu Prekmurja enaka kot leta 1910, starostna struktura prebivalstva pa v obeh enotah enaka Prekmurju kot celoti. Za delež moških (%M) smo predpostavili, da je bil enak kot leta 1931.

V tabeli 1 smo prikazali prebivalstvo Prekmurja razdeljeno na dve današnji upravni enoti (UE) za izbrana leta obdobja 1869-2019. Hkrati smo vključili tudi podatke o deležu moških in deležu starostnih razredov 0-14 in 65 in več let starih za leta, za katera smo dobili ustrezne podatke. Prikazani kazalci strukture po spolu in starostne strukture omogočajo iz tabele izračunati tudi delež žensk in delež delovnega kontingenta prebivalstva, vendar teh podatkov nismo mogli izrecno navesti v tabeli 1 zaradi preglednosti tabele in pomanjkanja prostora.

Število prebivalstva v obeh UE je doseglo maksimum v drugi polovici 1940ih let. Izračunani indeks 1948/1869 kaže za Lendavo hitrejšo rast prebivalstva z vrednostjo indeksa 165,5, medtem ko je bila vrednost enakega indeksa za Mursko Soboto 139,8. Presenetljivo pa je, da se je po letu 1948 hitrejša rast prebivalstva v Lendavi spremenila v hitrejše padanje. Indeks 2019/1948 kaže namreč za Lendavo vrednost 75,7, za Mursko Soboto pa 83,7. Navedena indeksa kažeta izrazito depopulacijo v obeh enotah in v Prekmurju kot celoti. V Lendavi se je v nekaj več kot 70 letih prebivalstvo zmanjšalo za skoraj četrtino, v Murski Soboti pa za nekaj manj kot petino. Ravno tako intenzivno padanje števila prebivalstva v razmerah, ko Slovenija v tem obdobju beleži sorazmerno hitro rast prebivalstva, pa nas v tem besedilu še posebej zanima z vidika povezanosti s kmetijskim prebivalstvom in dogajanjem na področju kmetijskih zemljišč.

Struktura prebivalstva po spolu v UE Lendava in Murska Sobota v tabeli 1 je običajna za moderna razvita prebivalstva. Podatek posebej ne izstopa niti v letih 1921 in 1948, čeprav sta to leti neposredno po dveh svetovnih vojnah. Veliko bolj pa se je spremenila struktura prebivalstva po starosti. Na voljo imamo le podatke o velikih starostnih kontingentih, vendar nam tudi ti pokažejo zelo izrazito staranje prebivalstva. Leta 1921 sta prebivalstvi UE Lendave in Murska Sobota začeli zapuščati tip mladega prebivalstva. V letu 2019 pa sta bili ti dve prebivalstvi že izrazito stari prebivalstvi. Indeksa 2019/1921 za 0-14 in 65 in več let staro prebivalstvo sta bila v UE Lendava 41,8 in 359,0 ter v Murski Soboti 42,4 in 363,9 zaporedoma. Indeks staranja, ki kaže število starih 65 in več let na 100 mladih starih 0-14 let je bil na začetku leta 2019 v UE Lendava 168,5 in Murska Sobota 168,2. Takšna starostna struktura je rezultat rodnosti ter selektivnosti smrtnosti in selitev po starosti in spolu, vendar se s temi procesi tukaj ne moremo podrobneje ukvarjati.

3 KMETIJSKA GOSPODARSTVA IN PREBIVALSTVO DRUŽINSKIH KMETIJ V PREKMURJU

Zelo velike spremembe v številu in demografskih strukturah prebivalstva imajo močan vpliv na različnih področjih družbenega življenja. Na ravni manjših regij je pogosto zelo malo statističnih podatkov za analizo takega vpliva. Še manj pa je podatkov s katerimi bi lahko oblikovali dolge časovne vrste. Občasno pa državna statistična služba organizira popise, ankete ali druge načine zbiranja podatkov za specifična področja, ki imajo tudi širši demografski pomen. Tak primer sta v Sloveniji popisa kmetijstva v letih 2000 in 2010. V teh dveh popisih najdemo tudi za občinsko raven podatke o kmetijskih gospodarstvih, prebivalstvu, ki je živelo na teh gospodarstvih razčlenjeno na različne demografske strukture, kmetijskih zemljiščih v uporabi kmetijskih gospodarstev in druge podatke. S tema dvema popisoma sicer ne moremo osvetliti dogajanja v Prekmurju na kmetijskem in s tem povezanim okoljskem področju niti za polovico stoletja, kaj šele za eno ali celo eno in pol stoletja. Lahko pa osvetlimo, kako se zmanjševanje števila prebivalstva v zadnjih 70 letih v kombinaciji z deagrarizacijo kaže pri prebivalstvu, ki živi na družinskih kmetijah.

Tabela 2: Število kmetijskih gospodarstev, kmetijska zemljišča v uporabi in indeksa obeh podatkov 2010/2000 po popisih kmetijstva v letih 2000 in 2010 za UE Lendava in Murska Sobota, njune občine in Slovenijo. Vir: SISTAT, SURS, dostop 18.9. 2019

UE, občine in Slovenija	Število kmetijskih gospodarstev			Kmetijska zemljišča v uporabi v ha		
	2000	2010	$I_{2010/2000}$	2000	2010	$I_{2010/2000}$
1	2	3	4	5	6	7
LENDAVA	2.121	1.361	64,2	11.341	11.133	98,2
Črenšovci	407	272	66,8	1.654	1.515	91,6
Dobrovnik	163	107	65,6	651	545	83,7
Lendava	758	4496	65,4	5.551	5.644	101,7
Odranci	220	144	65,5	822	882	107,3
Turnišče	369	194	52,6	1.717	1.706	99,4
V. Polana	204	148	72,5	946	841	88,9
M. SOBOTA	6.306	4.813	76,3	34.263	32.848	95,9
Beltinci	802	526	65,6	3.784	3.116	83,1
Cankova	309	228	73,8	1.855	1.660	89,5
G. Petrovci	457	364	79,6	2.132	1.931	90,6
Grad	833	382	84,3	1.614	1.381	85,6
Hodoš	63	43	68,3	476	487	102,3
Kobilje	88	57	64,8	481	492	102,3
Kuzma	277	236	85,2	844	829	98,2
Mor. Toplice	951	735	77,3	7.078	5.577	78,8
M. Sobota	582	358	61,5	3.596	5.909	164,3
Puconci	968	785	81,1	5.489	5.131	93,5
Rogašovci	529	409	77,3	2.083	1.779	85,4

Šalovci	365	306	83,8	2.087	2.025	97,2
Tišina	462	384	83,1	2.782	2.531	91,0
SLOVENIJA	86.437	74.646	86,4	485.897	474.432	97,6

V nadaljevanju bomo v tabeli 2 in tabeli 3 prikazali za UE Lendava in Murska Sobota ter za občine v okviru teh dveh UE podatke o številu kmetijskih gospodarstev, kmetijskih zemljiščih v uporabi, številu oseb na družinskih kmetijah po izbranih starostnih razredih za že omenjena popisa kmetijstva v letih 2000 in 2010. Za primerjavo in neke vrste kriterij ocenjevanja v obeh tabelah navajamo tudi ustrezne podatke za Slovenijo kot celoto. Podatke za UE Lendavo in Mursko Soboto smo dobili tako, da smo sešteli občinske podatke za občine znotraj teh dveh enot.

Popisa kmetijstva v Sloveniji letih 2000 in 2010 sta že kar malo odmaknjena, vendar novejših virov podatkov za problematiko, ki jo obravnavamo ni na voljo. Že ta dva popisa pa kažeta do kako velikih sprememb lahko pride pri posameznih kategorijah že v pičlem desetletju. Najlepši primer je število kmetijskih gospodarstev, ki se je v Prekmurju kot celoti med letoma 2000 in 2010 znižalo za 26,7 %, v UE Lendava in Murska Sobota pa za 35,8 in 23,7 % zaporedoma. Znižanje tega števila po občinah pa variira še znatno bolj, saj razmik znaša od okrog 15 do skoraj 48 %. Znižanje je precej večje v občinah lendavske UE, kar je posledica hitrejšega zmanjševanja števila prebivalstva v zadnjih desetletjih in večjega odseljevanja. Presenetljivo pa je, da je znižanje števila kmetijskih gospodarstev v 1. desetletju 21. stoletja manjše v občinah UE Murska Sobota, čeprav vemo, da te občine pokrivajo celotno Goričko, kjer je kakovost kmetijskih zemljišč precej nižja, težavnost obdelovanja pa precej višja kot v občinah lendavske UE. Primerjava s Slovenijo pa nam pokaže, da je bilo zmanjšanje v prekmurskih občinah precej večje kot v povprečju v Sloveniji, ne glede na to, da je Prekmurje precej bolj kmetijska pokrajina kot Slovenija kot celota. V Prekmurju se še zmeraj pozna razdrobljenost kmetijskih zemljišč in posledično težko življenje na majhnih kmetijah, ki jih ljudje intenzivno zapuščajo.

Tabela 3: Število oseb na družinskih kmetijah po izbranih starostnih razredih in po popisih kmetijstva v Sloveniji v letih 2000 in 2010 za UE Lendava in Murska Sobota ter njune občine. Vir SISTAT, SURS, dostop 18. 9 2019

UE, občine in Slovenija	2000			2010		
	Skupaj	Pod 25 (%)	55+ (%)	Skupaj	Pod 25 (%)	55+ (%)
1	2	3	4	5	6	7
LENDAVA	8.063	26,4	30,8	4.630	16,0	38,8
Črenšovci	1.658	26,1	29,1	993	16,8	38,3
Dobrovnik	513	21,1	35,3	353	14,4	41,1
Lendava	2.475	24,5	33,0	1.472	14,9	40,1
Odranci	984	30,7	25,0	514	11,7	41,6
Turnišče	1.536	28,6	31,7	703	16,1	36,8
V. Polana	870	27,1	29,8	595	21,2	35,1
M. SOBOTA	24.172	25,6	33,3	16.995	18,4	39,6
Beltinci	3.221	27,8	36,9	1.950	21,3	49,8
Cankova	1.252	27,9	30,0	888	21,8	33,7
G. Petrovci	1.576	22,3	36,3	1.222	17,0	40,8
Grad	1.687	27,7	31,8	1.305	15,8	39,8
Hodoš	218	26,6	35,3	160	20,0	33,8
Kobilje	302	18,9	34,1	218	20,2	40,4
Kuzma	1.114	25,0	29,3	814	18,9	38,9
Mor. Toplice	3.533	23,9	33,9	2.493	17,0	39,6
M. Sobota	2.223	24,4	32,7	1.259	20,7	38,0
Puconci	3.686	25,4	33,7	2.664	17,3	39,8
Rogašovci	2.108	27,8	30,6	1.557	19,7	34,0
Šalovci	1.345	23,5	35,7	1.044	14,7	39,9

Tišina	1.907	26,6	30,0	1.421	18,5	36,0
SLOVENIJA	322.981	28,2	31,1	259.075	20,9	35,2

Obseg kmetijskih zemljišč se je v obravnavanem desetletju v prekmurskih občinah ravno tako zmanjšal, čeprav je zmanjšanje bistveno manjše kot pri kmetijskih gospodarstvih. V dveh lendavskih in treh mursko soboških občinah pa se je obseg teh zemljišč celo povečal. Tudi variabilnost med občinami je precej nižja kot v primeru števila kmetijskih gospodarstev. Ti podatki kažejo, da kmetijskim gospodarstvom v prekmurskih občinah primanjkuje kmetijskih zemljišč. Hkrati pa proces opuščanja kmetijske dejavnosti, odseljevanje in ukinjanje kmetijskih gospodarstev ne vodi do enostavnega in hitrega prenosa kmetijskih zemljišč bodisi v najem ali celo v last kmetij, ki ohranjajo kmetovanje. Pri tem prenosu prihaja do različnih težav, od (pre)nizkih najemnin, šibke ekonomske moči kmetov do razdrobljenosti parcel. Zato ostaja marsikje kmetijska zemlja neobdelana, mnoge parcele pa prerašča trnje in gozd.

Tabela 3 nam kaže podrobnejšo sliko o starostni strukturi oseb, ki so v letih 2000 in 2010 živele v Prekmurju in Sloveniji na družinskih kmetijah. Prikazali smo samo delež mladih do 25 let starosti in delež starejših od 55 let. Tridesetletnega vmesnega starostnega razreda nismo posebej prikazali zaradi prostora v tabeli in želje, da tabela ne bi bila preobložena. Podatki v tabeli 3 kažejo dve glavni značilnosti. Prva je hitro zmanjševanje števila oseb, ki živijo na družinskih kmetijah v Prekmurju in njegovih občinah, pa tudi v Sloveniji v celoti. Druga značilnost pa je hitro staranje tega prebivalstva.

V Prekmurju je v pičlih 10 letih na začetku 21. stoletja število oseb, ki so živele na družinskih kmetijah, padlo za kar 32,9 %. Po upravnih enotah je bil padec v Lendavi 42,6 in v Murski Soboti 29,7 %. V Sloveniji je bil ta padec precej nižji, vendar z 19,2 % še zmeraj zelo visok. Podatkov po občinah ne bomo podrobneje obravnavali, vendar se slika pri njih praktično ne razlikuje od slike na ravni upravnih enot. Razen padanja števila oseb, ki živijo na družinskih kmetijah pa je prav tako dramatičen proces staranja prebivalstva, ki živi na teh kmetijah. To preprosto pomeni, da se delež do 25 let starih hitro zmanjšuje, delež starejših od 55 let pa intenzivno povečuje. To velja za Prekmurje, dve upravni enoti, prekmurske občine in Slovenijo kot celoto. Vendar je tudi pri tem procesu intenziteta staranja prebivalstva, ki živi na družinskih kmetijah manjša v Sloveniji kot v Prekmurju. V vseh starostnih strukturah pa lahko že na osnovi prikazanih podatkov vidimo, da se bo število oseb, ki živijo na družinskih kmetijah še naprej zmanjševalo, proces staranja tega prebivalstva pa se bo še nekaj časa nadaljeval v prihodnost.

4 KMETIJSKA GOSPODARSTVA IN KMETIJSKA ZEMLJIŠČA TER OKOLJE V PREKMURJU

Prekmursko kmetijstvo je še danes obremenjeno z dvema pomembnima zgodovinskima okoliščinama. Prva izvira iz zelo dolge vključenosti v ogrski del Avstro-Ogrske, kjer je ogrsko dedno pravo zagotavljalo dedovanje kmetijske zemlje vsem potomcem, s tem pa vodilo do velike razdrobljenosti kmetijskih zemljišč in prevladovanja zelo majhnih kmečkih gospodarstev. Takšna razdrobljenost se je ohranila v drugo polovico 20. stoletja, ko jo je še dodatno zamrznila socialistična politika 10 hektarskega zemljiškega maksimuma. Ta je kljub zelo hitrim gospodarskim spremembam v svetu praktično onemogočala koncentracijo v obliki rasti velikosti kmetij in v obliki zaokroževanja manjših parcel v večje. Zaradi tega imamo v samostojni Sloveniji in še posebej v Prekmurju procese, ki bi morali biti že zdavnaj končani.

Popisa kmetijstva v letih 2000 in 2010 nam nudita podatke, s pomočjo katerih lahko povežemo število kmetijskih gospodarstev in velikost kmetijskih zemljišč v uporabi. Velikost kmetijskih zemljišč v uporabi kmetijskih gospodarstev je izražena v hektarjih in razdeljena v tri velikostne razrede. Ti so do pod 5, 5 do pod 10 in 10 in več hektarjev. Že ti razredi kažejo, da ostajajo naše prekmurske kmetije še zmeraj izrazito premajhne in s tem neprimerne za učinkovito, mehanizirano in gospodarno moderno kmetovanje. Procesi koncentracije pa so bili v zadnjih desetletjih prepočasni.

Podrobneje si bomo navedene značilnosti ogledali na osnovi podatkov, ki jih prikazuje tabela 4. Ta vključuje število in odstotek kmetijskih gospodarstev po velikosti kmetijskih zemljišč v uporabi za UE Lendava in Murska sobota ter za Slovenijo kot celoto po popisih kmetijstva v letih 2000 in 2010. Dodajmo tukaj še, da velikostnih razredov kmetijskih zemljišč v uporabi nismo mogli bistveno spreminjati na osnovi podatkov v primarnem viru. Lahko smo le združili velikostna razreda do pod 2 in 2 do pod 5 v en združeni razred, ki je vključen v tabelo 4. Podatkov za zgornji odprti razred pa ni mogoče podrobneje razčlenjevati, ker niso na voljo v originalnem viru v razčlenjeni obliki. O velikosti kmetijskih gospodarstev na osnovi obsega kmetijskih zemljišč v uporabi lahko rečemo, da ni neke natančno določene velikosti, od katere naprej bi naj bilo moderno kmetovanje učinkovito in donosno. Prav gotovo pa obstajajo okvirne velikosti zemljišč, ki bi naj bila na voljo moderni kmetiji ne le za preživetje, ampak tudi za zagotavljanje življenjske ravni, ki jo v povprečju zagotavljajo druge dejavnosti v družbi. Takšna velikost je v današnjem času gotovo višja od 50 hektarjev, če že ni več 100 hektarjev na kmetijo. Tako velikih kmetij pa je ne le v Prekmurju ampak tudi v Sloveniji kot celoti zelo malo.

Tabela 4: Število kmetijskih gospodarstev po velikosti kmetijskih zemljišč v uporabi za UE Lendava in Murska Sobota ter za Slovenijo po popisih kmetijstva v letih 2000 in 2010. Vir: SISTAT, SURS, dostop 18. 9. 2019

UE in Slovenija		0 do pod 5 ha		5 do pod 10 ha		Nad 10 ha		Skupaj	
		2000	2010	2000	2010	2000	2010	2000	2010
1	2	3	4	5	6	7	8	9	10
Lendava	Št.	1.646	973	337	192	138	193	2.121	1.358
	%	77,6	71,6	15,9	14,1	6,5	14,2	100,0	100,0
Murska Sobota	Št.	4.057	3.150	1.454	1.013	593	649	6.104	4.812
	%	66,5	65,5	23,8	21,1	9,7	13,5	100,0	100,0
Slovenija	Št.	53.384	45.537	22.058	17.530	10.981	11.388	86.437	74.646
	%	61,8	61,0	25,5	23,5	12,7	15,3	100,0	100,0

Podatki v tabeli 4 kažejo, da je v obeh UE in v Sloveniji kot celoti med dvema popisoma kmetijstva potekala koncentracija v kmetijstvu. Število in delež kmetijskih gospodarstev v razredih 0 do pod 5 in 5 do pod 10 sta se med letoma 2000 in 2010 znižala, v najvišjem velikostnem razredu pa povečala tako v Prekmurju kot Sloveniji. Spremembe pa niti absolutno niti relativno niso bile posebej velike, kar kaže, da poteka proces koncentracije v kmetijstvu sorazmerno počasi.

Kmetijska pokrajina bo v Prekmurju še nekaj časa določena z relativno majhno velikostjo parcel, ki jih bo zlasti v goričkem delu zaraščalo grmovje, trnje in gozd. Kulturna krajina pa bi se še bolj zaraščala, če ne bi Krajinski park Goričko zagotavljal košnjo na mnogih travnikih, ki jih sicer lastniki ne bi pokosili. Hkrati pa lahko na osnovi osebnih izkušenj in poznavanja pokrajine zapišemo, da mnoge prekmurske kmetije ne kažejo velike inovativnosti v težnji za napredkom in boljšim življenjem, ki bi ga omogočalo kmetovanje. Če pa tega ne bo, bomo še naprej spremljali opuščanje kmetij in marsikje zaraščanje kmetijskih zemljišč.

5 SKLEP

Prebivalstvo Prekmurja se je v zadnjih 100 letih zelo spremenilo in moderniziralo. Demografski prehod je omogočil nastanek modernega demografskega režima. Ni pa mogel preprečiti depopulacije v zadnjih desetletjih in hitrega staranja prebivalstva. Oba procesa še dodatno krepi odseljevanje mlajšega prebivalstva. Depopulacija in staranje sta značilna tudi za prebivalstvo, ki živi na družinskih kmetijah. Število le teh se hitro zmanjšuje, procesi koncentracije in naraščanja površin v obdelavi družinskih kmetij pa so še naprej počasni.

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Ali (s priseljevanjem povezana) gospodarskopolitična negotovost vpliva na industrijsko proizvodnjo in brezposelnost v Franciji, Nemčiji, Združenih državah Amerike ter Združenem kraljestvu?

Does (Immigration-Related) Economic Policy Uncertainty Affect Industrial Production and Unemployment in France, Germany, the United States and the United Kingdom?

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POVZETEK
V tem prispevku proučujemo vpliv (s priseljevanjem povezane) gospodarskopolitične negotovosti na industrijsko proizvodnjo in brezposelnost v Franciji, Nemčiji, Združenih državah Amerike ter Združenem kraljestvu. Ugotovili smo, da šok gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo in poveča brezposelnost v vseh državah, razen v Nemčiji. Ugotovili smo tudi, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo v Franciji, v Nemčiji pa jo poveča. Te ugotovitve kažejo potrebo po preprečevanju (s priseljevanjem povezane) gospodarskopolitične negotovosti.

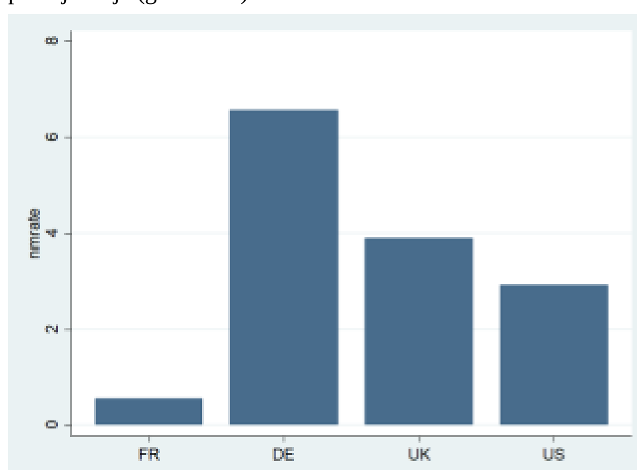
Ključne besede
(s priseljevanjem povezana) gospodarskopolitična negotovost, brezposelnost, industrijska proizvodnja, Francija, Nemčija, Združene države Amerike, Združeno kraljestvo

ABSTRACT
This paper examines the impact of (immigration-related) economic policy uncertainty on industrial production and unemployment in France, Germany, the United States and the United Kingdom. We have found that the economic policy uncertainty shock reduces industrial production and increases unemployment in all countries except Germany. We have also found that the immigration-related economic policy uncertainty shock reduces industrial production in France and increases it in Germany. These findings indicate the need to prevent (immigration-related) economic policy uncertainty.

Keywords
(immigration-related) economic policy uncertainty, unemployment, industrial production, France, Germany, United States, United Kingdom

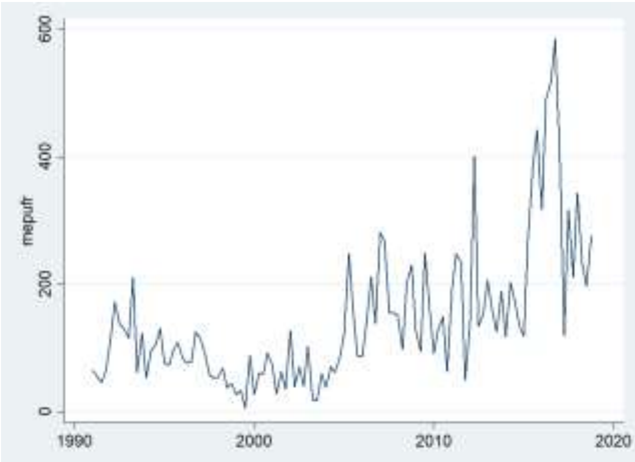
1. UVOD

Preseljevanje je normalen pojav, ki ga ni mogoče popolnoma preprečiti. Evropska in srednjeameriška begunska kriza sta povečali zanimanje ekonomistov in oblikovalcev politike za s priseljevanjem povezano gospodarskopolitično negotovost (angl. *immigration-related economic policy uncertainty*) ter povzročili potrebo po njenem stalnem spremljanju. V ta namen so S. R. Baker, N. Bloom in S. J. Davis [1] razvili časopisne indekse s priseljevanjem povezane gospodarskopolitične negotovosti (angl. *newspaper-based indices of immigration-related economic policy uncertainty*) za Francijo, Nemčijo, ZDA in Združeno kraljestvo, ki spadajo med države priseljevanja (gl. sliko 1).

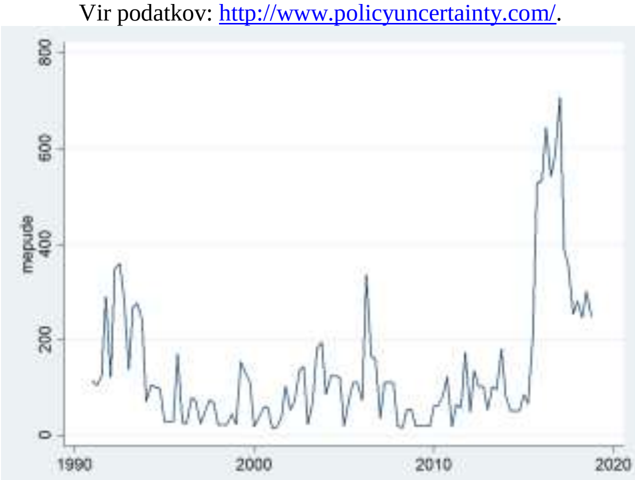


Slika 1: Stopnja neto preseljevanja (2015–2020)
Opomba: FR = Francija, DE = Nemčija, UK = Združeno kraljestvo, US = ZDA.
Vir podatkov: [2].

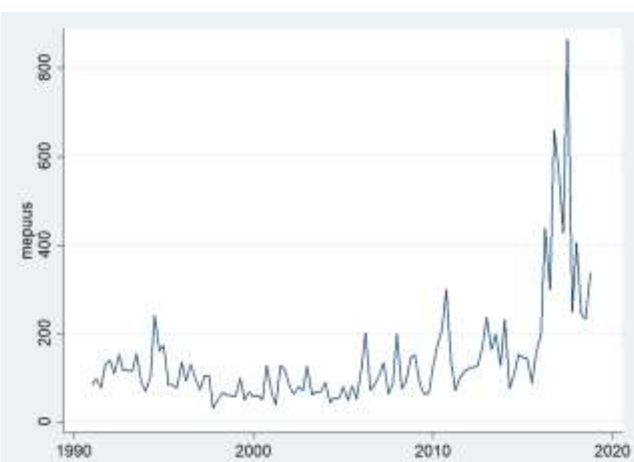
Slike 2–5 kažejo gibanje indeksov s priseljevanjem povezane gospodarskopolitične negotovosti za Francijo (mepufr), Nemčijo (mepude), ZDA (mepuus) in Združeno kraljestvo (mepuuk), tabela 1 pa korelacijo med njimi. Podatki kažejo, da je s priseljevanjem povezana gospodarskopolitična negotovost v teh državah dosegla višek v času evropske in srednjeameriške begunske krize.



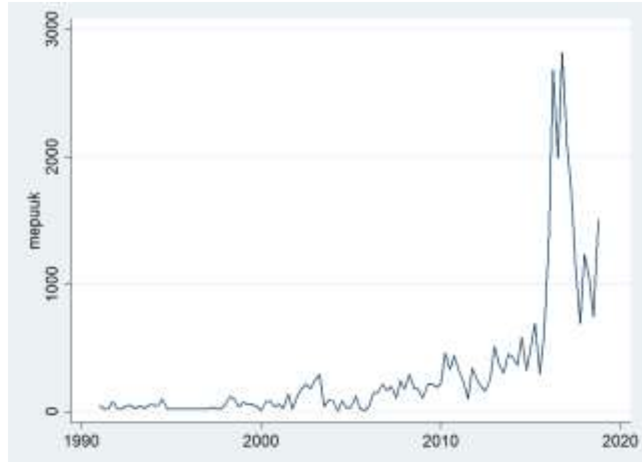
Slika 2: Gibanje indeksa s priseljevanjem povezane gospodarskopolitične negotovosti za Francijo (od prvega četrtletja 1991 do zadnjega četrtletja 2018)
Vir podatkov: http://www.policyuncertainty.com/.



Slika 3: Gibanje indeksa s priseljevanjem povezane gospodarskopolitične negotovosti za Nemčijo (od prvega četrtletja 1991 do zadnjega četrtletja 2018)
Vir podatkov: http://www.policyuncertainty.com/.



Slika 4: Gibanje indeksa s priseljevanjem povezane gospodarskopolitične negotovosti za ZDA (od prvega četrtletja 1991 do zadnjega četrtletja 2018)
Vir podatkov: http://www.policyuncertainty.com/.



Slika 5: Gibanje indeksa s priseljevanjem povezane gospodarskopolitične negotovosti za Združeno kraljestvo (od prvega četrtletja 1991 do zadnjega četrtletja 2018)
Vir podatkov: http://www.policyuncertainty.com/.

Tabela 1: Korelacija med indeksi s priseljevanjem povezane gospodarskopolitične negotovosti za Francijo, Nemčijo, ZDA in Združeno kraljestvo

	mepufr	mepude	mepuus	mepuuk
mepufr	1,000			
mepude	0,6379*	1,000		
mepuus	0,5934*	0,6438*	1,000	
mepuuk	0,7386*	0,7494*	0,7968*	1,000

Opomba: * $p < 0{,}05$.
Vir podatkov: lastni izračuni.

Ob zadnjih dogodkih z begunci v Evropi in Srednji Ameriki se sprašujemo, ali s priseljevanjem povezana gospodarskopolitična negotovost vpliva na brezposelnost in industrijsko proizvodnjo.

Ta prispevek dopolnjuje literaturo o (s priseljevanjem povezani) gospodarskopolitični negotovosti (v Franciji, Nemčiji, ZDA in Združenem kraljestvu) in se opira zlasti na ugotovitve S. R. Bakerja, N. Blooma in S. J. Davisa [3], T. Fraserja in M. Üngörja [4] ter M. Donadellija, L. Gerotte, M. Luccheta in D. Arzu [5].

2. PREGLED LITERATURE

V tem poglavju podajamo pregled literature o (s priseljevanjem povezani) gospodarskopolitični negotovosti.

2.1 Gospodarskopolitična negotovost

V literaturi srečujemo različne vrste kazalcev gospodarskopolitične negotovosti: časopisne, finančne itd. (gl. npr. [6]). S. R. Baker, N. Bloom in S. J. Davis [7] so razvili časopisni indeks gospodarskopolitične negotovosti (angl. *newspaper-based index of economic policy uncertainty*), o katerem se veliko govori in piše.

Na spletišču http://www.policyuncertainty.com/ so dostopni podatki o časopisnih indeksih gospodarskopolitične negotovosti za 22 držav (Avstralijo, Brazilijo, Čile, Francijo, Grčijo, Indijo, Irsko, Italijo, Japonsko, Južno Korejo, Kanado, Kitajsko, Kolumbijo, Mehiko, Nemčijo, Nizozemsko, Rusijo, Singapur, Španijo, Švedsko, ZDA, Združeno kraljestvo).

S. R. Baker, N. Bloom in S. J. Davis [8] so proučevali vpliv šoka gospodarskopolitične negotovosti na industrijsko proizvodnjo in zaposlenost v ZDA. Ugotovili so, da šok gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo in zaposlenost. S. R. Baker, N. Bloom in S. J. Davis [9] so proučevali tudi vpliv šoka gospodarskopolitične negotovosti na industrijsko proizvodnjo in brezposelnost na panelu dvanajstih držav (Francije, Indije, Italije, Japonske, Južne Koreje, Kanade, Kitajske, Nemčije, Rusije, Španije, ZDA, Združenega kraljestva). Ugotovili so, da šok gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo in poveča brezposelnost. G. Caggiano, E. Caselnuovo in J. M. Figueres [10] so proučevali vpliv šoka gospodarskopolitične negotovosti v ZDA na brezposelnost v Kanadi. Ugotovili so, da šok gospodarskopolitične negotovosti v ZDA poveča brezposelnost v Kanadi, vendar le v obdobju naglega upada gospodarske aktivnosti (angl. *bust*).

2.2 S priseljevanjem povezana gospodarskopolitična negotovost

T. Fraser in M. Üngör [11] sta proučevala vpliv šoka s priseljevanjem povezane gospodarskopolitične negotovosti na industrijsko proizvodnjo in brezposelnost v Franciji, Nemčiji, ZDA in Združenem kraljestvu. Z bivariatnim VAR-modelom sta ugotovila, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo v Franciji in ZDA ter brezposelnost v Združenem kraljestvu, z multivariatnim pa, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo v ZDA in jo poveča v Nemčiji ter Združenem kraljestvu.

M. Donadelli, L. Gerotto, M. Luccheta in D. Arzu [12] so tudi proučevali vpliv šoka s priseljevanjem povezane gospodarskopolitične negotovosti na industrijsko proizvodnjo in brezposelnost v Franciji, Nemčiji, ZDA in Združenem kraljestvu. Ugotovili so, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo v Franciji in ZDA ter jo poveča v Nemčiji in Združenem kraljestvu. Ugotovili so tudi, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zmanjša brezposelnost v Nemčiji, ZDA in Združenem kraljestvu ter jo poveča v Franciji.

3. METODE

V tem prispevku uporabljamo vektorski avtoregresijski (VAR) model, ki ga zapišemo tako:

$$y_t = c + \sum_{p=1}^{L} A_p\, y_{t-p} + e_t,\ t = 1, \dots, N,$$

kjer so y_t vektor endogenih spremenljivk v času t, c konstanta, A_p vektor regresijskih koeficientov, e_t napaka, t čas in L odlog, izbran na podlagi kriterijev FPE (= kratica za *F(inal) P(rediction) E(rror)*) in AIC (= kratica za *A(kaike) I(nformation) C(riterion)*).

V tem prispevku uporabljamo tudi Choleskyjevo dekompozicijo (angl. *Cholesky decomposition*). Vrstni red spremenljivk je: epu, (mepu), ir, logipi, logsp, logunrate (prim. [13]). V tabeli 2 podajamo njihov opis. V primeru Francije in ZDA uporabljamo četrtletne podatke za obdobje od prvega četrtletja 1991 do zadnjega četrtletja 2018, v primeru Nemčije in Združenega kraljestva pa četrtletne podatke od prvega četrtletja 1993 oz. 1997 do zadnjega četrtletja 2018.

Tabela 2: Opis spremenljivk

Spremenljivka	Opis	Vir
epu	indeks gospodarskopolitične negotovosti	EPU
ir	obrestna mera	OECD
logipi	logaritem indeksa industrijske proizvodnje	OECD
logsp	logaritem cen delnic	OECD
logunrate	logaritem stopnje brezposelnosti	OECD
mepu	indeks s priseljevanjem povezane gospodarskopolitične negotovosti	EPU

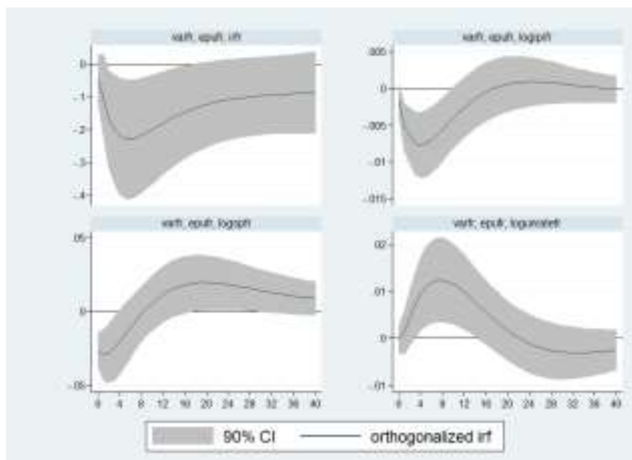
Opomba: EPU = http://www.policyuncertainty.com/.

4. REZULTATI

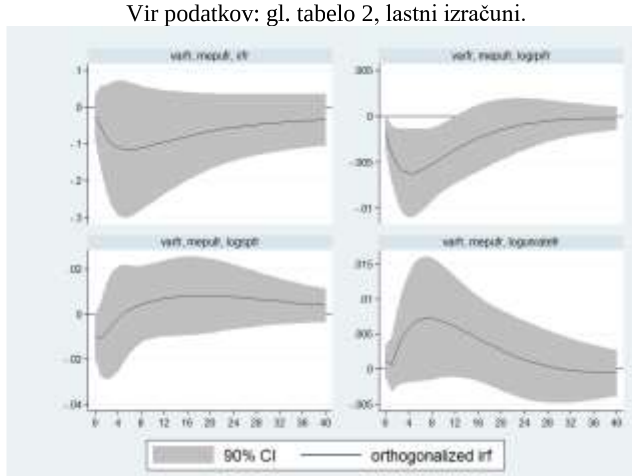
Šok (angl. *shock*) je nepričakovan dogodek. Slike 6, 8, 10 in 12 kažejo odziv spremenljivk ir, logipi, logsp in logunrate na šok gospodarskopolitične negotovosti (v velikosti standardnega odklona), slike 7, 9, 11 in 13 pa na šok s priseljevanjem povezane gospodarskopolitične negotovosti (v velikosti standardnega odklona) v Franciji, Nemčiji, ZDA in Združenem kraljestvu. Abscisne osi kažejo čas, ordinatne pa spremembe obrestne mere, logaritma indeksa industrijske proizvodnje, logaritma cen delnic in logaritma stopnje brezposelnosti.

S slik 6, 8, 10 in 12 razberemo, da šok gospodarskopolitične negotovosti zniža obrestno mero in indeks industrijske proizvodnje v vseh državah razen v Nemčiji, kjer se indeks industrijske proizvodnje zviša. Eden izmed razlogov za to bi lahko bila različna pričakovanja. S slik 6, 8, 10 in 12 razberemo tudi, da šok gospodarskopolitične negotovosti zniža cene delnic v vseh državah, kar smo pričakovali.

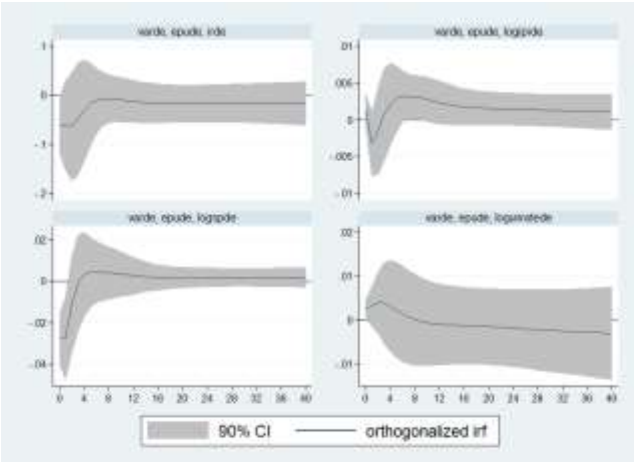
S slik 7, 9, 11 in 13 pa razberemo, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zniža indeks industrijske proizvodnje v Franciji, v Nemčiji pa ga zviša. S slik 7, 9, 11 in 13 razberemo tudi, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zviša cene delnic v ZDA, česar nismo pričakovali.



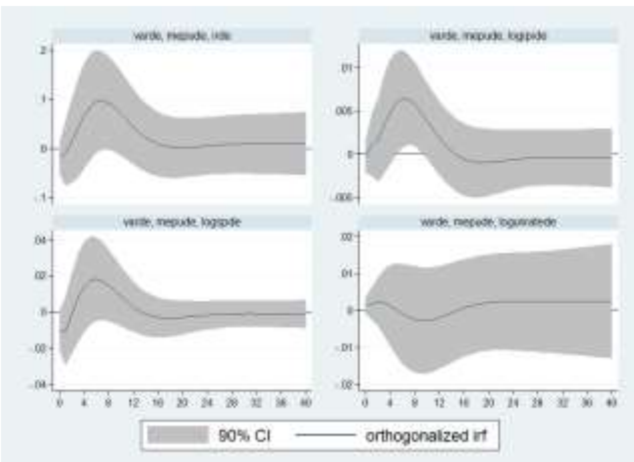
Slika 6: Odziv spremenljivk ir, logipi, logsp in logunrate na šok gospodarskopolitične negotovosti v Franciji
Vir podatkov: gl. tabelo 2, lastni izračuni.



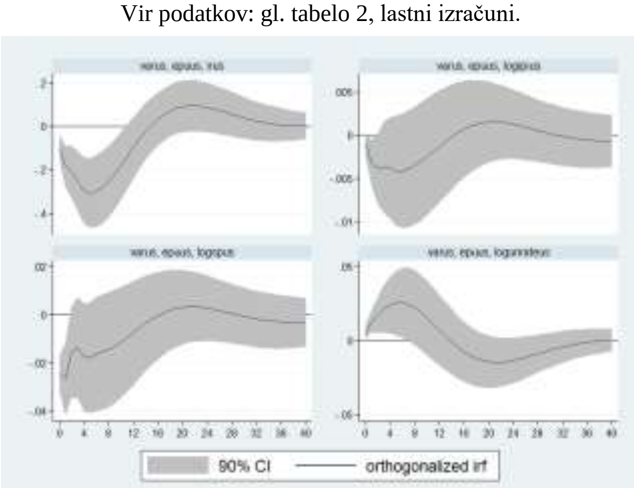
Slika 7: Odziv spremenljivk ir, logipi, logsp in logunrate na šok s priseljevanjem povezane gospodarskopolitične negotovosti v Franciji
Vir podatkov: gl. tabelo 2, lastni izračuni.



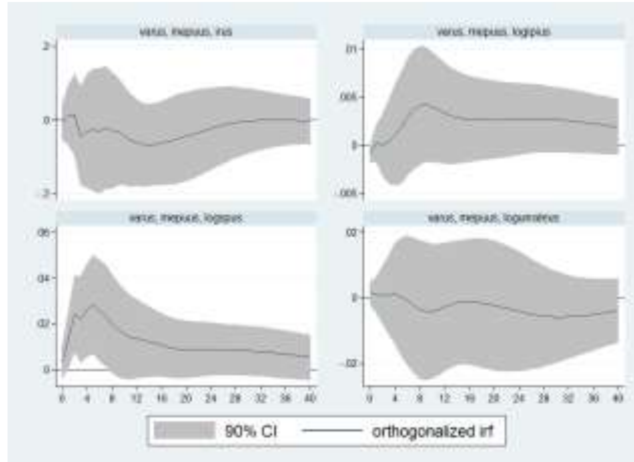
Slika 8: Odziv spremenljivk ir, logipi, logsp in logunrate na šok gospodarskopolitične negotovosti v Nemčiji
Vir podatkov: gl. tabelo 2, lastni izračuni.



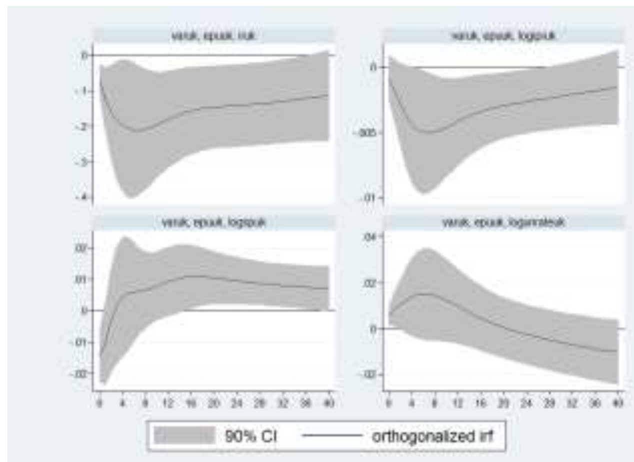
Slika 9: Odziv spremenljivk ir, logipi, logsp in logunrate na šok s priseljevanjem povezane gospodarskopolitične negotovosti v Nemčiji
Vir podatkov: gl. tabelo 2, lastni izračuni.



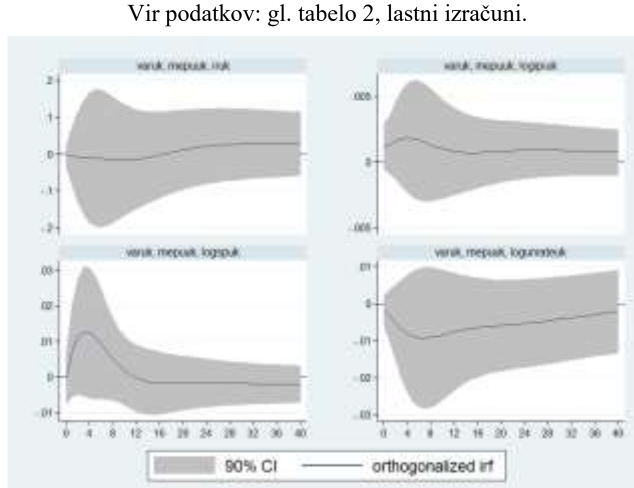
Slika 10: Odziv spremenljivk ir, logipi, logsp in logunrate na šok gospodarskopolitične negotovosti v ZDA
Vir podatkov: gl. tabelo 2, lastni izračuni.



Slika 11: Odziv spremenljivk ir, logipi, logsp in logunrate na šok s priseljevanjem povezane gospodarskopolitične negotovosti v ZDA
Vir podatkov: gl. tabelo 2, lastni izračuni.



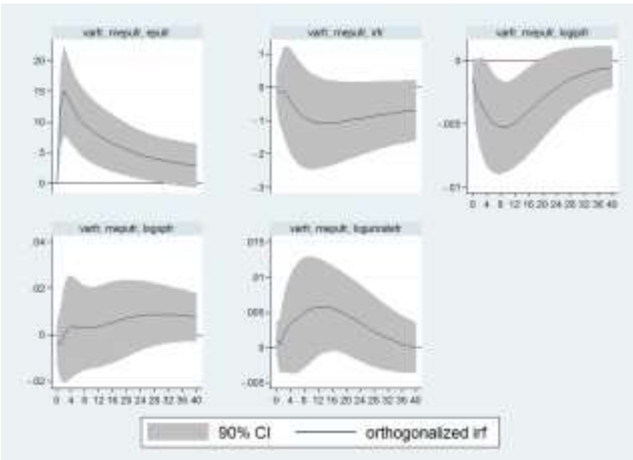
Slika 12: Odziv spremenljivk ir, logipi, logsp in logunrate na šok gospodarskopolitične negotovosti v Združenem kraljestvu
Vir podatkov: gl. tabelo 2, lastni izračuni.



Slika 13: Odziv spremenljivk ir, logipi, logsp in logunrate na šok s priseljevanjem povezane gospodarskopolitične negotovosti v Združenem kraljestvu
Vir podatkov: gl. tabelo 2, lastni izračuni.

Slika 14 kaže odziv spremenljivk epu, ir, logipi, logsp in logunrate na šok s priseljevanjem povezane gospodarskopolitične negotovosti (v velikosti enega standardnega odklona) v Franciji. Abscisne osi kažejo četrtletja, ordinatne pa spremembe indeksa gospodarskopolitične negotovosti, obrestne mere, logaritma indeksa industrijske proizvodnje, logaritma cen delnic in logaritma stopnje brezposelnosti.

S slike 14 razberemo, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zniža industrijsko proizvodnjo v Franciji.



Slika 14: Odziv spremenljivk epu, ir, logipi, logsp in logunrate na šok s priseljevanjem povezane gospodarskopolitične negotovosti v Franciji

Vir podatkov: gl. tabelo 2, lastni izračuni.

5. RAZPRAVA IN SKLEP

(S preseljevanjem povezana) gospodarskopolitična negotovost je priljubljena tema pogovorov med ekonomisti in oblikovalci politike. V tem prispevku smo proučevali vpliv šoka (s priseljevanjem povezane) gospodarskopolitične negotovosti na industrijsko proizvodnjo in brezposelnost v Franciji, Nemčiji, ZDA ter Združenem kraljestvu. Ugotovili smo, da šok gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo in poveča brezposelnost v vseh državah razen v Nemčiji. Ugotovili smo tudi, da šok s priseljevanjem povezane gospodarskopolitične negotovosti zmanjša industrijsko proizvodnjo v Franciji, v Nemčiji pa jo poveča. Te ugotovitve kažejo potrebo po preprečevanju (s priseljevanjem) povezane gospodarskopolitične negotovosti.

6. ZAHVALA

Zahvaljujemo se lektorjema za odpravo slovničnih in slogovnih napak ter anonimnemu recenzentu za predlagane popravke.

7. VIRI

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[12] Donadelli, M., Gerotto, L., Luccheta, M. in Arzu, D. 2019. Immigration, uncertainty, and macroeconomic dynamics. *The World Economy.* DOI= https://doi.org/10.1111/twec.12865.

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Spreminjajoči se pomen medgeneracijskih transferjev skozi čas v Sloveniji
Intra-generation transfers in Slovenia

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ABSTRACT

The paper presents intra-generation transfers in Slovenia.

POVZETEK

V svojem življenju se posamezniki soočajo z dvema obdobjema ekonomske odvisnosti, v času otroštva in v času starosti. V obdobju ekonomske odvisnosti posamezniki porabijo več kot zaslužijo. Ekonomska odvisnost mladih in starih je financirana s strani delovno aktivnega prebivalstva v obliki javnih in zasebnih transferjev ter javnega in zasebnega prerazdeljevanja iz naslova sredstev. Metodološki okvir računov nacionalnih transferjev (angl. National Transfer Accounts – NTA) nam s pomočjo koncepta primanjkljaja življenjskega cikla omogoča merjenje obdobja ekonomske (ne)odvisnosti.

V članku predstavljamo rezultate retrospektivne NTA za Slovenijo v obdobju 1993–2012. Rezultati kažejo, da mladi skozi čas ostajajo daljše obdobje ekonomsko odvisni od javnih in zasebnih transferjev. Na drugi strani zaradi daljšega ostajanja v zaposlitvi postanejo ponovno ekonomsko odvisni šele v nekoliko višji starosti, vendar je bil ta premik zanemarljiv v primerjavi s podaljšanjem življenjskega pričakovanja v tem času. V zadnjih dveh desetletjih se je tako obdobje ekonomske neodvisnosti posameznikov celo skrajšalo – iz 33 let v letu 1993 na 32 let v letu 2012. Rezultati kažejo tudi, da je ekonomska odvisnost mladih pretežno financirana z zasebnimi transferji (v višini 60 % celotnega financiranja ekonomske odvisnosti), medtem ko se starejši pretežno financirajo z javnimi transferji (v višini 80–90 % financiranja celotne ekonomske odvisnosti). Hkrati je skozi čas odvisnost mladih in starih v večji meri financirana z javnimi transferji.

1 UVOD

V svojem življenju gredo posamezniki skozi dve obdobji ekonomske odvisnosti: v času otroštva in proti koncu svojega življenja. V tem času trošijo več kot proizvedejo. Med obema obdobjema ekonomske odvisnosti je obdobje presežka dohodka iz dela nad potrošnjo. Razliko med potrošnjo in dohodkom iz dela v posamezni starosti imenujemo »primanjkljaj življenjskega cikla«. Primanjkljaj življenjskega cikla je v določeni starosti pozitiven, kadar potrošnja presega delovni dohodek posameznika v tej starosti. Ta primanjkljaj mora biti financiran z ekonomskimi tokovi, ki potekajo med posameznimi starostnimi skupinami. Tokove razdelimo na javne in zasebne neto transferje ter na javno in zasebno »prerazdeljevanje iz naslova sredstev« (angl. *asset-based reallocation*) [3].

Transferji med posameznimi starostnimi skupinami so ključnega pomena za razvoj in blaginjo posameznikov. Transferji, ki jih mladi in stari prejemajo od prebivalcev v delovni starosti, so ključnega pomena za njihovo preživetje. Mlajša generacija prejema pretežno (javne) transferje v obliki zdravstvene oskrbe in izobraževanja. Na drugi strani prejemajo starejši pretežno transferje v obliki zdravstva, dolgotrajne oskrbe in (javno financiranih) pokojnin.

V zadnjih letih se starostna struktura evropskega prebivalstva močno spreminja [2]. Starostna struktura prebivalstva vpliva na agregatno velikost in smer medgeneracijskih transferjev, kar posledično vpliva na gospodarsko dogajanje v posamezni državi. Kot posledica tega je metodologija na področju merjenja, modeliranja in ocenjevanja medgeneracijskih transferjev močno napredovala. V želji po sistematičnem in celovitem načinu merjenja in modeliranja ekonomskih tokov med različnimi generacijami so raziskovalci razvili t. i. metodologijo »računov nacionalnih transferjev« (angl. *National Transfer Accounts – NTA*).

Ekonomski razvoj podaljšuje obdobje posameznikove ekonomske odvisnosti. Mladi podaljšujejo obdobje izobraževanja in vse kasneje vstopajo na trg dela. V Sloveniji je to še bolj očitno, saj se tam mladi izobražujejo dlje časa kot v ostalih razvitih državah [6]. Na drugi strani starejši kljub hitremu podaljševanju pričakovane življenjske dobe ne podaljšujejo ustrezno tudi delovne dobe. Slovenija se tako v mednarodnih primerjavah izpostavlja tudi kot država z zelo nizkimi stopnjami aktivnosti v starostnih razredih 55–64 let [1].

Spremembe v starostni strukturi prebivalstva ter razvitost države tako povzročita spremembo velikosti medgeneracijskih transferjev in tudi pomen posameznih vrst prerazdeljevanja med generacijami. Z razvojem država oz. javni sektor vedno bolj prevzema nekatere funkcije družine [3]. Glavni namen pričujočega članka je torej celovito analizirati transferje med posameznimi starostnimi skupinami in primerjati njihov razvoj skozi čas. Za ta namen predstavljamo rezultate retrospektivne analize NTA za obdobje 1993–2012.

2 METODOLOGIJA IN PODATKI

V nadaljevanju bomo predstavili temeljna načela metodologije računov nacionalnih transferjev [3], [5]. Njihov temeljni cilj je meriti in analizirati ekonomske tokove med posameznimi starostnimi skupinami oziroma generacijami. Računi nacionalnih transferjev pomenijo novo poglavje v že obstoječem sistemu nacionalnih računov (angl. *System of National Accounts*) in dodajo dimenzijo starosti v sistem nacionalnih računov. Osrednji del metodologije predstavlja primanjkljaj življenjskega cikla. Razlika med potrošnjo in dohodkom iz dela je krita ali z neto transferji ali preko prerazdeljevanja iz naslova sredstev. Neto transferji so lahko javni ali zasebni. Neto zasebni tokovi se delijo na tokove med gospodinjstvi in tokove znotraj gospodinjstva. Prerazdeljevanje iz naslova sredstev je prav tako lahko zasebno ali javno in predstavlja razliko med dohodki iz premoženja in varčevanjem. Računovodska identiteta računov nacionalnih transferjev torej sloni na preprostem pravilu, da morajo biti vsi prilivi (v obliki dohodka iz dela, priliva transferjev ali dohodka iz premoženja) enaki vsem odlivom (v obliki potrošnje, odliva transferjev ali varčevanja).

Z namenom analiziranja medgeneracijskih tokov je potrebno najprej oceniti starostne profile za veliko število ekonomskih kategorij. Starostni profili predstavljajo povprečne vrednosti spremenljivke po posameznih starostnih skupinah. V prvem koraku oblikovanja starostnih profilov moramo pridobiti agregatne vrednosti posameznih kategorij. Te so bodisi neposredno vzete iz sistema nacionalnih računov bodisi ustrezno izračunane. V naslednjem koraku razdelimo agregatno vrednost med posamezne starostne skupine. Pri tem uporabimo podatke iz Ankete o porabi gospodinjstev za leta 1993, 1998, 2000, 2003, 2005, 2008, 2010 in 2012 [4]. Uporabljamo tudi druge anketne ali administrativne podatkovne vire, npr. mikro-podatke EU-SILC, podatkovne vire Ministrstva za finance, Zavoda za invalidsko in pokojninsko zavarovanje in Zavoda za zdravstveno zavarovanje Slovenije.

Starostne profile prilagodimo za faktor prilagajanja (angl. *adjustment factor*) tako, da se starostni profili, pomnoženi s starostno strukturo prebivalstva, ujemajo z agregatnimi vrednostmi. Starostni profili, pridobljeni iz anketnih podatkov, so večinoma na koncu izglajeni. Na ta način zmanjšamo variabilnost starostnih profilov, ki so posledica slučajnih dejavnikov v vzorčnih podatkih.

Ekonomski cikel sestavljajo potrošnja, dohodek iz dela in primanjkljaj življenjskega cikla, pri čemer je zadnji razlika med prvima dvema spremenljivkama. Ločeno ocenimo vrednost javne in zasebne potrošnje. Tako javno kot zasebno potrošnjo razdelimo na potrošnjo za izobraževanje, potrošnjo za zdravstvo in na ostalo potrošnjo (druga potrošnja, razen izdatkov za izobraževanje in zdravstvo). Agregatne vrednosti zasebnega sektorja predstavljajo finančne in nefinančne institucije, gospodinjstva in neprofitne institucije, ki služijo gospodinjstvom. Javni sektor predstavlja država. Zasebna potrošnja, ki je v anketi poročana na ravni gospodinjstva, je na ravan posameznika ocenjena s pomočjo regresijske funkcije (v primeru izdatkov za izobraževanje in zdravstvo) oz. s pomočjo ekvivalenčne lestvice (v primeru ostale zasebne potrošnje). Ker Anketa o porabi gospodinjstev ne vsebuje podatkov o javni potrošnji, so starostni profili ocenjeni preko različnih administrativnih virov podatkov. Ostali del javne potrošnje, ki ni namenjen zdravstvu in izobraževanju, je pretežno sestavljen iz kolektivne potrošnje, kot so npr. obramba države, policija, delovanje državnih institucij. Kolektivna potrošnja je enakomerno prerazporejena med različne starostne skupine.

Dohodek iz dela je v skladu z računi nacionalnih transferjev mera proizvodnje. Dohodek iz dela vsebuje zaslužke zaposlenih in zaslužke samozaposlenih oseb, v anketi poročane na individualni ravni. Vsi prispevki zaposlenih in delodajalcev so del dohodeka iz dela.

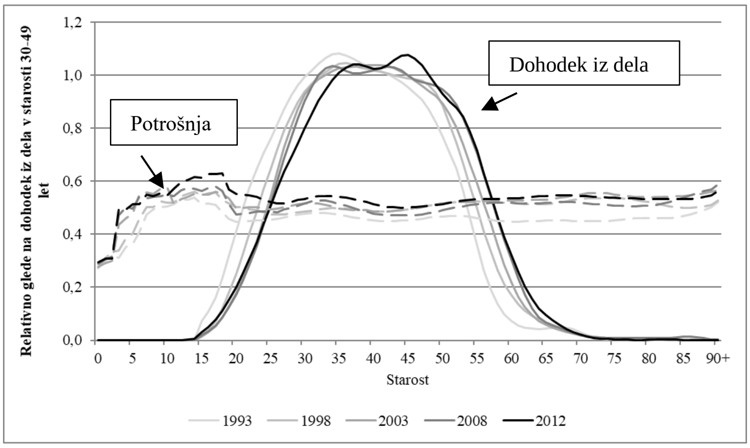
Primanjkljaj življenjskega cikla predstavlja razliko med potrošnjo in dohodkom iz dela. Enega izmed možnih načinov financiranja primanjkljaja življenjskega cikla predstavljajo zasebni in javni neto transferji. Javne transferje delimo na javno potrošnjo in javne tekoče transferje. Javna potrošnja predstavlja prilive za posameznika, in sicer v obliki dobrin in storitev, prejetih neposredno s strani države. Na drugi strani lahko posamezniki prejmejo od države transferje v denarni obliki. Ker predstavljajo transferji v denarni obliki neposredne prejemke za posameznika, so del Ankete o porabi v gospodinjstvih. Neto javni transferji predstavljajo razliko med prilivi in odlivi javnih transferjev. Odlivi javnih transferjev predstavljajo davke, socialne prispevke in ostale davke, ki jih plačujejo posamezniki. Starostni profili za javne odlive transferjev so ocenjeni na podlagi že obstoječih starostnih profilov, npr. starostni profil socialnih prispevkov iz starostnega profila dohodka iz dela. Javni tekoči transferji so v skladu z računi nacionalnih transferjev razdeljeni na transferje za izobraževanje, zdravstvo, pokojnine, brezposelnost in druge transferje, ki jih posamezniki prejemajo.

Kot že omenjeno, delimo zasebne transferje na transferje med gospodinjstvi in transferje znotraj gospodinjstva. Transferji med gospodinjstvi predstavljajo neposredne transferje med gospodinjstvi in posredne transferje, posredovane s strani neprofitnih institucij, ki služijo gospodinjstvom. Medtem ko lahko agregatno vrednost neto transferjev med gospodinjstvi pridobimo iz sistema nacionalnih računov, lahko vrednost transferjev znotraj gospodinjstev ocenimo zgolj kot ostanek razlike med zasebno potrošnjo in razpoložljivim dohodkom. Posamezniki, katerih razpoložljivi dohodek ni dovolj visok za pokritje potrošnje, prejemajo transferje s strani ostalih članov gospodinjstva, katerih razpoložljivi dohodek presega potrošnjo.

Primanjkljaj življenjskega cikla lahko krijemo tudi s prerazdeljevanjem iz naslova sredstev. Ta prikazuje razliko med dohodki iz premoženja in varčevanjem. Prihodki iz premoženja so sestavljeni iz prihodkov iz kapitala in prihodkov iz lastnine. Pri ocenjevanju starostnih profilov prerazdeljevanja iz naslova sredstev je uporabljena predpostavka, da ti prilivi/odlivi tečejo h/od glavi gospodinjstva (angl. *household head*).

3 REZULTATI

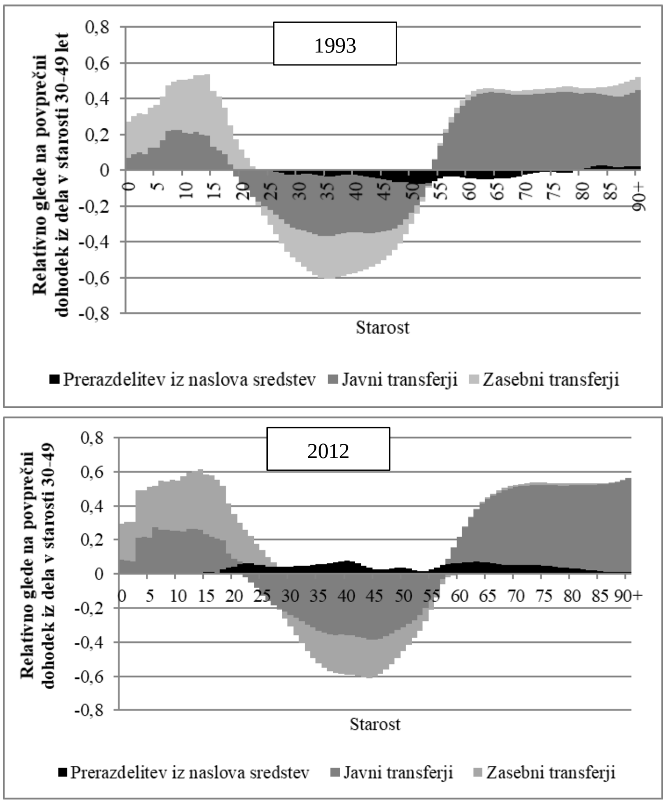
V sliki 1 predstavljamo starostni profil dohodka iz dela in potrošnje med letoma 1993 in 2012. Za namen primerljivosti rezultatov v času so le-ti predstavljeni relativno glede na povprečni dohodek iz dela v starosti 30–49 let. Rezultati kažejo, da ima delovni dohodek v vseh letih tipično obliko obrnjene U-krivulje. Dohodek iz dela od 15. leta starosti naprej narašča kot posledica vstopanja na trg dela in hkrati naraščanja zaslužkov zaposlenih. Zaslužki zaposlenih so najvišji v času delovne starosti, potem začnejo upadati. Na drugi strani je potrošnja, z izjemo vrha v času izobraževanja mladih, razmeroma konstantna pri vseh letih starosti.



Slika 1: *Starostni profil dohodka iz dela in potrošnje, Slovenija, 1993-2012*

Skozi čas se mladi dlje časa izobražujejo in s tem kasneje vstopajo na trg dela. Na drugi strani se skozi čas posamezniki kasneje upokojujejo. Starostni profil delovnega dohodka se tako skozi čas premika na desno, k višjim starostnim razredom. Poleg tega se skozi čas povišuje potrošnja relativno glede na dohodek iz dela. Kot rezultat se v času skrajšuje obdobje ekonomske neodvisnosti oz. obdobje negativnega primanjkljaja (tj. pozitivnega presežka) življenjskega cikla povprečnega posameznika. V letu 1993 je presežek življenjskega cikla trajal 33 let (med 21. in 53. letom starosti), do leta

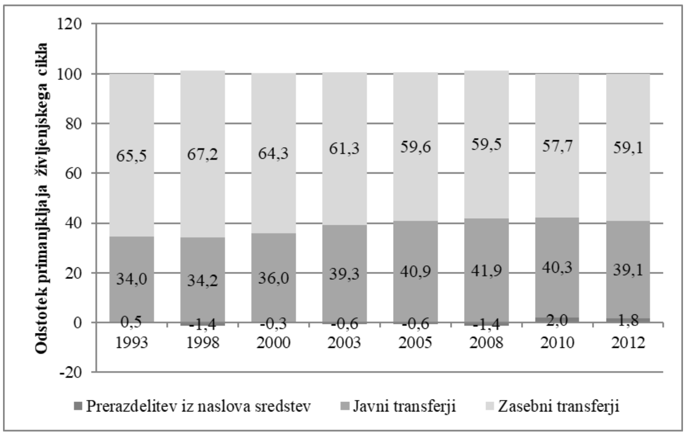
2012 pa se je skrajšal na 32 let (med 26. in 57. letom starosti).



Slika 2: *Financiranje primanjkljaja življenjskega cikla Slovenija, 1993 in 2012*

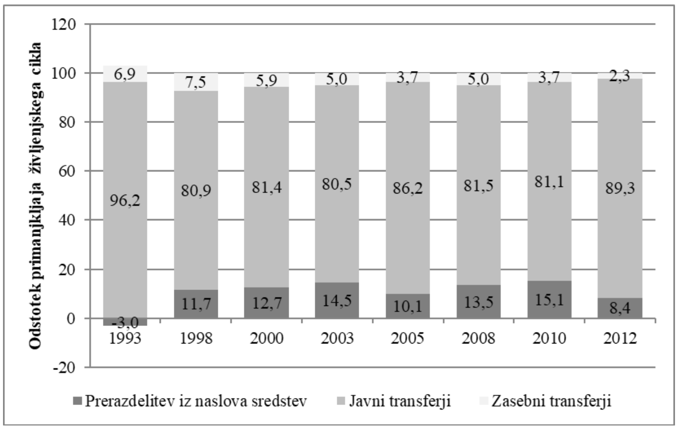
Poleg dolžine ekonomske (ne)odvisnosti je pomembno tudi, na kakšen način se odvisnost financira; gre predvsem za razmerje financiranja preko javnih in/ali zasebnih transferjev. V sliki 2 tako prikazujemo financiranje življenjskega cikla v letih 1993 in 2012. Neto javni transferji (razlika med javnimi prilivi in odlivi) so negativni v času delovne starosti in pozitivni v času otroštva ter v višjih starostnih razredih. V obdobju med letoma 1993 in 2012 se starostni profil neto javnih transferjev pomika v desno kot posledica kasnejšega zaposlovanja mladih in kasnejšega izstopa starejših iz trga dela. Če je povprečni posameznik postal neto plačnik v javnofinančni sistem leta 1993 pri 19. letu starosti, je postal v letu 2012 neto plačnik pri 22. letu starosti. Na drugi strani ostajajo posamezniki neto plačniki v javnofinančni sistem dlje časa, in sicer do 58. leta starosti v letu 2012, medtem ko so bili v letu 1993 neto plačniki zgolj do 54. leta starosti. Neto zasebni transferji tečejo pretežno od posameznikov v delovni starosti k posameznikom v nižjih starostnih skupinah, in sicer predvsem v obliki transferjev znotraj gospodinjstva. Tudi starostni profil neto zasebnih transferjev se v letih od 1993 do 2012 pomika v desno. To kaže na podaljševanje dobe ekonomske odvisnosti otrok od svojih staršev. Medtem ko so bili neto zasebni transferji za mlade v letu 1993 pozitivni zgolj do 22. leta starosti, se je ta meja v letu 2012 povišala na 27 let. Na drugi strani se povišuje tudi starost, do katere so starejši posamezniki neodvisni od zasebnih transferjev.

V sliki 3 prikazujemo spreminjanje pomena posameznih virov financiranja ekonomske odvisnosti mladih. Primanjkljaj življenjskega cikla mladih, starih 0–19 let, je v vseh letih analize pretežno financiran s strani zasebnih transferjev. V letu 2012 je bilo 59 % odvisnosti mladih financirane z zasebnimi transferji. Vendar pa se skozi čas pomen zasebnih transferjev v financiranju ekonomske odvisnosti zmanjšuje, in sicer s 66 % v letu 1993 na 59 % v letu 2012. Ob tem se povečuje pomen javnih transferjev za financiranje ekonomske odvisnosti mladih. Odstotek javnih transferjev v ekonomski odvisnosti mladih se je namreč povišal s 34 % v letu 1993 na 39 % v letu 2012.



Slika 3: *Financiranje primanjkljaja življenjskega cikla mladih (starih 0-19 let), Slovenija, 1993-2012*

Medtem ko se mladi še vedno pretežno financirajo z zasebnimi transferji, je ekonomska odvisnost starejših pretežno financirana z javnimi transferji. V preučevanem obdobju je bil odstotek javnih transferjev najvišji v letu 1993, ko je zaradi izgube zaposlitve v času tranzicije socialne transferje prejemal visok delež posameznikov. Če pa se osredotočimo zgolj na obdobje med letoma 1998 in 2012, opazimo porast odstotka javnih transferjev v financiranju ekonomske odvisnosti starih 65 let in več, in sicer z 81 % v letu 1998 na 89 % v letu 2012.



Slika 4: *Financiranje primanjkljaja življenjskega cikla starih (65+ let), Slovenija, 1993-2012*

4 SKLEP

V pričujočem članku predstavimo rezultate retrospektivne analize NTA, ki nam s pomočjo koncepta primanjkljaja oz. presežka življenjskega cikla omogočajo analizo posameznikove ekonomske odvisnosti oz. neodvisnosti skozi življenjski cikel in njeno financiranje skozi javne in zasebne transferje ter prerazdeljevanje iz naslova sredstev. V letu 2012 je presežek življenjskega cikla kot razlika med celotno potrošnjo in celotnim dohodkom iz dela trajal zgolj med 26. in 57. letom starosti. To pomeni, da posamezniki ustvarijo s svojim dohodkom iz dela dovolj za financiranje svoje potrošnje zgolj v tem razponu 32 let. Skozi preučevano obdobje analize se ta razpon počasi skrajšuje (v letu 1993 je trajal 33 let). V vseh preostalih letih starosti so posamezniki ekonomsko odvisni od drugih, saj njihova potrošnja presega delovni dohodek.

V obdobju 1993–2012 so posamezniki večinoma financirali svojo potrošnjo preko javnih in zasebnih transferjev, medtem ko prerazdeljevanje iz naslova sredstev predstavlja zgolj majhen delež financiranja potrošnje posameznikov. Otroci so predvsem odvisni od zasebnih transferjev, medtem ko so starejši pretežno odvisni od javnih transferjev. Starejši prejemajo zgolj majhen delež zasebnih transferjev. Medtem ko zasebni transferji tečejo pretežno navzdol (od starejših k mlajšim), javni transferji potekajo pretežno navzgor (od mlajših k starejšim).

V obdobju 1993–2012 se delež financiranja potrošnje mladih skozi javne transferje povečuje. Javni sektor na ta način prevzema skrb za mlade. Na drugi strani se povišuje tudi delež javnih transferjev v financiranju odvisnosti starejših. Glede na to, da se viša delež ekonomsko odvisnega prebivalstva glede na tiste, ki si sami financirajo svojo potrošnjo, bo večji pomen javnih transferjev v financiranju odvisnosti mladih in starih brez ustreznih reform (ki pa smo jim počasi že priča) močno ogrozil vzdržnost javnofinančnega sistema.

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IONIS - Indoor and outdoor NITICSplus solution for dementia challenges
Tehnološke rešitve in storitve za pomoč pri izzivih demence v okviru programa AAL in projekta IONIS

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ABSTRACT

Demographic changes and the aging population in Europe and in Slovenia respectively increase the demand for some particular ICT services – including health services. The reasons for this are multiple: increase in chronic diseases, increase in diseases due to changing lifestyles, increasing demands of the people for new, more sophisticated diagnostic and therapeutic methods, biological and effective medicines and specifically for the respected field considered in this article the increase of simptoms related to alzheimer desease namely dementia. The European Commission sees one way to face the challenge and to solve the problem by introducing new services based on the new models and the new information and telecommunication solutions. Health services and home care services at a distance are the future for aging Europe. These services correspond to the needs of the information society. The European Commission sees such services as a possibility of building a sustainable health care system and contribution to a better life for elderly. Here presented are the basic features of IONIS project supported within the AAL program perspective.

POVZETEK

Demografske spremembe, predvsem staranje prebivalstva povzročajo v Evropi in v Sloveniji strmo naraščanje potreb po zagotavljanju različnih storitev, vključno z zdravstvenimi storitvami oblikovanimi po potrebah starostnikov. Poleg naraščajočega pomanjkanja zdravstvenih delavcev glede na potrebe, predvsem starejših, nad 65 let, obstaja vedno večja potreba te populacije zaradi spremenjenega načina življenja, porasta kroničnih bolezni, upravičenih zahtev po učinkovitejših diagnostičnih ter terapevtskih metodah in bioloških zdravilih ter specifično za področje, ki ga obravnava ta članek, porast simptomatike povezane z alzheimerjevo boleznijo in sicer demenco. Glede na te razmere naraščajo tudi stroški vezani na večji obseg potrebnih storitev kar vpliva na stabilnost zdravstvenih virov. Evropa predvideva na tem področju neizbežne spremembe, ki jih bo mogoče vpeljati s podporo učinkovitejših modelov informacijskih in telekomunikacijskih storitev. Storitve zdravja in oskrbe na domu na daljavo so storitve prihodnosti za **starajočo Evropo.** Pomenijo prispevek k **izboljšanju zdravja, k zmanjšanju neenakosti v zdravju in boljšo odzivnost sistema zdravstvenega varstva** glede na potrebe in upravičene zahteve ljudi. So tudi dejavnik transformacije obstoječega zdravstvenega sistema iz sistema, ki je ustrezal industrijski družbi v sistem, ki bo zadovoljil **potrebe informacijske družbe**, seveda ob vseh dodatnih izzivih, ki jih prinaša npr. **informacijska izključenost**. Evropska komisija vidi v tovrstnih storitvah na daljavo možnost za izgradnjo vzdržnega sistema zdravstvenega varstva in omogočanje kakovostnejšega življenja evropskih državljanov.

1. UVOD

Storitve zdravja na daljavo so najraznovrstnejše storitve za pridobivanje oz. ohranjanje zdravja in posegajo na področja kot so informiranje ali multimedijsko izobraževanje, konzultacije ter diagnostične in druge podporne storitve.

V Sloveniji, se v povezavi z razvojem storitev zdravja na daljavo uporabljala posamezne rešitve, aplikacije in orodja v telemedicini in v okviru pametne specializacije se razvojniki osredotočajo tudi na oblikovanje sodobnih zdravstvenih storitev, ki se izvajajo z uporabo informacijskih in telekomunikacijskih tehnologij (IKT) in so zato delno ali v celoti dostavljene virtualno – so torej storitve za zdravje na daljavo. Orodja in tehnologije so uporabljene kot sredstvo za izvajanje in podajanje teh storitev, IKT omrežja pa kot povezovalec dveh ali več posameznikov v teh interakcijah.

Aktivnosti na področju zdravja na daljavo in telemedicine v tujini

Delo na področju storitev zdravja na daljavo je intenzivno tako v Evropi kot drugod po svetu: ZDA, Japonska, Malezija, Singapur itd. Obstajajo številna mednarodna in evropska združenja najrazličnejših akterjev na področju zdravja na daljavo: strokovna, projektna, industrijska in druga združenja. Med njimi je potrebno omeniti: COCIR - European Coordination Committee of the Radiological, Electro-medical and Healthcare IT Industry; Continua Health Alliance (230 organizacij iz vsega sveta); ISfTeH - International Society for Telemedicine and eHealth. V njem so predstavniki 68 držav, med njimi od leta 2009 dalje tudi Slovensko društvo za medicinsko informatiko kot predstavnik Slovenije; ATA - American Telemedicine Association, ZDA; NIFTE - National Initiative for Telehealth, Kanada; PERSA - Association of Social Support Monitoring Services, Avstralija.

Pregled obstoječih rešitev in storitev za zdravje na daljavo v Evropski uniji

Evropska komisija aktivno podpira razvoj in raziskave na področju novih tehnologij in tehnoloških rešitev na področju zdravja na daljavo skozi številne instrumente: okvirni programi (FP7, FP6, FP5, FP4,...); ICT PSP - Information and Communication Technologies Policy Support Programmes; **AAL JP – Active and Assistive Living Joint Programme.** Sredstva usmerjajo v razvoj na tem področju tudi nekatere evropske agencije npr.: European Agency for Health and Consumers, European Commission Executive Agency for Education, Audiovisual and Culture in the framework of the Lifelong Learning Programme.

Predstavitev projekta IONIS

IONIS je angleška kratica za projekt, ki združuje tehnologije in storitve za ljudi, z zmanjšanimi kognitivnimi sposobnostmi (MCI – Mild Cognitive Impairement) in osebe v začetnih fazah demence. Platforma, ki temelji na povezovanju različnih visoko tehnoloških napravah je uporabniško usmerjena na širok spekter možnih izzivov in rešitev.

IONIS rešitev lahko nadomesti določene vsakodnevne funkcije in na prilagojen način podpira osebo z blagimi do zmernimi simptomi demence, kot so problem s spominom in upadom razumevanja - duševnega delovanja in procesov pridobivanja znanja ter razumevanja preko razmišljanja, izkušenj in preko čutil. Integriranost tehnologije s storitvami nudi podporo tako negovalcem kot tudi oskrbovancem.

IONIS oblikovanje funkcionalnosti in namen

IONIS temelji na preteklih izvedenih projektih v okviru programa AAL - ACTIVE AND ASSISTED LIVING PROGRAMME - ICT for ageing well.

Temeljne funkcionalnosti za IONIS so bile razvite tekom projekta NITICS (Networked InfrasTructure for Innovative home Care Solutions – Omrežna Infrastruktura za inovativno rešitev domače nege), ki je bil po zaključku izbran za enega od najbolj odličnih in uspešnih AAL projektov. NITICS platforma bo v prihodnosti opremljena z novimi notranjimi in zunanjimi funkcijami in rešitvami.

IONIS končni uporabniki in cilji

Končni uporabniki storitev IONIS so tako primarni kot sekundarni uporabniki.

Primarni končni uporabniki so osebe, z zmanjšano kognicijo oziroma so v začetnih fazah demence. Kljub zmanjšanemu spominu in kognitivnih sposobnosti so zmožni izvajati običajne dejavnosti znotraj in zunaj svojega bivalnega okolja. Skupina teh uporabnikov vključuje osebe vseh starosti in ne le starostnike, ki imajo podobne simptome bolezni.

Sekundarni končni uporabniki so negovalci, tako poklicni kot tudi prostovoljci in svojci osebe z simptomi demence. Ciljna skupina so predvsem osebe, ki v skupnem življenju in pogosto komunikacijo z dementno osebo naletijo na fizične, psihološke ali finančne težave.

Partnerji projekta

Konzorcij za razvoj storitev ter tehnologije za IONIS vključuje partnerje iz Švice, Romunije, Poljske, Madžarske in Slovenije. Vključena so podjeta s področja tehnološkega razvoja programske in tehnične opreme (EXYS, CITST, SOFTIC), tehnične univerze (University Politechnica of Bucharest, Warshaw University of Technology), medicinska fakulteta (Department of Geriatrics Warshaw), domovi za ostarele ter specifične strokovne organizacije za obravnavo, raziskavo in razvoj storitev za podporo osebam z demenco (Oszi Napsugar Otthon, Alzheimer Slovenija – društvo Spominčica in Zavod IZRIIS).

2. ZAKLJUČEK

Razvoj sistema za podporne storitve za osebe z demenco bo v okviru razvoja sistema za spremljanje in podporo na nivoju širše regije, kot je Evropska skupnost lahko pomembno zmanjšal dejanskegi pojav neenakosti v zdravju pri obravnavani populaciji.

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Agresija ter čustveno procesiranje pri moških z izkušnjo fizične in spolne zlorabe v otroštvu
Men abused as children

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ABSTRACT
Analyses of aggression and feelings of men abused as children are presented in this paper.

POVZETEK
V raziskavi smo proučevali odnos med izkušnjo fizične in/ali spolne zlorabe v otroštvu, agresivnim vedenjem in čustvenim procesiranjem pri odraslih moških. V raziskavi je sodelovalo 57 moških z izkušnjo fizične in/ali spolne zlorabe v otroštvu ter 65 moških iz kontrolne skupine. Izpolnjevali so vprašalnik o travmi v otroštvu (CTQ), vprašalnik agresij (AQ) ter vprašalnik čustvenega procesiranja (Epi). Rezultati raziskave so pokazali višjo stopnjo agresija in sovražnosti pri udeležencih z izkušnjo fizične in/ali spolne zlorabe v otroštvu.

Ključne besede
Zloraba v otroštvu, agresija, čustvena stabilnost, moški.

1. UVOD
Izkušnja travme v otroštvu je dejavnik tveganja za razvoj številnih psihopatoloških motenj in stanj, kot je depresija, posttravmatska stresna motnja (PTSM), samomorilno vedenje, odvisnosti ter , mejna osebnostna motnja. Prav tako obstaja večje tveganje za delinkventno vedenje, prestopništvo ter nasilno vedenje odraslih. Mladostniki, ki so bili v otroštvu žrtve spolne zlorabe, so izraziteje nagnjeni k delinkventnemu vedenju, v odraslosti pa 2,5-krat pogosteje samopoškodovanju [1]. Raziskovalci na področju zlorabe v otroštvu ugotavljajo, da zloraba povzroči pomembne in nevrobiološke spremembe na ravni limbičnega sistema [2,3,4] in tako neposredno vplivajo na posameznikovo spoprijemanje in soočanje s stresnimi situacijami, razvoj prilagoditvenih motenj in težav v čustveni regulaciji. Sistem regulacije instinktov, ki se nahaja v desnem orbitofrontalnem korteksu in je povezan z limbičnim sistemom ter uravnava vzburjenost, ima ključno vlogo pri posameznikovem čustvenem stanju, saj se prav tu odvija procesiranje tako pozitivnih, kot tudi negativnih čustev in čustvenih stanj [4]. Prav zaradi omenjenega se posamezniki, ki so preplavljeni s spomini na spolno in fizično zlorabo, pogosto znajdejo brez možnosti svobodnega in umirjenega odločanja. Čeprav sta spolna in fizična zloraba otroštvu čedalje bolj raziskana in evidentirana, pa v literaturi še vedno primanjkuje raziskav, ki bi proučevale dolgoročne posledice oz. korelate izkušnje spolne in fizične zlorabe fantov v otroštvu z načinom čustvenega doživljanja kasneje v odraslosti.

2. METODA

2.1 Udeleženci
V raziskavi je sodelovalo 122 udeležencev s povprečno starostjo 39,5 let (SD = 10,6). Najmlajši udeleženec je bil star 20, najstarejši pa 67 let. Večina udeležencev (69,4 %) je bilo zaposlenih, 17,4 % (N=21) jih je imelo status študenta, 5,8 % (N=7), štirje (3,3%) pa so bili upokojeni. S srednješolsko izobrazbo je bilo 22,1 % udeležencev (N=27), 7 je bilo gimnazijskih maturantov (5,7 %), 28 jih je imelo višje oz visokošolsko izobrazbo (22,9 %), 48 (39,3 %) univerzitetno, 10 (8,2 %) je bilo specialistov oz. magistrov znanosti, dva udeleženca (1,6 %) pa sta imela doktorat. V partnerski zvezi je bilo 77,7 % udeležencev, od tega jih je bilo 68 poročeni, 26 pa neporočenih v izven zakonski zvezi. 22 udeležencev (18,2 %) je bilo samskih, 5 (4,1 %) pa razporočenih oz. ločenih. Na vprašanje, ali imajo svoje otroke oz. so starši, je pritrdilno odgovorilo 60 udeležencev (49,2%), 43 udeležencev ni imelo svojih otrok (35,2 %), 19 udeležencev (15,6 %) pa na to vprašanje ni odgovorilo. Na vprašanje, ali so že bili kdaj v psihoterapevtski obravnavi, je pritrdilno odgovorilo 51 (41,8 %) udeležencev, 71 (58,2 %) pa nikalno.

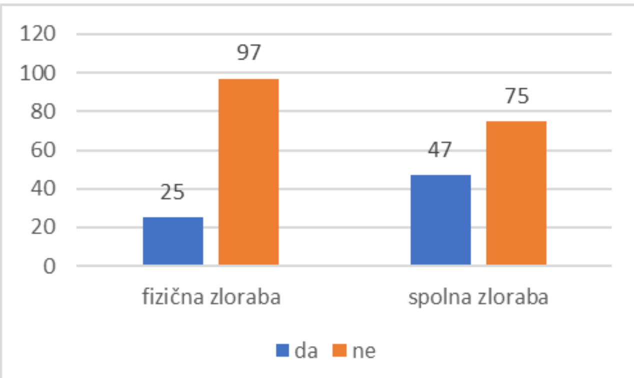
2.2 Pripomočki
Vprašalnik o travmi v otroštvu (ang. Childhood Trauma Questionnaire – CTQ) (Bernstein in Fink 1998) je samo-ocenjevalni vprašalnik in zajema kratek, zanesljiv in veljaven pregled nad zgodovino zlorabe in zanemarjanja v otroštvu. Za namen raziskave smo uporabili dimenziji fizična in spolna zloraba.
Vprašalnik agresije (ang. The Buss–Perry Aggression Questionnaire - BP-AQ) (Buss in Perry 1992) je namenjen ugotavljanju štirih dimenzij agresivnosti: fizične agresije, verbalne agresije, jeze in sovražnosti. Vprašalnik ima dobro zanesljivost in veljavnost.
Vprašalnik čustvenega procesiranja (ang. Emotional processing invemtory – EPi) (Reid in Harper 2007) je namenjen ugotavljanju stopnje funkcionalnosti čustvenega procesiranja na treh področjih: odprtost izražanja čustev, čustvena stabilnost in stopnja zmožnosti presojanja in uporabe čustev.

2.3 Postopek
V okviru raziskovalnega projekta smo pridobili dovoljenja za uporabo izbranih vprašalnikov (CTQ, AQ in EPi). Podatke smo zbirali od januarja 2018 do marca 2019. Povezavo do

raziskovalnega vprašalnika smo objavili na različnih spletnih straneh, forumih in socialnih omrežjih. Izpolnjevanje vprašalnikov je trajalo 10 do 15 minut. Pridobljene statistične podatke smo obdelali s statističnim programom IBM SPSS 25. Izračunali smo osnove deskriptivne statistike, Kolmogorov-Smirnov test za preverjanje normalnosti distribucij dimenzij uporabljenih merskih instrumentov, zanesljivost s Cronbachovim koeficientomin, neparametričen Kruskal-Wallis test za preverjanje razlik glede na stil navezanosti, dvosmerno ANOVO.

3. REZULTATI

Z vprašalnikom CTQ, s katerim smo preverjali izkušnjo fizične in spolne zlorabe v otroštvu, smo ugotovili, da je 38,5% udeležencev ima izkušnjo spolne zlorabe, 20,5% pa je imelo izkušnjo fizične zlorabe (slika 1). Dobra polovica udeležencev (N=65; 53,3%) ni poročala ne o fizični, ne o spolni zlorabi, 15 udeležencev (12,3%) pa je v otroštvu doživelo tako spolno, kot tudi fizično zlorabo, 32 (26,2%) jih je doživelo samo spolno zlorabo, 10 (8,2%) udeležencev pa je poročalo samo o fizični zlorabi v otroštvu.



Slika 1: Izkušnja fizične in spolne zlorabe

Table 1: Deskriptivna statistika za merske spremenljivke

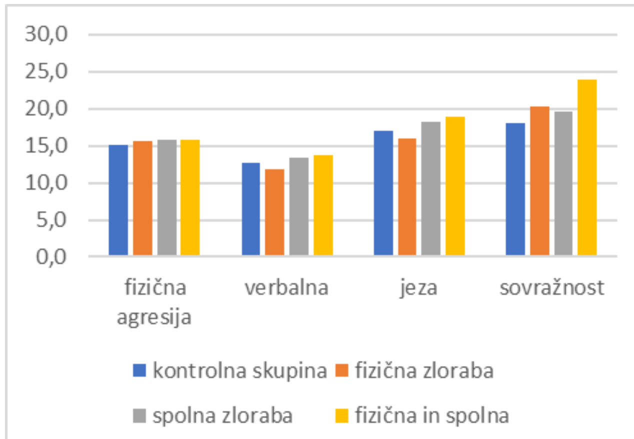
	N	Min	Max	M	SD	Spl.	Kurt.
AQ-fizična	120	9	30	15,6	3,6	,579	1,372
AQ-verbalna	120	8	21	13,0	2,4	,508	,364
AQ-jeza	120	9	28	17,6	3,4	,605	,928
AQ-sovražnost	120	8	35	19,5	5,9	,485	-,035
AQ-skupaj	117	39	99	65,3	11,1	,412	,448
EPS-izražanje	121	7	24	15,6	3,5	-,331	-,149
EPS-uporaba	119	7	25	17,2	3,5	-,321	-,465
EPS-stabilnost	122	5	25	17,7	4,4	-,755	,366

Tabela 1 prikazuje opisne statistike za uporabljene merske dimenzije agresije in čustvenega procesiranja. Kot je razvidno iz tabele, je pri dimenziji fizična agresija razpršenost podatkov asimetrična, pri vseh ostalih pa približno sledi normalni. V nadaljevanju smo za spremenljivko "fizična agresija" uporabili Kruskal-Wallisov test, za ostale variable pa enosmerno analizo variance.

3.1 Razlike v agresiji glede na izkušnjo in vrsto zlorabe

Zanimalo nas je, ali med skupinami udeležencev, ločenimi glede na prisotnost ali odsotnost izkušnje fizične in/ali spolne zlorabe v otroštvu obstaja značilna razlika v stopnji doživljanja fizične, verbalne agresije, jeze in sovražnosti. Levenov test je potrdil predpostavko o homogenosti varianc, v nadaljevanju pa je izračun analize variance pokazal statistično pomembne skupine med skupinami pri variabli sovražnost [$F(3, 116) = 4.55$, $p = 0.005$] in skupnem rezultatu agresije [$F(3, 113) = 3.56$, $p = 0.017$].

Post hoc primerjave z uporabo Tukey HSD testa je pokazal, da je bila sovražnost statistično pomembno višja pri udeležencih z izkušnjo fizične in spolne zlorabe v otroštvu ($M = 23.9$, $SD = 6.2$) v primerjavi s kontrolno skupino ($M = 18.1$, $SD = 5.5$), prav tako pa je bila agresija tudi v skupnem seštevku bolj izražena pri udeležencih z izkušnjo fizične in spolne zlorabe v otroštvu ($M = 72.4$, $SD = 12.6$) v primerjavi s kontrolno skupino ($M = 62.9$, $SD = 10.7$).



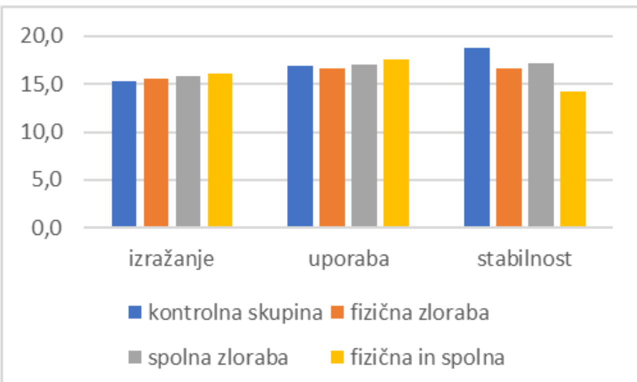
Slika 2: Izraženost agresije glede na izkušnjo fizične in spolne zlorabe

V nadaljevanju nas je zanimalo, ali med udeleženci z izkušnjo fizične in spolne zlorabe v otroštvu in izkušnjo udeležbe v psihoterapevtski obravnavi obstaja razlika ali interakcija v doživljanju agresije. Rezultati dvosmerne ANOVE so pokazali, da obstaja statistično pomembna interakcija med izkušnjo spolne zlorabe in izkušnjo udeležbe v psihoterapevtski obravnavi, $F(1, 115) = 8.39$, $p = 0.005$ v stopnji sovražnosti. Udeleženci z izkušnjo spolne zlorabe v otroštvu in izkušnjo psihoterapevtske obravnave izražajo večjo stopnjo sovražnosti, kot udeleženci, ki so poročali o izkušnji spolne zlorabe, niso pa nikoli bili vključeni v psihoterapevtsko obravnavo, medtem ko je bila stopnja sovražnosti pri udeležencih, ki niso imeli izkušnje spolne zlorabe v otroštvu nižja pri tistih udeležencih, ki so bili vključeni v psihoterapevtsko obravnavo, v primerjavi s tistimi, ki izkušnje psihoterapevtske obravnave niso imeli.

3.2 Razlike v čustvenem procesiranju glede na izkušnjo in vrsto zlorabe

Nadalje smo želeli preveriti, ali med skupinami udeležencev, ločenimi glede na prisotnost ali odsotnost izkušnje fizične in/ali spolne zlorabe obstajajo razlike v čustvenem procesiranju, in sicer odprtosti izražanja čustev, stopnji zmožnosti presojanja in uporabe čustev ter čustveni stabilnosti. Levenov test je potrdil predpostavko o homogenosti varianc, v nadaljevanju pa je izračun analize variance pokazal statistično pomembno razliko med skupinami v čustveni stabilnosti [$F(3, 118) = 5.23$, $p = 0.002$], in sicer je bila pri udeležencih z izkušnjo fizične in spolne zlorabe v otroštvu ($M = 14.3$, $SD = 5.4$) v primerjavi s kontrolno skupino ($M = 18.8$, $SD = 3.7$) statistično pomembna slabša stopnja čustvene stabilnosti.

Prav tako smo želeli preveriti, ali med udeleženci z izkušnjo fizične in/ali spolne zlorabe v otroštvu in izkušnjo udeležbe v psihoterapevtski obravnavi obstaja razlika ali interakcija v stopnj čustvenega procesiranja. Rezultati dvosmerne ANOVE so pokazali, da obstaja statistično pomembna interakcija med izkušnjo spolne zlorabe in izkušnjo udeležbe v psihoterapevtski obravnavi v stopnji čustvene stabilnosti $F(1, 116) = 7.00$, $p = 0.009$. Udeleženci z izkušnjo spolne zlorabe v otroštvu in izkušnjo psihoterapevtske obravnave izražajo nižjo stopnjo čustvene stabilnosti, kot udeleženci, ki so poročali o izkušnji spolne zlorabe, niso pa nikoli bili vključeni v psihoterapevtsko obravnavo, medtem ko med udeleženci, ki so imeli izkušnjo psihoterapevtske obravnave in tistimi, ki je niso imeli, ni bilo bistvene razlike v čustveni stabilnosti.



Slika 3: Sposobnost čustvenega procesiranja glede na izkušnjo fizične in spolne zlorabe

4. RAZPRAVA

Rezultati raziskave so pokazali, da je bilo od vseh udeležencev 38,5% spolno zlorabljenih, kar predstavlja skoraj vsakega tretjega udeleženca (2,6). Izkušnjo fizične zlorabe je imelo 20,5% udeležencev, kar predstavlja vsakega petega udeleženca (4,9).

Primerjava agresivnosti med skupinami ločenimi glede na izkušnjo spolne in/ali fizične zlorab ter kontrolno skupino je pokazala, so udeleženci z izkušnjo fizične in spolne zlorabe v otroštvu poročali o statistično pomembno močnejšem doživljanju sovražnosti, kot tudi agresije v primerjavi s kontrolno skupino udeležencev. Tudi druge raziskave kažejo podobne rezultate, in sicer imajo moški s spolno zlorabo v otroštvu kasneje v odraslosti dva do štirikrat pogostejše agresivno vedenje, razpoloženjske motnje [5].

Udeleženci z izkušnjo spolne zlorabe v otroštvu in izkušnjo psihoterapevtske obravnave izražajo večjo stopnjo sovražnosti, kot udeleženci, ki so poročali o izkušnji spolne zlorabe, niso pa nikoli bili vključeni v psihoterapevtsko obravnavo, medtem ko je bila stopnja sovražnosti pri udeležencih, ki niso imeli izkušnje spolne zlorabe v otroštvu nižja pri tistih udeležencih, ki so bili vključeni v psihoterapevtsko obravnavo, v primerjavi s tistimi, ki izkušnje psihoterapevtske obravnave niso imeli. Dobljeni rezultati se skladajo relacijsko paradigmo, ki v poudarja pomembnost naslavljanja najbolj bolečin afektov v terapevtskem procesu. Terapevt preko mehanizma kompulzivnega ponavljanja in introjekcijsko-projekcijske identifikacije sledi ciklom agresivnih afektov [2,3,7].

Primerjava čustvenega procesiranja med skupinami udeležencev je pokazala statistično pomembno razliko med skupinami v čustveni stabilnosti, medtem ko v odprtosti izražanja čustev in stopnji zmožnosti presojanja ni bilo razlik. Udeležencih z izkušnjo fizične in spolne zlorabe v otroštvu so imeli v primerjavi s kontrolno skupino statistično pomembno slabšo čustveno stabilnost. Tudi raziskave potrjujejo, da pri posameznikih, ki so utrpeli izkušnjo zlorabe v otroštvu, zlasti spolne, razvojni deficiti desnohemisferskih možganskih območji vplivajo na kasnejše procese zaznavanja, reguliranja, procesiranja in komuniciranja afektov [2,3,4]. Rezultati raziskave kažejo na pomembno področje, ki bi ga bilo v prihodnje potrebno še podrobneje raziskati in vključiti tudi primerjavo z ženskami, kot tudi pogledati procesno spremembo v čustvenem procesiranju pri posameznikih z izkušnjo zlorabe in vključenostjo v psihoterapevtski proces.

" Doseženi rezultati so delno nastali v okviru projekta št. J5-9349, ki ga je financirala Javna agencija za raziskovalno dejavnost Republike Slovenije iz državnega proračuna."

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Kratek pregled osnovnih problemov urejanja prostora in ukrepov s stališča varstva okolja zaradi posledic prometa
Environmantal problems and solutions related to traffic

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ABSTRACT
The base of the presentation is participation at The SMILE Workshop 2003, before Slovenia became the member of European Union. In that time Slovenia was obliged to accept all European law valid in that time, including some Directives of the environment protection. One of them was also the EU Directive against noise protection (DIRECTIVE 2002/49/EC, of the European parliament and of the council relating to the assessment and management of environmental noise Directive (END)), which is very influent to the traffic problems, in the same way as other Directives (about air pollution, energy consumption, etc.)

Povzeto po obravnavah na dogodku The SMILE Worshop 2003:

Participants at the SMILE workshop 20 – 21 October 2003 in Berlin, Germany

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Ključne besede: promet, okolje, EU direktive, zdravje, hrup

1. UVOD
Pregled je bil v večjem obsegu in detajlneje predstavljen v okviru posebnih delavnic na nivoju evropske unije.
Kot v primeru drugih evropskih primerljivih mest velja tudi za primer Ljubljane, vendar v praksi (še vedno – od leta 2008 dalje) ni zadovoljivo zaživel
Za izpolnjevanje okoljskih direktiv odgovarja Evropi država, za to je pomembno, da izpolni svoj del usmeritvenih in nadzorstvenih nalog

2. IZHODIŠČE
DIRECTIVE 2002/49/EC
OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL relating to the assessment and management of environmental noise Directive (END)
(Direktiva Evropskega Parlamenta in Sveta 2002/49/ES z dne 25. junija 2002 o ocenjevanju in urejanju hrupa v okolju (UL L št. 189 z dne 18. 7. 2002, str.12–26))

Druge direktive, ki obravnavajo promet kot izvor negativnih vplivov na okolje

3. DANAŠNJI PROBLEMI TIPIČNEGA SREDNJEEVROPSKEGA MESTA:
- relativno močni prometni tokovi
- slabo stanje cestnih površin
- relativno visoke dovoljenje hitrosti vožnje
- omrežje in kvaliteta javnega transporta sta ne-odgovarjajoči
- kvaliteta in omrežje peššpoti in kolesarskih stez so neprimerni oz. nezadostni
- v Sloveniji pa še posebej nezadostno železniško omrežje in njegova neudobna ponudba za potniški promet, slabe kapacitete za tovorni promet

4. DANAŠNJI PROBLEMI NA DRŽAVNEM NIVOJU I.:
- močni prometni tokovi in vsakodnevne migracije
- močan tranzitni cestni promet, tudi tovorni
- omrežje in kvaliteta javnega transporta sta ne-odgovarjajoči
- Povezave z javnim potniškim prometom so slabe
- pomanjkljivo in zastarelo železniško omrežje
- manjkajo celotne trase (na primer „tretja prometna os“ sploh ni podprta z železniškimi povezavami, podobno proti Kočevski, itd.)
- slabo stanje cestnih površin
- kvaliteta in omrežje peššpoti in kolesarskih stez so nezadostni oz. neprimerni

5. DANAŠNJI PROBLEMI NA DRŽAVNEM NIVOJU II.:
- Strategija prostorskega razvoja RS se ne izvaja
- Vloge naselij v prostoru niso uresničene
- Planiranje prostorskih namenskih rab na nivoju države je nezadostno in neracionalno
- Zaradi slabega planiranja prostora ni nadzora nad vzdržnimi prometnimi tokovi
- Državni strateški prostorski načrt ni izdelan in sprejet

6. SPLOŠNO:
Situacija obremenitve s polucijami od prometa v mestih in v njihovih stanovanjskih naseljih:
- je pretežno povzročena s hrupom, umazanim zrakom, pretirano energetsko porabo, pretirano porabo prostora s strani prometa

- glavni vir hrupa so velikokrat državne ceste, ki prečkajo ali obkrožajo mesto
- prestavitve cestnih tras velikokrat premešča onesnaženje v posamezne bivalne, »mirne« stanovanjske cone

Posledice:

- Ljudje se selijo na podeželje
- Delovna mesta ostanejo večinoma v mestu
- To pomeni za mesto:
- Več prometa
- Več hrupa in drugih obremenitev okolja
- Več stroškov (za sanacije)
- Manj dajatev iz davkov v mestno blagajno

Zaradi nakopičenih okoljskih problemov in prikazanih posledic je potrebno izdelati:

- Akcijski plan (za zmanjševanje hrupa, za zrak, za energetsko bilanco, za ohranjanje neobnovljivih virov oziroma preprečevanje drugih obremenitev okolja)
- (nacionalni) PROGRAM VARSTVA OKOLJA na ravni države
- USTREZEN - okoljsko preverjen - URBANISTIČEN DOKUMENT s trajnostno naravnano vsebino kot pravna podlaga za prostorske ureditve trajnostnega značaja
- Državni strateški prostorski NAČRT (sama STRATEGIJA ni dovolj)

7. ZAHTEVE DIREKTIVE END:

Akcijski plan (po »uredbi« RS OPERATIVNI PROGRAM) vsebuje:

- Planiranje prometa
- Planiranje prostorskih namenskih rab (sem spada tudi prostorsko razporejanje storitvenih dejavnosti, kot je šolstvo, zdravstvo, javne usluge (banke, pošta,itd..)) z ugodnimi dostopi in prometnimi tokovi
- Ukrepi ob izvorih glede hrupa, plinov, PM10, itd…, ukrepi glede energetske porabe, prostorske neracionalnosti
- Znižanje (hrupnih) emisij

Za primerjavo:
IZ U R E D B E o ocenjevanju in urejanju hrupa v okolju (Uradni list RS 121/2004 z dne 11. 11. 2004)
PRILOGA 5
ZAHTEVE PRI IZDELAVI OPERATIVNIH PROGRAMOV VARSTVA PRED HRUPOM
Operativni program varstva pred hrupom mora vključevati najmanj naslednje elemente:

- opis poselitvenih območij,
- opis pomembnih cest,
- opis pomembnih železniških prog ali večjih letališč in drugih upoštevanih virov hrupa,
- pristojni organ,
- pravna podlaga,
- veljavne mejne vrednosti za kazalce hrupa,
- povzetek rezultatov kartiranja hrupa,
- ovrednotenje ocenjenega števila ljudi, ki so izpostavljeni hrupu,
- identifikacijo problemov in razmer, ki jih je treba izboljšati,
- zapis organiziranih javnih predstavitev in posvetovanj,
- vse veljavne ukrepe za zmanjšanje hrupa in
- vse projekte, ki so v pripravi,
- ukrepe, ki jih nameravajo pristojni organi sprejeti v naslednjih petih letih, vključno s kakršnimikoli ukrepi varovanja mirnih območij,
- dolgoročno strategijo,
- finančno informacijo (če je na voljo): proračune, oceno stroškovne učinkovitosti, oceno stroškov in koristi,
- določbe, načrtovane za ovrednotenje izvajanja in rezultate načrtov ukrepanja.

2. Ukrepi, ki jih nameravajo pristojni organi sprejeti na področjih znotraj svoje pristojnosti, lahko na primer vključujejo:

- načrtovanje prometa,
- načrtovanje namenske rabe prostora,
- tehnične ukrepe pri virih hrupa,
- izbor tišjih virov,
- zmanjšanje širjenja zvoka,
- ureditvene ali ekonomske ukrepe ali pobude.

3. Vsak operativni program varstva pred hrupom mora vsebovati ocene glede zmanjšanja števila prizadetih ljudi (motenih, z motenim spancem ali drugo).

Končni učinki akcijskega plana in bodoči razvoj mesta in mestnih naselij:
Ljudje se bodo znova naseljevali v mestu

- To pomeni za mesto:
- Manj prometa
- Manj hrupa
- Več dohodka iz davkov
- Manj stroškov
- Kvaliteta življenja bo izboljšana

8. ZAKLJUČKI PREDSTAVITVE SANACIJE VZORČNEGA MESTA V OKVIRU DELOVNE SKUPINE EU

Preveritev celotnega procesa znižanja (hrupnih) obremenitev v okolju na vzorčnem primeru kaže na naslednje:

- Učinkovit proces zmanjševanja problemov (vpliva – hrupa) lahko bazira samo na kompletu različnih tipov ukrepov
- Prebivalci posameznega (protihrupno) saniranega mesta (ki so bili izpostavljeni več kot 55dB(A) jakosti hrupa) se lahko ob tem nadejajo povprečno za 5dB(A) znižani ravni hrupa, največja redukcija pa lahko doseže tudi 14 dB(A)
- Korist znižanja okoljskih problemov (na področju nivoja hrupa) se lahko ovrednoti na 2 Mio EURO na leto za primer mesta, ki je bilo predmet obdelave (cca 30 000 prebivalcev)

9. ZAKLJUČEK PREDSTAVITVE PROBLEMATIKE

Končni učinki akcijskega plana in bodoči razvoj mesta in mestnih naselij:
Ljudje se bodo znova naseljevali v mestu
Ključnega pomena pri aktivnostih varstva okolja je "hoteti" in politična volja v vodstvih političnih skupnosti
V tujini je po izkušnjah iz delavnic EU to podprto s pritiski volivcev na politične predstavnike
(pri nas bi morala biti uvedena osebna odgovornost zaradi neizpolnjevanja EU direktiv)

10. DODATNO:

Evropska konferenca ministrov odgovornih za regionalno planiranje (CEMAT)
http://www.mop.gov.si/fileadmin/mop.gov.si/pageuploads/zakonodaja/mednarodni_dokumenti/CEMAT_vsebina.pdf

VODILNA NAČELA ZA TRAJNOSTNI PROSTORSKI RAZVOJ EVROPSKE CELINE
Pripravil Odbor visokih uradnikov
IV. Načela trajnostne prostorske politike za Evropo

(32) Urbani sistemi in funkcije, vključno s srednje velikimi in majhnimi regionalnimi središči, naj bi se razvijali tako, da bi prebivalci s podeželja imeli lažji dostop do teh središč
3. Spodbujati bolj uravnoteženo dostopnost
(34) Panevropsko prometno omrežje je treba hitro dokončati saj je prvi pogoj za zagotavljanje dobre dostopnosti do krajev po vsej Evropi
Že sklenjene sporazume o oblikovanju omrežij bo morda treba še enkrat preveriti in dopolniti s stališča prostorskega razvoja.
(35) Da bi lahko dosegli regionalno bolj uravnotežen razvoj, bi bilo treba izboljšati povezave med majhnimi in srednje velikimi mesti, med kmetijskimi in otoškimi območji ter transevropskimi omrežji in prometnimi centri (železnice, avtoceste, plovne vodne poti in pristanišča, letališča ali intermodalni centri).

11. IZ VSAKDANJIH RAZPRAV V MEDIJIH:

V medijih zasledimo vsebine z opisom problemov v družbi republike Slovenije, kot so:

- Slovenija mora poročati EU o urejanju javnega potniškega prometa
- V Ljubljano se vsak dan vozi že pol Slovenije
- Koliko ministrov je uvajalo enotno vozovnico od leta 2007
- Glede na neprestano naraščanje prometnih tokov so nujne integracijske strategije, ki bi upoštevale različne prometne modele in - v enaki meri - zahteve politike prostorskega razvoja. Pri tem bi morali upoštevati predvsem tiste prometne panoge, ki imajo manjši vpliv na okolje: železnica, kopenske vodne poti in pomorski prevoz.
- 2007–2009 na ministrstvu za promet pripravijo teoretični del integriranega javnega potniškega prometa (IJPP). Priprava poteka za časa ministrov Janeza Božiča, Radovana Žerjava in Patricka...

OPOMBA: Če tega »integriranega JPP« nimaš na čem izvajati, ne pomaga nič.

12. LITERATURA

[1] Finance, 21.05.2019
Koliko ministrov je uvajalo enotno vozovnico od leta 2007 src="https://beta.finance.si//pics//cache_za/zastoj-01-ss.JPG-1000px.1437132904.JPG.cut.s-57b82a3e7f0a2.jpg"
[2] Delo: Slovenija je pri stroških gospodinjstev za mobilnost na prvem mestu v EU.
Iz zakonodaje
[3] ZVO in drugi zakoni
[4] EU Direktive
[5] CEMAT

Najnovejše demografske projekcije in ekonomska odvisnost v Sloveniji
Slovenian demographic projections and generation transfers

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POVZETEK

Slovenija in evropske države so priča hitremu staranju prebivalstva. Ustaljeni kazalnik »koeficient starostne odvisnosti« primerja število ekonomsko odvisnih (v starosti 0–19 let in 65+) z delovnim kontingentom (prebivalci v starosti 20–64 let). Metodologija računov nacionalnih transferjev (angl. *National Transfer Accounts, NTA*) prikazuje dejansko porazdelitev dohodka iz dela in potrošnjo po starosti, s tem pa tudi dejansko ekonomsko odvisnost v gospodarstvu. Na ta način bolj realistično zajamemo vpliv sprememb v starostni strukturi prebivalstva na vzdržnost in ekonomijo nasploh. Ugotavljamo, da oba kazalnika kažeta, da bo v prihodnje močan demografski pritisk na naraščanje odvisnosti. Naposled uvedemo še nov kazalnik, to je razmerje med celotno proizvodnjo neplačanega gospodinjskega dela in njegovo potrošnjo. Tudi v tem delu gospodarstva ugotovimo dodatni pritisk na vzdržnost, vendar pa je v primerjavi s tržnim delom ekonomije ta negativni vpliv majhen.

ABSTRACT

Slovenia and European countries are facing rapid population ageing. Conventional ‘dependency ratio’ indicator compares the number of dependant individuals (aged 0–19 and 65+) with the number of working age individuals (aged 20–64). The National Transfer Accounts (NTA) methodology shows actual age distribution of labour income and consumption and therefore also economic dependency. This way we capture more realistically the impact of changing population age structure on sustainability and economy in general. We find that both indicators show strong demographic pressure on economic dependency in the future. Finally, we introduce new indicator, defined as the ratio between total production and total consumption of unpaid household work. In this part of the economy we find additional pressure on sustainability, but this negative impact is small when compared to the market part of the economy.

Keywords

Population ageing, economic dependency, National Transfer Accounts, projections

1 UVOD

Starost je ena glavnih določevalk človekove aktivnosti. V začetku svojega življenja z ekonomskega vidika ne ustvarjamo ničesar, prav tako je tudi proti koncu življenja naša proizvodnja praviloma manjša kot naša proizvodnja. Zato je pomembno, da spremljamo spreminjanje starostne strukture prebivalstva, ki se s staranjem prebivalstva hitro spreminja. Po najnovejših Eurostatovih demografskih projekcijah naj bi se delež delovnega kontingenta (stari 20–64 let) zmanjšal z 59,4 % v letu 2018 na 52,1 % v letu 2050. Na drugi strani naj bi se v tem obdobju delež prebivalstva v starosti 65 let in več povišal z 19,7 % na 28,5 %. Ob tem pa naj bi ostal delež starih 0–19 let približno nespremenjen na ravni okrog 20 % vseh prebivalcev [1].

Vendar pa je opredeljevanje obsega ekonomske odvisnosti in obsega proizvodnje s fiksnimi starostnimi mejami velika poenostavitev. Po eni strani prehodi med ekonomsko odvisnostjo in samostojnim financiranjem potrošnje (oz. ustvarjanjem presežka) niso točno pri starosti 20 in 65 let, po drugi strani pa niso vsi ekonomsko odvisni posamezniki odvisni v enaki meri in tudi presežek ni pri vseh enak [2]–[5]. Metoda Računov nacionalnih transferjev (angl. *National Transfer Accounts, NTA*) razčleni ustvarjeni dohodek iz dela in potrošnjo v gospodarstvu po starostnih skupinah. Na ta način bolj realistično zajamemo vpliv sprememb v starostni strukturi prebivalstva na ekonomijo in dolgoročno vzdržnost.

V tem članku nas zanima vpliv staranja prebivalstva v Sloveniji na naraščanje obsega ekonomske odvisnosti glede na obseg dohodka iz dela v gospodarstvu. NTA metodologija sicer nadalje zagotovi tudi informacije o ekonomskih tokovih med posameznimi starostnimi skupinami po posameznih vrstah tokov, skozi katere posamezniki financirajo primanjkljaj dohodka iz dela glede na svojo potrošnjo: javni transferji (npr. javno financirano šolstvo, zdravstvo, dolgotrajna oskrba), zasebni transferji (npr. starši financirajo prehrano, obleko, stanovanje svojih otrok) in interakcija s sredstvi (npr. najem kredita, dohodkih iz naslova dividend in drugih naložb) – npr. [2]. Vendar pa nas v tem članku zanimajo zgolj starostni vzorci potrošnje in dohodka iz dela v povezavi z demografskimi projekcijami, ki podajo splošno in celovito sliko o vplivu demografskih sprememb na ekonomijo.

Najprej izračunamo razliko med potrošnjo in dohodkom iz dela v posamezni starosti. To razliko imenujemo »primanjkljaj življenjskega cikla« (angl. *life cycle deficit, LCD*), kjer pozitivne vrednosti kažejo obdobje ekonomske odvisnosti v (naj)nižjih in (naj)višjih starostnih razredih. Vsoto vrednosti primanjkljaja življenjskega cikla (povprečne vrednosti vrednosti na prebivalca, pomnoženo s številom prebivalcev v posamezni starosti) izrazimo relativno glede na celotni dohodek iz dela v gospodarstvu, ki ga izračunamo tako, da pomnožimo povprečni dohodek iz dela na prebivalca s številom prebivalcev v posamezni starosti. Pri rezultatih se osredotočimo predvsem na spreminjanje tega razmerja v obdobju projekcij.

NTA metodologija je usklajena s sistemom nacionalnih računov (angl. *System of National Accounts, SNA*) in torej uvaja dimenzijo starosti v ta ustaljen sistem merjenja bruto domačega proizvoda. Hkrati pa to pomeni, da je v izračunih upoštevan samo tisti del storitvenih dejavnosti, ki se izvajajo na trgu, kar je tudi ena izmed kritik tega ustaljenega načina merjenja agregata ustvarjene proizvodnje. Veliko ekonomske aktivnosti namreč poteka v okviru gospodinjstev v obliki neplačanega dela [6], [7]. Govorimo npr. o čiščenju in pospravljanju stanovanja, skrbi za otroke, pripravljanju obrokov, pranju perila in raznih drugih produktivnih aktivnostih. Te aktivnosti so enakovredne aktivnostim, ki se sicer lahko izvajajo na trgu in takrat tudi štejejo v bruto domači proizvod, medtem ko če jih izvajamo sami, ne štejejo. Zato se je NTA analiza v preteklosti razširila tudi na neplačano gospodinjsko delo. Ta metodologija se imenuje »računi nacionalnih transferjev časa« (angl. *National Time Transfer Accounts, NTTA*) [8], [9]. Podatke za to analizo dobimo iz anket o porabi časa, kjer upoštevamo aktivnosti, ki jih opravimo doma v gospodinjstvu za nas ali za druge družinske člane in bi jih lahko namesto nas opravil kdo drug (»kriterij tretje osebe«). Z upoštevanjem neplačanega gospodinjskega dela uvedemo v tem članku nov kazalnik, to je razliko med celotno potrošnjo storitev neplačanega gospodinjskega dela in vrednostjo proizvodnje teh storitev, ki jo izrazimo relativno glede na celotni dohodek iz dela v gospodarstvu.

V naslednjem poglavju bomo predstavili metodologijo in podatke za tri kazalnike, ki jih bomo v članku izračunali. V tretjem poglavju bomo predstavili rezultate analize, medtem ko v zadnjem poglavju sklenemo svoje ugotovitve.

2 METODOLOGIJA IN PODATKI

V tem članku bomo predstavili tri verzije koeficienta starostne odvisnosti. Pri izrazoslovju uporabljamo izraz »koeficient starostne odvisnosti«, glede na to, da ta izraz uporabljata Statistični urad Republike Slovenije, Urad za makroekonomske analize in razvoj in še nekateri drugi.

Prvi kazalnik starostne odvisnosti je običajni demografski koeficient starostne odvisnosti (označevali ga bomo s *KSO*), ki je opredeljen kot:

$$KSO = \frac{P_{0-19} + P_{65+}}{P_{20-64}} \cdot 100 \tag{1}$$

Število prebivalcev (P) za starostna razreda 0–19 let ter 65 let in več torej delimo s številom prebivalcev v starosti 20–64. Število prebivalcev po posameznih starostnih razredih odčitamo iz Eurostatovih projekcij EUROPOP2018, ki jih je Eurostat objavi v letu 2019.

Drugi kazalnik je kazalnik starostne odvisnosti, ki bo temeljil na starostnih profilih (kakor imenujemo povprečne vrednosti na prebivalca) potrošnje in dohodka iz dela, ki so izračunani po NTA metodologiji. Uporabili bomo podatke, ki smo jih izračunali v okviru projekta Sedmega okvirnega programa (FP7) Evropske unije z akronimom »AGENTA«, ki je potekal v obdobju 2014–2017. Rezultati, ki smo jih izračunali v okviru projekta, so javno dostopni na domači strani AGENTA projekta v Podatkovnem raziskovalcu (angl. *Data Explorer*) [10]. NTA koeficient starostne odvisnosti (*NtaKSO*) bomo tako izračunali kot:

$$NtaKSO = \frac{\sum_{i=0}^{S}(C_i - YL_i) + \sum_{i=Z}^{80+}(C_i - YL_i)}{\sum_{i=0}^{80+} YL_i} \cdot 100 \qquad (2)$$

pri čemer *S* označuje starost v otroštvu oz. mladosti, v kateri je LCD še zadnjič pozitiven, medtem ko *Z* označuje starost, v kateri LCD postane ponovno pozitiven – in sicer v višji starosti, ko se posamezniki umikajo iz zaposlitve. Nadalje, *i* označuje starost, *P* označuje število prebivalstva, *YL* je oznaka za dohodek iz dela in *C* za potrošnjo. Pri tem so vse kategorije potrošnje (*C*) in dohodka iz dela (*YL*) izražene v agregatni obliki, torej pomnožene s številom prebivalstva v posamezni starosti.

Končno pa na novo uvedemo še tretji kazalnik, to je NTTA koeficient starostne odvisnosti (*NttaKSO*), ki je osredotočen na neplačano gospodinjsko delo:

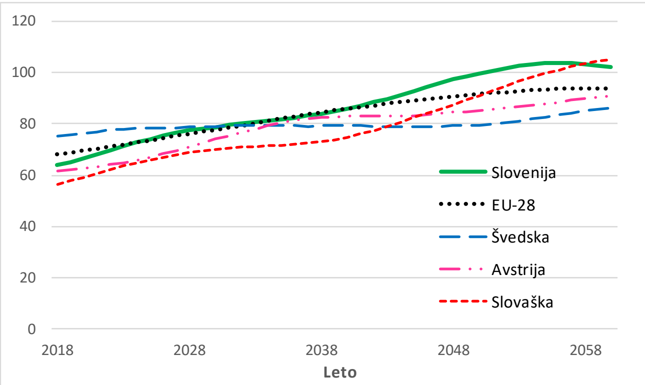
$$NttaKSO = \frac{\sum_{i=0}^{80+}(NDP_i - NDO_i)}{\sum_{i=0}^{80+}(YL_i)} \qquad (3)$$

Pri tem *NDP* označuje prilive iz naslova neplačanega dela, torej potrošnjo storitev neplačanega dela, medtem ko *NDO* označuje odlive iz naslova neplačanega dela, torej vrednost proizvedenih storitev, ki so bile proizvedene z neplačanim gospodinjskim delom.

Tudi tokrat uporabimo v imenovalcu celotni dohodek iz dela v gospodarstvu. S tem je imenovalec pri tem kazalniku isti kot pri prejšnjem kazalniku, kar pomeni, da lahko rezultate tega kazalnika primerjamo oz. seštevamo z rezultati prejšnjega kazalnika. Izračun smo naredili tako, da samo z domače strani AGENTA projekta [10] vzeli starostne profile proizvodnje in potrošnje v minutah, nato pa smo v vsakem letu projekcij te starostne profile množili s porazdelitvijo prebivalcev po starosti. Za namene primerljivosti s prejšnjim kazalnikom smo minute pretvorili v denarne enote (EUR) na osnovi urne postavke za delo, ki je najbližje neplačanemu gospodinjskemu delu. Urne postavke smo vzeli iz leta 2010, saj se na to leto nanašajo tudi NTA rezultati, ki jih uporabimo pri drugem izmed navedenih kazalnikov.

3 REZULTATI

V sliki 1 predstavljamo ustaljeni demografski koeficient starostne odvisnosti (*KSO*) na osnovi projekcij prebivalstva EUROPOP2018. Čeprav je Eurostat projekcije izdelal vse do leta 2100, smo naše obdobje predstavitve rezultatov skrajšali na obdobje do leta 2060. Prvič zato, ker postajajo za tako zelo oddaljeno obdobje demografske projekcije vedno bolj nezanesljive, medtem ko se za obdobje do okrog 30 let v prihodnost smatrajo kot precej zanesljive. Drugič pa zato, ker se od okrog leta 2060 naprej staranje prebivalstva več ne zaostruje. Glede na EUROPOP2018 naj bi se od 2060 do 2100 koeficient starostne odvisnosti namreč gibal okrog vrednosti 100, kar pomeni, da naj bi bilo število prebivalcev 0–19 let in 65+ let skupaj približno enako kot število prebivalcev v starosti 20–64 let. Skupaj z rezultati za Slovenijo prikazujemo v sliki 1 tudi še rezultate za EU-28 in za izbrane države, ki imajo pri posameznih kazalnikih v izhodiščnem letu visoke oz. nizke vrednosti.



Slika 1: Koeficient starostne odvisnosti (KSO) za Slovenijo, EU-28 in izbrane države

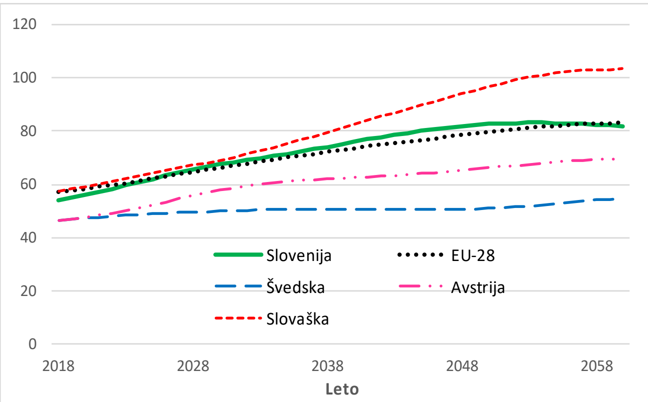
Vidimo lahko, da ima v začetnem letu 2018 Slovenija nekoliko nižji koeficient starostne odvisnosti kot vse EU države skupaj (63,8 za Slovenijo in 68,2 za EU-28). Po projekcijah Eurostata se do leta 2024 vrednosti *KSO* za Slovenijo približujejo vrednostim

KSO za EU-28, nato so do 2040 praktično iste, nakar postanejo vrednosti za Slovenijo precej višje kot za EU-28 (v 2060 102,1 za Slovenijo in 93,9 za EU-28). V sliki 1 prikazujemo še rezultate za Švedsko, ki ima eno najvišjih vrednosti *KSO*, na drugi strani pa za Slovaško, ki ima eno najnižjih vrednost *KSO* v letu 2018 med EU državami. Za namene naslednjega kazalnika dodajamo še Avstrijo, ki ima v letu 2018 prav tako podpovprečno vrednost *KSO*.

Nizke vrednosti *KSO* so posledica visokega deleža posameznikov v delovni starosti in/ali nizke rodnosti v zadnjih dveh desetletjih, ki povzročajo trenutno nizek delež prebivalcev v starosti 0–19 let. Visoke vrednosti so posledica visoke rodnosti v primerjavi z drugimi državami in visokega življenjskega pričakovanja – tipičen tak primer je Švedska.

Projekcije kažejo, da se bo v prihodnje v vseh državah koeficient starostne odvisnosti povišal zaradi nadaljnjega podaljševanja pričakovanega trajanja življenja in prehajanja številčnih generacij (v večini držav gre za številčne *baby-boom* generacije) iz delovnega kontingenta v starost 65+.

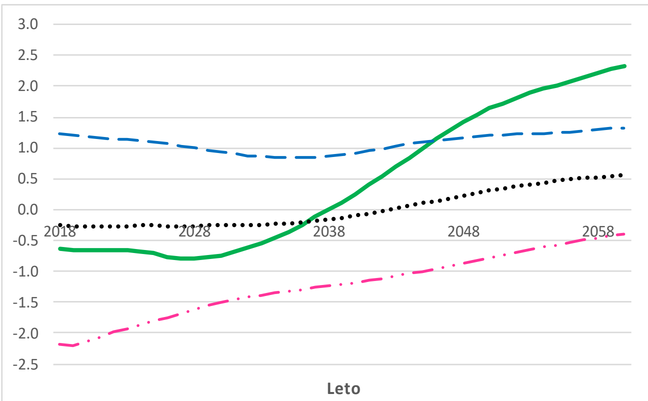
Drugi kazalnik je NTA koeficient starostne odvisnosti (*NtaKSO*). Pri tem kazalniku poleg sprememb v starostni strukturi prebivalstva, kot izhaja iz demografskih projekcij, vplivata na rezultat tudi starostna vzorca potrošnje in proizvodnje. Ta dva vzorca lahko demografski pritisk okrepita ali pa ga ublažita.



Slika 2: NTA koeficient starostne odvisnosti za Slovenijo (izraženo glede na celotni dohodek iz dela krat 100), povprečje 25 EU držav in posamezne izbrane države

Kot prikazuje slika 2, so rezultati pri tem kazalniku bistveno različni od rezultatov pri prvem kazalniku. Švedska več ni država z eno najvišjih vrednosti, temveč z eno najnižjimi, saj na Švedskem ostajajo v zaposlitvi precej dalj časa kot v kateri koli drugi izmed analiziranih 25 EU držav, za katere so bili v okviru AGENTA projekta izračunani NTA starostni profili. Enako nizko vrednost *NtaKSO* ima tudi Avstrija, ki je značilna po tem, da posamezniki zelo hitro vstopajo v zaposlitev. Razlike med državama se pojavijo tudi tekom obdobja projekcij. Daljše ostajanje v zaposlitvi je namreč na dolgi rok bolj učinkoviti odgovor na staranje prebivalstva. Hkrati Švedska nima številčnih *baby-boom* generacij, ki pri večini drugih držav v izhodiščnem letu znižujejo *KSO*, tekom obdobja projekcij pa ga povišujejo, saj prestopajo iz delovnega kontingenta (20-64 let) v starostni razred 65+. Tako na Švedskem *NtaKSO* tekom obdobja projekcij praktično ne narašča. Slovenija je v projekcijah *NtaKSO* kazalnika blizu povprečja EU-25 – v začetku nekoliko pod povprečjem EU-25, nato nekoliko nad in v zadnjih letih projekcij ponovno blizu povprečja EU-25.

V nadaljevanju želimo z *NttaKSO* preveriti še, ali se morebiti s spreminjanjem starostne strukture prebivalstva nakazuje dodatna obremenitev (ali morebiti razbremenitev) v obliki neplačanega gospodinjskega dela. Tudi ta oblika dela je namreč zelo odvisna od starosti posameznikov. Največ gospodinjskega dela opravijo posamezniki v delovnem kontingentu, še več pa v času po upokojitvi, dokler jim zdravje še služi za opravljanje neplačanega gospodinjskega dela. Vse do najvišjih starostnih razredov proizvajajo storitev neplačanega gospodinjskega dela več kot jih trošijo. Največji potrošniki storitev neplačanega gospodinjskega dela so otroci v najnižjih starostnih razredih, ki pa storitev neplačanega gospodinjskega dela sploh ne opravljajo, tako da je v teh starostnih razredih razlika med potrošnjo in proizvodnjo zelo velika. Hkrati pa se delež otrok, kot smo ugotovili, tekom obdobja projekcij praktično ne bo spreminjal, tako da ne pričakujemo bistvenih sprememb iz tega naslova.



Slika 3: NTTA koeficient starostne odvisnosti za Slovenijo (izraženo glede na celotni dohodek iz dela), povprečje 25 EU držav in posamezne izbrane države

Kot vidimo v sliki 3, v izhodišču vrednosti niso 0, kot bi to pričakovali. Celotna vrednost proizvodnje iz naslova neplačanega gospodinjskega dela bi namreč morala biti po definiciji enaka celotni vrednosti potrošnje storitev neplačanega gospodinjskega dela. Temu ni tako zato, ker so bile ankete o porabi časa izvedene v različnih letih, nekatere tudi v zelo oddaljenih od leta 2018. Za Slovenijo je npr. bila anketa o porabi časa izvedena v letu 2000. To pomeni, da bi se vrednosti proizvodnje in potrošnje ujemali, če bi uporabili razporeditev prebivalstva iz leta 2000, medtem ko mi v začetku obdobja projekcij uporabimo porazdelitev prebivalstva po starosti iz leta 2018. Za interpretacijo rezultatov to pomeni, da ni smiselno gledati absolutno raven v posameznih letih, temveč samo spremembo tekom obdobja projekcij.

Vidimo, da je povečanje *NttaKSO* za povprečje 16 držav EU, za katere smo imeli na voljo podatke, minimalno – za manj kot 1 odstotno točko glede na celotni dohodek iz dela. Vrednost je pozitivna, kar pomeni, da bo spremenjena demografska struktura, ki izhaja iz demografskih projekcij, povečala celotno potrošnjo napam celotni proizvodnji neplačanega gospodinjskega dela. Gre za hipotetično povečanje, saj morata biti potrošnja in proizvodnja biti v vsakem letu po definiciji enaki. Pozitivne vrednosti povečanja tega kazalnika torej kažejo, za koliko se bo morala glede na obstoječe vzorce v prihodnje bodisi zmanjšati potrošnja bodisi povečati proizvodnja neplačanega gospodinjskega dela.

Za Švedsko spremembe obstoječih starostnih vzorcev potrošnje in proizvodnje praktično ne bodo potrebne. V sredini obdobja projekcij se vrednosti celo nekoliko znižajo, kar pomeni, da bi se lahko zaradi demografskih sprememb celo nekoliko bodisi povečala potrošnja bodisi zmanjšala proizvodnja neplačanega gospodinjskega dela. Večji pritiski pa se obetajo Avstriji in še bolj Sloveniji, kjer naj bi se demografski pritisk na nevzdržnost obstoječih starostnih vzorcev proizvodnje in potrošnje pričel čez okrog 15 let in bi se nato do leta 2060 povišal za okrog 3 odstotne točke glede na celotni dohodek iz dela v gospodarstvu.

Absolutne vrednosti na y-osi so v sliki 3 mnogo nižje kot v sliki 2, ob tem pa so oboje vrednosti izražene glede na celotni dohodek iz dela v gospodarstvu, kar pomeni, da jih lahko neposredno primerjamo. Vidimo torej, da bo sicer obstajal negativni pritisk staranja prebivalstva na obstoječe vzorce potrošnje glede na proizvodnjo tudi pri neplačanem gospodinjskem delu, vendar pa bodo ti pritiski mnogo manjši kot pritiski na razkorak med potrošnjo in dohodkom iz dela v tržnem delu ekonomije.

4 SKLEP

Slovenija in evropske države so priča hitremu staranju prebivalstva. V članku najprej predstavimo pogosto uporabljan »koeficient starostne odvisnosti« kot demografski kazalnik za ugotavljanje povezave med spreminjajočo se starostno strukturo prebivalstva in ekonomskimi učinki oz. vplivom na vzdržnost. Pri tem uporabimo najnovejše Eurostatove demografske projekcije EUROPOP2018, izdelane v letu 2019. Ugotovimo, da bi v skladu s temi projekcijami število odvisnih (v starosti 0–19 let in 65+) na 100 oseb v delovnem kontingentu (prebivalci v starosti 20–64 let) v Sloveniji naraslo s 63,8 v letu 2018 na 102,1 v letu 2060, medtem ko bi bil porast za države EU-28 z 68,2 na 93,9.

Vpliv demografskih sprememb na ekonomsko vzdržnost pa je odvisen od dejanskega trošenja in proizvajanja v posamezni starosti, ne zgolj arbitrarno določenih starostnih mej med omenjenimi tremi starostnimi skupinami. Metoda Računov nacionalnih transferjev (angl. *National Transfer Accounts, NTA*) zato razčleni ustvarjeni dohodek iz dela in potrošnjo v gospodarstvu po posameznih starostnih razredih. Na ta način bolj realistično zajamemo vpliv sprememb v starostni strukturi prebivalstva na naraščanje obsega ekonomske odvisnosti glede na obseg dohodka iz dela v gospodarstvu. Tudi ta kazalnik kaže na močno povišanje ekonomske odvisnosti v prihodnje – z 54 % celotnega dohodka z dela v letu 2018 na 82 % v letu 2060. Tokrat je porast za Slovenijo približno enak kot za povprečje 25 EU držav, za katere smo imeli na voljo NTA podatke. Zanimiv je primer Švedske, ki ima po vrednosti demografskega kazalnika (koeficient starostne odvisnosti) v letu 2018 eno najvišjih vrednosti, hkrati pa ima eno najnižjih vrednosti NTA koeficienta starostne odvisnosti (*NtaKSO*). Na Švedskem namreč ostajajo v zaposlitvi bistveno dlje kot v drugih državah, kar je zelo učinkovit način za omejevanje demografskega pritiska na ekonomsko vzdržnost. Ti rezultati poudarjajo, da je dobro izračunavati različne kazalnike starostne odvisnosti, saj nam s primerjavo v času in med državami kažejo naravo neravnotežja in sugerirajo smeri ustreznih ukrepov ekonomske politike.

Naposled smo uvedli še nov kazalnik, to je razmerje med celotno proizvodnjo neplačanega gospodinjskega dela in njegovo potrošnjo. Tudi tu ugotovimo dodatni rahli pritisk na vzdržnost, vendar pa je v primerjavi s tržnim delom ekonomije ta negativni vpliv majhen. V Sloveniji se v obdobju projekcij (2018 do 2060) razmerje med potrošnjo storitev neplačanega dela in proizvodnjo storitev neplačanega razkorak poviša v primerjavi s celotnim dohodkom iz dela za okrog 3 odstotne točke, medtem ko je povečanje za povprečje 16 držav, za katere imamo na voljo podatke, manj kot 1 odstotno točko.

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Okolje, znanost, stroka in politika
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POVZETEK

Obravnavana je nujnost naslonitve politike, ki odloča, na znanost in stroko, še posebno na področju okolja. Napačne odločitve ali opuščanje reševanja okoljskih problemov so prikazane na treh primerih. Dana je pobuda, da se Državni svet v večji meri vključi v okoljsko problematiko.

ABSTRACT

In this paper, the necessity of politics to take up science and profession seriously is discussed, especially with environmental issues. Wrong decisions or abandoning to resolve environmental problems are presented with three examples. It is suggested that National Council of the Rebublic of Slovenia is much more active with environmental problems.

Ključne besede: znanost, okolje, stroka, politika, degradirana območja, pitna voda, vetrne elektrarne

1. UVOD

V kakšnem okolju bomo živeli, naj bi odločali prebivalci. Pri tem razumemo, da v okolje spadajo poleg urbaniziranih območij tudi narava, krajina in kulturna krajina, kmetovanje. Na drugi strani za preživljanje potrebujemo delo in zaslužek. Temu služijo na tej stopnji civilizacije proizvodnja in storitve (tudi javne, netržne), ki potekajo v objektih, ki so umeščeni v prostor, ki je tudi naše okolje. Pri tem je prihajalo in še prihaja do degradacije, razvrednotenja našega okolja. Sporno umeščanje objektov se praviloma opravičuje z novimi delovnimi mesti in potrebo po razvoju. Z ozirom na posledice, nekatere se pokažejo mnogo kasneje, lahko ugotavljamo, da je bil razvoj pozitiven, vendar lahko tudi negativen. Prav tako je lahko vpliv razvoja na naše okolje pozitiven ali negativen. Posebej se bojimo negativnega vpliva na zdravje. Tega bi se morala bati tudi politika, odločevalci, tako lokalni kot državni, saj bolezni dvigajo stroške, tako za državo kot za podjetja pa tudi za zaposlene.

Ker je skoraj vse naše življenje urejano s predpisi, je zaradi negativnih primerov prišlo tudi na tem področju do varovalk, ki bi naj preprečile ali čimbolj zmanjšale negativne vplive na okolje in zdravje ljudi.

Izjemno koristno je najprej prebrati pouk iz preteklosti, da bi znali bolj modro ravnati v prihodnosti in tako poučili tudi našo mladino, kaj se lahko zgodi, če ignoriramo znanost in znanje in tveganje prevzemajo tisti (pri nas poslanci, vlada, župani in občinski svetniki, politične stranke), ki za negativne posledice svojih odločitev nikoli ne odgovarjajo.

Vsak odločevalec bi moral knjigo o tem prebrati kot obvezno berilo, podobno, kot tudi učenci in dijaki ter študenti v šolah. Naslov (2001) je: "Pozne lekcije iz zgodnjih svaril: previdnostno načelo 1896 – 2000 " [1].

Samo en primer, ki je še vedno aktualen pri nas – azbest. Koristno tudi za dandanašnje inšpekcijske službe. Beremo: " Leta 1898 je Lucy Deane, britanska inšpektorica za tovarne, ugotovila: *Škodljivi učinki azbestnega prahu so sprožili tudi preiskave mineralnega prahu z mikroskopom, ki jih je opravil kraljevi zdravstveni inšpektor. Jasno se je pokazalo, da so delci ostri in nazobčani kot steklo – če so bile ustvarjene razmere, da so se dvignili od tal in lebdeli v zraku, je bil njihov vpliv tako škodljiv, kot je bilo pričakovati".*

In naprej: " Sto let pozneje, leta 1998, se je britanska vlada odločila prepovedati uporabo '*belega* ' azbesta, to odločitev pa je naslednje leto sprejela tudi Evropska unija. V Veliki Britaniji dandanes zaradi azbesta umre 3.000 ljudi na leto, v Zahodni Evropi pa se v prihodnjih petintridesetih letih pričakuje kakih 250.000 do 400.000 primerov raka, katerega vzrok je izpostavljenost azbestu v preteklosti. Naš "*modri* " azbest je še bolj nevaren. Z njim so delali v Salonitu, Anhovo (danes Kanal ob Soči).

Kot zanimivost, v tej študiji najdemo tudi primer " norih" krav.

Ena od varovalk je v Ustavi Republike Slovenije, ki pa jo politika vedno manj spoštuje: " *72.člen (zdravo življenjsko okolje)*: *Vsakdo ima v skladu z zakonom pravico do zdravega življenjskega okolja. Država skrbi za zdravo življenjsko okolje. V ta namen zakon določa pogoje in načine za opravljanje gospodarskih in drugih dejavnosti "* [2].

Alarmantno je, da so poslanci in stranke v zadnjih dveh letih skoraj izločili prebivalce od uveljavljanja 72.člena Ustave RS. Primer je Gradbeni zakon, ki okoljsko mnenje postavlja kot neobvezno, prevladalo je prepričanje, da so okoljska vprašanja samo administrativna ovira za investitorje. Nižje še nismo bili, saj so v negativnem smislu " *popravili* " tudi Zakon o varstvu okolja: 51.a člen: predhodno mnenje, kjer je javnost izključena, tiče se pa izdelave ali ne izdelave presoje vplivov na okolje in pridobitve okoljevarstvenega soglasja, kar se že zlorablja ter še avtomatično podaljšanje OVD po desetih letih za nedoločen čas, spet brez prisotnosti javnosti.

Računamo, da bi DS pozval DZ, da te člene odpravi.

Druga varovalka je Aarhuška konvencija [3] iz leta 1998 z dovolj povednim naslovom: "Konvencija o dostopu do informacij, udeležbi javnosti pri odločanju in dostopu do pravnega varstva v okoljskih zadevah.'', ki pa je od politike ignorirana, kar je razvidno iz prejšnjega besedila in društva, ki se pritožijo, torej uporabijo pravna sredstva, so kritizirana od strani poslancev in vlade, češ, kaj se pa grejo, da ovirajo razvoj. Seveda, ne glede na to, če je ta spoznan za negativnega s strani javnosti.

Pri tem je treba povedati še to, da ima javnost zelo majhne ali nikakršne možnosti za uporabo dragega pravnega varstva, kot tudi, da bi lahko naročila znanstvene in strokovne študije v določenih primerih, saj take možnosti predvideva tudi Aarhuška konvencija, s ciljem izdelave strokovnih alternativnih rešitev določenega problema.

Javnost ima na razpolago tudi znanstveno literaturo in v svojih vrstah tudi znanstvenike in strokovnjake za določena področja. Vendar skoraj vsi sodelujejo s tako imenovano civilno družbo prostovoljno, medtem, ko so državne institucije dobro plačane.

Naj omenimo eno od vodil razvoja, kakršnega bomo morali vedno bolj prevzemati, to je *"sonaravni razvoj* ". Podlago najdemo v univerzitetnem učbeniku prof. dr. Dušana Pluta: "*Geografija sonaravnega razvoja "* (2010) [4].

Kakorkoli, računamo na Državni svet, da pokrene postopke za uveljavljanje pravice do zdravega okolja in popolne uveljavitve Aarhuške konvencije. Ne smemo pozabiti, da ima po Ustavi RS oblast ljudstvo, vendar politika napačno razume predstavniško demokracijo, češ, da ko so izvoljeni, nima ljudstvo več nič za soodločat. Uveljavitev soodločanja ljudstva, še posebej na področju okolja in povezanega zdravja je ključna za napredek naše družbe. V zadnjem času skušajo politične stranke zaobiti soodločanje ljudstva s sprejemom specialnih zakonov (Lex specialis), na primer za Magno.

Druga ključna aktivnost Državnega sveta na katero računamo je, uveljavitev odgovornosti na vseh ravneh odločanja, za odločitve pa tudi za opustitve, kot velja v Kazenskem zakoniku. Kar mora veljati tudi za politične stranke. Lahko se izdela analizo za nazaj, kdo je že kdaj v politiki odgovarjal za svoje odločitve. Ugovor, češ, da pride do sankcioniranja na volitvah ni argument, saj se v štirih letih ali celo manj naredi veliko nepopravljive škode (na primer prodaja dobrih podjetij in bank). Volitve tudi zato ne prinesejo sprememb, ker vodilne stranke vsakokrat privatizirajo državo in uveljavijo strankokracijo [5].

V nadaljevanju na kratko navajam nekaj primerov ignoriranja stroke in znanosti ter dokazov za nemoč javnosti.

2. PRIMERI NEODGOVORNEGA ODNOSA POLITIKE DO OKOLJA IN ZDRAVJA PREBIVALCEV, IGNORIRANJA ZNANOSTI IN STROKE TER PREDLAGANE REŠITVE

2.1 Celjska kotlina

Stanje: Zgodba o jari kači in steklem polžu, kot nekatere druge [6]. Odgovarja nihče. Ljudje nadpovprečno umirajo, večni župan se norca dela. Politika je neučinkovita, samo prelaga v bodočnost.

Ustanovi se Združenje civilnih iniciativ. Na pomoč pokličejo znanost in stroko. Inštitut za okolje in prostor (IOP) organizira I. konferenco o degradiranih območjih (2010) [7]. Največ o Celjski kotlini, zaradi strupene zapuščine stare Cinkarne v tleh, v zraku, v vodah, tudi podtalnici. Ali kot zapiše prof. dr. Franc Lobnik (Biotehnična fakulteta): " *Številne raziskave tal v Mestni občini Celje so pokazale, da je območje Celja močno onesnaženo z nekaterimi potencialno toksičnimi kovinami, predvsem kadmijem Cd, svincem Pb in cinkom Zn. "*. Izide Zbornik z analizami in rešitvami ter visokoletečimi obljubami nekaterih vidnih politikov.

Potem nič. Civilne iniciative opozarjajo, naročajo na svoje stroške dodatne analize, ki potrjujejo že dokazano, odkrivajo nove lokacije strupov. Občina gradi velike zgradbe na onesnaženi zemljini (Tehnopolis) ali dovoljuje gradnjo (Harvey Norman), z velikimi izkopi strupene zemljine, ki jo odvažajo neznano kam (nekaterim na občini gotovo znano) in, ki jo je znanost prepoznala za hudo nevaren odpadek.

IOP na vse to organizira II. konferenco (2013) [8], s poudarkom na Celjski kotlini. Znanost nastopi z dodatnimi podatki in rešitvami. Spet uvodne velike besede o reševanju, zdaj drugih politikov.

Vmes medijski članki, TV, ugotovijo še nevarno onesnaženo zemljino v več Celjskih vrtcih. Sanacijo obravnava tudi odbor SAZU in opozori na nujnost reševanja. Stranka SMC predlaga zakon o sanaciji Celjske kotline, a ga takratna ministrica za okolje in prostor (DeSUS) zavrne in v DZ ni sprejet.

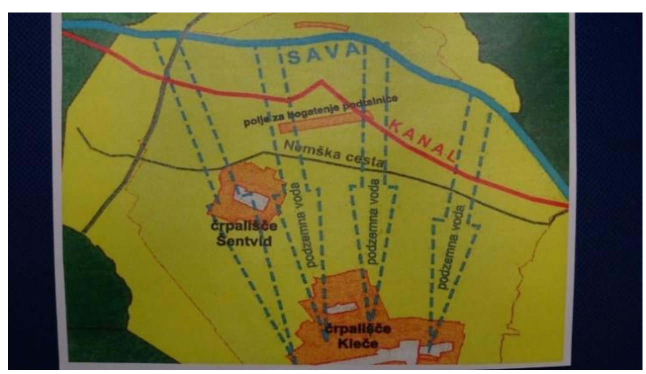
Spet smo na začetku, čas teče, ljudje umirajo za rakom nad slovenskim povprečjem.

Rešitev: Takojšen sprejem zakona o sanaciji Celjske kotline, s pospešenim reševanjem, ne tekom 15 let kot je bil prejšnji predlog. Sredstva obvezno iz Evrope.

2.2 Kanal C0 s fekalijami preko glavnega zbiralnika pitne vode za Ljubljano

Stanje: Kanal C0 je v izvajanju, a nad večjim delom zbiralnega polja ustavljen. Gradbeno dovoljenje ne vsebuje zasebnih parcel kmetovalcev in tako oni branijo svoje parcele in pitno vodo za vso Ljubljano. Investitorja sta Mestna občina Ljubljana in država, denar v večjem delu evropski. Organizirana je civilna iniciativa, zadeva je večkrat v medijih, oglaša se stroka, ki ugotavlja katastrofalno zastavljen projekt politike. Stroke ni bilo zraven. Niti se projekt ni obravnaval skozi okoljsko presojo v javnosti. Namerno so se izognili javnosti. Zavedli tudi evropske organe in banko.

Zdaj so posledice tu. Zadevo sta obravnavala tudi dva odbora državnega zbora in zahtevala revizijo projekta in postopka ter potrditev tega zbiralnika pitne vode izjemne kvalitete za kritično infrastrukturo po zakonu o kritični infrastrukturi. Viri pitne vode za mesta z več kot 100.000 prebivalci se morajo proglasiti za kritično infrastrukturo, saj je veliko število ljudi ogroženih v kriznih razmerah.



Slika 1: Rdeča črta pomeni traso načrtovanega kanala, rumeno ozadje pa zbiralno polje pitne vode. Črtkane puščice kažejo smer potovanja podtalnice od Save proti črpališčem. Celotno območje je nad potresno prelomnico, tako, da je puščanje dodatno zagotovljeno v naslednjih 30 letih. Morda že po petih letih ne bo na položaju nobenega od odgovornih, kanal bi pa ostal.

Narejena je bila potresna študija, s pripombo, da je pa analizo na strižne sile potrebno še narediti. Ta pa ni bila narejena.

Strokovno mnenje več strokovnjakov lahko preberemo v članku prof. dr. Mitje Rismala et al.: Povezovalni kanal C0 [9]. Javni interes zaščite vira odlične pitne vode brez kloriranja ni bil spoštovan. Obenem pa stroka ugotavlja, da je navezava Medvod in Vodic povsem nestrokovna in nepotrebna. Obe občini sta bili potegnjeni v projekt samo zato, da bi prišli do večjih evropskih sredstev. Dodaten škandal pa je, da javno podjetje, ki bi moralo ščititi pitno vodo, zagovarja tàko diverzijo na pitno vodo. Vpliv politike namesto znanosti in stroke je očiten.

Rešitev: Kanal bi lahko trasirali po Celovški cesti, da se izogne viru pitne vode. Če bi bil projekt v javni razpravi, bi alternativno rešitev že v začetku izbrali. Takemu postopku je namenjena Aarhuška konvencija. V resnici kanal v tem delu sploh ni potreben. Čiščenje komunalnih vod se praviloma izvaja lokalno. Lahko ga tudi opustimo.

2.3 Načrtovanje vetrnih elektrarn v Sloveniji

Stanje: Kaotično načrtovanje vetrnih elektrarn (VE) v Sloveniji je dejstvo. Tako je v majhni KS Senožeče načrtovano preko 60 vetrnih turbin, vsaka nazivne moči 3 MW (zelo redko dosežene) in višine stolpa preko 100 m. Cena posamezne VE (brez stroškov umeščanja) je preko 3,5 milijona evrov. Skupaj minimalno 210 mio evrov. Čemu? Z izkoristkom 15 do 20 %. Načrtovana vetrna polja (naziv za več VE) se imenujejo VE Senožeška brda (40 VE), VE Zajčica (9 VE) in VE Griško polje (12 VE) (Dolenja vas). Podatki o posameznih načrtih so dosegljivi na spletu. Po načrtih bi postavitev obkrožila več krajev, na vzpetinah, prebivalcem praktično nad glavo. Seveda bi vse postavljali v čisti naravi, ob tem, da je razvojna usmeritev teh krajev turizem in da se nahajajo v MAB (Man and Biosphere) območju UNESCO Škocjanskih jam, kar pomeni določeno zaščito narave, prebivalcev in trajnostni razvoj, ne pa industrijske cone v naravi, kar VE so.

Pri Dolenji vasi že stoji ena z 2,3 MW in 100 m višine. Druga 55 m visoka in z 1 MW nazivne moči pa v bližnjem Razdrtem ob avtocesti pod Nanosom.

Načrtov za VE je še več. Dravske elektrarne Maribor (DEM), ki že upravljajo hidroelektrarne na Dravi (OVE – obnovljiv vir energije) bi tudi postavljale VE v čisti naravi, na Košenjaku nad Dravogradom (VE Ojstrica). Od osmih prvotno načrtovanih jim je DOPPS (Društvo za opazovanje in preučevanje ptic Slovenije) popustil za tri. Toda za vsako bi morali izsekati gozd v velikosti 100 x 60 m (nogometno igrišče), popolnoma izravnati teren za postavitev dvigal izjemnih dimenzij, ki lahko dvignejo več deset ton težak generator na višino nad sto metrov. Da ne govorimo o izsekavanju gozda ob razširitvah gozdnih poti za tovore izjemnih dimenzij in teže ter za polaganje električnih kablov do transformatorskih postaj v dolini. Ta kratek opis je potreben, da se zavemo, kaj v bistvu počnemo, za nikakršen izplen, saj se na veter, kot kaotičen pojav res ne moremo zanesti in je vsaka elektrika najnižje kvalitete kot je lahko, z ozirom na stabilne (24/7) vire, ki so osnova napajanja omrežja.

Načrtov je še več po Sloveniji. A Slovenija ima tudi precej razpršene poselitve, tako, da vsaka postavitev pomeni velik škodljiv vpliv na okolje, naravo in prebivalce.

Omrežje se mora prilagajati porabi in uravnavati proizvodnjo po porabi vsak čas. Proizvodnja se prilagaja s pomočjo daljinsko upravljanih hidro elektrarn (HE in OVE), ki so najbolj prilagodljive. Kaotično vdiranje vetrne elektrike in zopet nenapovedana prekinitev, ker je vetra zmanjkalo, bi tako morali uravnavati s HE. Torej s cenejšo OVE. Smisel? TEŠ 6 ne bo zaradi VE spuščal nič manj CO2.

A poglejmo si, kako VE škodujejo zdravju prebivalcev. Vztrajno zanikanje industrije vetrnih elektrarn ni pomagalo, da se ne bi informacije o zdravju škodljivem hrupu VE prebile v svetovno javnost. Brez posebnih raziskav so na pojav opozorila zapuščanja domov, odselitve v kraje brez VE, saj prebivalci niso mogli več prenašati škodljivega vpliva hrupa VE: noči brez spanja, glavoboli, nezmožnost koncentracije in še več drugih vplivov, ki jih je znanost začela podrobneje proučevati. Rezultati so porazni za VE.

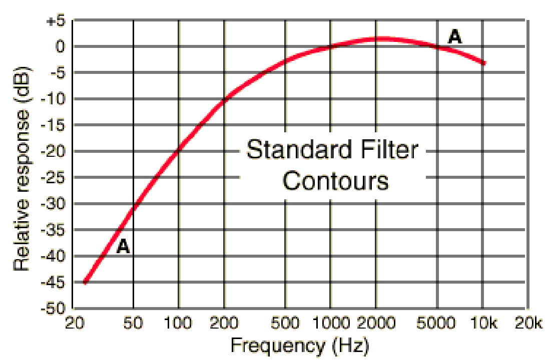
VE v obratovanju namreč oddajajo vibracije (zraka, delno tal) v področju infrazvoka (pod 20 Hz, neslišen) in nizkofrekvenčnega hrupa (pod 200 Hz). Posebno pred infrazvokom se ne moremo zaščititi v stanovanjih (šolah, uradih idr), prodira skozi zaprta okna (ima veliko valovno dolžino), dolg, še vedno škodljiv domet (več kilometrov) in v sobah lahko resonira, kar še ojača impulze. Čeprav je v naravi infrazvok prisoten (valovi, potresi, komunikacija velikih živali-slonov) pa gre tu za, značilen za VE, stalen pulzni pojav, kot bi kapljala voda na čelo.

Več o tem lahko izvemo na primer iz predavanj dr. fizike Mariane Alves-Pereira [10], ki se že 30 let ukvarja s tem področjem (ne le pri VE, tudi na letališčih, v večjih industrijskih obratih), ima več znanstvenih člankov v recenziranih revijah in, ki je bila na obisku v Ljubljani in Senožečah, povabljena s strani Civilne iniciative za zaščito Senožeških brd [11]. Podatke o teh vplivih pa zbirajo tudi po svetu, na primer [12], [13].

Dejansko so prebivalci v Sloveniji povsod, kjer se načrtujejo VE v brezpravnem položaju. Ko bi poklicali inšpekcijo zaradi škodljivega vpliva VE, bi ta lahko samo ugotovila, da nima pravne podlage za ukrepanje, na primer za ustavitev VE. To se je že zgodilo v Dolenji vasi, kjer stoji VE. O tem, kako jim tista VE škoduje, je bilo že več TV oddaj. Pa nič.

Namreč, nimamo predpisa o dovoljeni najmanjši razdalji od VE do meja parcele, na kateri je stanovanje, šola, prostori, kjer se zadržujejo ljudje. Po svetu se oblikuje mnenje, na osnovi meritev izven in v stanovanjih, da je minimalna razdalja 5 km, še posebej, če gre za vetrno polje z več VE.

Obenem nimamo predpisa o merjenju infrazvoka, še manj v pulznem razširjanju (kratek čas, visoka moč). V merjenju povprečja, kar je rutinska metoda, se pulzi prikrijejo. Niti za področje nizkofrekvenčnega hrupa VE nimamo predpisov. Za VE bi morali izdelati predpis, predno se postavijo, ne po tem. Zdaj je predpis le za merjenje hrupa v dBA. "A" filter odreže večji del nizkofrekvenčnega hrupa in infrazvoka. (glej tudi [10]).



Slika 2: Merjenje hrupa v dBA načinu odreže infrazvok, saj je ta filter prilagojen karakteristikam ušesa [14].

Se bodo morali prebivalci KS Senožeče po nekaj letih obratovanja teh VE polj izseliti? Ali politika sploh razmišlja dalj kot za 4 leta? Kdo bo za to odgovarjal? VE naj bi trajale 20 let. Znano je [10]), da ne gre samo za kratenje spanca in glavobole, ampak se z leti pojavi debelitev ožilja, slušnih organelov, genske spremembe, nosečnost (če pri živalih, mar tudi pri ljudeh?) in še marsikaj. Uveden je pojem vibroakustična bolezen VAD [15]. Rezultat je lahko infarkt, deformirani organi novorojencev itd.

Obstaja tudi že pravna praksa. Zaradi omenjenih škodljivih učinkov hrupa VE so morali na pritožbo prebivalcev po odločitvi portugalskega sodišča 4 VE odstraniti [16].

Nekateri omenjajo Nemčijo kot primer uvajanja VE pod geslom Energiewende (energetski preobrat). Prof. Mihalič (Fakulteta za elektrotehniko, Katedra za elektro sisteme) je dovolj poveden. Kot znanstvenik in strokovnjak svari pred zablodo [17] [18].

Rešitev: Prepoved postavljanja vetrnih elektrarn po Sloveniji in ukinitev subvencij zanje, zaradi česar se investitorji sploh odločajo za investicijo, ne zaradi manj CO2. Primer: eden od investitorjev (VE Zajčica) je Amicus d.o.o, podjetje za oglaševanje na velikih plakatnih mestih (jumbo ipd) ob avtocestah in drugod.

Politika je spet padla na izpitu iz tehnike in znanosti, čeprav ju ima na doseg. Politika mora začeti odgovarjati zaradi nestrokovnega pristopa in ignoriranja znanosti in tehnike.

3. DISKUSIJA

Iz izvajanj v uvodu in iz primerov je razvidno, kako slaba je politika na področju okolja pri nas in kako nujno je, da začneta znanost in stroka vstopati v odločanje o pomembnih vprašanjih našega pozitivnega razvoja pa tudi sanacije degradiranih območij. Seveda je nujno tudi upoštevati argumente javnosti, prebivalcev, s tem, da mora stroka dati dobre utemeljitev, razumljive vsakomur.

Preprečiti je potrebno vsakršno izogibanje politike in investitorjev okoljskim presojam in je potrebno zakonodajo ustrezno popraviti.

Izredno pomembna postaja vloga Državnega sveta pri teh "*popravilih*" zakonodaje. Prav tako DS bi moral tudi poskrbeti za izobraževanje svetnikov kakor tudi poslancev in vlade o okoljskih vprašanjih. Običajno se večina novih izvoljenih ali imenovanih funkcionarjev na okolje ne spozna in zato prinaša napačne odločitve, morda všečne kapitalu, na škodo slovenskega okolja, narave in prebivalcev.

Problematike je veliko, tu so odločitve o novi jedrski elektrarni, sežigalnicah, obstoječih obratih za sežig ali sosežig, zbiralnicah odpadkov, slabi požarni varnosti (Kemis in drugi veliki požari), degradirana področja, ohranjanje pitne vode in kmetijskih površin, pa tudi Nature 2000, gozdov.

Kritično je zanemarjanje stroke in znanosti pri oblikovanju projektov in strateških ter drugih odločitvah. Prav tako pa nihče ne ve, kaj je to trajnostni razvoj v Sloveniji. Smo butična dežela in se tujih praks ne da kar slepo prenašati k nam (na primer VE).

Z dobro voljo in pomočjo Državnega sveta se lahko sistematično lotimo razreševanja aktualne in strateških usmeritev slovenskega pozitivnega razvoja.

4. ZAHVALA

Zahvala vsem prostovoljcem kjerkoli so, društvom, civilnim iniciativam, pa tudi znanstvenikom in strokovnjakom, ki so neumorni v prizadevanju za uveljavitev dejanske demokracije in v skrbi za zdravo okolje, čisto pitno vodo in, ki svarijo pred negativnimi posledicami napačnih odločitev politike.

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PREDGOVOR

Pod okriljem multikonference »Informacijska družba« po letu premora zopet organiziramo tudi konferenco Robotika, s katero nadaljujemo tradicijo raziskovalne robotike v Sloveniji.

Robotika je v vzponu in čeprav jo mnogi še zmeraj dojemajo kot znanstveno fantastiko, je tudi uporabniška robotika že nekaj časa nekaj povsem realnega in oprijemljivega, kmalu pa bo tudi že nekaj običajnega. Robotika je tudi skorajda vseprisotna. Brez robotskih manipulatorjev si ne znamo več predstavljati sodobnih industrijskih procesov, ki pa se z razvojem znanosti tudi spreminjajo. Niso več nemi, neodzivni mehanizmi v kletkah temveč sodelavci, zaenkrat v industriji, kmalu pa že doma. Tako sodelovanje ima svoje varnostne zahteve, ki so postale pomemben del moderne robotike. Hkrati s razvojem robotike v industrijskih okoljih, se razvija tudi robotika povsod drugod. Ne presenečajo kirurški roboti ali servisni mobilni roboti, ki dostavljajo pakete in hrano ter čistijo in stražijo javno infrastrukturo. Domišljija in pa želje ljudi ne poznajo mej, zato se raziskovalna robotika trudi z razvojem velikih večnamenskih robotskih hišnih pomočnikov. Pri razvoju tako kompleksnih in avtonomnih sistemov, kar nekateri ocenjujejo, da je težje kot raketna znanost, je pomembna izmenjava idej in mnenj, kar je tudi namen konference Robotika.

V zborniku so zbrani prispevki raziskovalcev Odseka za avtomatiko, biokibernetiko in robotiko na Inštitutu Jožef Stefan, veseli pa smo, da imamo letos prispevke s svetovno priznanega in Instituta za robotika in mehatroniko z JOANNEUM Research Inštututa v Celovcu. Upamo, da bo izmenjava idej in raziskovalnih rezultatov vodila v nadaljnje skupne podvige, ki bodo še naprej pomagali soustvarjati trende raziskovalne robotike.

Andrej Gams in Aleš Ude

FOREWORD

Robotics conference in the scope of the Information Society is continuing its biannual tradition, is again a part of the multiconference, and continues the rich tradition of research robotics in Slovenia.

Robotics is on the rise and even though many people still perceive it as science fiction, even consumer robotics has passed from the realm of fiction to something real, tangible. Robotics is also omnipresent. Many industrial processes today simply cannot be conceived without the use of robotic manipulators. However, with advances of science, industrial processes and the role of robots are also changing. Robots are not anymore mute, unresponsive mechanisms in cages, but coworkers. Thus far in the industry, but sooner rather than later, they will take this role in our homes as well. Such collaborative robotics brings about also its own demands for safety, which are becoming an important topic of modern robotics. Together with the change of robotic role in industrial processes, robotics is changing everywhere. The use of surgical and mobile service robots, which deliver packages and food and clean and guard public infrastructure is not a surprise anymore. As human imagination and wishes do not know any borders, research robotics is working hard towards the development of multipurpose, autonomous, robotic household assistants. The development of such systems, which some consider more complex than rocket science, requires cooperation between researchers and the exchange of ideas and opinions. Exchange of ideas and opinions is also the main aim and goal of the Robotics conference in the scope of the Information Society multiconference.

The conference proceedings contain papers from researchers of the Department for Automatics, Biocybernetics and Robotics of Jožef Stefan Institute. We are delighted to have attracted contributions from researchers of the world-renowned Institute for Robotics and Mechatronics from JOANNEUM Research, Klagenfurt, Austria. We hope that the exchange of ideas will lead to joint undertakings and will help to co-shape the trends of research robotics in the future.

Andrej Gams and Aleš Ude

PROGRAMSKI ODBOR / PROGRAMME COMMITTEE

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Autonomous learning of assembly policy

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ABSTRACT

In the paper, we propose to learn an assembly task from the corresponding disassembly. Autonomous learning of disassembly can be easier than learning of the corresponding assembly task, because the admissible set of motions during disassembly is initially fully constrained by the environment. During the disassembly the robot exploits its compliance in order to detect admissible motions and takes appropriate decisions when multiple options exist. Learning of the disassembly was realized using hierarchical reinforcement learning. The disassembly policy is then used to derive the corresponding assembly policy. The proposed approach was experimentally validated on the case of light-bulb assembly.

KEYWORDS

reinforcement learning, robot learning, autonomous assembly

1 INTRODUCTION

Developing robust assembly skills is one of the main challenges in contemporary robotics. Assembly skills are needed not only in production plants, but will also be important for the future generation of home and service robots. For fast deployment of such tasks, new user-friendly tools for programming robot operations are needed. Ideally, a robot would be able to derive assembly policy autonomously.

Autonomous policy learning, is usually accomplished by utilizing reinforcement learning. Starting from an existing parameterized policy, a robot tries to adapt to a new situation by randomly changing task parameters and find out how to modify the policy to maximize the reward function [9, 12]. However, the main challenge is huge search space which characterizes an assembly policy. For that reason, there were very few successful attempts of completely autonomous learning of assembly tasks in robotics [4, 7]. Existing techniques for reducing the search space of reinforcement learning usually assume prior information about process, either in an explicit form or inherited from previous experiments and therefore still rely on skilled robot operators that guide the robot through the learning process [5].

In our previous research, we proposed an alternative approach to autonomous policy learning, which unifies compliant motion control and reinforcement learning. Tasks that involve interaction with the environment are traditionally considered as extremely hard to learn due to the unknown and possibly changing environment. On the other hand, interacting with the environment can be advantageous to accelerate the learning process. Namely, if appropriately addressed, learning of physically constrained tasks is more efficient than the learning of tasks, where a robot can move completely freely in space. The reason is that the environment limits the admissible movement directions. Consequently, the number of parameters that need to be learned can be greatly reduced. To implement this type of learning, we need to make use of the natural robot motion along with the constraints imposed by the environment. Compliant robot control provides a suitable framework for implementing such a strategy. This concept has been already successfully applied to the learning of tasks such as autonomous learning for doors and drawers opening [8].

In this paper, we present how the above-described methodology can be extended to autonomous learning of assembly operations. The main idea is that robot first learns the reverse action – disassembly of an object. In an assembled object, the set of possible motions is constrained, and typically only a single motion or operation is possible. During the disassembly, the motion becomes less and less constrained until the part is completely disassembled and the environment no more constrains motion of individual parts. The situation is opposite during the assembly. The initially virtually unlimited set of possible motions becomes more and more constrained as the assembly process advances. Given no previous knowledge about the task, learning of disassembly is therefore more straightforward than learning of the assembly task. Imagine generic peg-in-hole task: by removing a peg from a hole, we also learn the exact pose of the hole, whereas we would first have to guess where the hole is if we are to insert the peg into the hole without any prior knowledge.

Similarly, we transfer the knowledge obtained during disassembly to the corresponding assembly process. We assume that the initial assembly policy can be obtained by reverse execution of the learned disassembly policy. This is possible because in most cases assembly and disassembly are mutually reversible operations. Common assembly tasks such as putting/placing, peg-in-hole, or screwing are directly reversible [6]. Tasks that result in structural deformations or require external equipment (e.g. riveting pistol and rivets) are not directly reversible, but can be omitted for the purposes of disassembly learning and manually added to the final assembly policy.

This paper is structured as follows. We first introduce our algorithm for hierarchical reinforcement learning on the example of maze learning in Section 2. Then we present the underlying intelligent controller in Section 3. In section 4, we present our methodology to learn assembly policy from disassembly policy, along with experiential verification of the proposed framework in Section 5. We conclude with a short summary.

IS2019, October 7–11, 2019, Ljubljana, Slovenia, Europe

2 HIERARCHICAL REINFORCEMENT LEARNING

In the reinforcement learning (RL) literature, maze learning has been traditionally used as a benchmark for validating learning algorithms. Maze learning also bears a lot of similarities with disassembly process, where the robot should come from an initially fully contained state into the final unconstrained state. Within a maze, the agent mostly follows the corridors and only has to take decisions in the crossings.

Traditional approaches rely on discrete state-space with predefined set of actions as illustrated in Figure 1.

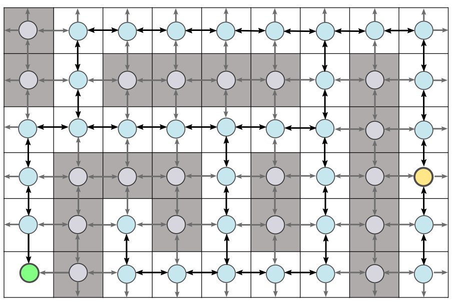

Figure 1: An example of maze with 9×11 cells. White cells represent corridors where the agent can move, whereas gray cells are walls. The state space for maze learning is represented with a graph. In each state (represented as node), the agent can choose from a fixed set of possible actions (represented with edges): relative left, right, up and down movement. The agent starts in the yellow node and should learn to exit maze (arrive at green node).

In contemporary robotics we need continuous policies. Within the traditional RL framework, an approximation of continuous policy can be achieved by increasing the number of states and actions, which substantively deceases the performance of the learning.

Considering the example in Figure 1, we can notice that in the discretization of the maze many of the states are redundant and the robot can not access them (wall cells). Following the corridor, the agent eventually arrives either at a crossing, in a dead-end or to the target. This suggests, that also the states between two crossings and between a crossing and a dead-end or the target can be left out.

Therefore, we propose to dynamically assign states rather than allocate them in advance. A suitable framework to achieve this is hierarchical reinforcement learning, where we combine RL with control algorithm as shown in Figure 2.

The upper hierarchical level is classical RL algorithm, where the states are discovered online by the lower hierarchical level. The later consists of an intelligent compliant controller, which autonomously moves within the environment constraints and detects where multiple movement options exist. The states for the upper level are only assigned when multiple options are possible.There are two main benefits of using such approach:

- The generated policies are inherently continuous.
- The number of states is greatly reduced.

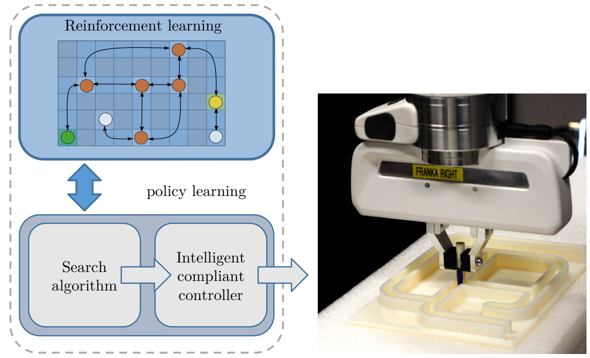

Figure 2: Block scheme of the proposed hierarchical policy learning algorithm. The upper level is RL of the policy, where the states and actions are represented with a directed graph. The lower level is an intelligent controller, consisting of a search algorithm and a Cartesian impedance controller.

The states and actions of hierarchical RL can be also represented with nodes and edges, respectively, of a directed graph as shown in the upper blue box in Figure 2.

3 INTELLIGENT COMPLIANT CONTROLLER

The lower level of the hierarchical learning utilizes a compliant control framework. As the robot moves along the boundaries, the controller searches for possible alternative movement directions.

In general, the physical constraints of the system are not known in advance. To find a feasible initial motion direction, the controller keeps applying force in random directions until this results in a movement. We then use operational space compliant controller to continue the motion in the initiated direction. The control parameters make the robot more compliant in directions orthogonal to the movement direction.

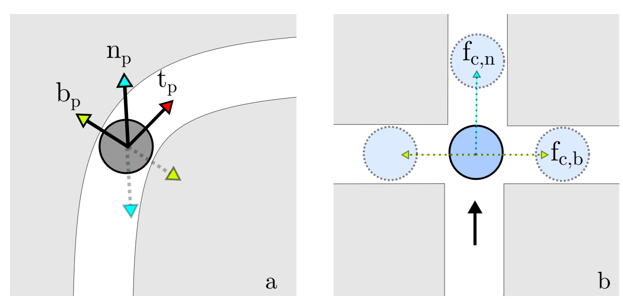

Figure 3: Searching path and possible states in restricted environment. The left part (a) shows Frenet-Serret frame attached to the end effector in the labyrinth. The right part (b) shows an instance, when the controller discovers a new state for reinforcement learning. Both parts show how search forces are applied in the normal and binormal direction.

We specify these directions using Frenet-Serret frames along the resulting motion trajectory [10] as illustrated in Figure 3 a. The Frenet-Serret frame can be expressed $\mathbf{R}_p = \begin{bmatrix} \boldsymbol{t}_p & \boldsymbol{n}_p & \boldsymbol{b}_p \end{bmatrix}$ with

- the unit vector $\boldsymbol{t}_p = \frac{\dot{\boldsymbol{p}}}{\|\dot{\boldsymbol{p}}\|}$ tangent to the curve, pointing in the direction of motion,
- the normal unit vector $\boldsymbol{n}_p = \frac{\dot{\boldsymbol{p}} \times \ddot{\boldsymbol{p}}}{\|\dot{\boldsymbol{p}} \times \ddot{\boldsymbol{p}}\|} \times \boldsymbol{t}_p$, and
- the binormal unit vector $\boldsymbol{b}_p = \boldsymbol{n}_p \times \boldsymbol{t}_p$

where $\boldsymbol{p} \in \mathbb{R}^3$ are the measured positions of the robot end-effector.

In order to follow environmental constraints, we exploit robot's compliance. We modified a passivity-based variant of impedance control for manipulators with flexible joints [2] by allowing to set the compliance along the operational space trajectory expressed using Frenet-Serret frame rather than global frame. The task command input $\ddot{\mathcal{X}}_c = \left[\ddot{\boldsymbol{p}}_c^{\mathrm{T}}, \dot{\boldsymbol{\omega}}_c^{\mathrm{T}}\right]^{\mathrm{T}}$ is then given by:

$$\ddot{\boldsymbol{p}}_c = -\mathbf{R}_p \mathbf{D}_p \mathbf{R}_p^{\mathrm{T}} \dot{\boldsymbol{p}} + \mathbf{R}_p \mathbf{K}_p \mathbf{R}_p^{\mathrm{T}} \boldsymbol{e}_p, \tag{1}$$

$$\dot{\boldsymbol{\omega}}_c = -\mathbf{R}_o \mathbf{D}_o \mathbf{R}_o^{\mathrm{T}} \boldsymbol{\omega} + \mathbf{R}_o \mathbf{K}_o \mathbf{R}_o^{\mathrm{T}} \boldsymbol{e}_q, \tag{2}$$

where e_p and $\boldsymbol{e}_o$ are position and orientation tracking errors; $\mathbf{K}_p$ and $\mathbf{K}_o \in \mathbb{R}^{3\times 3}$ are the diagonal matrices, which define the positional and rotational stiffness in the Frenet-Serret and global frames, respectively. Likewise, $\mathbf{D}_p$ and $\mathbf{D}_o \in \mathbb{R}^{3\times 3}$ are diagonal damping matrices, which are set to $\mathbf{D} = 2\sqrt{\mathbf{K}}$ for critically damped system. For other parameters, please see [1].

By applying high positional gain in the direction of movement and low gains in the orthogonal direction, the robot can autonomously move along the environmental boundaries. However, following the constraints alone can not discover new states for the upper RL level. For this, small test forces are applied in the positive and negative directions of the normal and bi-normal (see Figure 3). All test forces are applied in each test position, which are placed in short intervals along the entire trajectory. If the robot moves above some predefined positional displacement threshold as a result of applying this forces in multiple directions in the same test position, the controller has found a new state (see Figure 3 b). In the new state each action corresponds to applying the specific force, which results in a movement in one of the admissible directions. The controller waits for the decision of RL algorithm, which action to take.

We assume that motion can be stopped only due to the task constraints. If the motion is interrupted, the controller searches for a new feasible motion by applying a random force in a random direction in the same manner as at the beginning. Following this strategy, the robot eventually generates a continuous policy.

4 ASSEMBLY LEARNING BY DISASSEMBLY

We can apply the same algorithm as for maze learning to disassembly operations. Key stages of disassembly and their analogies in the graph representation and hierarchical reinforcement learning are summarized in the Table 1.

A positive reward is given only when the robot has disassembled the object, i.e the target state. Negative reward is assigned when the robot arrived in a state where the motion could not be continued.

When the robot explores state s_k, the action-value function $Q(s_k, a_k)$ is updated according to the SARSA algorithm [11]:

$$Q(s_k, a_k) \leftarrow Q(s_k, a_k) + \alpha(r_k + \gamma Q(s_{k+1}, a_{k+1}) - Q(s_k, a_k)), \tag{3}$$

where s_k is the label of the k-th state, a_k is the label of the action taken in s_k, r_k is the reward obtained in state s_k, $0 < \alpha < 1$ is the learning gain and $0 < \gamma < 1$ is the discount factor, which gives recent rewards higher importance. The optimal policy can be obtained by applying ϵ-greedy strategy in the form

$$\pi(s) = \begin{cases} \arg\max\limits_a \; Q(s,a), & \text{with probability } 1-\epsilon, \\ \text{random action}, & \text{with probability } \epsilon, \end{cases} \tag{4}$$

where parameter ϵ is the ratio between the exploration and exploitation [12].

Using the hierarchical reinforcement learning, the robot not only learns the disassembly policy, but identifies all crucial stages for the corresponding assembly process.

We assume that assembly and disassembly are mutually reversible operations, therefore we obtain initial assembly policy by merely reversing the disassembly policy. However, even if the operation is reversible small deviations in part geometry, grasping, material, etc. can result in failure. To account for this, we have to apply appropriate control together with the exception strategies, which mimic human behavior during the assembly.

We set high gains in all spatial directions until the parts to be assembled are in contact. This assures precise path tracking during the approach motion in assembly. When the parts are in contact, we use the same compliance settings as during disassembly.

During the assembly, we measure contact forces and torques and compare them with the measured forces and torques during disassembly. Note that the forces/torques during assembly have the opposite sign in relation to those measured at disassembly. If the values are still notably different, we slow down the motion and if the forces/torques are still increasing, we carry out a trajectory in the

Table 1: Key stages of disassembly and their analogies in hierarchical reinforcement learning and graph representation

Observation	Lower level	Upper level	Graph
Fully assembled product.	Controller tries to move in different directions and thereby determines admissible directions.	Start state	Yellow node
Partially disassembled product.	Controller follows the environmental constraints and moves in the only admissible direction.	Action	Edge
Multiple options to continue disassembly.	Controller tries to move in different directions and thereby determines admissible directions.	State	Orange node
Disassembly cannot be continued in the same direction.	Goes in reverse direction.	Penalty state	White node
Fully disassembled product.	Controller can freely move.	Target state	Green node

opposite direction for some time and then try again, as suggested in [6].

For improving the obtained policies many different methods exists. We apply iterative learning control, which has proven useful for on-line adaptation of force profiles in manipulation tasks [1].

5 EXPERIMENTAL VERIFICATION

We experimentally verified the proposed disassembly learning on a Franka Emika Panda robot. The control algorithm was implemented as a ros_control plugin in C++ using libfranka[3], while the learning algorithm was implemented in Matlab as a ROS node.

We verified the proposed approach using a R5W car bulb and corresponding plastic casing, used to fix the bulb above the registration plates. The R5W bulb is mounted into the plastic casing using bayonet mechanism as shown in Figure 4.

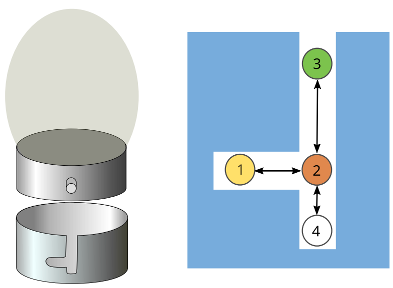

Figure 4: On the left illustration of a bayonet bulb with the corresponding casing is shown. Bayonet mechanism consist of radial pins, and a matching slot and spring to keep the two parts locked together. On the right, a projection of the slot in the casing to the plane is shown along with states than can be discovered by the controller. In disassembly task in order to release the lock, the robot first has to rotate the bulb across the horizontal part of the slot and then the pin slides into the vertical part of the slot. By lifting it upwards, the robot eventually learns to remove the bulb.

This example shows why disassembly can be easier than the assembly. In disassembly, the robot starts in state 1, and the only decision it has to make is in the state 2 to arrive in the state 3. In assembly, however, it has first to learn the proper pose of the state 3 and then search for the state 2.

The robot learns to remove the bulb from the casing as shown in Figure 5.

Applying the procedure described in Section 4, the robot successfully learns the assembly operation - bulb insertion.

6 CONCLUSIONS

Physical constrains can be used to structure and reduce search space for reinforcement learning. During the disassembly the motion of object parts is more constrained. As a consequence, learning of disassembly can be easier than learning of assembly.

Hierarchical reinforcement learning, consisting of high level decision making and intelligent compliant controller, has proven to be an efficient framework for learning in the constrained environments, such as disassembly processes. The controller exploits its

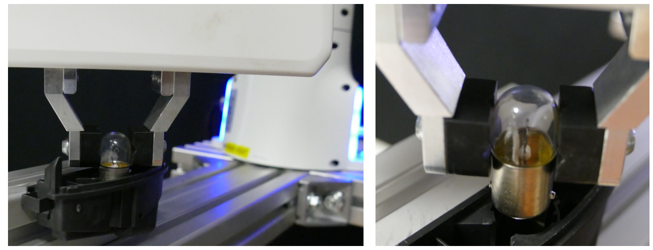

Figure 5: On the left the bulb is mounted in the casing. On the right the bulb is removed from the casing revealing its two radial pins.

compliance in order to detect admissible motions. When motion in multiple directions is possible, decisions are taken at the upper hierarchical level.

The proposed approach was experimentally validated on the case of light-bulb insertion. During the disassembly (bulb removal from the casing), all crucial stages for the corresponding assembly process (bulb insertion) can be learned autonomously and simplify the assembly learning.

Our future research will focus on evaluation of the proposed method for objects, composed of multiple parts.

ACKNOWLEDGMENTS

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Grasp Detection for Human-to-Robot Object Handover

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ABSTRACT

This project presents an attempt to apply current state-of-the-art methods for grasp pose estimation to human-to-robot handover scenarios. The implemented method shall enable a robotic mobile manipulator to perform antipodal grasps on previously unknown objects presented by a human collaborator.

1. INTRODUCTION

Grasping is to be considered one of the fundamental object manipulation tasks a robot has to perform. In a **human-robot collaboration** scenario with a human giver handing over an object to a robot receiver the perception task is to determine the desired object transfer point and a corresponding grasp pose. This has proven to be challenging especially when facing unknown objects in unstructured environments. Driven by applications in fields such as warehouse automation or flexible manufacturing, recent advances in object agnostic robotic bin picking, mainly inspired by vision-based deep learning techniques, suggest that currently proposed methods are increasingly capable of solving these **grasp synthesis** tasks.

Mahler et al. [1] trained a neural network, dubbed grasp quality CNN (GQ-CNN), to learn the evaluation of a grasp success probability. The model is trained on the Dexnet-2.0 dataset; an extensive collection of synthesized RGB-D images annotated with corresponding grasp configurations. By iteratively ranking and resampling grasp candidates this method has shown to yield good proposals for unknown real world objects. Morrison et al. [2] propose a fully convolutional generative grasp CNN (GG-CNN) estimating individual maps for grasp quality, gripper angle and gripper width from a given 2 image. The resulting best grasp is determined by choosing the gripper configuration corresponding to the highest success probability encountered in the grasp quality map.

2. METHOD

Our method builds on the idea of estimating grasp configuration maps as in GG-CNN and extends the approach by adding a semantic segmentation layer to enforce scene understanding. This acts as guidance to focus on the region of interest for the object handover task and avoid estimating grasps that would collide with the hand of the human collaborator. The proposed fully convolutional neural network architecture is based on a U-Net inspired structure featuring encoder and decoder each comprised of four residual network blocks connected by an atrous spatial pyramid pooling layer to foster scale invariance. At the input stage, the network is fed a depth map acquired by an RGB-D sensor. The multi-headed output consists of a pixelwise semantic segmentation classifying as background, hand or object, a grasp center point quality map, a grasp angle map and a gripper opening width map. To obtain training data we extend the pipeline of DexNet 2.0 by combining it with the hand pose estimation data synthesis approach of Riegler et al. [3]. This enables us to render depth images and segmentation masks and to annotate corresponding grasp rectangles as introduced by Jiang et al.[4] for scenes in which a human presents an object to hand over in various poses and viewpoints.

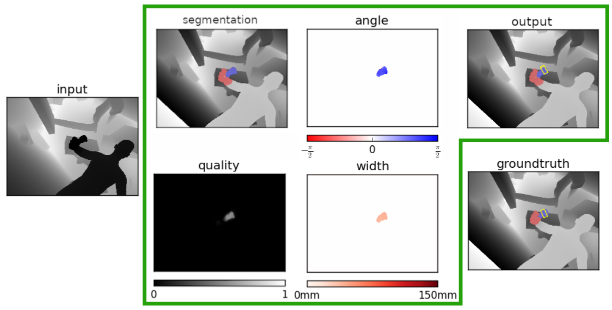

Figure 1: Left: input depth image. Green box: intermediate segmentation and grasp maps, resulting output estimated grasp configuration. Bottom-right: ground truth segmentation and grasp configuration

We are currently constructing a data acquisition pipeline to capture real world ground truth using RGB-D sensors, to bridge the sim-to-real gap due to noisy sensors by fine-tuning the trained model on such data.

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Autonomous adaptation to changes in production demands with a reconfigurable robot workcell

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ABSTRACT

Current challenges in automation represent automating low-batch production processes where changes in the production parameters happen frequently. These type of production are often happening in Small and Medium-sized Enterprises, which have many time been dismissed as potential end user of automation technologies. This was mainly due to the high costs of setup, both in terms of the costs of the equipment and time required to set it up. In this paper we present a new type of reconfigurable robot workcell for fast set-up of automated assembly processes for SMEs. By developing passive reconfigurable elements and integrating intuitive programming by demonstration methodologies we were able to reduce the costs and set-up times for the automation of few-of-a-kind manufacturing processes without losing the flexibility of the system to cope with changes in market demands.

KEYWORDS

robotics, reconfigurability, ROS, assembly

1 INTRODUCTION

The trend of incorporation robots into manufacturing processes is on the rise. While high cost of process automation does not represent a significant challenge for large enterprises, *Smaller and Medium-sized Enterprises* (SME) might not undertake such an investments. Beside the price of the robots and the necessary accompanying hardware for automation, the cost of the time spend on the integration of robotic systems can also be high. Another hurdle for automatization of processes in SMEs is the need for quick adaptation to ever changing market demands.The paradigm of Reconfigurable Manufacturing Systems (RMS) [6] addresses the efficient and quick adaptation of the production process. Although a RMS can have a more complex design and achieve a lower throughput as classic automation approaches, they proved to be more applicable in processes with the need for often changes [10]. But in order to make RMS affordable for SMEs , a high investments cost of incorporating them in the manufacturing process needs to be avoided [3].

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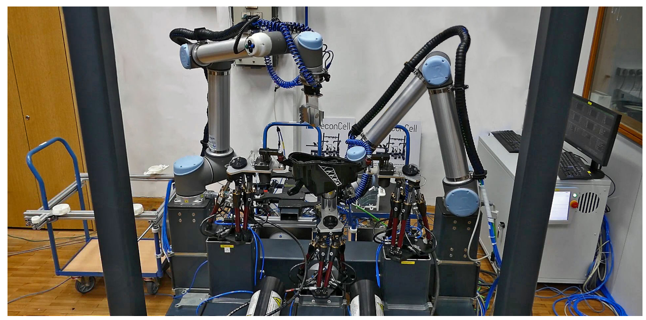

Figure 1: The proposed reconfigurable robot workcell executing an example assembly process.

The goal of the presented system is to offer a reconfigurable robot workcell in line with the RMS paradigm. The workcell must be appropriate for SMEs, where low-volume high-diversity production often takes place. The proposed systems combines a reconfigurable ROS-based software architecture and novel hardware elements that offer cost efficient solutions to reconfigurability. In addition, programming by demonstration methods for teaching of robots assembly skills are included in order to reduce the setup time.

While novel approaches in hardware design for reconfigurable robot workcells are presented in section 2, section 3 describes the software architecture of the cell. Section 4 presents technologies for fast set-up times and intuitive robot programming. Concluding remarks and implementation results are given in the last section.

2 RECONFIGURABLE HARDWARE

While designing the reconfigurable robot workcell in line with the RMS paradigm several aspects need to be taken into consideration: the desired physical properties (size, stiffness, robot workspace, etc.); available factory space; the integration of the workcell into the establish production process without too many significant changes; and the ability of the cell to quickly adapt to changing demands in the process. To ensure the workcell's ability for reconfiguration and adaptation in an affordable way, we introduced several passive reconfigurable hardware component as an alternative to off-the-shelf solutions.

The **reconfigurable frame** of the workcell connects the robot to peripheral modules. Several requirement need to be taken into account while designing the frame. While the cell's stiffness is paramount, as even small frame deformations can result in large positioning errors, the structure must be easily adaptable to ensure the needed reconfiguration. The affordability of such a solution should also be taken into account. To ensure the stiffness of the frame structure can be comparable with welded joints and at the same time enable simple assembly and modifications, rectangular steel beams in combination BoxJoint connectors [7] were selected.

Reconfigurable robot tools were also introduced. A mounted a tool exchange system at the robot's end effector enables a vast array of assembly operations by un/equipping tools needed for various steps in the process. Besides ensuring a stiff coupling between the robot and the tool, the exchange systems provides electrical power, Ethernet connectivity, and pressurised air to the tool.

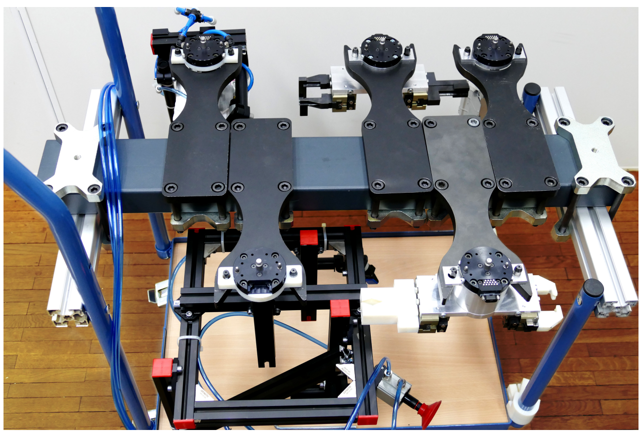

Figure 2: Various robot tools mounted on a rack. The robot can attach the one needed for the current task.

Special "**Plug & Produce**" (PnP) connectors were developed to ensure the connectivity to peripheral modules. These peripheral modules are crucial in a reconfigurable environment, as they enhance the cell with various functionalities. Used modules can include various fixtures, material flow management, tool storage, etc. These modules need to be introduced or removed from the workcell as quick as possible with as little disturbance to the process as possible. The design of the PnP connectors provides a highly repeatable, stiff, and quick mechanical coupling of the modules to the cell. Beside a mechanical coupling, connectors enable the transfer of data, pressurised air, and electrical power. This enables the peripheral modules to be self sufficient and connect to the overall structure of the cell as quickly as possible. While PnP connectors allow us to introduce new modules into the workcell such modules often need to be introduced manually, and can not be regarded as fully autonomous.

A concept of **passive reconfigurable elements** introduces needed reconfiguration into the cell, while reducing the cost of the elements. In contrast to standard off-the-shelf solutions, which often include active components, these passive reconfigurable elements do not contain any actuators or sensing equipment. By removing these components the price tag is lowered. To compensate for the missing sensors and actuators in these passive elements, robot is used in the reconfiguration step. A number of passive hardware components were used in various assembly operations. One example of a passive reconfigurable element is a passive rotary table (depicted in Fig. 3). By rotating the table, the workpiece on the table is oriented in the desired way. This is achieved by releasing the table's brakes, re-orienting it by the robot arm, and engaging the brakes as the desired orientation is reached. The last orientation of the table is stored by storing the robot's position.

3 RECONFIGURABLE SOFTWARE

Providing connectivity with respect to the data flow is another paramount issue for a proper workcell. Peripheral modules should be connected to the workcell and between each other, in order to receive and broadcast data and instructions. The data should be parsable by all software components within the system. To ensure the software modularity and connectivity, the proposed software architecture is ROS-based. The software system architecture of the workcell is depicted in Figure 5.

A **robot workcell ROS backbone** was implemented to ensure the needed connectivity. Just the data flow between all the modules is not enough to achieve the desired modularity of the system. The data should be structured in a way that is parsable by all the modules in the workcell. The suitable framework is offered by the Robot Operating System (ROS) [8], which enables the development of software components that need to share data over the common network. In addition it allows monitoring and controlling the complete workcell.

ROS-based modules ensure that they are all connected within the workcell through the ROS network. All modules are equipped with the computational hardware that enables running ROS *nodes*. This means each module's data and functionalities are available through the workcell ROS network. They are denoted as Micro computer in Fig. 5. A top-level task scheduling software can controll all modules as soon as they are plugged into the cell. They are connected to the cell using the described hardware components (PnP connectors or tool exchange systems).

Low level real-time robot control is another crucial part of the proposed reconfigurable workcell. To follow the previously described paradigms of seamless integration of all the hardware components in the workcell, robots should be treated as a ROS enabled module. While industrial robots are equipped with a control box that provides real-time control, most of them do not offer support for running ROS nodes and in turn are not able to communicate over the ROS network. A special communication layer that connects the robot module to the rest of the ROS network was implemented. In order to not make the workcell robot-specific an abstraction layer that supports different types of robots was introduced. It enable programming of new strategies through a suitable control interface and various trajectory and feedback control strategies. Again, independently of the selected robot. This abstarct layer enchances the overall modularity of the cell.

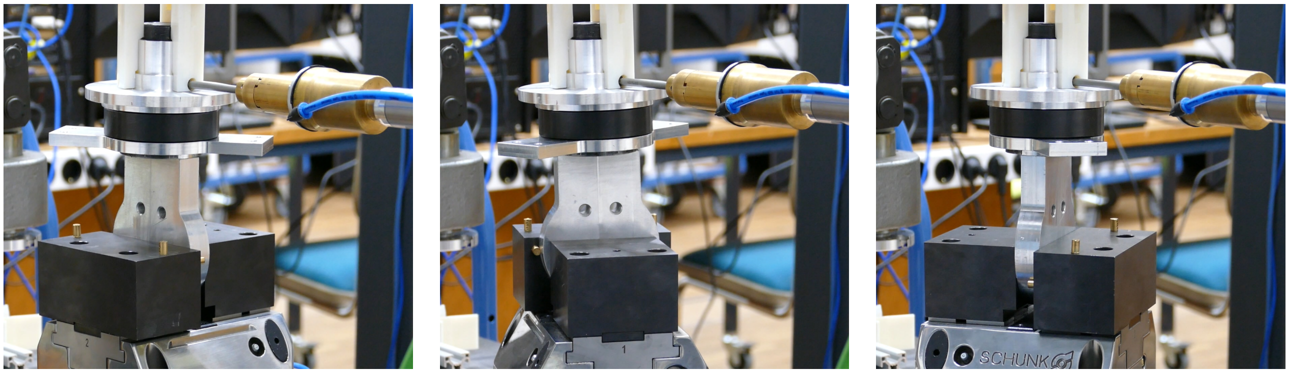

Figure 3: An example use of the passive rotary table. As can be seen in the figure, the table is being used to fasten screws on 3 different sides of a workpiece. As it would be impossible to reach the object on all three sides with the screwdriver, due to the kinematic restrictions, the table needs to be used.

4 ASSEMBLY SEQUENCES

During a set-up of a classic assembly workcell, a significant portion of the time is dedicated to determining, writing and compiling of the assembly sequence. In order to reduce the set-up time and enable short reconfiguration times between different assembly processes, this should be done as fast as possible. In this section we present a set of technologies that facilitate and accelerate the programming of robot workcell assembly operations.

Learning of **assembly skills through programming by demonstration** (PbD) enables defining the robot motions for a complete assembly process in an intuitive and faster way for non-expert users. PbD provides an approach to define these motions in a natural way and avoids coding complex programs in a robot-oriented programming language [1, 2, 4]. The two present PbD approaches are kinesthetic teaching and remote guidance.

With kinesthetic guidance the user moves the robot by physically guiding through its workspace and thus showing the desired movement. This approach is commonly used in collaborative robotics as it is effective to use with robots which have torque-controlled actuators [5]. The quality of the dynamic model and torque sensors greatly impact the ease of guidance and the needed physical effort. This in terms effect the quality of the shown movement and the smoothness of the demonstrated path.

While useful, the drawbacks of non-perfect kinesthetic guidance represent an inconvenience when working towards methods to shorten times of robot programming. As a result, a large amount of time can be spend to achieve the desired movement and/or configuration of the robot. To mitigate these drawbacks a remote control interface was developed and integrated in the workcell. A displacement of the analogue sticks of a consumer grade joystick was mapped to the Cartesian space velocities. This allows the user to control the robot in a smooth way and can mitigate the drawback of kinesthetic guidance when needed.

A **database of assembly skills** acquired during PbD should be be accessible throughout the entire software framework of the workcell. In order to handle storing and loading of the learned skills, MongoDB database was integrated into our system. Whenever a new skill is learned, a new named entry is created in the database. An assembly sequence can then read the desired database entry from the database and move the robots accordingly. If we wish to update a certain skill, we can simply overwrite the entry with a newly modified skill. In this way, we avoid changing the top-level assembly sequence program.

Figure 4: A consumer grade joystick interface that we used to perform precise motions of the robot in Cartesian space.

State machine assembler is a crucial part of any workcell. An engine for state machine code generation was developed to further accelerate the programming process of the workcell assembly sequence. While there are numerous ROS-based packages aimed at facilitating the high-level task programming by using state machines, defining complex robot behaviours with these tools can be complex. It requires a programmer to dedicate his attention to the structure of the state machine, the basic code, and the programming language syntax. To expedite and enhance this process, a method for code generation, A meta-scripting and templating method was was developed to speed up the process. The details on this are omitted in this paper and the reader is referred to our previous work on this topic [9].

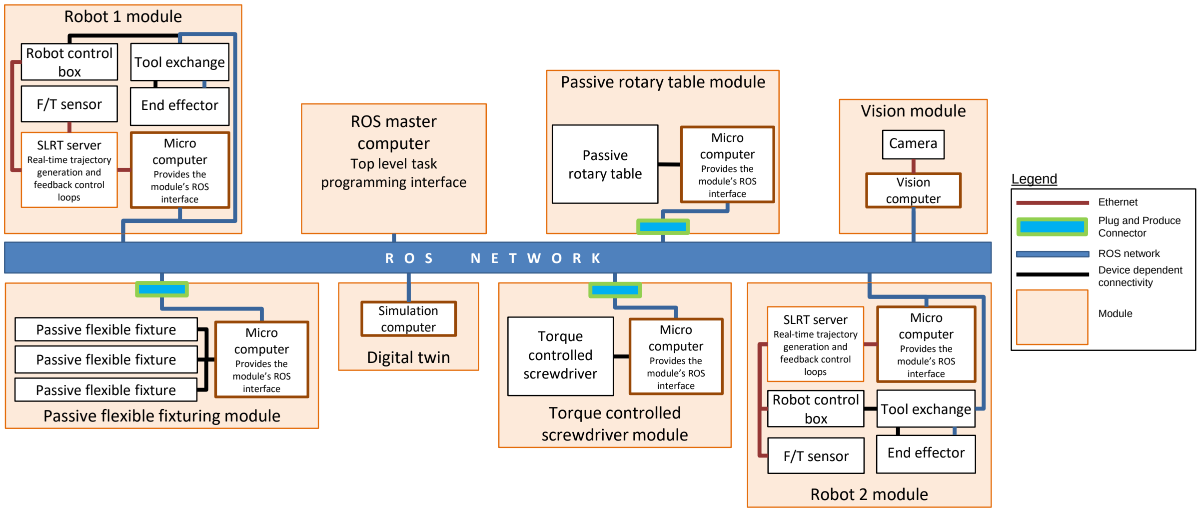

Figure 5: Software architecture for the reconfigurable robot workcell with various software and hardware modules.

5 CONCLUSION

In this paper we present a new type of robot workcell which is highly reconfigurable with innovative hardware concepts and components with a ROS-based software backbone. Throughout the work that lead to the presented results we focused not only towards providing methods for autonomous reconfiguration of the cell in order to adapt to production changes, but also to shorten set-up times by implementing various programming by demonstration technologies. In order to show the industrial relevance of our work we evaluated the proposed paradigms, the underlying technology and the overall quality of the cell through the implementation of various use-cases. The use-cases were provided by SMEs from different fields of industry and our task was to automate part of the production line that is currently done either manually or does not posses the desired flexibility. These use-cases range from the (1) assembly of automotive headlights, (2) the assembly of linear drives, (3) the assembly of a robotic gripper, (4) assembly of airport runway lights and finally the (5) assembly of printed circuit boards (PCBs). The successful implementations provided us with the overall proof that the developed solution are of interest in the industry. We were also able to acquire the first reference key performance indicators, e. g. cycle time, reconfiguration time, setup-time, etc. Throughout the implementation of the various use-cases some of the key equipment stayed the same (i.e. robots, tool rack, etc.), however other parts of the cell were reconfigured according to the requirements of each experiment. Some application-specific periphery modules were either added or removed.

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Challenges of Collaborative Mobile Manipulation for Industrial Applications

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Modern manufacturing processes require high flexibility and human-machine collaboration to cope with increasing product variability, shorter production life cycles, and higher quality demands. Collaborative mobile manipulators (CMMs) meet these requirements. They combine the freedom of movement, higher payload, and speed of mobile robots with the univeral applicability, positioning accuracy and repeatability of manipulator arms, equipped with collaborative features, like operator safety and sensitivity, in order to operate near and with humans. Despite recent innovations the industrial application of CMMs did not progress as expected. The main challenges for collaborative mobile manipulation can be found in the following areas:

Sensors and Perception Mobile collaborative applications require fast, robust, and highly accurate localization and detection of objects in the environment, ideally in a range between sub-millimeter to several meters. For safe human-robot interaction the accurate detection and localization of humans and estimation of applied forces for precise, safe and collision-free movement is paramount. As CMM movements are only limited by the environment they need a panorama view. This requires multiple sensors of different types, mounted to maximize the field of view while minimizing self-occlusion, multi-sensor calibration, and fast and reliable algorithms for data fusion and interpretation. Occlusion, due to CMM and operator movement, produces blind spots which decreases safety and productivity. Current research efforts aim towards better machine learning-based perception methods, novel multi-sensor modalities, and entirely new sensor systems; for instance capacitive surrounding-sensing ”artificial skins” will result in more sensitive and safer manipulation and contactless interaction with humans.

Control One particular concern is to maintain the stability of the mobile platform while performing manipulation tasks with the arm. Inherent kinematic redundancy of the combined system is another problem. The degrees of freedom associated to the combination of a mobile platform with a manipulator are different in their dynamical and kinematic properties and have fundamentally different effects on the performance of the overall system. Redundancy resolution has a task of utilizing degrees of freedom in such a way that each subsystem is optimally exploited in terms of joint limit avoidance, stability, energy consumption, fault recovery, obstacle avoidance, and so on.

Task Scheduling and Allocation Collaborative applications require multi-agent planning with temporal and spatial constraints to schedule and allocate tasks. The complexity of the combined optimization problem and the unforeseeable agent behavior impedes fast reactions that are required in dynamic situations. Furthermore, most planning techniques treat humans rather as obstacles, a source of uncertainty, than cooperating entities. Models and fast methods are required to capture uncertainties and skills for both human and robotic agents and to take them into consideration when tasks are allocated.

Human-machine Interface and Programming CMMs present a natural step toward flexible universal robot systems. Non-intuitive kinematic properties make conventional programming tedious and require some form of teaching. For complicated tasks which include simultaneous movement of the whole robot some form of semi-autonomous control has to be present and reprogramming is then reparametrization through interaction. Well-accepted contact-based human-machine interfaces are unsuitable for interaction with a moving system when the robot is either too far away or the position is changing. Even when use-cases are stationary, the geometrical properties of the system force interfaces to be placed on the platform within the manipulator workspace which is in many cases highly inconvenient.

Safety Currently no safety standard addresses mobile manipulation directly. Usually several more general ISO-standards are taken into account when designing robot application that are safe for humans, the environment, and the robot. Critical points during safety assessment are often safety-certified fail-safe hardware and software, and the risks of battery operation, locomotion in large environments, and autonomy of the device. Especially the uncertainty introduced by humans combined with robot autonomy poses a big problem, as robot safety usually tolerates only marginal uncertainties. This results in severe limitations, most noteably speed and force reduction, which lessen the applicability and productivity of CMMS considerably.

Security As industrial settings become more and more digitized and connected, also the threat level in terms of cyber-attacks dramatically increases. From a systems engineering point of view, a mobile manipulator is a complex system of systems. In such systems, the risk of uncovered security issues increases along with the growth of complexity. Considering sensitive mobile manipulators, outside influence may lead to harm to humans if (software-defined) safety functions are exposed to attacks.

Resilience in mobile manipulation

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ABSTRACT

Safety and Security in robotics have long been known to go together hand in hand in order to make robots safe around humans. In modern, intelligent robots however, where software is a dominating part, the quality and reliability of software is a key issue.

To gain most from the increased potential of robots, adequate software architectures must be developed to handle their complexity. In this abstract, we sketch our ideas and work towards combining software architectures with robot security to work towards highly capable, secure robots.

KEYWORDS

software, security, mobile manipulation

1 RESILIENT SOFTWARE FOR COMPLEX ROBOTS

Security in robotics has gained some attention in the recent years. It has been shown that the most popular framework, ROS, has severe deficiencies in terms of security [1] resulting in easy-to-hack robots [2]. However, software engineering methods in robotics are still lacking the proper attention. We argue that for safety and security of robots, high-quality software is key. We present our work in software architectures and their security and hint towards later research directions.

1.1 Software architecture for mobile manipulation

In [3], we have shown an architecture for our CHIMERA mobile manipulator. This architecture separates the software into hardware, abstraction and application layers and defines clear interfaces between each. The driver layer can be exchanged to enable the reuse of business software on multiple robot platforms. Further, it defines a dedicated space where system integrators can enhance the core firmware with drivers and additional functions.

1.2 Security architecture for mobile manipulation

The architecture described above needs security measures integrated in order to protect the robot from outside attacks. Obviously, network and operating system security are required measures. However, we are convinced, that a multi-level approach is required, where multiple layers of security are implemented. Our secure architecture is shown in fig 1.

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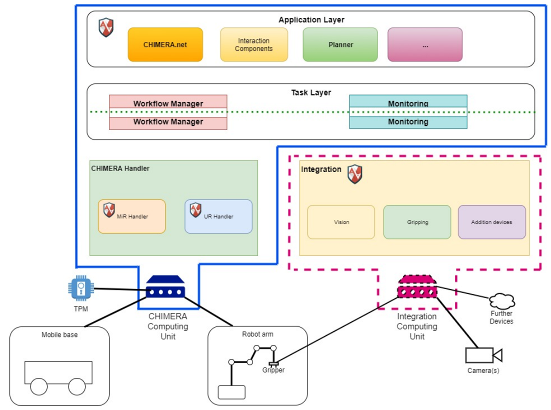

Figure 1: Software architecture for mobile manipulators.

In our approach to securing the software architecture, we heavily rely on isolation. We use two dedicated computing units where each one has different security levels. The CHIMERA computing unit contains the core business software and drivers for mobile base and arm. The Integration computing unit contains code and device drivers developed by system integrators. This separation ensures, that the integrator cannot compromise the security of the core system. In addition, individual layers of the architecture are isolated in separate docker containers with well-defined security boundaries.

2 RESEARCH DIRECTIONS

As part of this ongoing work, we want to establish Software as the third "S" of great robots besides Safety and Security. We see all three topics tightly integrated and required to make future robots productive companions in- and outside of industry. We will work on methods for better robot software that also enables developers to better test their software and easily employ security measures.

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Visual Feedback and Learning for Optimal Velocity of Robotic Visual Quality Inspection

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ABSTRACT

Robotic learning can effectively be applied for industrial applications. In this paper we show one such example, with a learning algorithm applied to reach the optimal velocity of robotic motion for visual quality inspection. If such learning is performed before the start of the production, even if it takes a lot of repetitions, it can achieve faster cycle times and thus greater productivity. The described approach is general and can be used with different types of learning and feedback signals. In the paper we analyze the appropriate feedback signal and show the results of learning for a standard area-scan camera.

KEYWORDS

robotic learning, visual feedback, focus measure, robotic quality control

1 INTRODUCTION

Many operations are performed with autonomous robots in factories, and many more are expected in the factories of the future. Often, visual feedback is used to provide the trajectory of the robot. [16]. However, various vision techniques, such as time of flight, structured light, laser triangulation, RGB cameras, stereo vision, etc. are used for quality control processes in the industry [4, 9]. Quality control can take different modes. For example, discrete checking of an object from a few viewpoints and comparing the acquired images to predefined templates [11]. Another option is to continuously acquire images with either moving the in-hand camera, or moving the object in front of the camera. A plethora of advanced methods for image processing for quality inspection have been proposed, including deep learning methods [17].

For effective vision-based operations, the machine vision hardware needs to be properly set-up and tuned. In large-scale automated production, it is typically set-up once, and then it remains in the same configuration throughout its life cycle. Consequently, machine vision hardware is often designed in a way that some adjustments can only be carried out manually. Many lenses thus have a fixed focal length and manual adjustment of the iris and focus [1]. However, even if the vision-hardware is set up only once, the process still constitutes a tedious and demanding task. For example, in continuous visual inspection, e. g., for visual inspection of weld seams [18], requires the robot to follow the seam with the camera at the end-effector. The image has to be sharp in all the positions and at all velocities. Thus, for such continuous visual quality control, the operator has to define the correct robot path, but also the correct speed, because too fast motion in front of the camera might result in a blurry image.

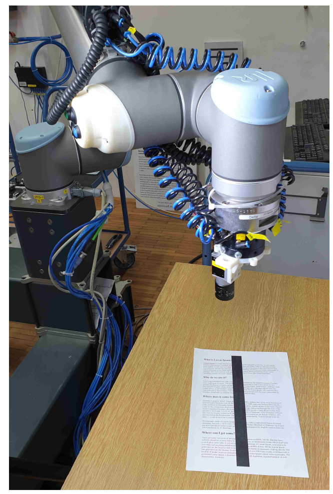

Figure 1: The robot cell composed of a UR-10 robot, a Basler acA1300-60gm area scan camera, a dedicated light source (not shown) and the dummy flat object at a calibrated distance from the robot.

The demands of the industry typically culmulate in having to move as fast as possible in order to reach high cycle times. [19]. Thus, when programming robot motion for quality control, the path can be properly configured by exporting the object CAD data and appropriate robot-to-object calibration, but the speed of robot motion is typically left to the operator, who spends a considerable amount of time hand-tuning it. However, this tuning could be left to an autonomous learning algorithm with proper feedback. In this paper we briefly analyze possible visual filters for appropriate feedback, and demonstrate how hand-tuning can be automated by employing learning algorithms.

1.1 Problem Statement

We investigate learning of motion speed for continuous visual quality inspection of products with a robot using an in-hand camera. The system should:

- follow a predefined path,

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- autonomously optimize motion velocity using learning, so that
- the velocity of motion does not introduce blurring, i. e., a reduced focus measure.

We also analyze appropriate visual feedback filters to determine image sharpness.

The following assumptions hold. i) A CAD system provides an accurate robot path (trajectory) consisting of required positions and orientations; ii) proper robot-object calibration can be achieved; iii) The system operates under constant lighting and camera conditions.

To achieve seamless velocity modulation, we applied Dynamic movement primitives (DMPs) developed by Ijspeert et al. [10]. We used a variant of DMPs called Cartesian Space Dynamic Movement Primitives [21] for the trajectory encoding. Other trajectory encoding approaches could easily be applied, for example Gaussian Mixture Models [3]. For the learning we applied Iterative Learning Control (ILC) [2, 6]. Again, other methods, such as reinforcement learning [5, 13] could be applied.

2 FOCUS MEASURE

Visual quality inspection requires sharp, focused images. Only a few industrial camera/lenses on the market provide autofocus, with little information about how focus is determined in these cameras [1].

We first used robot-driven autofocus as described in [1] to set our fixed-focus camera at the right distance from the object for inspection. To do this we used squared horizontal gradient focus measure, as suggested by [1]. This focus measure has a distinct bell-shape characteristics, with the best focus achieved at the peak. The robot moves the camera perpendicularly to the object of inspection, away and towards the object. After detecting the peak value (the focus measure begins to decrease), the robot reverses its motion and travels in the other direction at a slower speed, again until crossing the peak value. These movements are repeated until the accurate position resulting in peak focus measure ϕ is obtained. Details of this method and results showing that the achieved focus measure is higher than the one achieved by manually positioning the camera, are presented in [1].

Using this approach we can set the camera into focus for one point, for example above the starting point of the path of inspection. We assume that the desired inspection path has been extracted from a CAD model of the inspected object. To obtain the reference values $\phi(t)$ for all points on the inspection trajectory, the robot moves along the desired inspection path. However, the question is whether speed has an effect on the focus measure, and furthermore, out of many focus measures that exist, which will be most effected by the speed.

Focus measures are based on different orders of differentiation (first or second), image histogram, correlation and data compression [14]. Methods employing first-order gradients use different operators, such as squared gradient, Sobel (horizontal, vertical, combined), Laplacian, Scharr, and others. We tested several possible focus measures. We moved the robot with an in-hand camera over a dummy object at three different velocities, completing the motion in 3s, 20s, and 60s. Figure 2 shows the relative focus measure as a function of normalized time (phase), going from 0 to 1, for different measures. The label states the measures used. The feedback focus measures were normalized to the initial value. As we can see, a higher velocity indeed decreases the focus measure, and the effect is different for different focus measures.

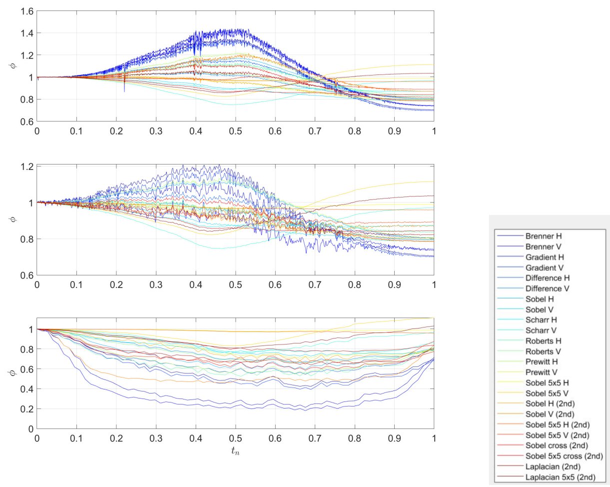

Figure 2: Different focus measures at different speeds of robot motion (top: 60s, middle: 20s, bottom: 3s), for normalized time. The measures were normalized to the initial value.

Figure 3 shows filtered values of relative difference between slow and fast motion for the top 10 focus measures. We can see that squared horizontal gradient focus measure is the most reactive to change of velocity. Is is provided by

$$\phi = \sum_{x=0}^{M-1} \sum_{y=0}^{N-2} \left(I(x, y+1) - I(x, y)\right)^2 . \tag{1}$$

Here the image is sized $M \times N$, with $I(x, y)$ the intensity values at pixels (x, y).

The values would be the same for the vertical gradient if the camera were rotated 90°. The vertical horizontal gradient is calculated by

$$\phi = \sum_{x=0}^{M-2} \sum_{y=0}^{N-1} \left(I(x+1, y) - I(x, y)\right)^2 . \tag{2}$$

Brenner vertical and horizontal filters provide similar values. They are defined by

$$\phi = \sum_{x=0}^{M-1} \sum_{y=0}^{N-3} \left(I(x, y+2) - I(x, y)\right)^2 . \tag{3}$$

for the horizontal and

$$\phi = \sum_{x=0}^{M-3} \sum_{y=0}^{N-1} \left(I(x+2, y) - I(x, y)\right)^2 . \tag{4}$$

for the vertical filter.

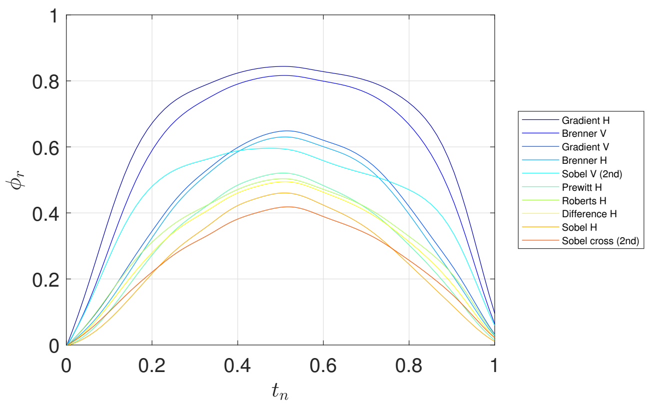

Figure 3: Filtered relative change of feedback values for 10 different focus measures.

3 TRAJECTORY ENCODING

In this paper we used the original formulation of Cartesian DMPs from [21], expanded with temporal scaling, as originally proposed for standard DMPs in [15].

The following parameters compose a CDMP: weights $\boldsymbol{w}_k^p$, $\boldsymbol{w}_k^o \in \mathbb{R}^3$, $k = 1, \ldots, N$, which represent the position and orientation parts of the trajectory, respectively; trajectory duration τ and the final desired, goal position $\boldsymbol{g}^p$ and orientation $\boldsymbol{g}^o$ of the robot. Variable N sets the number of radial basis functions that are used to encode the trajectory. The orientation is in CDMP represented by a unit quaternion. In this paper we only consider the positions.

$$\begin{aligned} \nu(s)\tau\dot{\mathbf{z}} &= \alpha_z(\beta_z(\mathbf{g}^p - \mathbf{p}) - \mathbf{z}) + \mathbf{f}_p(s), && (5) \\ \nu(s)\tau\dot{\mathbf{p}} &= \mathbf{z}, && (6) \end{aligned}$$

Variable $\nu(s)$, as a function of the phase, provides temporal scaling. Parameter $\boldsymbol{z}$, denotes the scaled linear velocity ($\boldsymbol{z} = \tau\dot{\boldsymbol{p}}$). The nonlinear parts, termed also forcing terms, $\mathbf{f}_p$ and are defined as

$$\mathbf{f}_p(s) = \boldsymbol{D}_p \frac{\sum_{k=1}^N \mathbf{w}_k^p \Psi_k(s)}{\sum_{k=1}^N \Psi_k(s)} s, \qquad (7)$$

Forcing terms contain parameters $\boldsymbol{w}_k^p, \in \mathbb{R}^3$. They have to be learned, for example directly from an input Cartesian trajectory $\{\boldsymbol{p}_j, \dot{\boldsymbol{p}}_j, \ddot{\boldsymbol{p}}_j, t_j\}_{j=1}^T$. The scaling matrix $\boldsymbol{D}_p, \in \mathbb{R}^{3\times 3}$ can be set to $\boldsymbol{D}_p = \boldsymbol{I}$. Other possibilities are described in [21]. The nonlinear forcing terms are defined as a linear combination of radial basis functions Ψ_k

$$\Psi_k(x) = \exp\left(-h_k\,(x - c_k)^2\right). \qquad (8)$$

Here c_k are the centers and h_k the widths of the radial basis functions. The distribution of weights can be, as in [20], $c_k = \exp\left(-\alpha_x \frac{k-1}{N-1}\right)$, $h_k = \dfrac{1}{(c_{k+1} - c_k)^2}$, $h_N = h_{N-1}$, $k = 1, \ldots, N$. The time constant τ is set to the desired duration of the trajectory, i. e. $\tau = t_T - t_1$. The goal position is usually set to the final position on the desired trajectory, i. e. $\boldsymbol{g}^p = \boldsymbol{p}_{t_T}$. Detailed CDMP description and auxiliary math are explained in [21].

Temporal scaling $\nu(s)$ provides a trajectory that defines a speed profile of the motion. It is composed of a weighted combination of kernel functions

$$\nu(s) = \frac{\sum_{k=1}^R \mathbf{w}_k^\nu \Psi_k(s)}{\sum_{k=1}^R \Psi_k(s)}. \qquad (9)$$

Here R defines the number of kernel functions, given in (8), for temporal scaling. For simplicity, this number can be the same as N in (7). The weights $\mathbf{w}_k^\nu$ need to be learned in the same manner as the weights for position trajectories.

4 IMPROVING SPEED OF QUALITY CONTROL WITH LEARNING

Focus measure is repeatable, and there is a clear difference in ϕ for different motion speeds, as evident from Fig. 2. Therefore, we can use ϕ as the feedback for learning.

The goal of learning here is to achieve a fastest possible velocity profile, where there will be only little or even no degradation of the focus measure. Thus, the motion will be executed as fast as possible, and the sharpness of the image, used for quality inspection, will not degrade.

It should be noted that with the chosen parametric speed profile representation, different means of learning open up, as was shown in [5], or in [12]. In this paper we have chosen one of the variations of iterative learning control. The advantage of using a learning control method is that it requires very few iterations to improve results. However, such methods never truly converge, but only asymptotically approach the target value [2].

The chosen learning algorithm for learning was previously applied for coaching of robot motion through human intervention [7]. A short recap is provided for completeness of the paper. Its basis is learning of weights of CDMPs, but in this case it is used for the learning of the weights of the velocity profile ν. The weights of the velocity profile $\boldsymbol{w}^\nu$ are iteratively updated (for 1DOF) with

$$\begin{aligned} w_{i,j+1}^\nu &= w_{i,j}^\nu + \Gamma_{i,j+1} P_{i,j+1} r e_j && (10) \\ P_{i,j+1} &= \frac{1}{\lambda}\left(P_{i,j} - \frac{P_{i,j}^2 r^2}{\frac{\lambda}{\Gamma_i} + P_{i,j} r^2}\right) && (11) \\ e_j &= f_{\mathrm{targ},j} - w_{i,j}^\nu r. && (12) \end{aligned}$$

Here $j + 1$ stands for the next time sample and i for the selected weight. P_i, is the inverse covariance of w_i, r is the amplitude gain. To apply this algorithm for modifying the speed profile based on the focus measure ϕ, we replace (12) with

$$e_j = k * (\phi_{\mathrm{slow}} - \phi_{\mathrm{fast}}). \qquad (13)$$

here k is a positive constant gain. The whole algorithm is described in procedure of Fig. 4. The learning takes place until a predefined threshold of e_j is reached. This threshold can be determined empirically.

Instead of learning directly on the weights, one can also simply generate the velocity profile from the weights and add to it a scaled e_j,

$$\nu_{l+1}(t) = \nu_l(t) + k e_j(t), \qquad (14)$$

where the gain k is set empirically and l stands for iteration. The resulting $\nu_{l+1}(t)$ is then again encoded into weights, for example

procedure LearnProfile
  record ϕ for slow (practically static) motion;
  record ϕ for fast motion with w_i^v = const;
  while $\phi_{\text{latest}} >$ threshold
    execute motion with current w^v
    calculate new error of ϕ with $\phi - \phi_{\text{latest}}$
    update $\mathbf{w}^v$ using (10), (11) and (13)
  end

Figure 4: Procedure for learning the velocity profile using the squared gradient focus measure.

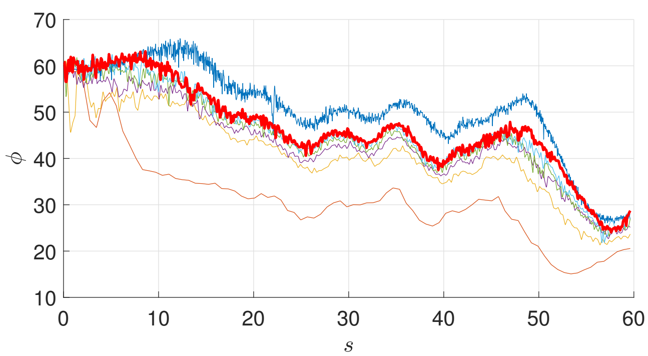

Figure 5: Results of velocity learning for a dummy flat object. The top lines shows absolute ϕ for slow 60s motion. The bottom line shows ϕ for fast, 3s motion. ϕ over iterations is shown between, with the final, red line almost the reference, but at 19.12s.

iteratively using (10) – (12), or with a batch conversion, as shown in [10].

Figure 5 shows the results of the algorithm, applied on a dummy object, using the algorithm described in Fig. 4 and squared horizontal gradient focus measure. Results on a curved object were reported in [8].

5 CONCLUSION

Learning algorithms have tremendous potential to improve the productivity of industrial processes today, not only in the future. The results show that autonomous learning algorithms can improve the performance of the robot, and that such algorithms can be effectively applied optimizing production processes. Thus, they can relieve and help operators/engineers. Fine-tuning and calibration of the processes is a tedious, long process, requiring a lot of effort. Time and money can be saved both in the set-up as well as in the improved productivity.

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Intuitive Hand-Guidance of a Mobile Manipulator

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ABSTRACT
Mobile manipulators are robot systems which enable the capabilities of logistics and manipulation tasks. Thus, they potentially close unconsidered gaps regarding flexibility in modern production lines. We address the problem of developing an easy-to-use interface for intuitive robot programming. This interface implements a whole-body compliance control to allow for hand-guidance.

1. INTRODUCTION
Producing small lot-sizes or highly customized products require enhanced flexibility within the manufacturing processes. This raises the need for flexible and easily adaptable robotic systems. While conventional automated production lines are usually prepared and programmed by external experts, modern applications require frequent adaption or reprogramming. To enable this directly for workers, without explicit programming skills but high domain knowledge, an intuitive interface is needed. One well-known technique is kinesthetic programming by demonstration, where a compliant robot can be hand-guided into desired configurations. While the compliance control for serial manipulators has been well investigated, the whole-body compliance for a mobile manipulator, consisting of a serial manipulator on top of a mobile base, has gained little attention yet. Leboutet et al. [1] presented a strategy with hierarchical force propagation for a mobile manipulator with omni-directional base. Navarro et al. [2] proposed a system where the motion distribution between the serial manipulator and the mobile base is done with optimization.

2. METHOD
In our previous work [4] we presented a control strategy for whole-body compliance of a mobile manipulator with differential drive. A force/torque sensor is mounted close to the end-effector (EE) to measure the external wrench applied by the user. The robot shows kinematic redundancies regarding the 3D task space since the 6 degrees of freedom of the arm are supplemented with those of the mobile base. Our control structure focuses on resolving these redundancies by implementing three different modes: A *pull-mode*, where the mobile base can be pulled like a steered trailer, which means that the base is rotating and translating towards the EE and haptic feedback is given to the user by means of a virtual spring. In the *ur-mode* only the serial arm moves, and the *push-mode* allows for pushing the mobile base while receiving haptic feedback of a virtual spring. The decision, which mode is used depends on the actual position of the EE. Two circles in the xy-plane define two borders of cylindrical shapes in the 3D space. If the EE leaves the outer circle *pull-mode* is active, in between the two circles the *ur-mode* is active and inside the inner circle *push-mode* becomes active.

The proposed control structure was successfully validated throughout laboratory experiments, but approaching arm configurations close to singularities proved to be problematic. Since the suggested controller uses end-effector velocities as control inputs, close to a singular configuration, a rather slow end-effector motion may lead to very high joint velocities causing possibly dangerous situations. In [3] we extended our controller to avoid approaching singular arm configurations by providing haptic feedback to the user. We did a detailed analysis of all possible singularities of the UR10 and implemented virtual springs to avoid them.

For future work it is planned to integrate haptic feedback to avoid self collisions. Furthermore, depending on the choice of the radius of the inner circle, the workspace of the serial arm is restricted, since when the inner circle is entered by the EE, *push-mode* is active and a virtual spring will move the EE back outside of the inner circle. We plan to refine the strategy at this point to minimize the volume of the restricted workspace.

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Learning Robotic Handwriting with Convolutional Image-to-Motion Encoder-Decoder Networks

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ABSTRACT

Learning to recognize and reproduce handwriting is a familiar skill taught to every educated human being but is challenging to teach to a robot given its tight coupling between perception and motion. In this work, we address the specific task of recognizing digits in single images and reproducing the digits in the form of robot end-effector trajectories encoded as dynamic movement primitives (DMPs) used to control the pen strokes. Here we present a convolutional image-to-motion encoder-decoder deep neural network architecture that takes the raw digit images as input and produces the DMP parameters as output, learning a mapping between the two as a latent representation. The architecture is tested on several challenging noisy digit datasets under different training regimes and compared to an architecture without convolutional layers in the image encoder where it is shown to provide robust results for the digit writing task.

KEYWORDS

deep neural networks, dynamic movement primitives

1 INTRODUCTION

Effectively learning to predict action mappings directly from perceptual input is a highly challenging problem in robotics research that has seen a broad variety of approaches attempting to solve it in different settings. The particular setting under consideration in this work is depicted in Fig. 1, in which a robot must learn direct mappings between handwritten characters in input images and the motion trajectories needed to draw them. In previous work we proposed a fully-connected encoder-decoder network architecture [6] that used dynamic movement primitives (DMPs) [5] for movement representation and this proved to be an effective choice both for representation and learning with the neural network and ultimately for control of the robot when drawing the actual digits. The fully-connected architecture, however, was not ideal for image representation.

Here we investigate a different architecture that combines the benefits of convolutional layers for image encoding with those of a fully-connected encoder-decoder architecture for DMP parameter prediction and image-to-motion representation in a low-dimensional latent space. This combination allows for relatively robust prediction compared to the previously proposed architecture, even when the input images are heavily corrupted by noise. The use of convolutional layers has the added benefit of significantly reducing the number of network parameters and by pre-training these layers on images from a similar image domain, the learning process is further improved.

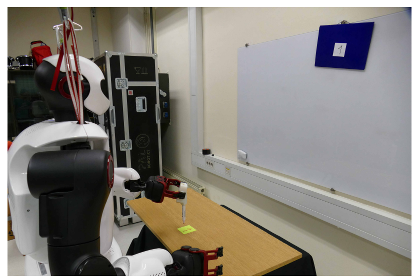

Figure 1: Writing digits with a robot using image-to-motion encoder-decoder network prediction.

Autoencoders [3], as well as variational autoencoders [4], have been demonstrated to be quite effective when it comes to calculating DMP-based representations of human motion. Since our focus is on learning direct mappings between images and actions, instead of using such autoencoder networks in which the DMP encoding occurs in the latent space, we use an encoder-decoder architecture in which the image is encoded from the input layer, the DMP parameters are predicted at the output layer and the transformation and generalization of the image-to-motion representation occurs in the low-dimensional latent space. Encoder-decoder networks in combination with convolutional layers have proven to be useful in computer vision. A well-known example is SegNet [1], in which pre-trained convolutional layers from a convolutional neural network (CNN) were adapted to form a fully-convolutional encoder-decoder architecture for semantic pixel-wise segmentation.

Usually when CNNs are used for supervised learning of perception-action couplings, they are used i combination with another neural network in two separately trainable parts. In [9], Yang et al. first used a deep convolutional autoencoder for finding camera image features and then in combination with recorded robot angles, formed sequences for the learning task dynamics with a time delay neural network. Pervez et al. [7] used a pre-trained CNN for finding task parameters from input images, while using a another fully-connected neural network to learn to generate forcing terms

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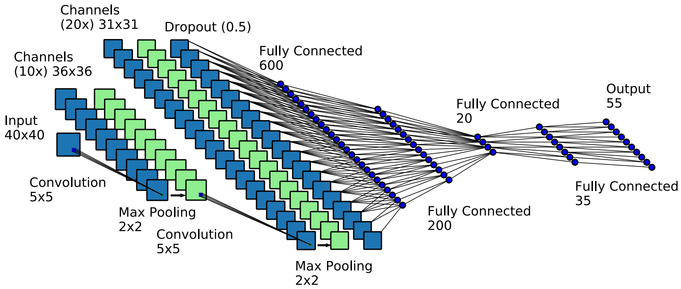

Figure 2: The CIMEDNet architecture.

from the clock signal and task parameters, before combining both networks in an end-to-end training scheme. Both of these two examples produce the next step from the image of the current step while working in online loop, whereas our method, by contrast, uses just single images for generating entire trajectories.

2 CONVOLUTIONAL IMAGE-TO-MOTION ENCODER-DECODER NETWORKS

The structure of the data under consideration in this work is the same as in [6] where the input and output data pairs take the form $\mathbf{D} = \{\mathbf{C}_j, \mathbf{M}_j\}_{j=1}^{M}$ where M is the number of input and output training pairs, $\mathbf{C}_j \in \mathbb{R}^{H \times W}$ are the input images of width W and height H, and $\mathbf{M}_j$ the corresponding movements associated with each image, i. e. $\mathbf{M}_j = \{y_{i,j}, t_{i,j}\}_{i=1}^{T_j}$. Here $y_{i,j} \in \mathbb{R}^{\mathrm{d}}$ are the vectors describing the movement's degrees of freedom, e. g. Cartesian positions or joint angles, $t_{i,j} \in \mathbb{R}$ the measurement times for the j-th movement, and d is the number of degrees of freedom. However, it should be noted that in this paper, we convert the movements $\mathbf{M}_j$ to DMPs and construct all of the datasets used to train the network models as follows: $\mathbf{D}' = \{\mathbf{C}_j, \mathbf{k}_j\}_{j=1}^{M}$, where $\mathbf{k}_j$ are the DMP parameters calculated for each movement $\mathbf{M}_j$ and are represented as

$$\mathbf{k}_j = \left\{\{w_k\}_{k=1}^{N},\ \tau,\ g,\ y_0\right\}. \tag{1}$$

The construction of DMPs and the nature of the parameters $\{w_k\}_{k=1}^{N}$, τ, g and y_0 are explained in detail in the following subsection.

2.1 Motion Representation with DMPs

Letting a time-dependent movement trajectory be denoted as $y(t) \in \mathbb{R}^d$, a DMP specifying this trajectory is given by the following system of differential equations

$$\tau\dot{z} = \alpha_z(\beta_z(g - y) - z) + \mathrm{diag}(g - y_0)\mathbf{F}(x), \tag{2}$$

$$\tau\dot{y} = z, \tag{3}$$

where $y_0 \in \mathbb{R}^d$ is the initial position on the trajectory, $g \in \mathbb{R}^d$ the final position on the trajectory, $\mathrm{diag}(g - y_0) \in \mathbb{R}^{d \times d}$ a diagonal matrix with components of vector $g - y_0$ on the diagonal, $\mathbf{F}(x) \in \mathbb{R}^d$ a nonlinear forcing term, $z \in \mathbb{R}^d$ a scaled velocity of motion, and $x \in \mathbb{R}$ the phase defined by the following equation

$$\tau\dot{x} = -\alpha_x x. \tag{4}$$

The phase x is used instead of time to avoid explicit time dependency. It is fully defined by setting its initial value to $x(0) = 1$. Eq. system (2) – (4) constitutes a *dynamic movement primitive* (DMP).

If the parameters $\tau, \alpha_x, \alpha_z, \beta_z \in \mathbb{R}$ are defined appropriately, e. g. $\tau, \alpha_x > 0$ and $\alpha_z = 4\beta_z > 0$, then the linear part of equation system (2) – (3) becomes critically damped and y, z monotonically converge to a unique attractor point at $y = g$, $z = 0$. The forcing term $\mathbf{F}(x)$ is usually defined as a linear combination of radial basis functions

$$\mathbf{F}(x) = \frac{\sum_{k=1}^{N} w_k \Psi_k(x)}{\sum_{k=1}^{N} \Psi_k(x)} x, \tag{5}$$

$$\Psi_k(x) = \exp\left(-h_k (x - c_k)^2\right), \tag{6}$$

where c_k are the centers of Gaussians distributed along the phase of the trajectory, and h_k their widths. The role of $\mathbf{F}$ is to adapt the dynamics of (2) – (3) to the desired trajectory $y(t)$, thus enabling the system to reproduce any smooth movement from the initial position y_0 to the final configuration g. This can be accomplished by computing the free parameters $w_k \in \mathbb{R}^d$ using regression techniques. See [8] for more details.

α_z, β_z, and α_x are usually constants that do not change between movements. Thus the neural network needs to learn the other parameters of differential equation system (2) – (4) to fully specify a DMP as defined in Equation (1).

2.2 Network Architecture

In our improved architecture, images are encoded via convolutional layers that are pre-trained as part of a basic CNN classifier that was trained on the original MNIST dataset. The input is a $40 \times 40 \times 1$ grayscale pixel image, followed by a convolutional layer with 5×5 kernel size and 10 feature maps, a convolutional layer with 5×5 kernel size and 20 feature maps, a 0.5 dropout layer, a fully-connected layer of size 320, a fully-connected layer of size 50 and the output layer of size 10 matching the number of digits. After training the classifier, the fully-connected layers are removed and the convolutional layers are retained and are used to form the first layers of the encoder in our proposed architecture. These two convolutional layers are followed by two added fully-connected layers with sizes of 600 neurons and 200 neurons, illustrated on the left side of Fig. 2.

Following the bottleneck of the network that forms the latent space representation, a decoder is formed via a number of fully-connected layers that gradually expand the number of units in each layer until the final output layer which has a size set to 55 units in order to match the DMP parameters $\{w_k\}_{k=1}^{N}$, τ, g and y_0. The layers of the decoder are illustrated on the right side of 2 starting with the bottleneck of size 20, followed by a layer of size 35 and finishing with the output layer. This is the same decoder structure as used [6] and we retain it here as-is, having found it to be effective throughout our experiments for this particular use case. The cost function used to evaluate the output of the network is the same as that of Equation (9) in [6], which is defined for the j-th DMP as follows:

$$\mathrm{E}_p(j) = \frac{1}{2}\left(\sum_{k=1}^{N} \|w_k - w_{k,j}\|^2 + (\tau - \tau_j)^2 + \right.$$
$$\left. + \|g - g_j\|^2 + \|y_0 - y_{0,j}\|^2\right), \tag{7}$$

where $\{\{w_k\}_{k=1}^N, \tau, g, y_0\}$ denotes the output of the neural network and $\{\{w_{k,j}\}_{k=1}^N, \tau_j, g_j, y_{0,j}\}$ the DMP parameters from the training data $\mathbf{k}_j \in \mathbf{D}'$. For further details on the gradient calculations required for minimizing the cost function via backpropagation we refer the reader to [6].

3 EXPERIMENTS

In our experiments, we trained both the fully-connected image-to-motion encoder-decoder architecture (IMEDNet) and the convolutional architecture (CIMEDNet) on various digit image and motion trajectory datasets. The IMEDNet architecture was the same as described in [6] with fully-connected hidden layer sizes of 1500, 1300, 1000, 600, 200, 20, and 35 neurons, respectively. The CIMEDNet architecture was as described in Section 2.2 and as illustrated in Fig. 2.

In the case of CIMEDNet, we also experimented with either freezing the convolutional layer weights or training the entire network end-to-end. The results for these different training regimes are cataloged in Table 1.

3.1 Datasets

In order to construct **D**, we employed the same scheme described in [6] to generate 40×40 images of synthetically written digits and associated two-dimensional artificial writing trajectory movements. Briefly, the synthetic trajectory data was generated using a combination of straight lines and elliptic arcs. These geometric elements were used to generate grayscale digit images and their paramaters were varied according to a uniform distribution. The resulting images were processed with a Gaussian filter and some moderate salt-and-pepper noise was added to the foreground pixels. Finally, both the generated trajectories and the resulting images were transformed using affine transformations composed of translation, rotation, scaling, and shearing. These parameters were again taken from a uniform distribution. For the DMP representation of the trajectories, 25 radial-basis functions were selected for every dimension. The weights of these basis functions form together with the common time constant (1 parameter) and the start and the goal values of a planar movement (2×2 parameters), the full set of 55 DMP parameters that represent the motion. Using this procedure, several datasets were generated both with and without similar noise as used in the noisy MNIST (n-MNIST) datasets [2] as follows:

- **s-MNIST:** 2000 pairs of images and trajectories without any added noise were generated for each digit, for a total of 20000 samples that were split in a 70%/15%/15% ratio between training/validation/test data,
- **s-MNIST-AWGN-19.0:** 300 samples per digit/3000 total samples, using additive white gaussian noise with a signal-to-noise ratio of 19.0,
- **s-MNIST-AWGN-9.5:** 300 samples per digit/3000 total samples, using additive white gaussian noise with a signal-to-noise ratio of 9.5,
- **s-MNIST-MB:** 300 samples per digit/3000 total samples, using a motion blur filter emulating a linear motion of the camera of 5 pixels and a 15 degree motion in the counter-clockwise direction,
- **s-MNIST-RC-AWGN:** 300 samples per digit/3000 total samples, using a contrast range scaled down to half as well as additive white gaussian noise with a signal-to-noise ratio of 9.5.

It should be emphasized that in the results that follow, only the s-MNIST dataset was used for training the presented models.

3.2 Results

The main quantitative results are presented in Table 1 while qualitative results for selected samples are presented in Fig. 3. After training on the noiseless s-MNIST dataset each of the models were tested on all five of the noiseless and noisy s-MNIST datasets described in the previous section. The CIMEDNet architecture was trained with two separate training regimes in which the convolutional layer weights were frozen and the models were trained end-to-end respectively. For the quantitative evaluation, dynamic time warping was used to measure the mean pointwise pixel distance between the trajectories generated by the DMPs predicted by the networks from the digit images and the actual digit trajectories.

Table 1: DMP reconstruction statistics. The results are in pixels. The best result for each dataset is highlighted in boldface.

	IMEDNet (End-to-End)	CIMEDNet (Frozen Conv.)	CIMEDNet (End-to-End)
s-MNIST	0.22 ± 0.08	0.26 ± 0.10	$\mathbf{0.19 \pm 0.08}$
s-MNIST-AWGN-19.0	0.56 ± 0.20	0.54 ± 0.20	$\mathbf{0.36 \pm 0.14}$
s-MNIST-AWGN-9.5	1.66 ± 0.60	1.48 ± 0.55	$\mathbf{1.02 \pm 0.45}$
s-MNIST-MB	$\mathbf{0.35 \pm 0.15}$	0.47 ± 0.25	0.36 ± 0.12
s-MNIST-RC-AWGN	2.32 ± 0.77	2.19 ± 0.76	$\mathbf{1.93 \pm 0.66}$

As can be seen in Table 1, the CIMEDNet model that is trained end-to-end significantly out-performs the IMEDNet model on both the noiseless s-MNIST dataset and on most of the noisy s-MNIST datasets, apart from the dataset featuring motion blur noise. We reason that this may be due to the fact that motion blur can significantly distort overall object shape and edge profiles and given that convolutional neural networks function the basis of exploiting hierarchies of image filters often heavily represented by edge detectors, this may impact on their effectiveness in such circumstances. The CIMEDNet that was trained with frozen convolutional layers also fared well, beating the IMEDNet model on the same noisy datasets despite not scoring as well on the noiseless dataset. This indicates that the feature detectors in the convolutional layers allow for more robust generalization whereas fully-connected layers are more inclined to overfit.

The qualitative result samples in Fig. 3, are also interesting. Here, original trajectories are shown in blue whereas trajectories calculated by the neural networks are shown in red and samples in matching dataset rows are identical for a fair comparison between each network. Results using the s-MNIST-RC-AWGN dataset are omitted as the noise levels are so pathologically difficult that the qualitative results are comparatively worthless. However, the CIMEDNet

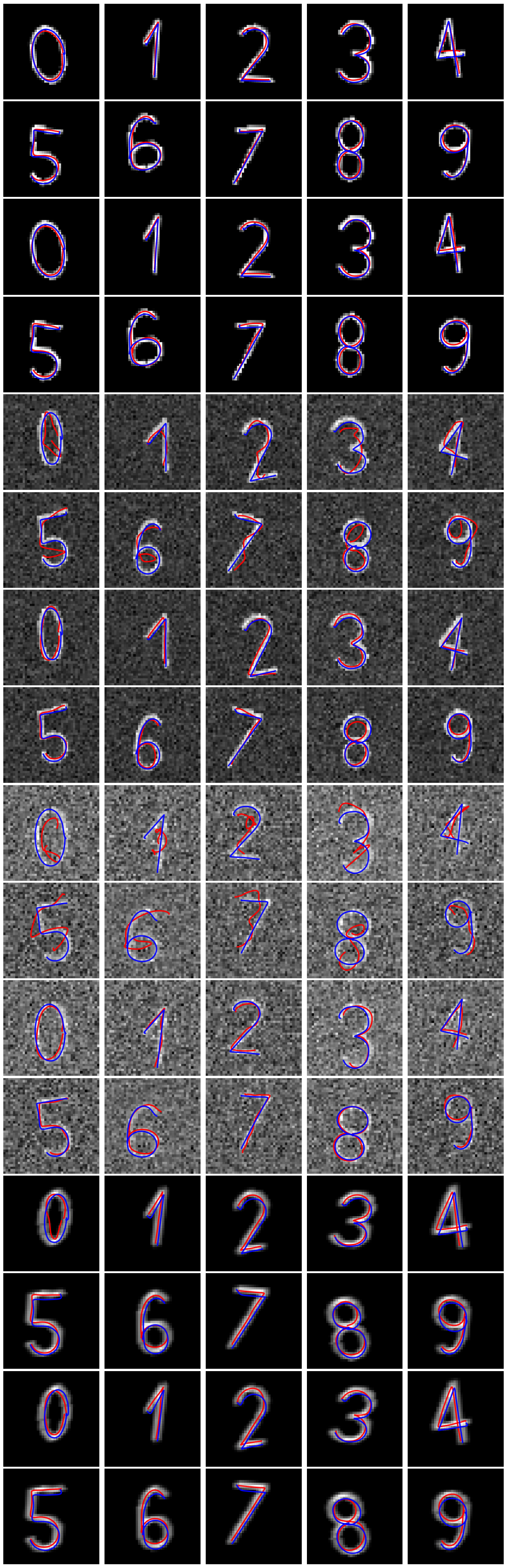

Figure 3: Example results for IMEDNet (rows 1, 2, 5, 6, 9, 10, 13 & 14) & CIMEDNet trained end-to-end (rows 3, 4, 7, 8, 11, 12, 15 & 16). Rows 1-4: s-MNIST, rows 5-8: s-MNIST-AWGN-19.0, rows 9-12: s-MNIST-AWGN-9.5 and rows 13-16: s-MNIST-MB.

model often performs surprisingly well given that it was not trained or fine-tuned on the noisy data. Both models appear to produce highly legible writing trajectories that closely match the actual trajectories in the case of the s-MNIST-MB dataset, but the CIMEDNet model is demonstrably superior to IMEDNet in many cases with the s-MNIST-AWGN-19.0 and s-MNIST-AWGN-9.5 data, producing much more legible results and demonstrating the robustness of the convolutional layers in dealing with even high noise levels.

4 CONCLUSIONS AND FUTURE WORK

We have presented an extended form of an encoder-decoder neural network for image-to-motion prediction that employs convolutional layers in the encoder in order to make the image recognition component more robust to noisy input. We have demonstrated that this architecture outperforms its predecessor on a variety of different kinds of noise. Regarding future work, we intend to further expand the capabilities of this model by incorporating layers from more powerful pre-trained CNN models into the encoder and training the network on more challenging image sets. One challenge here lies in either finding suitable image datasets that include trajectory information in their target outputs or in finding other means of producing images with corresponding motion trajectories, e.g. by gathering both in a robot simulation environment.

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Zbornik 22. mednarodne multikonference

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Interakcija človek-računalnik v informacijski družbi
Human-Computer Interaction in Information Society

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PREDGOVOR

Interakcija človek–računalnik v informacijski družbi je konferenca, ki jo organizira Slovenska skupnost za
proučevanje interakcije človek–računalnik. Namen konference je zbrati raziskovalce, strokovne delavce in študente s področja in ponuditi možnost izmenjave izkušenj in raziskovalnih rezultatov, kakor tudi navezave stikov za bodoče sodelovanje.

Tokratna, četrta reinkarnacija konference se prvič odvija pod okriljem novoustanovljenega SIGCHI poglavja ACM Chapter Bled k ustanovitvi katerega so prispevale ravno pretekle konference. O rasti HCI skupnosti v regiji pa priča tudi podvojeno število prispevkov, ki prihajajo z vseh večjih visokošolskih zavodov v Sloveniji in tudi iz tujine.

Teme, ki jih konferenca pokriva pa segajo od bolj uveljavljenih, kot so uporabnostno testiranje, vizualizacija in snovanje grafičnih uporabniških vmesnikov pa do virtualne in nadgrajene resničnosti, uporabniških vmesnikih v zdravstvu, avto-moto industriji, umetnosti in e-učenje.

FOREWORD

Human-computer interaction in information society is a conference organized by the Slovenian HCI community. The purpose of the conference is to gather researchers, practitioners and students in the field and offer the opportunity to exchange experiences and research results, as well as to establish contacts for future cooperation.

This year's fourth reincarnation of the conference is, for the first time, organized by the newly established SIGCHI Chapter ACM Chapter Bled, which is partly a result previous conferences. The growth of the HCI community in the region is also witnessed by the doubled number of contributions coming from all major higher education institutions in Slovenia and abroad.

The topics covered by the conference range from the more established ones, such as usability testing, visualization and design of graphical user interfaces to virtual and augmented reality, user interfaces in healthcare, automotive industry, arts and e-learning.

PROGRAMSKI ODBOR / PROGRAMME COMMITTEE

Analiza vpliva težavnosti računalniške igre na izmerjene vrednosti fizioloških signalov

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POVZETEK
Dobra računalniška igra je več kot samo privlačna grafika in zvok, ali zanimiv scenarij. Igralnost, pri čemer upoštevamo tudi njeno tekmovalnost in zahtevnost, predstavlja zelo pomemben vidik privlačnosti igre. Sprotno prilagajanje težavnosti med igranjem je osnova za dolgoročno privlačnost igre, vendar tovrstno prilagajanje zahteva poznavanje trenutne kognitivne obremenjenosti igralca. V tej študiji preiskujemo zmožnost široko dostopnih cenovno ugodnih naprav, ki merijo fiziološke signale, kot so pametne zapestnice, za sprotno ugotavljanje kognitivne obremenjenosti igralca. V naši študiji s pomočjo Microsoft band 2 zapestnice merimo fiziološke signale med igranjem preproste mobilne računalniške igre na treh zahtevnostnih stopnjah, ki smo jo izdelali v ta namen. Na podlagi izmerjenih podatkov in z uporabo algoritmov strojnega učenja poskušamo napovedati težavnostno stopnjo igrane igre. Rezultati kažejo, da pri napovedovanju tristopenjske težavnosti najbolje deluje model zgrajen z algoritmom Random Forest, ki je dosegel klasifikacijsko točnost 64%, pri čemer je kontrolna točnost znašala 33%. Ko pa smo omejili učinke časa nošenja zapestnice na izmerjene vrednosti, je najbolje deloval model zgrajen s pomočjo algoritma podpornih vektorjev. V tem primeru je šlo za klasifikacijo prve igrane težavnosti, ki je bila lahko lahka ali težka. V tem primeru je model dosegel 67% klasifikacijsko točnost.

Keywords
mobilno zaznavanje, strojno učenje, kognitivna obremenjenost

1. UVOD IN OZADJE PROBLEMA
Industrija računalniških iger zahteva od izdelovalcev visoko uspešnost. Zato se že od prvih začetkov komercializacije poskuša najti način, kako pridobiti igralce. Liu et al.[6] omenja vrsto tehnik, s katerimi ustvarjalci poskušajo izboljšati uporabniško izkušnjo svojih igric. Te so na primer izboljšava vizualnega okolja ali izdelava čim boljše zgodbe, vedno več pozornosti pa se posveča tudi prilagajanju težavnosti igre posamezniku.

Za doseganje sprotnega prilagajanja se lahko uporablja podatke, ki jih pridobivamo neposredno iz spremljanja igranja, primer takšnih podatkov bi bilo število zbranih točk, dosežen nivo, uporabnikov reakcijski čas, ali hitrost pritiskanja gumbov. Vendar ta način ugotavljanja obremenjenosti uporabnika zahteva posamezen model reakcij za vsako igrico posebej. Poleg tega so pri nekaterih igrah (npr. šah) reakcije bolj redke ali takšne, da je hitrost reakcije nepovezana z kognitivno obremenjenostjo uporabnika.

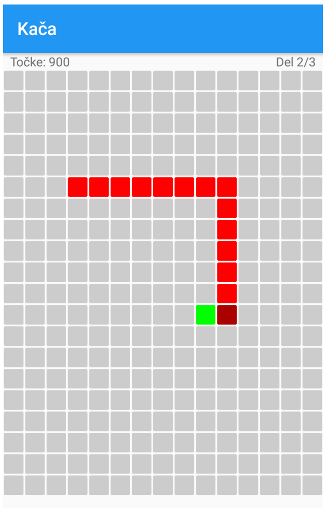
Zvišana psihološka obremenitev, npr. v obliki zahtevne naloge, povzroča aktivacijo simpatičnega živčevja, ki pa pospeši nekatere procese v telesu [2]. Znana je vrsta fizioloških signalov, ki sovpadajo z nivojem stresa, kot so na primer telesna drža, smer pogleda, EMG (elektromiogram) obraznih in drugih mišic, EKG, EEG signali. Bernardi et al. [1] so prikazali povezavo med nivojem stresa in podatki pridobljenimi iz različnih parametrov srčnega utripa. Podobno kot za srčni utrip je bila povezava prikazana tudi za druge signale, kot sta prevodnost in temperatura kože [7, 5]. Za meritev teh signalov se običajno uporablja posebna merilna oprema, ki pa je lahko draga in za uporabnika moteča. Za praktično uporabo bi bilo koristno, če bi bilo mogoče podatke pridobivati s pomočjo enostavno dostopne večnamenske in uporabniku nemoteče opreme. Poleg tega je nekatere izmed fizioloških signalov lažje meriti kot druge, zato se je za enostavno merjenje podatkov potrebno osredotočiti na lahko merljive signale, kot so srčni utrip, prevodnost kože in temperatura. Pomembno je tudi, da so ti signali čim bolj enoznačni, ponovljivi, ter da nanje vpliva čim manj stranskih dejavnikov.

Cilj raziskave je ugotoviti, ali bi bilo mogoče za določanje kognitivne obremenjenosti uporabnika uporabiti fiziološke signale, merjene z uporabo pametne zapestnice, sicer namenjene spremljanju športne vadbe. Na podlagi teh signalov bi potem lahko sprotno prilagajali parametre računalniške igre. Za preverjanje naše hipoteze smo izdelali Android aplikacijo s preprosto računalniško igro, ki jo je mogoče igrati na več težavnostnih stopnjah, med igranjem pa s pomočjo pametne zapestnice spremlja fiziološke signale igralca. Iz podatkov 22 prostovoljcev smo pripravili modele strojnega učenja, ki napovedujejo težavnost igre izključno na podlagi fizioloških signalov zajetih iz zapestnice. Rezultati kažejo, da je model zgrajen s pomočjo Random Forest tehnike najbolj natančen pri napovedovanju tristopenjske težavnosti – 64%, vendar, pri upoštevanju efekta časa nošenja zapestnice na zajete vrednosti fizioloških signalov, najbolj natančen model temelji na metodi podpornih vektorjev in dosega 67% natančnost pri napovedovanju dvostopenjske težavnosti.

2. UPORABNIŠKA ŠTUDIJA

2.1 Igrica

Za potrebe študije je bilo potrebno izdelati primerno računalniško igrico. Pomembno je bilo, da je igrica enostavna in razumljiva najširšemu krogu uporabnikov, da ima na igranje igre izkušenost igralca čim manjši vpliv, da igra omogoča enostavno spreminjanje težavnosti, ter dovolj zahtevna, da od uporabnika zahteva dovoljšnjo mero miselnega napora. Na podlagi teh zahtev smo se odločili za uporabo igre Kača. Izdelali smo svojo verzijo Kače za Android naprave. Igrici smo lahko enostavno prilagajali težavnost s pomočjo spreminjanja hitrosti premikanja kače. Med igro aplikacija zbira in shranjuje podatke s pametne zapestnice, ki je prek Bluetooth povezave povezana na telefon.



Slika 1: Zaslonski posnetek igre Kača

2.2 Pametna zapestnica

Uporabili smo pametno zapestnico Microsoft band 2 nižjega cenovnega razreda (cca. 100 EUR), ki je primarno namenjena spremljanju telesne vadbe. Zapestnica je merila podatke o srčnem utripu, prevodnosti kože in temperaturi kože. Poleg tega smo merili tudi pospeške, ki jih je občutila zapestnica.

2.3 Protokol testiranja

Med testiranjem so udeleženci raziskave igrali igro Kača na treh različnih težavnostnih nivojih. Vsak nivo je trajal vsaj dve minuti, vendar ne več kot tri minute. Takoj po končani posamezni težavnostni stopnji so udeleženci odgovorili na vprašalnik za določanje občutene zahtevnosti. Težavnostne stopnje so si sledile v vrstnem redu od najlažje do najtežje ali pa od najtežje do najlažje. Izbira med enim ali drugim zaporedjem je bila določena naključno. V naši raziskavi je tako 59% uporabnikov začelo igro z najtežjo stopnjo težavnosti. Za dve možni zaporedji smo se odločili zato, da smo lahko zagotovili čimbolj enostavno analizo podatkov. Zaradi pomanjkanja prostovoljcev so nekatere osebe izvedle več testov. Vse skupaj smo tako izvedli 27 eksperimentov.

Vprašalnik za določanje občutene zahtevnosti je vseboval šest vprašanj, ki jih določa NASA-TLX [4] vprašalnik, dodali pa smo še dve splošni vprašanji in sicer kako zahtevna ter kako zabavna se je uporabniku zdela igra. Vprašanja, ki jih določa NASA-TLX vprašalnik ocenjujejo miselni, fizični, ter časovni napor, kvaliteto izvedbe, vloženi trud in frustracijo. Na ta vprašanja so uporabniki odgovarjali z odgovori na 21 stopenjski Likertovi lestvici. Za oceno občutene zahtevnosti smo uporabili povprečno vrednost vseh odgovorov na NASA-TLX vprašanja.

3. ANALIZA IN REZULTATI

Zbrane podatke smo analizirali tako, da smo iz surovih podatkov najprej izračunali vrsto različnih značilk, nato pa smo uporabili različne algoritme strojnega učenja za napovedovanje težavnosti igre na podlagi teh značilk. Algoritme smo nato testirali z uporabo prečnega preverjanja, pri katerem smo v vsakem koraku kot testno množico uporabili podatke enega od uporabnikov, čigar podatkov nismo uporabili za gradnjo modela. Povezavo med značilkami in težavnostjo smo ocenjevali s pomočjo dosežene klasifikacijske točnosti.

3.1 Uporabljene značilke

Iz izmerjenih podatkov smo na podlagi metode Gjoreskega [3] izpeljali različne značilke osnovane na srčnem utripu, prevodnosti kože in temperaturi kože.

Značilke osnovane na srčnem utripu. Pričakujemo, da se bosta stres in miselni napor v srčnem utripu odražala tako, da se ob prisotnosti miselne obremenitve frekvenca srčnega utripa zviša, posledično se povprečen interval med utripi zmanjša, variabilnost intervalov med udarci srca pa se zmanjša [1], [8]. Zato so najpomembnejše lastnosti srčnega utripa, ki jih želimo zajeti v izpeljanih značilkah, frekvenca srčnega utripa in variabilnostih intervalov med posameznimi utripi (glej Tabelo 1).

Značilke osnovane na prevodnosti kože. Nourbakhsh et al. [7] so pokazali, da se stres in miselni napor odražata tudi v prevodnosti kože, zato smo uporabili tudi več značilk izpeljanih od tod (Tabela 2).

Značilke osnovane na temperaturi kože. Prikazano je bilo, da se stres in miselni napor odražata tudi v temperaturi kože. Primer tega so pokazali Herborn et al. [5], ki so raziskovali vpliv stresa na temperaturo kože pri toplokrvnih živalih. Zato smo izpeljali tudi nekaj osnovnih značilk iz temperature kože (Tabela 3).

Ime značilke	Oznaka
Povprečni srčni utrip	mean_hr
Povprečen čas med dvema zaporednima utripoma	ibi
Standardna deviacija časov med zaporednimi utripi	sdnn
Koren povprečja kvadratov razlik med sosednimi intervali	rmssd
Odstotek intervalov med zaporednimi utripi, ki so večji od 20 milisekund	pnn20
Odstotek intervalov med zaporednimi utripi, ki so večji od 50 milisekund	pnn50
SD1 indeks Poincarjevega grafa	sd

Tabela 1: Značilke osnovane na srčnem utripu.

Ime značilke	Oznaka
Povprečje prevodnosti kože	meanGsr
Standardna deviacija prevodnosti kože	stdGsr
25. centil prevodnosti kože	q25Gsr
75. centil prevodnosti kože	q75Gsr
Razlika med 1. in 3. kvartilom	qdGsr
Vsota odvoda signala prevodnosti kože	derivGsr
Povprečna moč signala, ki je izračunana kot povprečje kvadratov prevodnosti	powerGsr
Povprečno število vrhov na sekundo	rate_peaks
Vsota pozitivnih vrednosti v odvodu signala deljeno s številom meritev	sum_pos_deriv
Delež pozitivnih vrednosti v odvodu signala	prop_pos_deriv
Vsota odvoda osnove signala	deriv_tonic
Povprečna razlika med signalom in osnovo signala	sig_tonic_diff
Moč signala v različnih frekvencah	fp01-fp06
Razlika med maksimumom in minimumom signala	sig_overall_change
Razmerje med trajanjem največje spremembe in velikostjo spremembe.	change_rate
Značilke spremembe amplitude signala	*
Značilke vrhov signala	*

Tabela 2: Značilke osnovane na prevodnosti kože. * - združeno zaradi prostornih omejitev.

3.2 Rezultati klasifikacije

Podatke za analizo smo pripravili tako, da smo iz izmerjenih podatkov izračunali značilke. Napovedovalne modele smo nato testirali na rezultatih enega udeleženca naenkrat. Model smo učili na rezultatih preostalih udeležencev. Pri tem smo uporabili naslednje algoritme: random forest (RF), support vector machine (SVM), AdaBoost in logistična regresija (Log. reg.). Najboljšo klasifikacijsko točnost smo dobili z uporabo random forest (RF) algoritma, ki je pravilno napovedal 64% meritev (Tabela 4). Za kontrolo smo uporabili konstantni klasifikator.

Glede na to, da nam random forest klasifikator daje najboljše rezultate, je smiselno, da si ga podrobneje ogledamo. Če pogledamo matriko napovedi (Slika 2), lahko vidimo, da se srednja težavnost klasificira zelo dobro, med tem ko se pri ostalih dveh težavnostih bolj pogosto zgodi, da jih klasifikator zameša.

Ime značilke	Oznaka
Povprečna vrednost temperature kože	st_mean
Standardni odklon temperature kože	st_std
Razlika med kvartili temperature kože	st_qd
Povprečna hitrost spreminjanja temperature kože	st_diff

Tabela 3: Značilke osnovane na temperaturi kože.

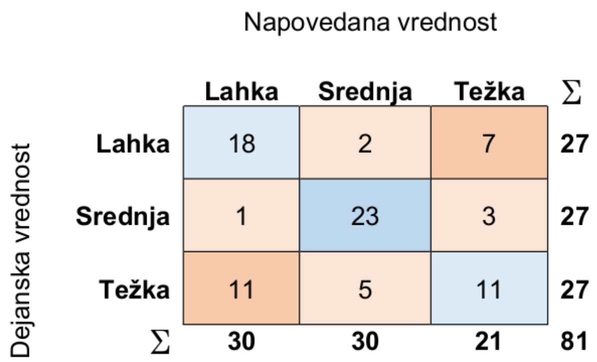
Tabela 4: Rezultati testiranja napovednih modelov. CA – classification accuracy (natančnost klasifikacije), AUC – Area Under Curve (območje pod krivuljo).

	Več. klas.	RF	SVM	AdaBoost	Log. reg.
CA	0.333	0.642	0.494	0.519	0.506
AUC	0.500	0.815	0.636	0.639	0.660

3.2.1 *Odvisnost meritve od trajanja uporabe zapestnice*

Kar nekaj izmed uporabljenih značilk se močno spreminja v odvisnosti od časa nošenja zapestnice, kar bi lahko povzročilo, da bi se klasifikator naučil ločevati med fazami testa na osnovi časa nošenja zapestnice namesto na osnovi dejanske težavnosti naloge. Ta učinek smo poskusili zmanjšati tako, da je polovica udeležencev različne težavnosti reševala v obratnem vrstnem redu, vendar pa se nam je ravno zaradi rezultata, da klasifikator večkrat zameša skrajni težavnostni stopnji, pojavil sum, da je težava kljub temu ukrepu še vedno prisotna. Ta sum smo še dodatno potrdili s tem, da smo uporabljene značilke rangirali na podlagi vrednosti gain-ratio. Ob tem smo ugotovili, da najvplivnejše značilke temeljijo na prevodnosti ter temperaturi kože in so zato odvisne od časa nošenja zapestnice.

Da bi to neželeno odvisnost odstranili, smo analizo podatkov ponovili na ta način, da smo pri vsakem izmed testiranj enako kot prej podatke normirali na podlagi vseh treh faz testiranja, pri klasifikaciji pa smo uporabili samo prvo fazo testiranja. Na ta način smo izločili večino učinkov, ki jih ima čas nošenja zapestnice na rezultate. V tem primeru sta bila ciljna razreda samo dva: lahka in težka stopnja, pri tem je težki stopnji pripadalo 59% podatkov (Tabela 5).



Slika 2: Matrika napovedi za random forest.

Tabela 5: Rezultati napovedovanja težavnosti prve faze testiranja.

	Več. klas.	RF	SVM	AdaBoost	Log. reg.
CA	0.593	0.630	0.667	0.667	0.630
AUC	0.500	0.600	0.625	0.625	0.600

V tem primeru vidimo, da je najboljši klasifikacijski algoritem metoda podpornih vektorjev (SVM), ki je dosegel 67% klasifikacijsko točnost. Ta vrednost sicer ni veliko višja od izhodiščne vrednosti, ki znaša 59%, vendar pa kljub temu nakazuje na to, da obstaja določena povezava med izmerjenimi fiziološkimi podatki ter težavnostjo igrane igre. Nekoliko slabši rezultat lahko pripišemo tudi dejstvu, da je bila za postavitev modela uporabljena samo tretjina meritev, saj smo za analizo uporabili samo podatke prve težavnostne stopnje od treh odigranih.

4. ZAKLJUČEK

V tem projektu smo poskusili ugotoviti, ali bi bilo mogoče uporabiti fiziološke signale, pridobljene s pomočjo pametne zapestnice, za ugotavljanje zahtevnosti igre, ki jo igra igralec. Poskušali smo potrditi hipotezo, da obstaja povezava med izmerjenimi biološkimi signali in težavnostjo igre, ki jo igra igralec. Za potrditev hipoteze smo izvedli eksperiment, pri katerem so prostovoljci igrali preprosto računalniško igro na treh različnih težavnostnih stopnjah. Med igranjem smo preko pametne zapestnice Microsoft band 2 spremljali njihove fiziološke signale in iz njih izračunali vrsto značilk. Na podlagi teh značilk smo z uporabo različnih algoritmov strojnega učenja izdelali modele za napovedovanje težavnosti igrane igre na podlagi uporabljenih značilk. Težavnost smo klasificirali v tri razrede in dosegli 64% klasifikacijsko točnost, vendar smo odkrili, da na napovedi vpliva čas nošenja zapestnice. Zaradi tega smo analizo ponovili tudi tako, da smo za vsak test upoštevali le prvo stopnjo testiranja, ki je imela pri nekaterih testih težko, pri nekaterih pa lahko težavnost. Na ta način smo se izognili učinkom trajanja nošenja zapestnice. V tem primeru so klasifikatorji dosegli točnosti okoli 67%, kar je občutno več kot 59%, ki jih je dosegel kontrolni klasifikator. Na podlagi teh rezultatov lahko potrdimo, da povezava med našimi izmerjenimi signali in težavnostjo igre res obstaja in da bi bilo mogoče sprotno prilagajanje iger z uporabo komercialno dostopne in splošno namenske opreme, ki igralcu ni moteča. V prihodnosti načrtujemo eksperiment razširiti z uporabo značilk, ki niso odvisne od časa nošenja zapestnice oziroma bi učinek nošenja zapestnice pri odvisnih značilkah zmanjšali z uporabo ustrezne normalizacije signala.

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Privacy preserving indoor location and fall detection system

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ABSTRACT

In this paper we present a prototype implementation of location aware floor tiling system. The prototype is based on cost effective and readily available sensors and controllers. They were designed to be easy to install and modular. A dynamic range adjustment algorithm was developed to make the system more flexible and more material agnostic. This allows the sensors to be integrated under virtually any flooring. The system was designed for passive and privacy preserving location detection but can be applied in various fields. In this paper we focus on the application of the technology for fall detection, studying behaviour patterns of buildings occupants, and other telemetry related to health.

CCS CONCEPTS

• **Computer systems organization** → **Embedded and cyber-physical systems**; • **Human-centered computing** → *Human computer interaction (HCI)*; • **Software and its engineering** → Software notations and tools.

KEYWORDS

Privacy preservation, Sensor Network, Location Detection, Smart Buildings

1 INTRODUCTION

Smart buildings have gained a lot of attention from both research and industry. Collecting information about the state of the building and its occupants can be very beneficial to many fields ranging from structural health monitoring, studying behavioral patterns that aid in designing buildings, and monitoring the health of a building's occupants. Most software and hardware combinations require knowledge about the position of occupants within the building at any given time. The existing approaches to on-site location data collection suffer from both usability issues and technological obstacles. Typical implementations include but are not limited to wearable devices (i.e., location aware bracelets) that can be discarded by unaware users, or require frequent battery charging, on-site support, and maintenance. Sensor networks that do not rely on wearable devices usually include cameras and microphones coupled with automatic face detection software that have a psychological impact on occupants and raise privacy concerns. To overcome these issues, the inventors designed a network of force resistor sensors deployed under the finishing layer of a floor. A high enough density of sensors allows for very accurate location detection, as well as detection of other forced-based phenomena such as falls. Additionally, walking patterns can be detected and analyzed to not only locate buildings occupants but plot a historical path. Moreover, the data can be used to create a heat-map and study behavioural patterns in of certain locations within the building. The Internet of Things (IoT) is experiencing widespread adoption across industry sectors ranging from supply chain management to smart cities, buildings, and health monitoring. However, most architectural patterns for IoT deployment rely on centralized cloud computing infrastructures [10] for providing storage and computing power. Cloud providers have high cost-based incentives to organize their infrastructure into clusters. Concerns about data protection and privacy have been growing in recent years due the frequency and severity of big data breaches becoming public [13]. As IoT adoption grows, more privacy preserving solutions and architectures must be developed to protect sensitive user data and at the same time allow harnessing the true potential of large scale sensor networks. The overall fall detection system market was valued at USD 358.6 million in 2016 and is expected to reach USD 497.3 million by 2022, at a CAGR of 5.58 % between 2017 and 2022 [12]. The growth of the fall detection market is largely driven by the growing population of older adults that can benefit from better accessibility to assistance in case of falls, improved health outcomes for those that fall, reduced medical expenses. In turn, these factors have driven increased demand for smartphone and wearable technology-based fall detection systems, and increased demand for multimodal technology. However, the low practicality and acceptability of the technology among older adults, and the use of data from simulated conditions for designing fall detection system algorithms acts as a restraining factor for the market. The technology proposed here addresses exactly these restraints. Multimodal sensors include accelerometers and gyroscopes; magnetometers; and audio, images, and video clips via speech recognition and on-demand video techniques. The last group is avoided by our system as it clashes with personal data concerns. The popularity of machine learning methods is the primary reason behind the growth of the market for multimodal sensors in the fall detection system market. Machine learning algorithms needs an array of data sources (e.g., sensor data) to carry out a real-time analysis of numbers and differentiate a fall from other activities of daily living [4]. Along with this, multimodal sensors also use artificial intelligence (AI) to detect falls.

2 POTENTIAL USE CASES

Two key features of the proposed solution are high availability and low costs. These attributes make the technology suitable for a wide range of solutions in a variety of environments. The inventors have proposed the following use-cases:

- Specifically designed algorithms that can detect accidental falls which can be used in homes for older adults, rehabilitation centres, and other cases that support fall-prone individuals. In case a fall is detected the system alerts caregivers.
- Analyzing collected data can provide more insights into how specific areas of the building are being used. This information can help optimize the design of future buildings (and improve existing ones), improve energy efficiency, and optimize the use of active systems. These gains apply to multi-passenger vehicles such as cruise ships and airplanes, as well.
- Specific solutions where anonymous tracking of occupants is needed, such as health institutions treating patients with Alzheimer's, and buildings with high occupancy dealing with extraordinary situations (i.e., when evacuation is required before activating fire suppression systems).

The proposed solution falls into the broad category of smart building technologies. It is estimated that global IoT smart building market will approach $51.44B USD globally by 2023 and 33 % of IoT smart building market will be powered by AI technologies by then. North America will lead the IoT smart building market with 36 % share. Smart building automation systems will grow at 48.3 % CAGR from 2018 – 2023. The key solution areas are MEC, 5G, real-time IoT data analytics, and asset tracking.

3 STATE OF THE ART - RESEARCH AREA DESCRIPTION

Demographic change towards an older society has driven both interest and innovation in technological solutions for older adults. However, technology adoption by older adults is lower than in other demographic segments. Lee and Coughlin [9] cite a lack of understanding in the needs, lifestyles, and expectations from technologies designed for them by a younger demographic. This gap poses an obstacle to realizing the potential of fall-detection technologies (and other solutions). However, passive solutions that remain cost competitive should encounter fewer barriers to adoption. Fall detection systems that maintain privacy and don't require active use (i.e., don't require actively wearing a monitoring device) are likely to be considered a valuable system by more users.

While there is no clear agreement on how to classify fall detection systems [6], the simplest classification is into two broad categories: wearable, and non-wearable [2, 8]. Wearable systems are typically based on accelerometers or gyroscopes in garments or other worn items (i.e., jewelry) that detect changes in the plane of motion [2]. Non-wearable systems are typically environmental sensors that may be cameras (e.g., infrared, video), acoustic sensors like microphones, or pressure plates [2]. Other classifications of fall detection systems are divided based on data source (i.e., vision-based, ambient sensors, kinematic sensors; [5]); data availability (i.e., because falls are rare events, a taxonomy based on data sufficiency is critical [7]). Other perspectives on fall detection are based on more human-centric approaches and discuss the status of the person before and after the fall (i.e., falls from sitting and standing positions may present themselves differently to different sensors, or that differences in body shape and position may impact fall detection to different sensors) [14]. Fall detection systems based on mobile devices has recently gained interest as well (c.f., [3], [1], [11]).

In addition to the value fall detection systems provide and their cost, other major concerns are privacy and reliability. The reliability of passive wearable devices are influenced by system issues (e.g., power source, connectivity, functionality, etc.) in addition to the requirement that they be worn, which requires active measures from the user. Non-wearable passive systems have the same system reliability concerns, but do not require active engagement from the user to fulfill their purpose. However, passive systems require the system be installed where the user will spend their time. Some active systems can follow the user beyond the confines of their residence, for example those based on mobile devices connected to cellular networks.

Fall detection systems are largely targeted towards older adults and other vulnerable groups that are likely to suffer from falls. However, the same technology can be applied in other situations as well. Pressure sensing floors may also be used to detect the presence of people in critical areas, for example to ensure an evacuation has occurred before fire suppression systems that can harm or kill people are activated. These systems operate based on sensors installed in floor systems that may replace standard floors entirely or may be mats that cover floors in critical areas.

4 THE PILOT IMPLEMENTATION

The pilot implementation is a floor system measuring 120 cm by 120 cm, with a standard laminate flooring surface over a layer of rolled foam insulating subfloor. Below this layer, a system of 9 force sensors are placed and wired to an Arduino micro-controller. When force is applied to the floor, for example by walking across, standing, or placing objects on it, voltage differential is measured to obtain estimates of amount of force applied to each sensor individually. The type of sensors used in pressure sensing tiles are force sensitive resistors that can sense force anywhere in the range of 100g-10kg.

The range can be altered by applying different resistance which was used to increase the interval to 30kg. The sensor network is dynamic, making it difficult to model. There are many factors contributing to the constant change in differential between force applied on the top of the floor tiling (i.e., walking) and measured force mostly due to unpredictable changes in the materials on all layers. Moreover, there are discrepancies between the sensing ranges of each individual sensor. Due to the varying compression resistance in the floor materials, one sensor in the network can measure higher pressure differentials than others where the material compresses less. Our solution is a dynamic range adaptive algorithm that constantly adapts the sensing range obtained from the initial calibration process. For each sensor, bounds are set as an interval $[x, y]$. The algorithm monitors the data stream and searches for new maximum and minimum values that are used to decrease the lower bound x or increase the upper bound y respectively. However, the increase is done by using the moving average with a configurable window. This is to mitigate potential outliers. To test the prototype, an application was built that can process the data stream from the controller and visualize the pressure detection in a form of a heat map. The software also includes a calibration guide for the initial setup that can be observed in Figure 2. The application also provides the an interface for data analysis. Modules can be developed to hook up to the data stream. The data stream is a snapshot of sensor data sent over a serial port (USB) every 200ms. The interface will be used to develop different modeling techniques to detect falls such as neural networks, association rules, etc.

Figure 1: Prototype solution using off-the-shelf sensors under a standard laminate floor. Arduino Mega collects all the data and a program on a notebook running all our algorithms visualizes possible fall situations.

5 DISCUSSION AND FUTURE CHALLENGES

A pilot implementation of the hardware and software solution was prepared at the beginning of 2019 and presented at the Chamber of Commerce and Industry of Slovenia at the Future Living exhibition. The setting was on display (and available for testing) for four months with no intervention. The setting comprised of an array of pressure sensing sensors integrated in a laminate floor system. The sensors were connected to a micro-controller that dynamically adjusted the sensing ranges of the array. The algorithm was capable of sensing and later ignoring placed objects. Although the technology has been tested on a small pilot implementation, the challenges presented by a specific implementation setting will bring unforeseen challenges. These challenges are amplified as most of the expected use cases involve humans and

Figure 2: Software calibration

human behaviour is hard to model. The integration of the proposed systems to the customer's environment depends also on the technologies used by the customer although the systems were developed using open interfaces. Additionally, the behaviour of the sensor grid must be tested on other materials that are less flexible and hence, decrease the sensing accuracy of the load cells. Mass production of the sensor tiles is also an aspect that still needs to be addressed. At the time of writing, a modular design based on integrated connectors in the shape of puzzle pieces is being considered. The puzzle type tiles could allow for seamless assembly with no wiring needed to create a special sensing layer underneath any type of floor.

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Exploratory data analysis of stream data in sports medicine domain

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ABSTRACT

In statistics, exploratory data analysis (EDA) is an approach to analyzing datasets to summarize their main characteristics, often with visual methods. A statistical model may optionally be used, but primarily EDA is for seeing what the data can tell us beyond the formal modeling or hypothesis-testing task. In this paper, we focus on analyzing stream data for the sports medicine domain, collected with a Polar M400 sports watch, with the aim of predicting the heart rate that the athlete must sustain on each race segment in order to achieve the best overall result (finishing time). We first provide an overview of data analyzing models for stream data. Next, we present related work, our data, and preliminary insights from visualizations after data preprocessing. Finally, we conclude the paper with a summary and future work.

CCS CONCEPTS

• **Applied computing** → *Health informatics*; • **Computing methodologies** → *Machine learning approaches*.

KEYWORDS

Data analysis, stream data, time-series data, sports medicine, heart rate.

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1 INTRODUCTION

Advances in GPS technology have enabled users to track outdoor activities like running, swimming, hiking, or cycling with their smartphones or GPS-enabled watches. Instead of merely gauging average pace, users can record their exact routes, as well as elevation changes, heart rate (HR) frequency, and other data.

In sports such as cycling, the main variable for training planning and analysis is the power expressed by each pedal stroke, but in running, and particularly in trail running, there is no universally accepted method to measure the power output of the athlete. For that reason, the main variable we consider in this study is heart rate. Accurate heart rate monitoring is essential in fitness, training, and testing. Clapp and Little [3] showed that manual pulse palpation provides inaccurate results. The use of the electrocardiogram (ECG) or Holter monitoring is too costly and complex for athletes to use in the field. The first wireless heart rate monitor, the portable Polar PE 2000, was introduced in 1983. It consisted of a transmitter and a receiver. The transmitter could be attached to the chest using either disposable electrodes or an elastic electrode belt. The receiver was a watch-like monitor worn on the wrist. The wireless Polar heart rate monitoring method was developed in the Department of Electronics at the University of Oulu. In the beginning, the heart rate monitors were targeted for coaches and athletes to optimize the quality and efficiency of training. Soon, exercise scientists started to research the monitors and use them in their work. Today, the selection of heart rate monitors includes easy-to-use products for everyone interested in wellness, fitness, and health [9].

Sports watches had been one of the most important training tools for every amateur and professional athlete in the past, and after incorporating GPS technology, they became even more valuable. These watches have huge advantages over previous generations of devices, because they precisely measure characteristic training data. As a result, runners and cyclists do not need to use any special sensors for determining their speed, altitude, or duration of activity [6].

Selecting the most promising algorithm to model and predict a particular phenomenon is the main interest of temporal data forecasting. Forecasting (or prediction), similarly to other data mining tasks, uses empirical evidence to select the most suitable model for the problem at hand, since no modeling method may be considered the best [12]. Each tracked activity is saved into a file. Data mining could be applied to this collection of data, which would help athletes analyze their workouts, predict their further training activities, give advice about nutrition, etc. [5].

This paper is organized as follows. In Section 2 we go over related work. Next, in Section 3 we present our data and the results of EDA. Finally, we present future work and conclude the paper in Section 4.

2 RELATED WORK

Current state-of-the-art in data analysis for time-series data based on HR comprises diverse research, ranging from clinical decision-support systems, over heart disease predictions, to smart coaching. In this section, we briefly review existing work in the sports domain, which is closely related to our proposed problem.

Fister et al. [6] introduce a novel intelligent planning method for training sessions: training plans are computer-generated using the Bat Algorithm, according to reliable data obtained from sports watches.

Gronwald et al. [7], use detrended fluctuation analysis to assess heart rate correlation properties, examine the influence of exercise intensity on total variability and complexity in non-linear dynamics of heart rate variability.

Billat et al. [1] detect marathon asymmetry with a statistical signature. They tested marathon running performance, and revealed significant statistical features by analyzing speed time-series data recorded by 273 runners' GPS trackers. The combination of trend and asymmetry build up a statistical signature for the speed time-series, which is identical regardless of performance level, gender, or race profile.

Using data from the GPS-based Strava application, Marty [11] predicts the speed of individual riders, at specific times in the day, on a 2-mile segment of a popular cycing track using Ridge Regression model.

Jin [8] uses data from previous training runs, and applies four regression models to predict a run pace for a specific route or segment in future runs: basic linear regression, as well as Weighted, Ridge regression, and Lasso regression.

Pharoah [13] develops and validates a new walking pace function using crowd-sourced GPS data. There are several functions hikers use to predict walking time based on elevation change or slope, the most popular of which is the Naismith function.

Parmezan et al. [12] provides a systematic literature review of the last decade, identify state-of-the-art models for time-series prediction, and test those methods on 95 datasets. They conclude that SARIMA is the only statistical method able to outperform, but without a statistical difference, the following machine learning algorithms: ANN, SVM, and kNN-TSPI. However, such forecasting accuracy comes at the expense of a larger number of parameters.

3 DATA COLLECTION

The dataset used for this project was extracted from the Polar Flow API[1]. Polar Flow is a free online tool for planning and analyzing training, activity, and sleep, using data tracked with Polar devices.

The analyzed data was collected from a single athlete's Polar M400 sports watch, in the period between June 2017 and July 2019. In that time, 133 training sessions were logged in various sport profiles: 'running', 'trail running', 'hiking', 'orienteering', 'vertical sports wall climbing', 'watersports kayaking', 'strength training', 'mobility dynamic', 'mobility static', 'core', 'other outdoor', and 'other indoor'. The Polar M400 wrist watch is equipped with a GPS sensor, and paired with a chest strap heart rate monitor. Each training session's data is stored in a separate .json file. This data was preprocessed, and multiple features used for data visualization.

The data was parsed into two separate csv files: "summary data" (further reference MV01), containing a brief overview of each logged training session; and "seconds data" (further reference MV02), containing detailed information recorded for every second of a particular training session.

In outdoor activities, GPS related data is stored in intervals of one second: HR (heart rate), altitude, speed, distance and GPS position (longitude and latitude). This were the training sessions we are interested in because we want to find out how is one's heart

[1] https://flow.polar.com/

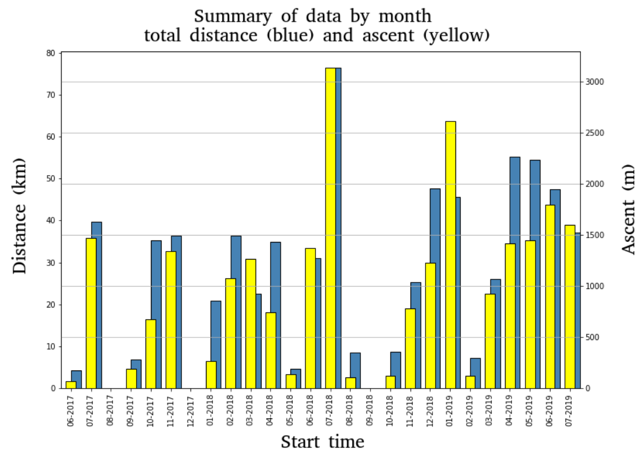

Figure 1: Summary of data by month; total distance (blue) and ascent (yellow)

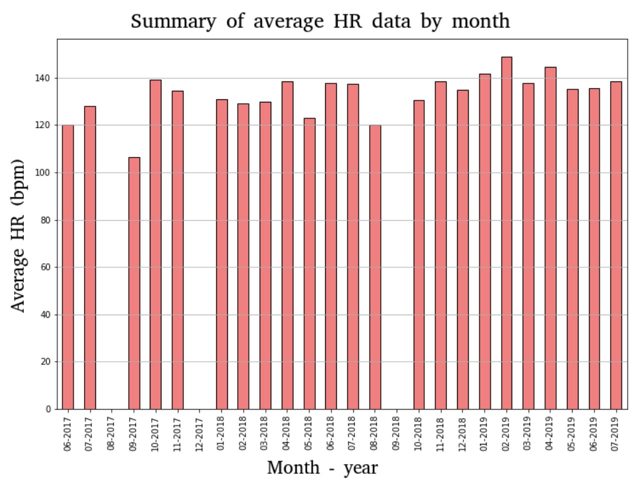

Figure 2: Summary of average HR data by month

responding to different terrain (slopes) and to progress over time due to training sessions done in the past.

In parsed files (MV01 and MV02), if some row of the file had missing data, it meant that it either wasn't done outside (no GPS related data like speed and altitude) or that heart rate strap haven't been worn (no HR data). There was no reason for keeping this rows and they were eliminated (dropped). In the end only training sessions of running, trail running and hiking were kept.

Table 1 lists the parameters recorded in MV01. The data in this file shows a general picture of the training sessions, and is used for extracting metadata about the person conducting the training sessions. In this case, VO_2 max, maximum and resting heart rate, aerobic and anaerobic threshold were changed only once. To increase data precision, the VO_2 max [14] test should be done periodically.

From summary data given in Figure 1, we can easily see the total distance and ascent done in training sessions of every month. When the distance bar is higher then the ascent bar, the training sessions were done on easier terrain (less altitude difference gained), and on steeper terrain in the opposite case. The longest distance was crossed in July 2018 (76.5 km), followed by May and June 2019 (55.3 and 54.5 km, respectively). Additionally, Figure 2 shows the average heart rate by month. One might expect higher average HR in months of higher training intensity, but this is not the case. This data is not very useful or explanatory without information on how “hard” the training was (which is based on speed and altitude difference). That is why we moved to more informative data, aggregated in MV02.

Parameters used in MV02 are shown in Table 2. Data was collected from the same training session files, and again preprocessed.

Table 1: Attributes of summary data file

Parameter	Description
startTime	Date and time at the beginning of the training session
stopTime	Date and time at the end of the training session
sport	Activity practised in given training session (for example: running, trail running, orienteering, stretching, hiking, core, etc.)
VO2max	VO_2 max is the maximal rate of oxygen uptake it is an important determinant of cardio-respiratory fitness and aerobic performance [14]
maximumHeartRate	Maximum heart rate – a variable that is editable in an athlete’s on-line profile (based on latest test)
restingHeartRate	Resting heart rate
aerobicThreshold	Aerobic threshold – the exercise intensity (HR) beyond which blood lactate concentration is no longer linearly related to exercise intensity, but increases with both exercise intensity and duration [10]
anaerobicThreshold	Anaerobic threshold – maximum steady-state lactate concentration [4]
distance	Overall distance crossed in given training session, measured in meters (every training session starts at 0 and counts meters continuously)
ascent	Overall ascent done in given training session, measured in meters
descent	Overall descent done in given training session, measured in meters
HRmin	Minimal HR measured during given training session
HRavg	Average HR measured during given training session
HRmax	Maximal HR measured during given training session

Table 2: Attributes of detailed data file

Parameter	Description
datetime	Exact time when sensors send data, every 1 second for every training session
f_num	File number, used for easier data editing
altitude	Altitude expressed in meters (exact altitude in given second)
heartrate	Heart rate frequency (e.g. 155)
speed	Moving speed in given second
distance	Distance, measured in meters (every training session starts at 0 and counts meters continuously; this parameter shows meters crossed from start of session to current point in time)
sport	Activity practised at given training session (for example: running, trail running, orienteering, stretching, hiking, core, etc.)

Table 3: Standard slope descriptors

Slope (%)	Approximate degrees	Terminology
0 - 0.5	0	Level
0.5 - 2	0.3 - 1.1	Nearly level
2 - 5	1.1 - 3	Very gentle slope
5 - 9	3 - 5	Gentle slope
9 - 15	5 - 8.5	Moderate slope
15 - 30	8.5 - 16.5	Strong slope
30 - 45	16.5 - 24	Very strong slope
45 - 70	24 - 35	Extreme slope
70 - 100	35 - 45	Steep slope
> 100	> 45	Very steep slope

We used only training sessions of running, trail running and hiking, and missing or incomplete data was dropped. Altitude difference was calculated over intervals of one second, and data aggregated in intervals of approximately 100 meters. Slope classification was added according to Barcelona Field Studies Centre [2] to each segment (see Table 3), along with ascent or descent labels, and the data was further grouped by slope and aggregated. We can see in Figure 3 that most training sessions were done on very gentle and gentle slope.

This data is going to be used in further modeling and predicting the best HR for each incline category of future races, based on provided GPS data on the particular track, and generated heart model of the athlete.

It is visible from Figure 4 that, while average HR has its own peaks (highest HR is achieved on races), average speed increases constantly over time, which means that athlete’s overall form is improving over time.

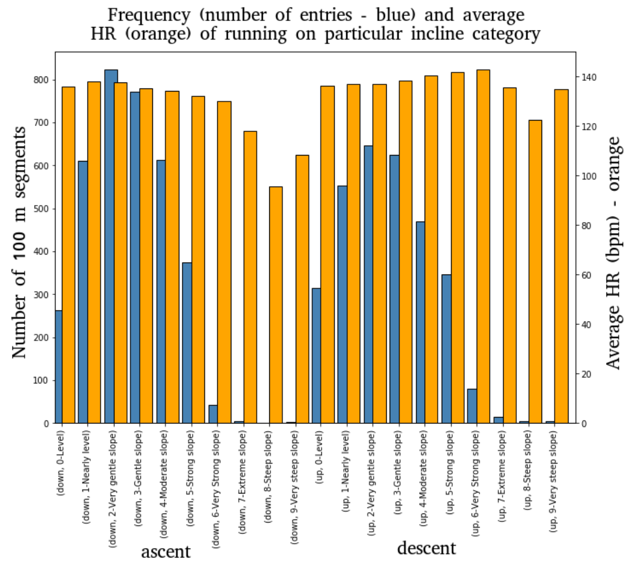

Figure 3: Frequency (number of entries - blue) and average HR (orange) of running on particular incline category

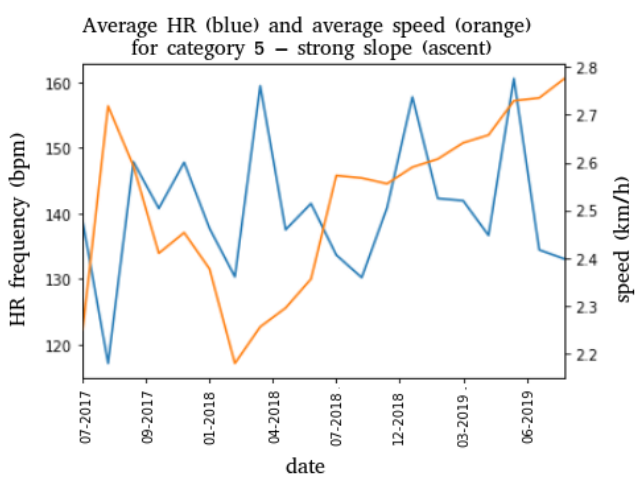

Figure 4: Average HR (blue) and average speed (orange) for category 5 – strong slope (ascent)

4 CONCLUSION AND FUTURE WORK

In recent years, wearable smart watches and devices have become very popular and widely used, along with the data-collecting capabilities they provide. Different makers of sports watches are making efforts to improve their products, in order to make them more accurate, and thus more helpful to users wanting to lead healthy lifestyles and gain improvements in sports and personal fitness.

The ultimate goal of our research is building a model for predicting a runner's ideal heart rate for particular moments and segments of their training session or future race, developed by taking into account gradual fitness improvements through time (learned through monitoring regular training), and dependant on current position (slope and incline, distance, time elapsed). Combining this information with the GPS route provided for a particular training or race track, the HR model would provide a prediction of finishing time and best maximal HR on different sections of the route, to help the athlete adjust their pace throughout the running session.

The first step in future research is to apply the most appropriate data mining methods for time-series data analysis, e.g. SARIMA, Support Vector Machine and kNN-TSPI, in order to extract interesting and usefull knowledge from our data.

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Sledenje pogledu s spletno kamero

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POVZETEK

Sledenje pogledu uporabnika med uporabo računalnika je najbolj priljubljeno v industriji iger in medicinskih aplikacijah. Čeprav so prvi sistemi za sledenje pogledu uporabljali spletne kamere, so se sčasoma v ta namen razvile posebne naprave, ki jih odlikuje precej večja natančnost in temu primerno višja cena. V naši raziskavi napravo za sledenje pogledu uporabljamo za odkrivanje disleksije pri osnovnošolcih. Zaradi želje po širši uporabi aplikacije, želimo napravo za sledenje pogledu nadomestiti s cenovno ugodnejšo spletno kamero. V pričujočem delu nas zanima, kakšno natančnost lahko dosežemo z uporabo spletne kamere in globokimi nevronskimi mrežami, ki jih uporabljamo pri učenju preslikave med položajem oči in točko na zaslonu.

Keywords

eye-tracking, webcam

1. UVOD

Sledenje očem pri uporabi računalnika postaja vse bolj priljubljeno. V industriji se najpogosteje uporablja za testiranje uporabniške izkušnje pri uporabi aplikacij in pri oglaševanju ter v industriji računalniških iger, kjer igralcu s prilagajanjem vmesnika omogoči večjo vživetost. Na raziskovalnem področju se zelo pogosto uporablja v medicinskih in psiholoških študijah, saj očesni gibi odražajo mnoge kognitivne in nevrološke motnje.

Aplikacija za odkrivanje disleksije, ki smo jo razvili v okviru projekta ŠIPK Disleksija [10], za sledenje pogledu uporablja sledilec očem proizvajalca Tobii. Čeprav je naprava relativno poceni, brez drage licence ni uporabna za naš namen. Testiranje otrok z aplikacijo je zato omejeno in dostopno le redkim. V želji po širši uporabi aplikacije želimo sledilec očem Tobii nadomestiti s cenovno ugodnejšimi in zelo razširjenimi spletnimi kamerami, kar bi uporabnikom omogočilo testiranje na domu.

V tej raziskavi poskušamo z uporabo globokega učenja in pristopov računalniškega vida doseči čim večjo natančnost sledenja pogledu s spletno kamero. Omejimo se na uporabo v aplikaciji za odkrivanje disleksije, ki je sestavljena iz šestih nalog. Štiri naloge uporabljajo večje grafične elemente in glede natančnosti niso zahtevne, dve bralni nalogi pa zahtevata visoko natančnost.

2. PREGLED PODROčJA

Sledenje pogledu s kamero je dobro raziskano; pregled metod je povzet v [2]. Problem sledenja tipično obravnavamo kot dva podproblema – zaznave očesa in napovedovanje točke pogleda. V splošnem se sorodna dela izogibajo uporabi specializiranih kamer. Tako so uporabljene kamere, kot tudi v našem primeru, povprečne kakovosti. Zaradi potrebe po delovanju v realnem času, sledenje pogledu onemogoča uporabo zahtevnih algoritmov. Komercialni sledilci očem ponujajo minimalno frekvenco 30Hz, kar je maksimalna hitrost zajemanja slik preprostih spletnih kamer.

Med pristopi, ki uporabljajo zgolj spletno kamero, so se za zelo uspešne izkazale metode, ki uporabljajo konvolucijske nevronske mreže, kar zahteva veliko količino podatkov [4, 12]. V prvem so uspeli zbrati podatkovno množico 2445504 slik in pripadajočih točk na zaslonu ter z njo dosegli odlične rezultate na pametnih telefonih in tabličnih računalnikih. V [12] so imeli bistveno manjšo učno množico – 213659 slik in priležnih točk. Primer klasičnega pristopa je predstavljen v [8], kjer za napoved uporabljajo interpolacijo, kot vhod pa točki središča zenice in zunanji očesni kotiček. Zanimiva je rešitev v [5], kjer za napoved uporabljajo vektor pridobljen iz slike očesa. Podrobnosti tega koraka lahko najdemo v [11]. Presenetljivo redko raziskave upoštevajo obraz; enostaven primer sledenja očem pri upoštevanju obraza najdemo v [7]. V članku je tudi opisano, da upoštevanje obraza ni pogosto zaradi potrebe po čim hitrejšem delovanju predlaganih pristopov.

Naša rešitev preizkuša primernost uporabe globokega učenje brez predhodnega učenja, kar ni preizkušeno v nobeni od predstavljenih implementacij.

3. TEORETIčNO OZADJE

Naš algoritem je sestavljen iz štirih delov: zaznavanje obraza (algoritem Viola-Jones), poravnave obraza z ansamblom regresijskih dreves, ocenjevanja centra očesa z gradienti slike in globoko nevronsko mrežo za modeliranje preslikave med očesom in točko na zaslonu.

Zaznavo obraza na podlagi preprostih značilk smo implementirali po [9]. Metoda razdeli obraz na kvadratne bloke, ki podajo oceno glede na razliko vsot dveh izbranih pravokotnih skupin slikovnih pik. To je mogoče izračunati zelo hitro z uporabo integralne slike, ki jo z enim obhodom izračunamo iz vhodne slike. Ker je število možnih preprostih značilnosti veliko (preko 180000 v primeru, ko je detektor velikosti 24×24), se za izbiro najboljših uporablja različico algoritma

AdaBoost. S tem med vsemi značilnostmi izberemo nekaj 100 ali nekaj 1000 takih, ki skupaj dobro delujejo. Končni algoritem deluje po principu kaskade klasifikatorjev. Za vsak nivo se z uporabo algoritma AdaBoost izbere nekaj preprostih klasifikatorjev. Njihove uteži so prilagojene tako, da na testni množici prepoznajo čim več obrazov. Napačno zaznane poskušamo odstraniti v kasnejših nivojih kaskade. Takoj, ko v enem nivoju v interesnem območju ne zaznamo obraza, to območje zavržemo.

Za poravnavo obraza smo uporabili ansambel regresijskih dreves [3]. Za učenje enega regresijskega drevesa uporabimo trojček, ki je sestavljen iz slike obraza, začetne napovedi oblike in ciljnega popravnega vektorja. Iz tega se naučimo regresijske funkcije, z uporabo algoritma iz [3] in vsoto kvadratov napake kot funkcijo izgube.

Center očesa določimo z gradienti slike po metodi [6]. Za vsako točko na sliki izračunamo vsoto vektorskih produktov med vsemi gradienti g_i in normaliziranim vektorjem premika d_i, ki imajo enako orientacijo. Vektor premika izračunamo z:

$$d_i = \frac{x_i - c}{||x_i - c||}, \forall i : ||g_i|| = 1, \tag{1}$$

kjer x_i predstavlja lokacijo gradienta g_i na sliki. Za boljšo robustnost algoritma se priporoča normalizacija gradientov. Prav tako je normaliziran vektor premika, saj tako ohranimo enako utež za vse slikovne pike. Končni optimalni center nato dobimo po enačbi:

$$c^* = \arg\max_c \left\{ \frac{1}{N} \sum_{i=1}^{N} (d_i^T g_i)^2 \right\} \tag{2}$$

Hitrost izračuna lahko zmanjšamo tako, da upoštevamo le gradiente z dovolj visoko magnitudo.

4. IMPLEMENTACIJA

Algoritem smo implementirali v programskem jeziku Python. Razdelimo ga lahko na štiri korake: zaznavanje obraza, zaznava interesnih točk na obrazu, zaznava središča zenice in napovedovanje točke pogleda.

4.1 Zaznavanje obraza

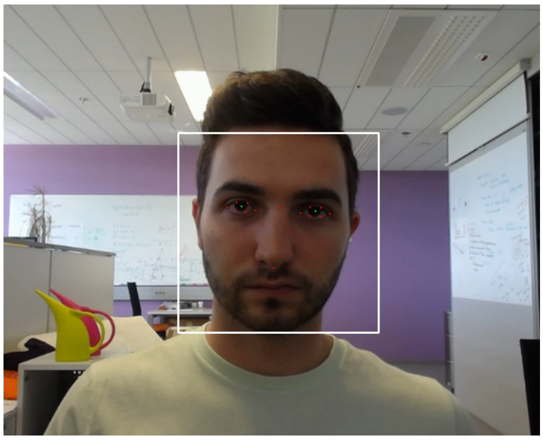
Za implementacijo algoritma smo uporabili že obstoječo implementacijo iz knjižnice openCV. Razred CascadeClassifier smo inicializirali s prednaučenimi kaskadami ("haarcascade_frontalface_default.xml"), ki so ravno tako del knjižnice. Za hitrejše delovanje smo sliko predhodno pomanjšali na velikost $(426, 240)$ in jo pretvorili v sivinsko sliko. Slednje od nas zahteva funkcija detectMultiScale, ki je del razreda CascadeClassifier. Ostala dva parametra, ki jih ta funkcija zahteva sta še skalirni faktor, ki smo ga nastavili na 1.3, kar je najmanjše število bližnjih mejnih pravokotnikov, katerega smo nastavili na 5. Rezultat funkcije so mejni pravokotniki vseh najdenih obrazov. Ker nas zanima le en obraz, med vsemi ohranimo le največjega. Razultat koraka je prikazan kot bel kvadrat na sliki 1.

4.2 Zaznava interesnih točk na obrazu

Za implementacijo tega koraka smo uporabili razred shape_predictor, ki je vključen v knjižnici dlib. Ta vsebuje tudi datoteko shape_predictor_68_face_landmarks.dat, ki jo uporabimo za inicializacijo razreda in vsebuje potrebne prednaučene parametre. Za pridobitev interesnih točk smo uporabili funkcijo predictor(), ki je del razreda shape_predictor in kot vhodna argumenta prejme sivinsko sliko in mejni pravokotnik. Sivinska slika je celotna slika, pridobljena iz spletne kamere, pretvorjena v sivinsko sliko. Mejni pravokotnik je rezultat prejšnjega koraka. Od 68 interesnih točk ohranimo le 14 izbranih. Rezultat koraka je prikazan kot množica rdečih točk na sliki 1.

4.3 Zaznava središča zenice

Za ocenjevanje centra zenice z gradienti slike smo uporabili [1]. Vhod v algoritem je sivinska slika očesa. Iz sivinske slike kamere iz prejšnjega koraka na podlagi interesnih točk izrežemo obe očesi. Nad dobljenima slikama uporabimo funkcijo iz knjižnice openCV, equalizeHist(). Obe sliki nato ločeno podamo v funkcijo locate(). Rezultat funkcije za vsako sliko sta x in y koordinati središč obeh zenic. Rezultat koraka je prikazan z zelenima točkama na sliki 1.



Slika 1: Prikaz dobljenih središč zenic (zelena barva), ohranjenih interesnih točk (rdeča barva) in mejnega pravokotnika okoli obraza.

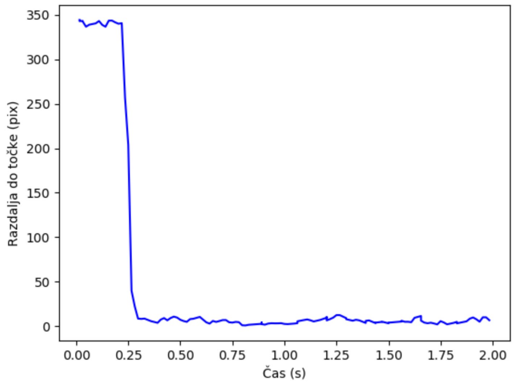
4.4 Napovedovanje točke pogleda

Iz knjižnice dlib smo uporabili razred MLPRegressor za implementacijo globokih nevronskih mrež. Tej smo pri inicializaciji nastavili 5 parametrov. Velikost skritih nivojev smo nastavili na $(23, 14, 6)$. Največje število epoh smo omejili na 500. Za aktivacijsko funkcijo smo uporabili ReLU. Za reševalnik smo nastavili adam. Toleranco smo nastavili na 10^{-5}. Vhodni nivo mreže prejme 48 parametrov sestavljenih iz 14 interesnih točk in 2 točk, ki predstavljata center zenice. Vhodne parametre pred učenjem s pomočjo razreda StandardScaler (del openCV knjižnice) s funkcijo transform() prilagodimo na interval, primeren za učenje.

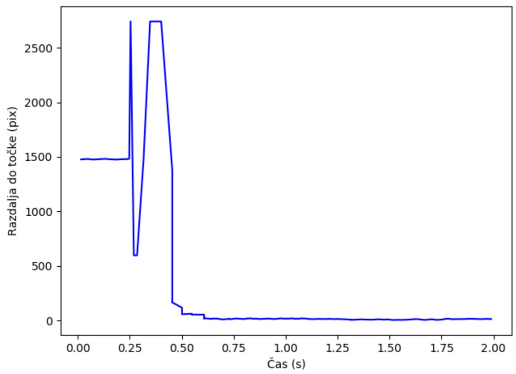
5. EKSPERIMENTI

Velik vpliv na točnost napovedi ima začetna kalibracija sistema: uporabnik na črnem zaslonu gleda v prikazujoče se rdeče točke. Na zaslonu je hkrati prikazana le ena točka na naključni lokaciji. Kalibracija je nujen korak za uporabo sledilca in je unikatna za vsakega uporabnika.

V sklopu delovanja in za potrebe eksperimentov definiramo



Slika 2: **Prikaz razdalje od napovedane točke pogleda do dejanske točke v odvisnosti od časa.**



Slika 3: **Prikaz razdalje od napovedane točke pogleda do dejanske točke v odvisnosti od časa.**

dodatne omejitve, vezane na aplikacijo za odkrivanje disleksije. Kamera mora biti fiksna, z resolucijo 1280 in hitrostjo vsaj 30 sličic na sekundo. Glava mora biti med uporabo od začetka kalibracije naprej v statičnem položaju, uporabnik pa v dobro osvetljenem okolju. Poleg tega pri vseh eksperimentih uporabljamo še nekaj statičnih parametrov. Zaslon z diagonalo 59.44 cm in ločljivostjo 1920×1080. Oddaljenost uporabnika od zaslona je 55 cm. Dolžina kalibracije je omejena na 5 minut. Predstavljeni eksperimenti so izvedeni na enem uporabniku.

5.1 Okno zajema podatkov in dolžina prikaza točke

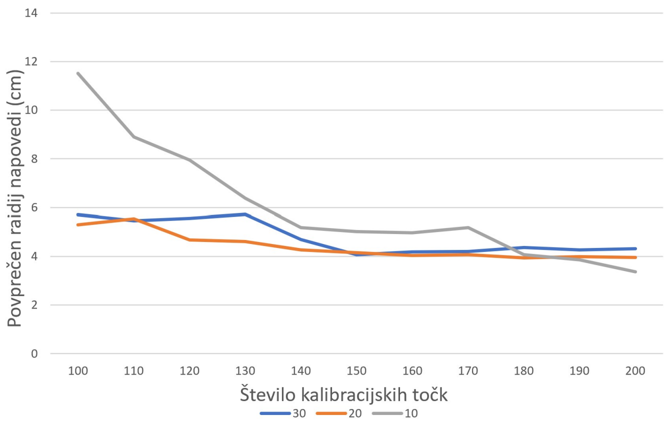
Za čim hitrejši proces kalibracije si želimo čim krajši čas prikaza točke. Ta sicer ne sme biti prekratek, saj si želimo, da uporabik udobno sledi menjavi točk. Pri oknu zajema je pomembno, da znotraj okna ne prihaja do večjih sprememb vhodnih parametrov (mirno oko). Hkrati si želimo, da je okno čim daljše, kar nam omogoča zajeti večje število podatkov.

Za nastavitev teh dveh parametrov bomo uporabili sledilec pogleda Tobii Pro nano. Na zaslonu prikazujemo točke in beležimo razdalje med dejansko točko na zaslonu in napovedano točko sledilca Tobii. Vsaka točka bo na zaslonu prikazana $2s$. Primer dobljenih rezultatov prikazuje graf na sliki 2. Ta graf prikazuje standardni primer preskoka očesa med kalibracijskima točkama. Po menjavi kalibracijskih točk potrebuje oko testiranca približno $0.25s$, da pogled preusmeri na novo točko. Med testom je v najslabšem primeru oko potrebovalo približno $0.5s$ za dokončno stabilizacijo, saj je preskosku sledil še manjši popravek. Graf na sliki 3 prikazuje primer preskoka, ki sta mu sledila kratek in malo daljši mežik očesa. Mežiki se lahko pojavijo kadarkoli v času prikaza točke, zato jih je potrebno upoštevati.

Na podlagi dobljenih rezultatov smo se odločili omejiti čas prikaza točke na $1.5s$, ter okno zajema na interval $[0.75, 1.5]$. Začetek okna zajema je nastavljen tako, ker želimo biti popolnoma prepričani, da je uporabnik pogled uspešno ustalil na točki, se pravi je dovolj oddaljen od točke preskoka. Konec okna je pomaknjen do konca prikaznega časa točke, saj iz pridobljenih podatkov ni videti, da bi kakovost fokusa v tem času padla. Za izbrano dolžino prikaza smo se odločili, ker nam omogoča zajem dovolj podatkov in uporabnik med kalibracijo ne dobi občutka čakanja.

5.2 Velikost in število kalibracijskih točk

Testirali smo tri velikosti kalibracijskih točk, s polmeri 30, 20 in 10 slikovnih pik. Za vsako velikost naredimo ločeno kalibracijo z 200 kalibracijskimi točkami. To je zgornja meja števila točk zaradi izbrane zgornje meje časa kalibracije in dožine prikaza ene točke. Takoj za kalibracijo zajamemo podatke novih 30 naključno generiranih točk, ki jih uporabimo kot testno množico. Za testiranje števila kalibracijskih točk razdelimo učno množico, ki smo jo pridobili med kalibracijo, na 20 podmnožic. Prva vsebuje 10 točk, vsaki naslednji pa dodajamo 10 točk tako, da zadnja vsebuje vse točke. Točke se dodajajo v enakem vrstnem redu, kot so bile zajete. Vpliv števila in velikosti kalibracijskih točk ocenimo iz grafa na sliki 4. Iz grafa je razvidno, da najboljši rezultat,



Slika 4: **Graf povprečne napake napovedi v odvisnosti od števila kalibracijskih točk za 3 velikosti kalibracijskih točk.**

$3,37$ cm, doseže kalibracija z 200 točkami, s polmerom 10 slikovnih pik. Graf je narisan le za učne podatke, ki vsebujejo med 100 in 200 kalibracijskih točk; rezultati množic z manj točkami so slabši in posledično neuporabni. Na grafu najbolj izstopa kalibracija s točkami polmera 10, katerih napaka je na začetku bistveno večja od ostalih, vendar hitro pade in da na koncu najboljše rezultate. Tukaj gre najverjetneje za visok delež šuma v zgodnjih podatkih, kar se nato z dodajanjem novih popravlja. Če primerjamo rezultate vseh treh velikosti kalibracijskih točk, opazimo, da z manjšanjem radija točke za 10 slikovnih pik napaka pade med 15 in 20 slikovnih pik. Manjšega polmera točke nismo testirali.

6. ZAKLJUčEK

Predstavili smo algoritem za oceno točke pogleda s spletno kamero. Z uporabo referenčnih točk in globoke nevronske mreže smo v najboljšem primeru dosegli napako $3,37$ cm. Na osnovi poskusov ugotavljamo, da naša metoda deluje pri različnih svetlobnih pogojih (različna jakost svetlobe, luč v ozadju), vendar bolje deluje pri močnejši osvetlitvi, brez ambientne osvetlitve pa metoda ni uporabna. Zaradi specifičnih omejitev predlaganega pristopa, bo tega težko direktno primerjati z drugimi. Za primerjavo bi morali omiliti omejitve ali testirati ostale pristope z enakimi omejitvami. V obeh primerih, bi za uspešno primerjavo potrebovali večje število ljudi. Predstavljen pristop je pogojno primeren za uporabo s ciljno aplikacijo, saj ne omogoča spremljanja branja.

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Prepričljive tehnologije za spodbujanje pravilne drže telesa pri sedenju

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POVZETEK
Članek obravnava tematiko prepričljivih tehnologij v povezavi z nepravilnim sedenjem. Dosedanje metode opazovanja pravilne drže telesa in spodbujanja pravilnega položaja telesa se delijo na video zaznavo in zaznavo s pomočjo senzorjev. Vsaka od teh metod ima določene prednosti in slabosti. Za potrebe raziskave smo izdelali rešitev, ki temelji na video zaznavi in predstavlja nov pristop pri spodbujanju pravilne drže sedenja z uporabo pametnega telefona usmerjenega v uporabnika. S pomočjo izdelane programske opreme smo izvedli raziskavo s prvim avtorjem članka v obdobju 30ih ur. V članku je predstavljena metoda merjenja sedenja in namestitev prototipa. Poleg merjenja sedenja s telefonom smo uporabili tudi študijo z dnevnikom. Rezultati kažejo, da se je kakovost sedenja izboljšala, kar nakazuje, da rešitev pomaga pri vzpostavitvi boljše drže hrbtenice pri sedenju.

Ključne besede
prepričljive tehnologije, položaj sedenja, ergonomija

Slika 1: Grafična ponazoritev uporabe prototipa.

1. UVOD
Današnji način življenja in dela vključuje veliko sedenja [12], ki je vključno s telesno neaktivnostjo vzrok mnogih bolezni, kot so debelost, visok krvni tlak, sladkorna boležen, tesnoba, depresija, rak debelega črevesa, bolečine v križu itd. Težava sedenja je tudi nepravilna drža, ki je vzrok ovirane zmožnosti za širitev pljuč, bolečine v hrbtenici, bolečin vratu, čeljusti itd. [2] Nepravilno sedenje vpliva na produktivnost [17] in povzroča visoke stroške za javno zdravstvo, saj nepravilna drža 80% ljudem povzroča zdravstvene težave vsaj enkrat v življenju. V članku predstavljamo enostavno rešitev, ki temelji na pametnem telefonu in meri ukrivljenost hrbtenice v realnem času s pomočjo računalniškega vida. Ker želimo graditi nov vedenjski vzorec, smo v sistem vključili koncept prepričljivih tehnologij s proženjem različnih sprožilcev.

2. PREGLED PODROčJA

2.1 Sedenje in položaj hrbtenice
V literaturi je opisanih več različnih a zelo podobnih pravilnih položajev sedenja [9]. Najpogosteje omenjana je definicija Evropske agencije za varnost in zdravje pri delu, ki opisuje pravilno ureditev delovne postaje. Kot pravilno telesno držo hrbta definicija omenja hrbet poravnan pravokotno na tla, da je kot med hrbtenico in koleni 90 stopinj pri čemer mora pogled glave biti usmerjen vodoravno.

2.2 Dosedanje metode opazovanja položaja telesa
Večina metod je namenjena sledenju gibanja telesa in zaznavanju različnih položajev, ki jih je mogoče uporabiti tudi za zaznavanje položaja sedenja. Načini zaznavanja položaja telesa se delijo v splošnem na dve metodi: prva uporablja video zaznavo telesa s pomočjo računalniškega vida, druga pa uporablja senzorje, nastavljene na telo ali na stol. Mogoča je tudi kombinacija obeh ali uporaba drugih ne-tehnoloških rešitev kot na primer PEO (Portable Ergonomic Observation). Slednja temelji na prisotnosti dodatne osebe.

2.2.1 Zaznavanje z računalniškim vidom
Ti pristopi lahko uporabijo eno ali več kamer [15], neposredno analizo videa v realnem času ali kasnejšo analizo slik pridobljenih iz videa, 3D modela telesa ali pa delujejo brez modelov. Ocenjevanje položaja telesa se uporablja za različne namene. Na primer za spremljanje starejših oseb [10], utrujenosti voznikov osebnih vozil tako z zaznavo položaja oči in ust [20], za ugotavljanje konteksta v pisarni [1] kot tudi za zaznavo položaja sedenja z zaznavo obraza uporabnika z merjenjem Hausdroffove razdalje s pomočjo kamere na ekranu [16]. Na enakem principu delujejo komercialni izdelki kot so Posture Minder, Philips Ergo Sensor in Visiomate (slednji za merjenje uporqablja ultrazvočni senzor razdalje). Obstoječe rešitve imajo določene pomanjkljivosti kot na primer: (i) dodajanje video kamer v prostor predstavlja težavo zasebnosti, kar je posebej problematično, ko kamer

ne upravlja opazovana oseba, (ii) nenatančno zaznavanje položaja sedenja, ki temelji le na zaznavanju relativni poziciji obraza/glave, (iii) potreba po dodatni strojni opremi, in (iv) nezdružljivost z obstoječo strojno opremo.

2.2.2 *Zaznava s pomočjo senzorjev*

Najpogostejši za zaznavo položaja telesa so senzorji pritiska telesa na stol in taki, ki merijo razdaljo med naslonjalom stola in hrbtom uporabnika. V porasti so tudi rešitve, ki uporabljajo merilnike pospeška, in pametna oblačila opremljena z različnimi senzorji.

Senzorji sile se uporabljajo na stolih za zaznavo zasedenosti stola ter za zaznavo položaja sedenja osebe na stolu. Tan et al. [18] so senzorje sile uporabljali za klasificiranje statičnih sedečih položajev in z metodo PCA (Principal Component Analysis) prepoznali 10 različnih sedečih položajev z 79% natačnostjo za nove uporabnike in 96% za znane uporabnike. Podobno so izvedli še v [8] medtem, ko so McCormick et al. [14] opazovali še ali so naslonjala za roke v uporabi, ali je v uporabi ledvena opora in ali je naslonjalo nagnjeno. Senzorje sile so uporabili tudi v metodi Preslikava pritiska [ang. Pressure mapping] za ocenjevaje udobja sedenja v avtomobilih in zdravstvu [3]. Pri metodi CARPIO so [7] uporabili poleg senzorjev na stolu še sistem, ki preko zaznavanja uporabe miške in tipkovnice ugotavlja, ali je računalnik v uporabi, kar z brezžično povezavo s senzorji na stolu omogoča večjo natančnost rezultatov. Xu et al. [19] so uporabili blazino eCushion, opremljeno s senzorji sile, ki jo lahko postavimo na obstoječi stol. Senzorje na stolih najdemo tudi v komercialnih izdelkih. Stol Axia Smart Chair je opremljen s šestimi senzorji, Darma pa pametna blazina, ki jo nastavimo na stol in beleži podatke o položaju sedenja, srčni utrip, dihanje.

Najpogostejši senzorji na telesu uporabnika so merilniki pospeška. S takimi senzorji, postavljenimi na ledvenem predelu hrbta, so v [5] prišli do zadovoljivih rezultatov sledenja položaja sedenja. Namesto merilnikov pospeška je mogoče uporabiti tudi (i) sprejemnike radio frekvenc ali WLAN omrežja, ki s pomočjo triangulacije določijo položaj telesa ali (ii) senzorje upogiba. Komercialna izdelka UPRIGHT[1] in Lumo Back[2] uporabljata merilnik pospeška nalepljen na vratni oz. ledveni predel hrbta in z vibracijo opozarjata uporabnika na napačen položaj. Lumo Lift[3] je pa senzor, ki ga namestimo na obleko. Izdelki iPosture[4], Prana Tech[5] in Fineck[6] nudijo podobne rešitve kot Lumo Lift, le da ima prvi še možnost zaznavanja dihanja, tretji pa je v obliki ogrlice. Obstajajo tudi oblačila z vgrajenimi senzorji, s katerimi lahko sledimo položaju telesa [13]. Na voljo so tudi komercialne rešitve, kot je na primer TruPosture, ki je namenjen izdelavi pametnih oblačil in omogočajo zaznavo pravilne drže telesa. Poleg omenjenih načinov, se lahko za zaznavanje položaja telesa uporabi še elektromiografija (EMG) [6], ki iz podatkov o mišični dejavnosti pridobi podatke o položaju telesa. Obstoječe rešitve imajo tudi določene pomanjkljivosti: (i) vstavljanje senzorjev na vsa oblačila iz garderobne omare lahko predstavlja finančni zalogaj, (ii) trajnost pametnih oblačil in ostalih pametnih izdelkov (npr. obraba, čiščenje, hitra zastarelost itd.), (iii) vsakemu pametnemu izdelku (stol, oblačilo) moramo nuditi tudi oskrbo z energijo.

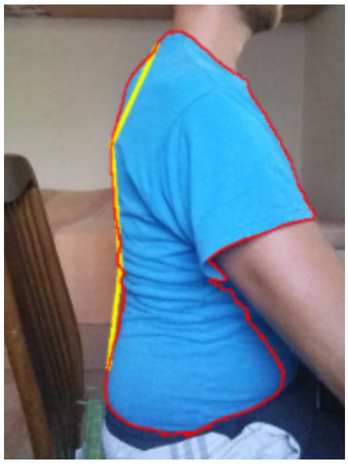
[1] `https://www.uprightpose.com/`
[2] `https://www.kickstarter.com/projects/lumoback/lumoback-the-smart-posture-sensor`
[3] `https://www.lumobodytech.com/`
[4] `http://www.iposture.com/`
[5] `http://prana.co/`
[6] `https://www.slashgear.com/fineck-smart-necklace-tracks-posture-neck-health-08358781/`

3. OPIS PROTOTIPA

Kot je razvidno na Sliki 1 smo v našem primeru uporabili stol brez naslonjala. Da bi dobili položaj hrbtenice pri pravilni sedeči drži smo eksperimentalnega uporabnika posedli na stol in njegovo držo popravili na željen končni položaj. Nato smo izmerili kot:

- spodnjega predela hrbta od najnižjega (medeničnega) dela hrbtenice do dela kjer je hrbtenica najbolj ukrivljena navznoter (4. vretence),
- srednjega dela hrbta kjer je hrbtenica najbolj ukrivljena navzven (od 4. do 12. vretenca) in
- zgornjega predela prsnega dela hrbtenice do začetka vratnega dela (od 12. do 18. vretenca).

Postopek smo večkrat ponovili in prišli do intervala mejnih vrednosti: spodnji del hrbtenice ne sme preseči 91 stopinj, srednji del hrbtenice mora biti med 80 in 100 stopinj, zgornji del hrbtenice pa ne manjši od 60 stopinj. Trije koti si vidni na Sliki 2.



Slika 2: Zaslonska slika prototipa s sledenjem obrisa majice in treh kotov hrbtenice.

Za implementacijo rešitve smo uporabili pameten telefon s sistemom Android, ker je to najbolj razširjena naprava s kamero. Pametni telefoni so prenosni, imajo veliko procesorske moči in zanje obstaja nekaj knjižnic namenjenih računalniškem vidu. Razvita aplikacija s pomočjo kamere in računalniškega vida sledi oprijeti majici uporabnika in ga s kratkim piskom opozori na nepravilen položaj glede na zgoraj navedene vrednosti. Ko je aplikacija odprta meri položaj enkrat na minuto, vsako merjenje pa traja 5 sekund. Aplikacija lahko prikaže tudi graf meritev v odvisnosti od časa. Za zaznavanje položaja telesa smo uporabili odprtokodno knjižnico OpenCV, aplikacijo pa razvili v JAVI. Podrobnejši opis algoritma je na voljo v [21].

4. EVALVACIJA PROTOTIPA

Pri pisanju zaključne naloge je prvi avtor članka namestil prototip za merjenje sedečega položaja hrbtenice na desno stran pisarniške mize, kjer je pisal nalogo. Sistem je uporabljal nekaj ur dnevno. Poleg podatkov o sedečem položaju, pridobljenih iz aplikacije, je po vsaki uri pisanja te naloge ustvaril nov vpis v dnevnik. Dnevnik je sestavljen v obliki vprašalnika. Vsak zapis v dnevnik zajema odgovor na naslednja vprašanja: (i) Koliko časa menite, da ste sedeli pravilno na lestvici od 1 do 10?, (ii) Kolikšno je bilo število opozoril aplikacije o napačnem sedenju?, (iii) Kako moteče je bilo opozarjanje aplikacije na lestvici od 1 do 10? (iv) Kolikšna je bila stopnja bolečin v hrbtu na lestvici od 1 do 10?, (v) Katero dejavnost ste opravljali med merjenjem?, (vi) Kakšna je bila stopnja koncentracije med dejavnostjo (1–5)? in (vii) Komentarji. Merjenje je trajalo 30 ur skozi 13 dni.

Vprašalnik dnevniške študije (ang. diary study) je bil razvit za potrebe naše raziskave. Pri dnevniški študiji raziskovalec namreč zastavi vprašanja glede na to, kaj želi od uporabnikov beležiti. Uporabniki lahko samoporočajo o določenem vedenju, frustracijah, mennjih, ponavljajočih se dogodkih, ipd. skozi daljše časovno obdobje in ko se odzivi pojavljajo sporadično ali v nenačrtovanih trenutkih. Vprašalnik je tako zelo odvisen od same študije.

5. REZULTATI RAZISKAVE ININTERPRETACIJA

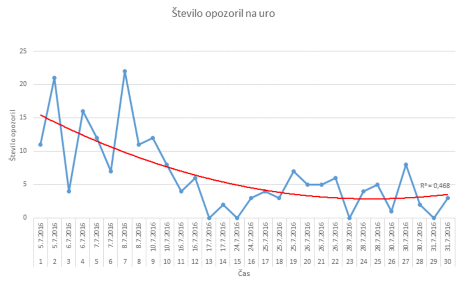
5.1 Bolečina v hrbtu

Izvor bolečine je bila uporaba stola brez naslonjala za hrbet in naslonjal za roke saj avtor navadno uporablja stol z naslonjali, ki omogočajo sedenje v položaju pri katerem so hrbtne mišice manj obremenjene. Avtor je tako na lastni koži izkusil, da je vzravnana sedeča drža zahtevna za hrbtne mišice. Posledica tega je bila, da je avtor moral po vsaki uri meritve vzeti nekaj minut premora. Prve dni je bilo težko sedeti v takem položaju več kot dve uri na dan. Prav tako je avtor med študijo (večinoma na začetku) od enkrat do dvakrat na uro zavestno prešel za nekaj sekund v nepravilno držo z namenom, da razbremeni mišice v hrbtnem predelu. Posebej zanimivo je, da je prototip kljub bolečini v hrbtu uspešno silil k pokončnem sedenju navkljub dejstvu, da je sedenje na stolu brez naslonjala v nepravilnem sključenem položaju manj utrujajoče za hrbtne mišice. Iz dnevnika je razvidno, da se je subjektivna ocena bolečine v hrbtu, zmanjševala saj so se tekom časa hrbtne mišice okrepile.

5.2 Vpliv prototipa na pravilno držo pri sedenju

Graf na Sliki 3 prikazuje število opozoril, ki so se zgodila tekom enournega cikla merjenja. Iz grafa je jasno razviden trend zmanjševanja kljub dejstvu, da se podatki ne prilegajo učni krivulji. Glede na to dejstvo (R2=0.487), iz zbranih podatkov ne moramo sklepati ali se je učenje pravilnega položaja sedenja zaključilo. Kljub temu lahko povzamemo, da je prototip pozitivno vplival na držo pri sedenju.

Zanimiv je tudi podatek o izmerjenih vrednostih treh predelov hrbtenice in spremembi skozi čas (Slika 4). Dnevna povprečja so bila vedno v meji pravilnega sedenja. Pozitiven trend se je pokazal pri zgornjem in spodnjem kotu, kjer se je s časom dnevno povprečje kota oddaljevalo od



Slika 3: Odstotek opozoril v razmerju s časom.

limitne vrednost. Pri srednjem kotu pa je velikost ostajala podobna čez celotno študijo. Pri rezultatih smo tudi opazili, da ledveni kot hrbtenice največkrat preide kritično mejo a so hkrati njegove povprečne vrednosti najbližje mejni vrednosti pravilnega sedenja (91 stopinj). Podatki tudi nakazujejo, da je ledveni del hrbtenice tisti, ki prvi odstopi iz pravilnega območja sedenja, šele nato sledita druga dva dela. Od tod sledi, da je prav spremljanje položaja ledvenega dela hrbtenice ključnega pomena.

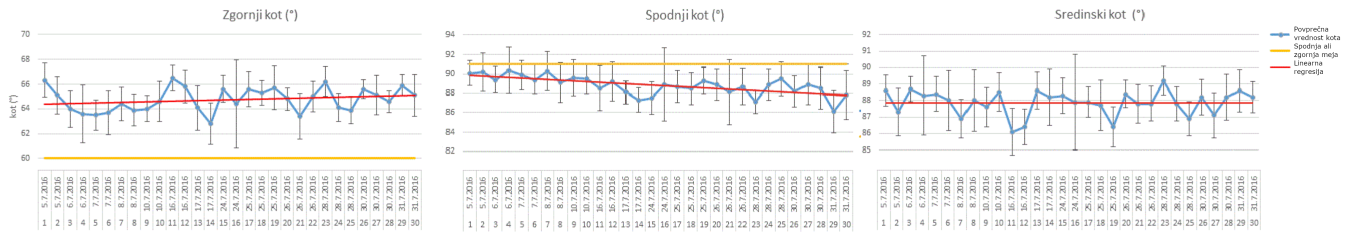
5.3 Ostale ugotovitve

Med uporabo aplikacije je postalo jasno, da je aplikacija veliko bolje zaznavala obris hrbtenice, če je prostor osvetljen z dnevno svetlobo. To ni bila težava, saj je bila soba, v kateri je avtor izvajal meritve, dobro osvetljena večji del dneva. Zagotovo pa obstaja možnost dodatne izboljšave pri zaznavi barv. Po nekaj dneh meritev je avtor ugotovil, da je pomemben odstotek časa uporabljal nepravilen položaj nog (prekrižane pod stolom). Tega podatka aplikacija ne meri. Ker je položaj nog ravno tako pomemben element pravilne drže pri sedenju, bi bilo v prihodnjih različicah aplikacije primerno razmisliti o rešitvi, ki vključuje sledenje položaja nog. V študiji z dnevnikom avtor podaja oceno o nadležnosti piska aplikacije, ki oznanja nepravilno držo. Rezultati kažejo, da opozorilo ni bilo moteče. Kot zadnje avtor ugotavlja, da je uporaba aplikacije vplivala na položaj sedenja tudi izven časa merjenja, ko je večkrat opazil, da podzavestno prehaja v vzravnano držo hrbtenice in jo uspe zadržati v takem položaju daljše obdobje.

Iz predstavljenih rezultatov lahko zaključimo, da se je stanje sedečega položaja sproti jasno izboljševalo, kar nam nakazuje, da rešitev pomaga pri vzpostavitvi nove navade: izboljšati držo hrbtenice v sedečem položaju. Žal na podlagi zbranih podatkov ni mogoče trditi, da je sprememba trajna. Novejše raziskave kažejo, da je za trajno spremembo navad potrebno od dva do osem mesecev [11], kar je odvisno predvsem od težavnosti želenega vedenja in motivacije ter sposobnosti uporabnika, ki želi vedenje doseči.

6. ZAKLJUčEK

Rezultati študije nakazujejo, da se je stanje sedečega položaja s pomočjo predstavljene rešitve tekom študije izboljševalo, kar nam nakazuje, da rešitev lahko pomaga pri vzpostavitvi nove navade: izboljšati držo hrbtenice v sedečem položaju. Trajnosti navade, ki jo je uporabnik pridobil ob uporabi aplikacije, žal nismo uspeli preveriti, saj le-ta zahteva daljše obdobje opazovanja.



Slika 4: Povprečne vrednosti kotov treh delov hrbtenice v razmerju s časom.

Študijo smo zasnovali samo z enim uporabnikom na podlagi trendov, ki nakazujejo veliko število aplikacij za manjše število uporabnikov in iskanje izjemne pozitivne izkušnje v nasprotju s preteklimi trendi, ko je majhno število aplikacij uporabljalo veliko število ljudi in je izkušnja bila lahko le povprečna [4]. Kljub temi bi v prihodnje bilo potrebno spremljati več uporabnikov in njihove navade v daljšem obdobju in upoštevati vse dejavnike kot so na primer bolezenska stanja.

Poleg tega obstaja tudi nekaj možnosti za izboljšave predstavljene rešitve, kot na primer izboljšava sledenja majice v slabših svetlobnih pogojih, sledenje nog med sedenjem, igrifikacija in spremljanje navad sedenja znotraj družbenega omrežja posameznika z večanjem možnosti družbene podpore.

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Nuni- A case study: A platform to distribute digital content to analog television data towards enhancing quality of life of senior citizen in Mexico.

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ABSTRACT
Nuni is a platform to distribute digital content for analog television. This was the final product derived of an student research project that was carry out to design a digital product to enhance quality of life of elderly people. This exploratory study help us to obtain quantitative and qualitative data from real users. The following document relates the process of implementing a User-Centered approach to identify a problem in an specific population and come out with a potential solution to improve, in this case, elders' lifestyle from a Mexican village in a southern state of Mexico who were the target audience in such project.

Keywords
Seniors, UCD, UX, Usability

1. INTRODUCTION
In 2017 young researches as part of one of the Human-Computer Interaction (HCI) courses in the Master Degree from the Technological University of the Mixteca were challenged to design a product/service to help a vulnerable population in a semi-rural context. Researches chose by convenience a village (Huajuapan de León) located in a poor zone in Oaxaca state (a region in the south of Mexico). The constraint to do the activity was to use the existing knowledge in HCI to solve the problem. The topic selected by students was: Elderly people.

Nowadays, there is a gap between technology and old adults that cuts off or limits the ability of the last ones to do their daily life and in some sense affects the way they interact with the surrounding world. According to the United Nations Fund for Population Activities (UNFPA) the number of elderly people in the world is increasing and the global population aged 60 year or more is twice larger than in 1980 [11] and is expected that this quantity will continue growing in future years. Mexico is not the exception and according to the federal government is estimated to have a population of 32.5 million of elders in 2050[5]. This is a major concern since seniors are been overtaken by the upgrades, changes and evolution related with technology. Such phenomena is forcing them to dislike, reject or in the worst case: being subjects of abuse, extortion or fraud through technology-related scams[9] as they become digital illiterates. From the perspective of Human-Computer Interaction we have observed that this phenomenon could be approached in another way, the idea is exceed the usability frontier and also fulfilling user experience attributes, name them: utility, adaptability and satisfaction.

1.1 Assistive technology for seniors
Technology for elderly people is not a new topic in the field. There are tools destined to help seniors in their day to day life, such as: hearing aids, conversation companions, digital tablets or mobile applications[7, 8]. Tools like those are categorised as "Assistive Technology" (AT).

An AT is defined as any tool that allows individuals with special necessities or disabilities to perform one specific activity without any kind of physical or mental barrier. There are many examples but the most commons are the wheel chair and the walkie-talkie. Despite the variety and quantity of technologies oriented to this population the misconception of them can lead to the dis-likeness or rejection of the tool, because of this, we consider relevant to distinguish between two different dimensions of ATs: i) Technologies designed for Seniors and ii) Technologies designed for care takers.

In this context, researches in HCI community have proposed new approaches that deal with this challenge of designing tools for old adults[10, 1]. But even though there are meaningful advances in the field is evident that old adults still show some resilience to use technology in their daily life. We see in this context an area of opportunity to do research and come up with one potential solution. We believe that by following a methodology centered in the senior, we will produce a consistent and feasible tool.

2. METHODOLOGY
For the purpose of this project we used a User-Centered Design Methodology (UCD) and combined it with some elements presented in other design models, such as: Norman's Emotional Design (2005)[6] and Design Aesthetics: principles of pleasure in design from Hekkert (2006)[4](see Figure 1)[3].

2.1 User Experience (UX)
User Experience (UX) is concept related with assessment of interactions produced between users and technological products/services. The goal is to provide meaningful and relevant experiences to users [2]. The value and interest that one

users gives to one specific tool/product/service come from the field of HCI. At the beginning, evaluations in this field were merely focused in assessing metrics, such as: success, efficiency, learnability and satisfaction. Usability was the most important metric of quality of any system.

As time passed, UX has included some other aspects that go beyond the usability and focuses in: a) motivations, values and views; b) characteristics of system (functionality, features) and c) interaction process (accessibility, aesthetics)[2].

For this project UX played a significant role in developing a system for old adults because it was important to pay attention in:

- What encourages elderly people to use technology, what makes an user like or dislike it, how do users feel regarding technology
- Are the existing systems suited for these special users, the system accomplish the goal it was meant for, what features make the system unique
- Is the system following patterns or guidelines of design for this population, is the system aesthetically attractive for users

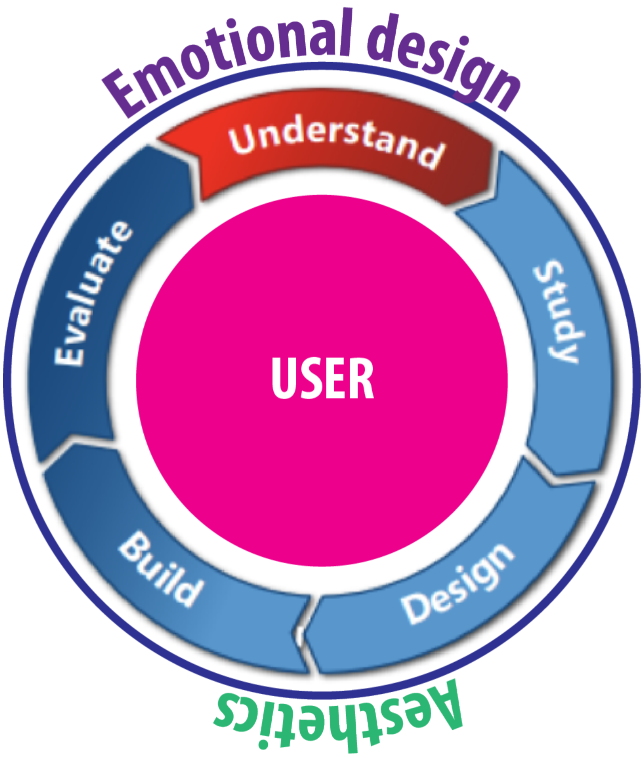

Figure 1: UCD-e: A typical iterative methodology.

3. EXPLORATORY STUDY

In this section the findings of the study are listed following the structure the methodology implemented during research.

3.1 Understanding

In order to comprehend what elderly people in Huajuapan de Leon face or struggle with in daily life, we did a documentary research followed by interviews with experts in the corresponding topic. This allowed us to understand the political, social and cultural variables that surround old adults. For instance, we found out among other findings, that mostly the person who takes care and/or is responsible of the grandfather or grandmother is the oldest woman related with them, namely: daughter, sister, auntie, etc.

3.2 Study

After previous stage, we visited the only nursing home in town to observe every-day life of the subjects. In order to do that, we used a technique called: contextual inquiry. We worked with 46 old individuals in between 60 and 95 years. The outcomes were the description of activities of the subjects in their day to day life. We were witnesses in real life of: the poverty, abandonment, harassment, cognitive and physical sickness they are exposed. In the other hand, we could also observe the relation they have with technology and the type of technology they use, which were mostly analog devices. Another technique to collect data during this stage was the focus group, which was implemented with people who is responsible whether of a grandfather or grandmother. In this activity, participants talked about how they support older people, specifically, how they supply medication, how they establish communication via phone with them and also how they implement activities to distract them from depression, such as: chitchatting, handcrafting, playing or walking.

3.3 Design and development

Findings from contextual inquiry and focus group allowed us to discuss, plan and propose a solution to deal with some of the problems elderly people face in daily life. The concept of the project was generated through the sketch board technique. The result was the design and development of a platform to distribute digital content for analog television. The project was named in Mixtecan (native indigenous Mexican language): Nuni that literally means corn but in this context works as analogy of something that needs no be cared.

3.3.1 What is Nuni?

Nuni is a web platform that hosts mobile apps designed for seniors. The apps can be installed in an android phone and are designed to work in complement with a Google Chromecast (take carer dimension). Nuni merges analog and digital technologies, allowing old adults to manipulate a medium that they are used to, in this case an analog television, and complement them whit the features of new technologies (elderly people dimension). The idea is to take advantage of the already existing mental model in the users (e.g. users know how to operate an analog radio or use a sewing machine).

3.3.2 How it works?

The Chrome-cast is connected to the analog television by using a modified HDMI to RCA converter. The Nuni system installs by default 4 applications that can be controlled using the standard TV remote control. The default applications are listed as: Inner calls: This app allows the grandparents just to receive inner calls from the smartphone. When the user gets a call, the picture and name of the caller is displayed in the TV. The call can be picked up whether using the button enter of the control remote or directly in the phone. Reminders: This app allows the caretaker to send reminders of medication via message to the grandparents. The app shows in the screen the image of the medication, the generic name of the medication, the underlying type of treatment and also the time and possible restriction of the medication. Mobility: Designed for the grandparent, the app encourage users to do some exercises, specifically designed for the limitation of their motor skills. This app uses the smartphone's camera to monitoring the workout. Stories: The application contains an avatar that pops-up randomly in time to ask the user to tell one history. The objective is to record the subject when telling the story. This story can be saved and later propagated to the family members of the user.

As we noticed, the system it self was not enough instrument to offer a solution to many different problems. There was a huge diversity and variety of issues that affects grandparents, and try to solve them all with one app was no ideal. For this reason, we went one step forward and propose to make an inclusive platform, where anybody interested in developing tools for one specific problem could do it just by reusing already existing projects or build with other users a social solution. In this context and to unify standards and generate well designed interfaces for seniors, Nuni platform offers precoded building blocks, apps presets, design guidelines, predesign elements that helps developers to create more usable and efficient apps for the final user.

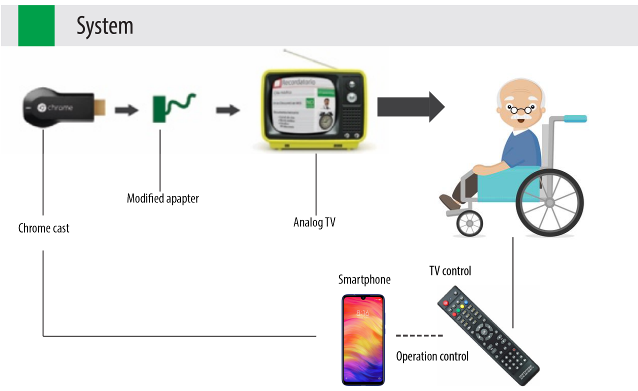

Figure 2: Nuni's workflow

3.4 Evaluation

First iteration. Using a first low fidelity prototype we assessed the interfaces by implementing a Wizard Oz technique with 5 real users. The intention was to validate the idea proposed. The outcomes of this exercise were: User struggled with icons and colors Interfaces. They were adapted accordingly to users feedback.

Second iteration. After implementing the modifications to the system a second prototype was tested with 10 users. The findings can be summarized as: Users faced problems with the typography and its size. Overall the system was accepted by users.

Third iteration. The high fidelity prototype was evaluated by 5 users. The technique implemented was usability testing. The overall results are:

- For the first prototype we evaluated 45 tasks of which 66.6% were successfully done.
- For the second prototype 170 task were evaluated with 92.9% of success fullness.
- For the last prototype we assessed 50 task and the completeness of the was 98%. 80% percent of users accepted and trust the system.
- Satisfaction of the system was mark with 9/10.

Figure 3: Usability testing

4. DISCUSSION

UCD is a methodology that is focused on identifying, comprehend and solve a potential problem but lacks of tools to deal with: aesthetics and emotional issues linked to the problem. In this case after reviewing the models of Norman and Hekker we were able to understand the problem as one small part of major problem. This conducted us to propose not just one product but a family of products that complement each other. With this exercise we learned good practices like:

- Make the task easy to understand and according to the user's context, skills, knowledge and background.
- Merge existing and new knowledge to generate an easy to remember-model.
- Re-use technology that people is familiar with.
- Create short tasks that don't demand an excessive use of retention. Seniors tent to have short memory and they struggle recalling details.

5. CONCLUSION

Developing tools for any group should consider not just usability and innovative features. Furthermore, while doing it, it should pay attention in cultural, social, personal, affective, and aesthetic implications. Applying UX tools allowed us to generate positive emotions in users. The result was a total users' adoption of the system.

Regarding to the observation we realized that there is more than one actor involved in elderly people life. To build better tools for them was important to consider caretakers, family members, doctors and neighbors, among others when developing tools for old age people.

Although Nuni is a scholar project, it has provided tools and guideline for future works related with seniors in semi-rural context. This work can easily be replicated in other contexts and adapted to different cultures. However, there is still too much to explore and consolidate in order to achieve a feasible result.

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Umestitev interaktivnih elementov in elementov igrifikacije na vnaprej zastavljeni učni poti

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POVZETEK
Članek obravnava možnosti umestitve interaktivnih elementov in elementov igrifikacije na učni poti Parka Škocjanske jame. Učno pot spremljajo informacijske table, ki obiskovalcem podajajo informacije o značilnostih parka. Table tako omogočajo pridobivanje znanja, ki je podkrepljeno z opazovanjem realnega sveta. Prav tako so dobrodošle za tiste, ki učne poti ne obiščejo v obratovalnem času parka in zato ne morejo dostopati do vsebin, ki so ponujene na informacijski točki parka. Informacijske table pa lahko dopolnimo z digitalnimi večpredstavnostnimi vsebinami, do katerih bi lahko uporabniki imeli dostop na učni poti in bi bile tako predstavljene v kontekstu okolja v katerem se uporabnik nahaja. Ena od možnih rešitev predstavlja združitev vsebin prek aplikacije za pametne telefone. V članku je predstavljena rešitev z osnovno strukturo in delovanjem aplikacije, ki vsebuje lokacijsko pogojene kvize na učni poti ter nagrade v obliki dodatnih digitalnih vsebin v virtualni resničnosti. Uporabnikom smo tako želeli ponuditi kvize in kratke digitalne vsebine samo na določenih lokacijah in jih odvrniti od nenehnega spremljanja uporabljane naprave. Z aplikacijo tako ne želimo spreminjati klasičnega obiska parka in raziskovanja okolice, temveč le popestriti doživetje obiskovalcev.

Ključne besede
igrifikacija, učna pot, dopolnjena resničnost, virtualna resničnopst, vseprisotno računalništvo

1. UVOD
V današnjem času se veliko ljudi odloča za obisk naravnih parkov in učnih poti kjer se najpogosteje preko informacijskih tabel ali drugih pripomočkov seznanijo z rastlinskim in živalskim svetom, tradicionalnimi obrtmi, naravnimi pojavi ter ostalimi naravnimi in kulturnimi znamenitostmi. [3, 1].

Primer učne poti je tudi učna pot Škocjan, ki se nahaja v Regijskem parku Škocjanske jame[1]. Učno pot spremljajo informacijske table, ki obiskovalcem podajajo informacije o značilnostih parka. Table tako omogočajo pridobivanje znanja, ki je podkrepljeno z opazovanjem realnega sveta. Ena od omejitev tovrstnih tabel je razpoložljiv prostor, kar upravljavce parka omejuje pri količini informacij, ki jih lahko podajo. Za rešitev te težave so v parku izdali vodnik v obliki žepne knjižice, ki dopolnjuje vsebino tabel[2]. Informacijske table in vodniki pa imajo tudi nekaj slabosti. Obiskovalci morajo za vodnik vedeti in si ga morajo predhodno priskrbeti pred obiskom parka in obstaja velika verjetnost, da ga bodo ljudje ne bodo brali med raziskovanjem učne poti. Poleg tega težavo predstavlja tudi težko spreminjanje vsebin tabel in vodnikov in s tem povezani stroški. Tako table kot vodnik žal ne omogočajo interaktivnosti. Večpredstavnostne vsebine pa bi bile odlično dopolnilo tabel na učni poti, saj bi lahko z njim popestrili obisk parka. V članku je predstavljena naša rešitev z osnovno strukturo in delovanjem aplikacije, ki vsebuje lokacijsko pogojene kvize na učni poti ter nagrade v obliki dodatnih digitalnih vsebin v virtualni in dopolnjeni resničnosti.

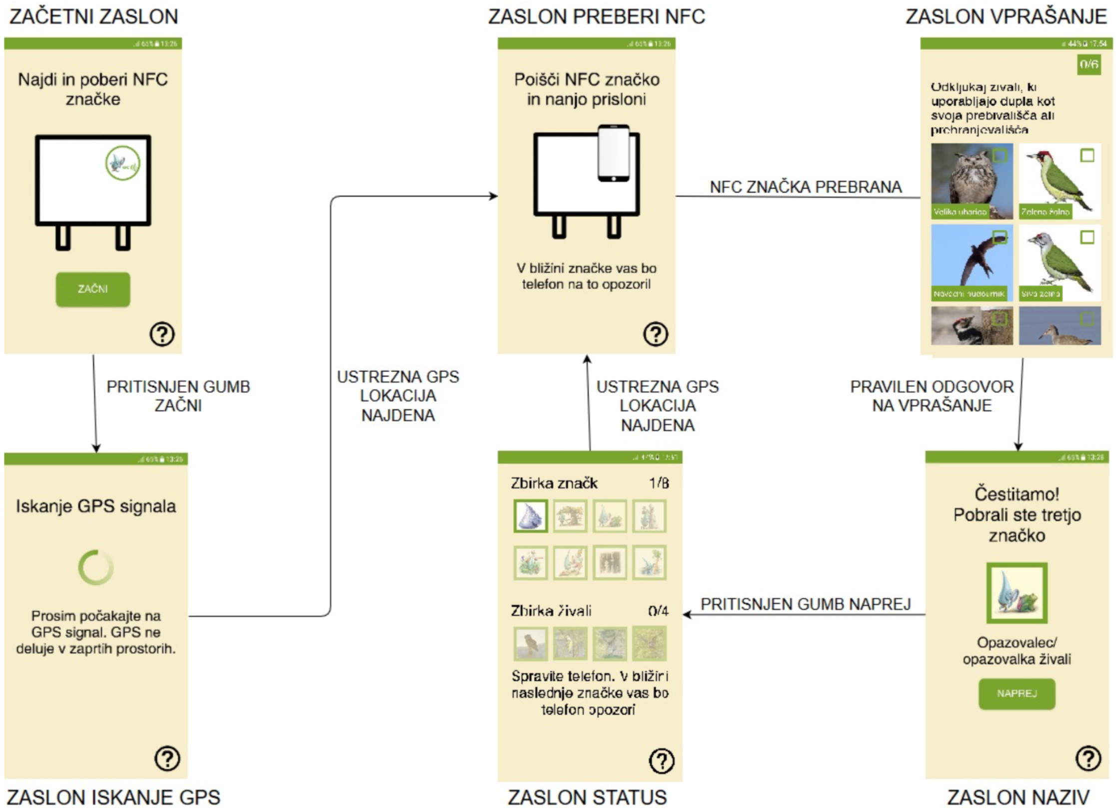
2. ZASNOVA APLIKACIJE
Pri zasnovi aplikacije smo sledili naslednjim vodilom: (i) Ponuditi smo želili lokacijsko pogojene vsebine na točno določenih lokacijah in nanje opozoriti uporabnika, (ii) Vsebine morajo biti kratke in zanimive, (iii) Odvrniti želimo uporabnika od uporabe elektronske naprave, kadar vsebine niso na voljo, in (iv) Uporabnika želimo motivirati z elementi igrifikacije.

Uporabniku želimo torej ponuditi kratke digitalne vsebine samo na določenih lokacijah in ga želimo odvrniti od nenehnega spremljanja uporabljene naprave, kar je ena ključnih težav pri večini lokacijsko pogojenih iger. Zaradi zahteve po čim krajšem času, preživetem na napravi, količina ponujenih digitalnih vsebin ne sme biti prevelika ne predolga saj ne želimo spreminjati klasičnega obiska parka in raziskovanja okolice, temveč le popestriti doživetje obiskovalcev.

2.1 Implementirana rešitev
Zaradi razširjenosti pametnih telefonom s sistemom Android smo se odločili, da izberemo to mobilno platformo za razvoj rešitve. Osnovna interakcija je predstavljena na Sliki 1. Po najdenem GPS signalu aplikacija pozove uporabnika naj telefon pospravi v žep in da ga bo opozorila, ko bo v bližini digitalnih vsebin. V bližini lokacije z digitalnimi vsebina dobi uporabnik opozorilo preko vibriranja. V okolici z digitalno vsebino morajo uporabniki poiskali NFC značko, ki bo omogočila sprožitev prikaza določene vsebine na telefonu. Pri prikazu vsebin smo se odločili za uporabo kratkih vpra-

[1] `https://www.park-skocjanske-jame.si/si/vsebina/izobrazevalni-programi/ucna-pot-skocjan`

[2] `https://www.park-skocjanske-jame.si/si/file/download/64_35f503bd4c772/Vodnik_po_ucni_poti.pdf`



Slika 1: Diagram, ki predstavlja potek interakcije z aplikacijo po korakih. "Zaslon vprašanje" ponudi uporabniku drugo vprašanje pri vsaki dopolnjeni tabli. Pri nekaterih tablah uporabnik dobi tudi živali v dopolnjeni ali virtualni resničnosti, kar je vidno na "Zaslon status". Na posamezno žival iz Zbirke živali ali značko iz Zbirke značk lahko upabnik tapne in s tem odpre posamezno vsebino.

šanj s slikovnim gradivom, ki so povezana z vsebino na informacijski tabli na določeni lokaciji. Po najdeni in uspešno prebrani NFC znački uporabnik dobi vprašanje in s pravilnim odgovorom pridobi še značko. Pri vsaki znački dobi uporabnik tudi enega od nazivov poznavalca parka (na sliki je to "opazovalec/opazovalka parka"). Po uspešno odgovorjenih nekaterih vprašanjih ima na voljo še dodatne vsebine, ki jih lahko "odnese" s seboj in si jih lahko ogleda tudi izzven parka kot nagrado. Dodatne vsebine so 360 stopinjski posnetki lokacij parka v katerih se nahajajo animirane živali. Podrobnejša implementacija je podana v [2].

3. ZAKLJUčEK

Aplikacijo nameravamo v prihodnosti dati na uporabo parku in uporabnikom. Uporabniki bodo s tem pridobili dodatno izkušnjo pri obiski parka. S seboj bodo lahko "odnesli" nagrado. S parkom smo se tudi dogovarili, da bi lahko uporabniki, ki so pridobili vse virtualne značke, dobili tudi fizično broško kot poznavalci parka. Z anonimiziranimi zajetimi podatki bi lahko upravljavci parka še bolje razumeli kateri deli učne poti so najbolj obiskani ter kako dobro informacijske table obiskovalce informirajo o značilnostih obiskanega območja. S tem znanjem bi lahko učno pot še bolje prilagodili različnim ciljnim skupinam. Poleg tega nameravamo z zbranimi podatki ugotoviti katere dele aplikacije uporabniki uporabljajo in katere ne ter poskušati izboljšati uporabniško izkušnjo.

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Interakcija z umetniškimi deli preko množičnega ocenjevanja

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POVZETEK

V realnem svetu (na primer v muzejih in galerijah) in pri uporabi spleta ali mobilnih aplikacij, ki prikazujejo umetniška dela, je uporabnik le pasiven bralec oziroma gledalec. Pri pregledu aplikacij za mobilne telefone, ki so namenjene umetninam, lahko opazimo, da jih velika večina samo podaja informacije. Gledalcu oziroma uporabniku takih aplikacij ponavadi ni mogočeno izraziti svoje mnenje in ga deliti z drugimi uporabniki. V ta namen smo razvili aplikacijo, s katero lahko uporabnik izrazi svoje mnenje o opazovanem umetniškem delu (ali mu je všeč ali ne) in določijo subjektivno vrednost umetnine. Po postavljeni oceni se lahko uporabniki primerjajo z drugimi uporabniki aplikacije. Z aplikacijo smo želeli ugotoviti, ali se lahko veliko število uporabnikov s svojim subjektivnim ocenjevanjem približa prodajnim cenam slik, kot to predvideva Wisdom of the crowd oziroma ocena velike množice ljudi. Izkazalo se je, da se ljudje v večini niso približali prodajni ceni slik. Izpostavili smo dva razloga: premajhen vzorec ocenjevalcev in subjektivna ter abstraktna narava umetnosti.

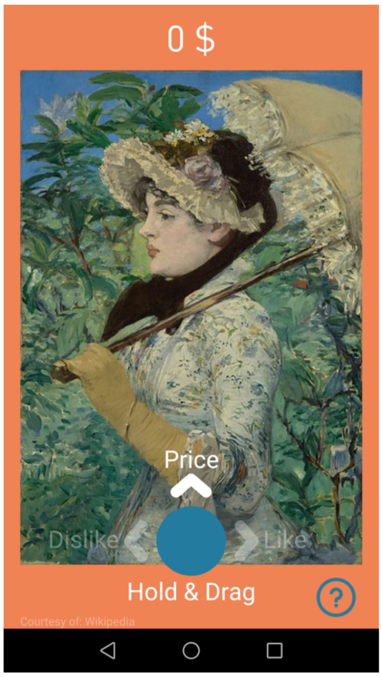
Keywords

umetnost, mobilna aplikacija, masovno ocenjevanje, ocena množice

1. UVOD

Pri obisku muzejev in galerij pa z umetniškimi deli nimamo nobene interakcije. Lahko jih samo opazujemo in podamo oceno umetnine. Ena od težav umetnosti je objektivno ocenjevanje kakovosti tako umetniških del kot umetniškega izražanja. Če neko umetniško delo oceni nekaj kritikov, ki se z umetnostjo ukvarjajo, obstaja velika verjetnost, da bomo dobili zelo različne ocene [1]. Poleg tega na ocenjevanje vplivajo različni dejavniki. Eden od teh je podzavestno odločanje za nakup izdelkov in storitev, ki so dražje in lepše zavite, saj so razumljene kot kakovostnejše [2]. Raziskave so na primer pokazale, da ljudje raje uživamo izdelke, kot sta vino in čokolada, če se zavedamo, da je njihova nakupna cena višja od primerljivih izdelkov [3].

Pri različnih ocenjevanjih lahko uporabimo koncept Wisdom of the crowd oziroma t. i. oceno množice, ki pravi, da je povprečje odgovorov na neko vprašanje velikega števila ljudi znotraj skupine skoraj enako ali celo natančnejše od najboljšega posameznika znotraj skupine [4]. Če na primer veliko število ljudi ocenjuje težo nekega objekta ali število kroglic v posodi ali kakšno drugo količino, se povprečna vrednost



Slika 1: Zaslonska slika ocenjevanja umetnine. Z vlečenjem krogca navzgor višamo ceno. Z vlečenjem levo in desno pa sliko všečkamo ali ne.

vseh ocen zelo približa realnemu številu. Tako ocenjevanje množice smo želeli uporabiti pri ocenjevanju umetniških del. V ta namen smo razvili mobilno aplikacijo Art Value, s pomočjo katere lahko uporabniki ocenjujejo umetniška dela.

2. IMPLEMENTACIJA

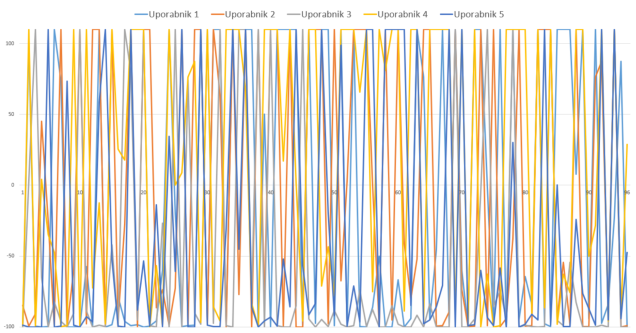
Aplikacija ponuja 96 umetniških del 70 različnih avtorjev. Uporabnik lahko posamezni sliki poda subjektivno oceno na dveh ravneh: všeč/ni všeč in določajo vrednost umetniškega dela (slej Sliko 1). Po ocenjevanju se prikažejo dejanska vrednost dela, podatki o sliki (ime avtorja, slike, letnica nastanka) in ocene vseh uporabnikov v obliki grafa. S predstavljenimi podatki želimo uporabnikom nuditi ozaveščanje o umetniških izdelkih, njihovih avtorjih in obdobju, v katerem so dela nastajala. Poleg tega pa želimo preko grafa omogočiti primerjavo lastne ocene z oceno množice. Nato gre lahko uporabnik na naslednjo sliko in jo oceni. Vsem uporabnikom se slike prikazujejo v istem zaporedju.

3. EVALVACIJA IN REZULTATI

Po slabem letu od objave aplikacije Art Value v Googlovi trgovini Play Store smo se odločili opraviti analizo rezultatov do 23. marca 2018. Aplikacijo je uporabljalo 79 uporabnikov. Vsak uporabnik je v povprečju ocenil 14 slik, poleg tega je v povprečju všečkal 14 slik, ni všečkal pa zgolj 5 slik. Od 1122 ocen je bilo všečkanih kar 817 (72,8 %), za 305 (27,2 %) slik pa so uporabniki izbrali možnost "ni mi všeč". Pri tem je potrebno poudariti, da se je, glede na visoko število všečkanih slik, le to ujemalo pri večini uporabnikov.

26,% (21 uporabnikov) vseh ocenjevalcev ocenilo samo 1 sliko. 12,7% oziroma 10 uporabnikov je ocenilo dve sliki, 13,9% oziroma 11 uporabnikov je ocenilo 3 slike, 11,4% (9 uporabnikov) je ocenilo samo 4 slike in 7,6% (6) uporabnikov je ocenilo 8 slik. Vredno je še poudariti, da so samo 4 uporabniki ocenili več kot 100 slik (to pomeni da je določene slike ocenil dvakrat), samo en uporabnik pa je ocenil več kot 200 slik. Preostali odstotki se porazdelijo med enim oziroma dvema uporabnikoma na oceno. To je bilo veliko pod pričakovanji, saj smo menili, da bo večina ocenila vsaj 5 slik.

Uporabniki so zelo slabo ocenjevali vrednost slike. Skoraj polovica vseh ocen je bila med 0 in 10% realne cene. Predpostavljamo lahko, da je za to krivo premajhno število uporabnikov in premajhno število ocen slik, zaradi česar ocenjevanje množice ni prišlo do izraza. Ali pa je umetnost je morda preveč subjektivna in abstraktna za množično ocenjevanje. Možno je tudi, da so slike precenjene v očeh ljudi ali pa so uporabniki ciljali na slepo.



Slika 2: Stopnje napak za prvi krog ocen 5 uporabnikov z največ ocenami.

Na Sliki 2 so prikazane stopnje napak za prvi krog (do 96. slike) ocen petih uporabnikov, ki so ocenili največje število slik (več kot 100). Na vertikalni osi je prikazan interval od –100% do 110% realne cene, na horizontalni osi pa, katera je bila ocena po vrsti. –100% na vertikalni osi pomeni nič dolarjev, 0% je realna cena slike, 100% pa pomeni dvakratna cena slike. Poudariti je treba, da smo zaradi nazornejšega prikaza vse ocene, ki gredo nad dvakratno vrednostjo slike, zaokrožili na 110%. S pomočjo grafa smo želeli ugotoviti, ali se bodo ocene vrednosti posameznih uporabnikov pri ocenjevanju skozi čas izboljševale (približevale realnim cenam). Če bi se to zgodilo, bi se koncentracija napak iz leve proti desni zmanjševala in približevala 0%, torej realni ceni. Kakor je razvidno iz grafa, se to ni zgodilo, saj vidimo konstantno naključno nihanje skozi celoten krog ocenjevanja. Iz tega lahko zaključimo, da se pri ocenjevanju uporabniki niso ničesar naučili, temveč so ocenjevali naključno. Seveda je treba poudariti, da je vzorec uporabnikov zelo majhen, tako je mogoče, da bi se pri večjem vzorcu stvari spremenile.

4. ZAKLJUčEK

Z aplikacijo smo želeli doseči, da čim več ljudi oceni čim večje število slik, pri tem pa smo želeli ugotoviti, ali se uporabniki s svojim subjektivnim ocenjevanjem lahko približajo prodajnim cenam slik, kot to predvideva Wisdom of the crowd oziroma ocena velike množice ljudi. Izkazalo se je, da se ljudje v večini niso približali prodajni ceni slik. Potencialnih razlogov za to je kar nekaj. Izpostavili smo predvsem dva.

Prvi je ta, da je bil vzorec ocenjevalcev premajhen, kar je posledično privedlo do preveč naključnih ocen. Za realno oceno množice bi potrebovali veliko več uporabnikov. Aplikacijo smo sicer reklamirali med svojimi prijatelji in znanci na straneh socialnih omrežij a smo to naredili le nekajkrat. Za doseči večje število uporabnikov bi bilo potrebno aplikacijo reklamirati skozi daljše časovno obdobje.

Drugi razlog je vezan na samo umetnost, pri kateri sta lepota in cena precej subjektivne in abstraktne narave. Oceno množice so najpogosteje raziskovali in dokazali pri reševanju težav, ki zahtevajo enotno številčno oceno. Enak učinek je možno doseči tudi pri težavah, pri katerih odgovor zahteva usklajevanje več informacij [4]. Ko govorimo o enotni številčni oceni mislimo na primer na oceno množice pri ocenjevanju vrednosti nekega izdelka, za katerega bi nekateri ljudje plačali manj, nekateri več, v povprečju bi pa plačali približek realne vrednosti. Podobno bi lahko pričakovali pri umetniških delih a je to potrebno šele dokazati. Lahko predpostavljamo, da je ocenjevanje vrednosti umetnin podobno kot ocenjevanje drugih izdelkov. Hkrati pa lahko predpostavljamo, da je umetnost precej subjektivna in so cene umetniških del precej visoke in uporabnikom tudi nedoumljive. To bi lahko trdili na podlagi dejstva, da se pet uporabnikov, ki so ocenili slabih 100 slik, pri ocenjevanju vrednosti ni približalo dejanski vrednosti skozi čas. V prihodnje bi bilo potrebno aplikacijo bolje reklamirati in pridobiti večje število uporabnikov, da bi lahko ovrgli ali sprejeli našo hipotezo o delovanju ocene množice pri umetninah.

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Igrifikacija virtualnega obiska učne poti Škocjan z uporabo mobilnih tehnologij in 360-stopinjskih posnetkov

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POVZETEK
V zadnjem desetletju se na svetovnem spletu pojavljajo storitve, ko je na primer Google Street View, ki nam omogočajo virtualni ogled cest, ulic, trgovin, muzejev in drugih objektov na ekranu ali s pomočjo naglavnih prikazovalnikov virtualne resničnosti. Za virtualne obiske oz. ogled se uporablja 360 stopinjske panoramske posnetke. V članku je opisan prototip virtualnega obiska učne poti v Parku Škocjanske jame, ki na poučen in interaktiven način predstavi učno pot ljudem pred samim fizičnim obiskom, ljudem, ki po fizičnem obisku želijo podoživeti pot in ljudem z omejeno možnostjo gibanja, da lahko pot, ki jim je nedostopna, sploh doživijo.

Ključne besede
virtualni sprehod, igrifikacija, panoramski posnetki, spletna aplikacija

1. UVOD
Učne poti so lahko zahtevne za obiskovalce z zmanjšano mobilnostjo, lahko vzamejo preveč časa, ali pa se ljudje želijo poučiti o poti pred samim obiskom. Zato smo želeli omogočiti virtualni obisk učne poti na zabaven in hkrati poučen način. Virtualni obisk poti smo želeli prilagoditi na način, da uporabnika zadržimo skozi celoten virtualen sprehod vključno s prvotnim namenom učnih poti - poučiti uporabnika o naravni in kulturni dediščini okolja v katerem se nahaja.

2. PREGLED OBSTOJEčIH VIRTUALNIH OBISKOV
Ker je virtualnih obiskov precej, bomo predstavili le dva kot primera dobre prakse. Pirvi je Night Walk, ki obiskovalca popelje po ulicah francoskega mesta Marseille. Sestavljen je iz številnih 360 stopinjskih posnetkov na katerih so označene zanimive točke; s klikom nanje se nam pokaže ali dodatna slika ali pa videoposnetek. Nekatere od njih vsebujejo vprašanje, ki je povezano z mestom. V zgornjem levem kotu je prikazano število vseh in število ogledanih točk. Ves čas nas spremljajo zvočni posnetki, ki so tako ali drugače povezani s trenutno panoramo. Na ekranu je viden tudi zemljevid, ki prikazuje, kje v mestu se uporabnik nahaja ter katere dele mesta si lahko ogleda. Drugi primer je aplikacija CŠOD Misija, ki omogoča virtualno-fizične sprehode na različnih lokacijah. Sestavlja jo veliko število učnih ali pohodniških poti, na katerih so označene zanimive geografske lokacije. Ko na podprti lokaciji uporabnik odpre aplikacijo mu ta ponudi izziv v obliki vprašanja. Pravilen odgovor je mogoče prebrati v opisu lokacije ali najti nekje v bližini. Za vsak pravilen odgovor uporabnik prejme točke in ko jih zbere dovolj pridobi značko uspešno opravljenega obiska.

3. ZASNOVA APLIKACIJE
Po pregledu različnih obiskov smo si virtualen obisk učne poti Parka Škocjanske Jame zamislili na podlagi sledečih zahtev.

(i) Enostaven dostop do virtualnega sprehoda (brez nameščanja dodatne programske opreme na uporabnikovo napravo, na primer preko spletnega brskalnika).

(ii) Prilagodljivost različnim velikostim zaslonov.

(iii)Prikaz interaktivnega zemljevida lokacij posameznih točk na učni poti. Možnost "sprehoda" z izbiro posamezne točke na zemljevidu ali pa zaporedno od prve do zadnje, kot bi jih obiskali v realnem svetu.

(iv) Prikaz in interakcija s 360 stopinjskimi posnetki za posamezno točko iz zemljevida tako, da omogočimo usmerjanje pogleda uporabnika v 360 stopinjskem posnetku z giroskopom na pametnem telefonu ali z miško na namiznih računalnikih in prikažemo označene zanimive dele na posnetku z dodajanjem opisov, slik, ali video posnetkov v 360 stopinjski posnetek.

(v) Prikazovanje vprašanja in možnih odgovorov povezanih s trenutno lokacijo, odgovarjanje in beleženje odgovorov kot element igrifikacije. Pri vsaki lokaciji na učni poti je na voljo vprašanje. Pravilen odgovor se skriva v dodanih opisih na 360 stopinjskem posnetku. Uporabnik ima na voljo 3 možnosti, od katerih je vedno pravilna le ena. S klikom na enega izmed odgovorov se prikaže pojavno okno z razlago. Ne glede na rezultat ima uporabnik možnost nadaljevati na naslednjo lokacijo.

(vi) Zbiranje nagradnih značk kot element igrifikacije. Uporabnik bo z odgovarjanjem na vprašanja povezanimi z lokacijo na učni poti zbiral nagradne značke. Če uporabnik pravilno odgovori na vprašanje, si pridobi značko, ki si jo lahko odpre v večji velikosti. Če uporabnik klikne na značko, ki je še ni pridobil, se mu pojavi opozorilo, ki ga vljudno povabi k odgovarjanju. Da bi obisk uporabniku predstavljal izziv, bo

Slika 1: Vmesnik virtualne poti na zaslonu namiznega računalnika. Uporabnik se trenutno nahaja na tretji točki sprehoda od osmih kar je vidno na zemljevidu zgoraj levo. Med točkami se lahko premika samodejno zaporedno z odgovarjanjem na vprašanja ali pa klikne na poljubno točko na zemljevidu in se premakne nanjo. Desno od zemljevida se nahajajo vprašanja in skrajno desno pridobljene značke. V spodnjem delu je panoramska slika na kateri lahko uporabnik odpira dodatne slike in besedilne opise.

lahko na vsako vprašanje odgovoril le enkrat. Če se zmoti, mora obisk začeti ponovno da bi zbral vse značke.

4. OPIS VMESNIKA

Vmesnik lahko vidimo na Sliki 1. Za virtualni obisk učne poti smo izbrali 8 geografski lokacij na sami učni poti, ki bodo predstavljene z 360 stopinjskimi posnetki. Pri postavitvi smo se odločili, da spletno aplikacijo razdelimo na 2 dela: zgornji, se deli še na 3 enote. Na levi je slika zemljevida učne poti Škocjan, na kateri so tudi označene geografske točke virtualnega obiska. Na sredini je prostor za vprašanje ter možne odgovore, desno pa so v 2 enaka stolpca po vrsti razvrščene nagradne značke. Celoten spodnji del zaseda interaktivna panoramska slika. Za prikaz panoramskih sliksmo uporabili orodje Google Poly.

Uporabnik začne svoj virtualni obisk na prvi točki. Če odgovori na zastavljeno vprašanje in če je odgovor pravilen, se odklene nagradna značka na katero lahko uporabnik klikne in si jo ogleda. Če je odgovor napačen, se pri nagradni znački pojavi rdeč X in odpre okno s pravilnim odgovorom. Odgovor na vprašanje se nahaja na panoramski sliki v dodatnih opisih. V kolikor želi uporabnik nadaljevati obisk, se naloži naslednja panorama in novo vprašanje. Uporabnik lahko na zemljevidu izbere tudi poljubno lokacijo in tako ne obišče virtualne poti v zaporedju. Ko uporabnik odgovori na vprašanje pri zadnji lokaciji se odpre novo okno, ki uporabnika obvesti, da je prispel na konec in ga povabi, da si s klikom na lokacijo na zemljevidu še enkrat pogleda 360 stopinjske posnetke.

5. ZAKLJUčEK

V spletno aplikacijo smo vgradili anonimno sledenje interakciji. V prihodnosti nameravamo izvesti študijo, ki bo razkrila kaj uporabniki počnejo na virtualni učni poti in ali je namen (učenje preko odkrivanja informacij na panoramskih slikah in zbiranja značk) dosežen. Podrobnejši opis ideje, zasnove in izvedbe izdelave spletne aplikacije virtualnega obiska učne poti je dosegljiva v [1].

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Virtual Reality and Neurocognitive Intervention: Rehabilitation approaches towards assisting autistic children with cognitive deficit

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ABSTRACT

Autism Spectrum Disorder (ASD) is a developmental condition in which the sufferer experiences difficulties in communication with other people, struggles with social interaction and is confused by the world around. Although there is no remedy for this condition, Various medical and technological organizations are working on the development of unconventional solutions such as therapy and assistance for aiding individuals with ASD to manage their condition. Information and communications technology (ICT) is used as a form of therapy in the clinical treatment of psychological disorders. Virtual Reality (VR) is a reasonably new addition to ICT based therapy which can be used to encourage, guide and support individuals with cognitive disorders to develop their skills necessary for independence. Previous researches and experiments have shown that it is possible to enhance the level of concentration, coordination, socialization, communication, self-awareness, and memory in individuals supported with VR. It is not only an ideal way of ameliorating these skills before encouraging individuals to try these out in the real world but also creates a safer environment. This paper focuses on exploring the VR based rehabilitation systems that look into the efficacy of the combination of VR and interactive rehabilitation techniques to complement the current conventional rehabilitation treatments for individuals with ASD. This will be presented through two examples: enhance awareness and coordination by teaching autistic children how to cross a road, and enhance focus and attention using a virtual classroom.

Keywords

Virtual reality, autism spectrum disorder, cognitive rehabilitation

1. INTRODUCTION

The incidence of ASD has increased steadily over the last twenty years. According to the National Autism Association statistics, it is the fastest growing developmental disorder, yet most underfunded [5]. Some studies have been published which show that in recent years there has been an increase in ASD cases by 78% since 2002 [5][1]. However, it must be noted that there is a lack of consensus regarding the prevalence of ASD. Recent studies published in March 2014 by the Center for Disease Control and Prevention (CDC) show that about 1 in 68 children has been identified with ASD in the USA. Studies in Asia, Europe, and North America have identified individuals with ASD with an average prevalence of between 1% and 2% [5]. ASD itself does not affect life expectancy; however research has shown that the mortality risk among individuals with ASD is twice as high as the general population, in large part due to drowning and other accidents. These numbers clearly exemplify that this is indeed an area of concern. Currently there is no cure for ASD, though with early intervention and treatment, the diverse symptoms related to ASD can be improved significantly to enable the person with ASD to lead a useful and productive life.

Since the 1960s the brain has been considered an irrecoverable organ, unable to substitute lost nerve cells [6]. As a result the loss of cognitive functioning were considered to be irreversible and untreatable. When the concept of neuroplasticity gained popularity in the 1980s, this view of the hardwired brain started to change and the potential for cognitive rehabilitation was acknowledged. Neuroplasticity entails the ability of the brain to alter existing connections between cells, to form new connections, to create new cells, and to resist cell death. It allows the neural networks in the brain to reorganize their architecture and functioning through exposure to new sensory experiences [14]. The idea was first proposed in 1892 by Santiago Ramon y Cajal, and subsequently neglected for the next 50 years [13]. Along with the support for the concept of neuroplasticity and how it may enable cognitive rehabilitation, VR was investigated as an enabling technology for cognitive interventions [13].

2. VR AND COGNITIVE REHABILITATION

The perceived impact of cognitive impairment on day-to-day functioning has led to the development of cognitive rehabilitation approaches intended to remedy these impairments, thus improving the functioning of people with psychiatric disabilities. In this context, professionals from different fields have been studying and developing cognitive rehabilitation strategies, generating controversy, and a variety of views regarding the effectiveness of each one. In general, these approaches may be classified as restorative or compensatory, as well as computerised and non-computerised.

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Some areas of particular interest in which applications of VR are being researched and developed are in clinical psychology, and the cognitive and neurosciences. VR can be used as an assessment or intervention instrument for the clinical treatment of psychological disorders. Studies have been conducted which focused on cognitive behavioral therapy for the rehabilitation of anxiety disorders such as fear of heights (acrophobia) [11], fear of flying (aviophobia) [11], fear of open spaces (agoraphobia) [7] and social phobia [7]. Other applications involve the rehabilitation of anxiety disorders such as Post Traumatic Stress Disorders for war veterans (Vietnam, Iraq, and Afghanistan) [9]. VR applications have also been developed to clinically rehabilitate a degradation of cognitive functioning resulting from a range of diseases including Alzheimers [8], schizophrenia [4] or conditions such as autism [3] and intellectual disabilities [12]. A functional overlap exists in many of these applications in that they can aim to achieve similar goals such as training with activities of daily life which support more independent living, enhancing cognitive performance and improving social skills.

2.1 Case Study I:Awareness and Coordination

One example of a VR for enhancing the awareness and coordination of ASD individuals is a study conducted by a team of researchers at the University of Haifa, Israel [2]. This system features several scenarios which are all designed to teach autistic children how to cross a road. The simulation shows a street with traffic lights and cars which the child interacts with. The child learns to cross a road safely and without placing them in danger or causing undue stress. Plus these skills are then practiced in a real-world but controlled area.

2.2 Case Study II:Focus and Attention

Virtual reality is also used to help autistic children with social attention problems. An autistic child often finds it difficult to read facial expressions, pick up visual cues or pay attention to another person while they speak. An example of a VR for enhancing the focus and attention of ASD individuals is a system developed in the US which aims to improve social attention in autistic children [10]. The child wears a head-mounted display (HMD) which shows images from a virtual classroom. This classroom contains a set of 3D virtual people or avatars who deliver an individual presentation. But each of these avatars starts to fade if the child looks away or loses interest.Figure 1 illustrates a scene from the commercial prototype of the virtual classroom.

Figure 1: A Scene from the virtual classroom [10]

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Interakcija z umetninami z uporabo tehnologije dopolnjene resničnosti

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POVZETEK

V članku je predstavljena zasnova in in opis prototipa aplikacije v obliki igre lov na zaklad v navezi z interakcijo z umetniškimi deli. Med obiskom muzeja ali galerije prototip uporabnikom ponudi uporabo dopolnjene resničnosti za popestritev samega obiska, kjer s pomočjo tabličnega računalnika (tablice) obiskovalec išče predhodno izbran in pobarvan kip. Lov na zaklad oziroma intzerakcija je zamišljena tako, da uporabnik pobarva pobarvanko, jo slika in se s tablico poda po galeriji ali muzeju. Če najde pobarvanki pripadajoči kip, se le ta ovije v pobarvano preobleko glede na pobarvano pobarvanko. Če pa izbere napačen kip, ga aplikacija na to opozori.

Ključne besede

dopolnjena resničnost, umetnine, igrifikacija, lov na zaklad

1. UVOD

Galerije in muzeji želijo ponuditi obiskovalcem izkušnjo, ki jim bo ostala v spominu, predvsem pa želijo v njih vzbuditi željo, da bi prišli še kdaj. Eden od načinov popestritve obiska galerije je uporaba sodobnih tehnologij kot na primer uvedba avdio vodičev ali postavitev zaslonov (lahko tudi QR kod) poleg umetnine, na katerih lahko preberemo nekaj več o umetnini sami, zgodovini avtorja, času nastanka umetnine ali pogledamo dodatne multimedijske vsebine. Tak pristop obiskovalcu kopico novih informacij, ki so povezane z določenim eksponatom.

Poleg naštetih tehnologij za uporabo v galerijah in muzejih obstaja še veliko možnosti, med katere sodi tudi dopolnjena resničnost. Dopolnjena resničnost je vrsta tehnologije, ki nam pogled na realni svet dopolni z računalniško ustvarjenimi virtualnimi vsebinami, kot so besedilo, zvok, slika ali video. Tehnika dopolnjevanja se odvija v realnem času in v korelaciji z obstoječo okolico. Na ta način gradimo uporabniško izkušnjo, kjer se digitalni svet in naša okolica prepletata in tako uporabniku omogočata nove načine interakcije z okoljem.

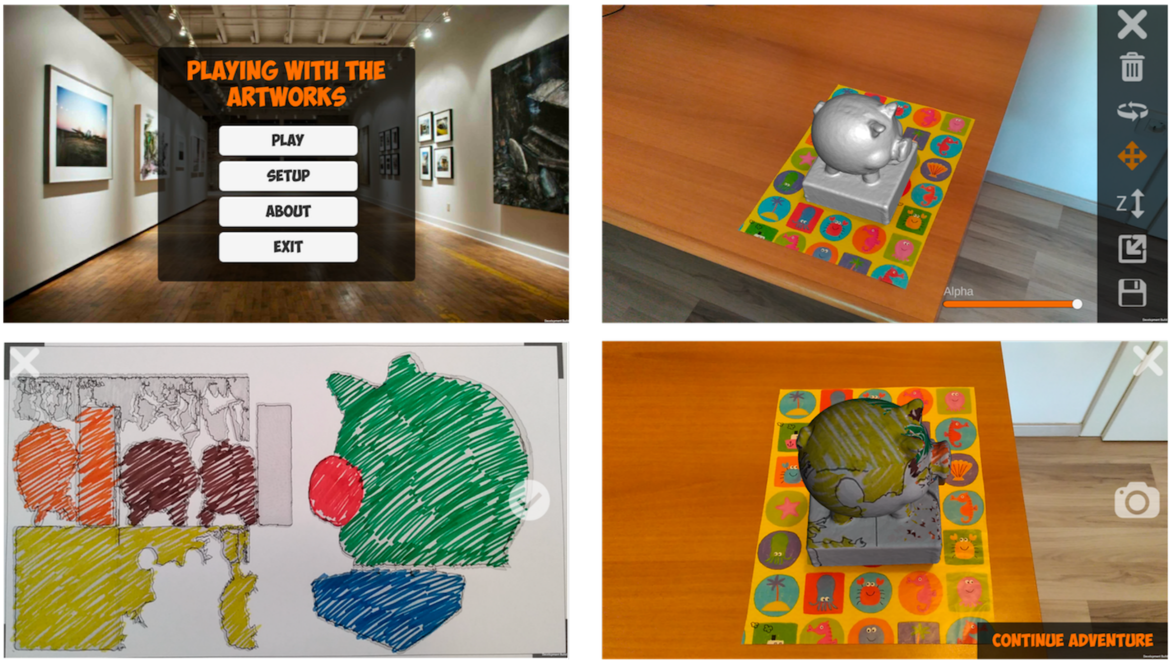
Članek nadgrajuje delo opisano v [1], ki opisuje način uporabe tehnologije dopolnjene resničnosti, ki omogoča uporabnikom, da med obiskom galerije postanejo soustvarjalci. Izdelan je bil prototip igre po zgledu igre lov na zaklad, ki je bil že večkrat raziskan v različnih okoljih in različnimi skupinami uporabnikov[2, 3, 4]. V [1] je bila ideja zasnovana tako, da vsak udeleženec prejme pobarvanko in jo pobarva po svoji želji. Pobarvanko slika s tabličnim računalnikom (tablico) in se poda na iskanje pobarvanki pripadajočega kipa. V primeru usmerjene tablice na pripadajoče umetniško delo pobarvana kontura prekrije le to. Prototip predstavljen v [1] je deloval le za 2D vsebino. Naša ideja je bila ustvariti podoben prototip, ki bo s pomočjo dopolnjene resničnosti omogočal interaktivnost s 3D objekti oziroma kipi.

2. ZASNOVA PROTOTIPA

Za razvoj aplikacije smo uporabili programsko opremo Unity3D, ki je namenjena razvoju računalniških iger in je hkrati tudi razvojno okolje. Kot privzeti programski jezik smo izbrali C#. Za razvoj rešitve smo uporabili platformo dopolnjene resničnosti Google Tango[1], vgrajeno v tablico Tango Development Kit, ki omogoča sledenje napravi v prostoru. Uporabili smo še programsko knjižnico Tango SDK za orodje Unity3D. 3D objekte smo dobili tako, da smo s Structure IO senzorjem[2] objekt skenirali in nato uporabili programsko opremo Skanect[3], ki zgenerira model oz. mrežo objekta s primerno geometrijo in primernim številom oglijšč. Dobljen model smo obdelali v orodju Blender kjer smo naredili UV preslikavo (ang UV texture mapping) in jo spremenili do te mere, da je preslikava še vedno nakazovala kaj naj bi uporabnik barval. Preslikava je tako bila osnova za pobarvanko. Ker se Tango tablica "zaveda" svojega položaja v prostoru smo lahko postavili pridobljen 3D objekt točno na položaj realenega objekta in hkrati pobarvanko (oz. pobarvano preslikavo) napeli nanj.

Delovanje aplikacije se deli na dva dela glede na skupino uporabnikov: obiskovalci galerij in uredniki vsebine, zadolženi za vzdrževanje podatkov v aplikaciji (Slika 1 zgoraj levo). Uredniki niso nujno kuratorji muzeja saj potrebujejo za postavitev igre nekaj naprednega tehničnega znanja. Uredniki morejo najprej posneti notranji razstavni prostor, kjer bodo obiskovalci kasneje uporabljali aplikacijo. To omogoča sama tablica Tango. Nato morejo izdelati 3D modele kipov, ki jih bi želeli v muzeju ali galeriji uporabiti v igri. 3D modele je nato potrebno uvoziti v aplikacijo in jih nato umestiti v prostor na položaj realnih kipov. Pri tem lahko urednik opravi manjše popravke (spremeni koordinate, velikost in orientacijo kipa). Končni izdelek je virtualni 3D-model kipa, ki sovpada s fizičnim kipom v realnem svetu kar je vidno na

[1]https://en.wikipedia.org/wiki/Tango_(platform)
[2]https://structure.io/
[3]https://skanect.occipital.com/



Slika 1: Vmesnik aplikacije. Zgoraj levo: izbira med uredniškim in uporabniškim delom. Zgoraj desno: urednikovo prilagajanje 3D modela kipu. Spodaj levo: uporabnikovo slikanje pobarvane pobarvanke. Spodaj desno: prilepljena tekstura iz pobarvanke na kip.

Sliki 1 zgoraj desno. Ker so vsi 3D modeli uvoženi v aplikacijo, ta ne potrebuje nobene povezave z internetom.

Druga vrsta uporabnikov so obiskovalci. Na začetku bo vsak uporabnik dobil tablico Tango in delovni list, na katerem se bodo nahajale pobarvanke (obdelane UV preslikave 3D modela), ki predstavljajo predele površine realnega kipa. Obiskovalci bodo pobarvanko po želji pobarvali in jo nato s pomočjo fotoaparata na napravi Tango znotraj aplikacije slikali (Slika 1 spodaj levo). Tu se začne lov na zaklad. Obiskovalci se bodo sprehajali po galeriji in iskali kip, za katerega menijo, da mu pripada pobarvanka. Z usmeritvijo kamere mobilne naprave proti določenemu kipu in izbiro preko zaslona bodo iskali ujemajoči se kip. V primeru izbire neujemajočega se kipa jih bo sistem na to opozoril in iskanje se bo nadaljevalo. V nasprotnem primeru se jim bo fizični kip na ekranu prikazal z njihovo pobarvano teksturo (Slika 1 spodaj desno). Tu se celoten postopek ponovi.

3. ZAKLJUčEK

V članku smo razvili prototip aplikacije v obliki igre lova za zakladom. S pomočjo tehnologije dopolnjene resničnosti smo želeli obiskovalcem med obiskom muzeja ali galerije omogočiti soustvarjanje in interakcijo z objekti v resničnem svetu.

Za implementacijo prototipa smo uporabili tehnologijo Tango, ki je bila ta dosegljiva v času izdelave. Tehnologijo Tango je podjetje Google 1. marca 2018 žal opustilo in nekatere od funkcionalnosti vgradilo v AR Core. Za nadaljno uporabo bi bilo potrebno aplikacijo prilagoditi novi AR knjižnici. Osnovna cena malega števila Tango naprav je bila okoli \$500. Mobilni telefoni in druge naprave z AR Core pa so bolj razširjene in tudi cene se začnejo pri \$300. Strošek za muzej ali galerijo je tako le nakup določenega števila naprav.

Poleg tega v zasnovi opisanega prototipa ni nobenih elementov igrifikacije oz. besedil, saj bi bilo te potrebno izdelati s kuratorji muzeja. V prihodnje bi bilo potrebno aplikacijo dopolniti še s temi vsebinami, glede na vsebine določiti ciljno skupino uporabnikov in raziskati uporabniško izkušnjo v realnem okolju. Aplikacijo bi lahko uporabili tako v zaprtih prostorih (muzeji in galerije) kot odprtih prostorih (mesto s kipi na trgih). Pri našem testiranju v notranjem okolju z uporabo aplikacije ni bilo težav. Uporabo v zunanjih prostorih bi bilo potrebno še raziskati.

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In-Game Economy Based on Blockchain

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ABSTRACT

In this paper we review the potential of using blockchain technology to tokenize in-game assets such as items and currency. We review existing projects developing technology to support this and through various available metrics and argue their potential for success. We provide insight into the potential formation of a global decentralized virtual marketplace where players can leverage the free market to seamlessly migrate between supported games taking the value with them. We also argue, that blockchain would infuse the much needed trust in virtual economies and make them more secure, less prone to manipulation, and easier to regulate and police.

CCS CONCEPTS

• **Applied computing** → **Electronic commerce**; • **Human-centered computing** → *Human computer interaction (HCI)*; • **Software and its engineering** → Software notations and tools.

KEYWORDS

in-game transaction, blockchain, coin, game engine, comparison

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1 INTRODUCTION

Games designers have steadily explored different models of monetization. A recent and emerging monetization model usually referred to as free-to-play is becoming more popular. The idea of this freemium business model is to monetize the content in the game instead of the game itself. More specifically, games frequently introduce an in-game virtual currency that users can buy with real currency and use in the game to buy items. With the growing support of fiat gateway, a service that allows you to convert fiat currency (a national currency, say US Dollars) in to cryptocurrency, and in-game purchase services in game platforms, such as Google Play and Apple's App Store, there is much less friction in buying in-game items. Such models have been a great success, with games like Clash Royale by Supercell creating 1 billion USD in revenue less then a year after launch [14]. There are many elements contributing to this success. In most cases, players must acquire virtual in-game currency by playing or acquiring it with real money in order to progress, speed up game processes that require waiting, upgrading items to lower the difficulty, etc. However, the virtual currencies are spendable only in the game and there is rarely a bi-directional value transfer of money. This prevents players from migrating their in-game valuables to other games, consequently forcing them to spend additional money should they choose to play a different game.

To overcome this limitation, independent marketplaces were created by players where items and accounts can be traded for currency or exchanged for other items and accounts. Due to the unregulated nature of these markets, trading is very risky. Additionally, the use of third party marketplace services creates a lot of unnecessary friction for users, requiring them to constantly switch between the game screen and different web-based marketplace services. A blockchain-based inter-operable protocol would revolutionize the gaming industry by enabling global virtual markets with no unnecessary friction and thereby increase market participation. Owning, transferring and trading digital assets could become as easy as playing a game.

2 GAME ENGINES AND BLOCKCHAIN

This section describes various game engines and possible options for blockchain payment integration, i.e. how different gaming platforms have begun to enable integration with their platform.

When the first games were introduced, the term "game engine" did not exist at all, since what we now understand as a game engine evolved with the computer game. Namely, each game had its own game drive, which made it possible to quickly debug, add new functionality and encapsulate logic, graphics and other components.

In the 1990s [6], however, the first broad-spectrum game engines began to develop, allowing the construction of similar games. For example, if a programmer wanted to make a racing game with a car, he made a game engine for such games and used a template to change the game to get from one version to another version. Examples of such gaming engines are Hydro thunder Engine [9], Quake [12], Doom [9], etc.

Subsequently, fully self-contained game engines began to develop, allowing the development of a wide range of different games, some of which have survived to this day. Examples of such engines that are still in the top spot in popularity today are Unity 3D [3] and Unreal Engine [6]. Among other things, these gaming engines are available free of charge, so that any future developer can get them for free and can immediately start making their own computer game.

Same parts of this paper are based on just one game engine technology. For these purposes, we have chosen Unity 3D [3]. The decision was mostly pragmatic as we had more experience in using the selected engine.

Games and blockchain

The widespread model of micro-payments in games resulted in a heterogeneous ecosystem of virtual currencies that are not inter-operable and often prone to manipulation. One of the key concerns are the so called "game of luck" elements of random chance to obtain virtual items, which have met some regulatory issues and are often compared to gambling. Another issue for costumers is the constantly changing chance for loot boxes in order to achieve more balance and in-game economic stability. Hence, the in-game economy can not be considered free and open market. Instead, it is heavily regulated and manipulated, with a goal to set the best ratio between player engagement and revenue. Virtual markets can become quite large, and often though basic principles of supply and demand should drive the market [15], virtual markets behave very differently [2]. Additionally, game designers can manipulate the supply of goods without player's awareness should they choose to conceal it due to the centralized nature of the virtual currency and luck ratios in loot boxes. These issues can be addressed by using a trust-less system (that does not depend upon the intentions of its participants, who may be honorable or malicious), which is one of the key properties blockchain technology has.

Tokenization of real and virtual assets is one of the use-cases for blockchain-based tokens. At the time of writing (May 2019), Ethereum [1] was home to more then 200,000 ERC20 token contracts alone, making it the largest blockchain network for tokenized assets and utility tokens. Ethereum has many token standards, among which the ERC-721 token standard for non-fungible tokens allows games to represent a specific virtual item as a unique token, while the ERC20 standard can serve as fungible in-game currency. There are many benefits to tokenizing in-game assets such as:

- Transparency of supply and demand: The smart contract can keep record of all tokens (in-game items) and their owners. Due to the immutable and transparent nature of blockchain, these contract states can be queries by anyone.
- Transparency for trades, transfers and value at any given time: Decentralized protocols supporting an ERC standard can inherently support all tokens in compliance with the standard. An illustrative example would be the 0x Protocol [16] that enables most popular ERC standards including ERC-721 to be traded between two parties in a completely decentralized and trusted way. This would enable players to trade their tokenized assets between games.
- Transparency of loot box chances and inability to manipulate: Loot box chances can also be written in smart contracts to prevent manipulation. Additionally, with the help of oracles providing safe random, the randomness .
- Easier regulation: The blockchain can provide a historical and immutable record that can be used by regulators to monitor and police the virtual markets.
- Interoperability between games, merging virtual economies: With interoperability standards for trading, landing, borrowing, etc., currently separated virtual markets can be a bridge through trade. This could create a global in-game virtual economy where players are free to migrate their value from game to game through trade.

Due to the high potential of blockchain technology in revolutionizing gaming, many start-ups were funded through initial coin offerings to try and build the technology needed for integration.

3 PRESENTATION OF THE AVAILABLE TECHNOLOGIES

This section presents the blockchain technologies that were found by the authors and tested on a proof of case implementation with mostly default settings. The observed technologies are:

- Enjin [4],
- WAX [8],
- Decentraland [5],
- Loom Network [11],
- Funfair [10].

Each blockchain technology is presented and a comparison of the comparable properties is presented in Section 3.

Enjin

The oldest blockchain technology aimed at in-game transactions is Enjin [4] that was presented to the public in 2009, but the blockchain-based crypto coin with the same name was presented in 2017. The vision of this technology is to allow developers to develop their games as easily as possible, with as little background as possible, so anyone with some programming knowledge can integrate their technology and easily connect to blockchain. The focus of Enjin technology is on the Unity 3D game engine.

From a practical point of view, the use of Enjin looks like this: first, the user (in this context, the developer) must provide the Unity 3D game engine and prepare the foundations of the game. Once this is set up, it has to download the Enjin SDK from the Internet, which ensures proper communication of Unity 3D and the Enjin platform. The integration of these two technologies is automatic.

WAX

WAX technology [8] has not yet come fully into use but is already extremely popular and highly anticipated. WAX technology is praised for its full compatibility with the very popular and well-known EOS [7] technology (at the time of writing [1] this is the third most popular Blockchain technology). WAX promises developers an easy integration of their technology into existing systems, regardless of the game drive or the game program where current technology is in use.

The user will either play a game or see something related to the game online (say, some good) and decide to buy it. All he/she has to do is to click on a button to purchase this item, which may be a direct purchase, or request a replacement for another user. Clicking on the button will introduce the WAX authorization to complete the entire process for the user.

[1]Coincodex, May 2019: https://coincodex.com/crypto/eos/?period=YTD

Decentraland

This is a technology that allows the user to buy a virtual estate on the Ethereum network [1], modify, edit and monetize them. As the name implies, the point is that all these virtual estates are decentralized. Which means that there is no central institution that controls who owns any of the possessions and that can also be used (or that the institution would collapse and all users would lose all the possessions). Thus, the whole system is decentralized, which enables, among other things, direct purchase, sale and control of the user's part of the property. The process of using this technology is very different from all the others presented in this paper, namely, the whole system is divided into two goods: Mana and Land. If we want to have our digital property inside Decentraland, we can buy it through their "Mana" store. This is essentially the cryptocurrency behind Decentraland. So the developer first has to buy the right amount of "Mana" through an online exchange, then go to the Decentraland store and buy any property there.

Loom Network

The technology is based on the very popular Ethereum [1] technology, allowing the user to build their own Ethereum private chain. As Ethereum is considered the most popular blockchain technology (besides Bitcoin, which cannot be used for this purpose), Loom Network has become very popular as well.

The entire communication with Loom Network goes through Loom SDK (software development kit). The interface of the SDK takes care of converting user function calls into their Loom network equivalents. Loom SDK is independent of the gaming engine.

Funfair

The company's focus is on online casino games, but, in general, their technology can be used in other games, even in gaming engines. The technology allows players to look into the code, which means they can see if the game is really fair. Among other things, they can see its operation on the blockchain itself, so fair play can prove its "honesty" immediately.

Comparison

These projects are still in early deployment phases; currently, there are only a few small games testing out the potential of tokenizing in-game assets. There are also issues with scalability of the Ethereum's base layer, which has a relatively low transaction throughput. Ethereum has a plan to address this issue in the following years by upgrading to Ethereum 2.0. Meanwhile, some projects decided to implement plasma [13] chains to speed up and batch transactions to achieve higher

Table 1: Comparison of monetised values of presented technologies.

Technology	ERC-721	Plasma	Engine integration	Market cap ($)	Place
Enjin	Yes	Yes	Yes (Unity)	120	top 60
WAX	Probably	No	No	72	top 90
Decentraland	No	Yes	No	64	top 100
Loom network	Yes	Yes	No	62	top 100
Funfair	No	Yes	No	41	130

throughput. In Table 3, we compare selected projects by market cap that could be a measure of market confidence in the project, support for plasma chain (which indicate innovation and scalability), support for non-fungible token standard ERC-721 and game development engine integration.

As it is shown in the Table 3 both Enjin and Loom Network support ERC-721 standard (while WAX will most likely support it at its release). Interesting point is that both technologies offer even better token standards (Enjin supports ERC-1155 and Loom Network supports ERC-1187). The Ethereum Plasma support metric did not prove to be helpful in this study, since every technology supports it (aside from WAX, which is on EOS, therefore it cannot support it). A real breakthrough of the study was the Engine integration metric, which showed why the Enjin dominates the ladder - it is the only top 100 technology which supports an engine integration. We observe that Enjin has the most potential regarding support, which is further validated by market confidence – the last two metrics.

4 PILOT IMPLEMENTATION

The implemented game possesses a fully functional decentralised system for trading cards between players. The game is made in Unity 3D game engine with Enjin SDK integration for supporting decentralised trading. The system detects tokens from player's digital wallet and recognize every token as an in-game virtual item. The trading system is generic, so a token can represent any virtual item, for example a card, sword, skill, pet, car, house, etc.

5 CONCLUSION

Blockchain technology has the potential to revolutionize the in-game virtual markets. The standards for tokenizing assets enable easy support by decentralized protocols. Clearly, there is a a growing interest within the gaming industry to adopt this technology, with an ever-growing number of protocols with some already integrated in-game development engines. The potential to bridge virtual markets into a global economy is very ambitious and requires further analysis to address question such as:

- How these markets would behave?
- Would they need to be regulated?
- Will more profitable games be played more?
- Can game designers attract players by increasing demand for their in-game items instead of investing in marketing?

However, there is currently very little data available to analyze, simulate or predict potential market behaviour.

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Middle-European Conference on Applied Theoretical Computer Science

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https://matcos.iam.upr.si/

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PREDGOVOR

Spet so minila tri leta in pred nami je nova konferenca MATCOS (Middle European Conference on Applied Theoretical Computer Science). Če se odločite, da boste prinesli konferenco v novo mesto in upate, da bo vaš napor obrodil sadove, poskušate pridobiti čim boljše strokovnjake v programski odbor. Da jih pridobite, pregledate vse svoje povezave – vse samo zato, da bi bila konferenca čim boljša. Ko konferenco organizirate v drugo, že bolje razumete težave, ki vas čakajo in se jim poskušate izogniti. Na koncu, če je konferenca uspešna, pričnete verjeti, da bo prav tako uspešna tudi naslednja. Tako lahko tretji MATCOS smatramo kot začetek nove tradicije. Poleg tega smo v paleto konference poskusili dodati nove »barve«.
V programskem in organizacijskem odboru so ostali vsi aktivni člani, vrata pa smo odprli nekaterim novim članom. Sicer je področje konference ostalo nespremenjeno, vendar so teme posameznih prispevkov širše. Ostala je tudi navezava na študentsko konferenco StuCosRec (Student Computer Science Research Conference). Novost je bila vključitev kratkih prispevkov poleg rednih. Po recenzijah bomo na konferenci tako poslušali 21 rednih in 16 kratkih prispevkov.
Thomas Pock z Unverze za tehnologijo v Gradcu je »zagotovilo«, da se bo kakovost vabljenih predavanj nadaljevala. Žarišče njegovega raziskovanja predstavlja po eni strani razvoj matematičnih modelov računalniškega vida in obdelave slik ter po drugi strani razvoj učinkovitih konveksnih ne-gladkih optimizacijskih algoritmov. Upamo, da bo predavanje uporabno tako za strokovnjake kot za širšo publiko.
Člani programskega in organizacijskega so v zadnjih nekaj mesecih pred konferenco opravili veliko delo. Zato vsem, ki ste pomagali pripraviti in izvesti »tradicionalni« tretji MATCOS en velik hvala.
Upamo, da boste ta dneva v Kopru resnično uživali ter vzpostavili nove strokovne stike med konferenco MATCOS-19.

V imenu organizatorjev
Andrej Brodnik and Gábor Galambos
sopredsedujoča

FOREWORD

Three years is over again, and we organise the new MATCOS (Middle European Conference on Applied Theoretical Computer Science) conference. If you decide to bring a conference in a new city you hope that your efforts will be successful, therefore you try to bring together good people in the PC and you leave no stone unturned within your connection to make the first conference on the best level. Arriving to the second instance you start to understand the difficulties of a conference organisation, but if this second attempt becomes more successful then you begin to trust to the next one. We can consider the third MATCOS as the beginning of a new tradition, so during the organisation process we tried to bring new “colours” to the palette of the conference.

As you can see the active members in the Organising Committee and the Program Committee remained, and we opened the door for new members. The scope is the same as earlier but the subject of the accepted papers are wider. We kept the StuCosRec (Student Computer Science Research Conference) adjoint. This time we accepted besides the regular papers also short papers giving place to more new subjects. After the review process we accepted 21 regular talks and 16 short talks to be presented.

Thomas Pock from the Graz University of Technology is the “assurance” that the high level invited talks will be continued this year too. The focus of his research is the development of mathematical models for computer vision and image processing as well as the development of efficient convex and non-smooth optimization algorithms. We hope that his talk will be useful for the expert and enquirers, equally.

The members of PC and OC did an excellent job during the last few months. Thanks to everybody who helped to organised this “traditional” 3rd MATCOS conference.

We hope you will enjoy these two days in Koper and you can establish new professional contacts during the MATCOS-19 conference.

On behalf of the organisers
Andrej Brodnik and Gábor Galambos
co-chairs

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On the notion of duals of certain AB functions

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ABSTRACT
In this paper we employ two different notions of duals of certain classes of Boolean functions which are used for the purpose of deriving other interesting combinatorial objects from suitable mappings from $\mathbb{F}_2^n$ to $\mathbb{F}_2^n$. A class of particular interest in this context is almost bent (AB) functions having the property that their (Walsh) spectral characterization possess a desired structure. We give a general result regarding the Gold AB functions, state one conjecture regarding the Welch AB functions and some computational results for the Kasami AB functions. Applying another definition of dual, introduced by Hodžić *et al.* [7] we provide computational evidence that the duals of Gold AB functions may build a space of bent functions (vectorial bent) though a more rigour theoretical analysis is needed.

Keywords
Vectorial bent functions, AB functions, Dual functions, Walsh spectrum

1. INTRODUCTION
Mappings from $\mathbb{F}_2^n$ to $\mathbb{F}_2^m$ are called vectorial Boolean or (n, m)-functions. Any such function $F : \mathbb{F}_2^n \to \mathbb{F}_2^m$ can be represented in the form

$$F(\mathbf{x}) = (f_0(\mathbf{x}), f_1(\mathbf{x}), \dots, f_{m-1}(\mathbf{x}))\,,\ \mathbf{x} \in \mathbb{F}_2^n$$

where $f_i : \mathbb{F}_2^n \to \mathbb{F}_2$, $i = 0, \dots, m-1$, are called *coordinate (Boolean) functions* of F and the $2^m - 1$ non-zero linear combinations of its coordinates are termed as *component functions*. When n is odd, (n, n)-functions that offer optimal resistance against both linear and differential cryptanalysis [6, 9] are called *almost bent* (AB) functions. There are a few known infinite families of these functions though their complete classification seems to be elusive. Another combinatorial objects of particular importance in cryptography, coding and design theory, is a class of vectorial bent functions having the property that all the component functions are *bent* which are characterized by a unique feature of having (uniform) flat Walsh spectrum. Nevertheless, it was shown by Nyberg [10] that vectorial bent functions $F : \mathbb{F}_2^n \to \mathbb{F}_2^m$ may only exist for even n and then necessarily $m \le n/2$. Even though there is an extensive research on both these classes of functions so far there has been no explicit connection between them. The main purpose of this article is to establish some (partial) connections and indicate the possibility of relating these structures through so called duals of Boolean functions. The concept of dual was originally defined for bent functions but it can be generalized to so-called plateaued Boolean functions. Employing two different definitions of duals, we will provide some theoretical results that indicate certain regularity in the dual space of AB functions. Furthermore, we provide computational evidence that a different definition of a dual function, introduced originally in [7], can identify vectorial bent functions in the dual space of Gold AB functions. Even though we do not completely understand the mechanisms behind this phenomena this connection is of great interest.

1.1 Definitions and terminology
The vector space $\mathbb{F}_2^n$ is the space of all n-tuples $\mathbf{x} = (x_0, \dots, x_{n-1})$, where $x_i \in \mathbb{F}_2$. For $\mathbf{x} = (x_0, \dots, x_{n-1})$ and $\mathbf{y} = (y_0, \dots, y_{n-1})$ in $\mathbb{F}_2^n$, the usual dot product over $\mathbb{F}_2$ is defined as $\mathbf{x} \cdot \mathbf{y} = x_0y_0 \oplus \cdots \oplus x_{n-1}y_{n-1}$. The *weight* $wt(\mathbf{x})$ of $\mathbf{x} = (x_0, \dots, x_{n-1}) \in \mathbb{F}_2^n$ is computed as $wt(\mathbf{x}) = \sum_{i=0}^{n-1} x_i$. By "$\sum$" we denote the integer sum (without modulo evaluation), whereas "$\bigoplus$" denotes the sum evaluated modulo two. The *Walsh-Hadamard transform* (WHT) of $f \in \mathcal{B}_n$, and its inverse WHT, at any point $\mathbf{u} \in \mathbb{F}_2^n$ are defined, respectively, by

$$W_f(\mathbf{u}) = \sum_{\mathbf{x} \in \mathbb{F}_2^n} (-1)^{f(\mathbf{x}) \oplus \mathbf{u} \cdot \mathbf{x}}, \tag{1}$$

$$(-1)^{f(\mathbf{x})} = 2^{-n} \sum_{\mathbf{u} \in \mathbb{F}_2^n} W_f(\mathbf{u})(-1)^{\mathbf{u} \cdot \mathbf{x}}. \tag{2}$$

The sequence of the 2^n *Walsh coefficients* given by (1), as $\mathbf{u}$ goes through $\mathbb{F}_2^n$ is called the *Walsh spectrum* of f, denoted by

$$\mathcal{W}_f = (W_f(\mathbf{u}_0), \dots, W_f(\mathbf{u}_{2^n-1})),$$

where $\mathbf{u}_0, \dots, \mathbf{u}_{2^n-1} \in \mathbb{F}_2^n$ are ordered lexicographically.
With $\mathcal{B}_n$ we denote the class of all *bent* Boolean functions defined on $\mathbb{F}_2^n$, i.e., all functions whose Walsh spectrum takes the values $\pm 2^{\frac{n}{2}}$. A class of Boolean functions on $\mathbb{F}_2^n$ characterised by the property that their Walsh spectra is three-valued (more precisely taking values in $\{0, \pm 2^{\frac{n+s}{2}}\}$ for a positive integer $s < n$) are called *s-plateaued* functions. [3] In case $s = 1$ ($s = 2$) for n odd (n even), the functions are called *semi-bent*. For a bent Boolean function f defined on $\mathbb{F}_2^n$, its ***dual*** $\tilde{f}$ is defined as a function from $\mathbb{F}_2^n$ to $\mathbb{F}_2$, for which it holds that

$$(-1)^{\tilde{f}(\mathbf{u})} = 2^{-\frac{n}{2}} W_f(\mathbf{u}),\ \ \mathbf{u} \in \mathbb{F}_2^n.$$

A standard way of defining the dual $\tilde{f} : \mathbb{F}_2^n \to \mathbb{F}_2$ of an s-plateaued Boolean function f on $\mathbb{F}_2^n$ is as follows:

$$\tilde{f}(\mathbf{x}) = 2^{-\frac{n+s}{2}} |W_f(\mathbf{x})|,\ \ \mathbf{x} \in \mathbb{F}_2^n.$$

If $F = (f_0, \ldots, f_{n-1})$ is an (n,n)-function, we define its dual $\tilde{F} = (\tilde{f}_0, \ldots, \tilde{f}_{n-1})$ as an (n,n)-function whose coordinates correspond to the duals of the coordinates of F.

2. DUALS OF AB FUNCTIONS

In this section we analyze several classes of power AB functions with respect to their duals defined in the standard way. Table 1 gives a list of certain exponents d for which the function $F(x) = x^d$, where $F : \mathbb{F}_{2^n} \to \mathbb{F}_{2^n}$, is an AB function.

Function	d	Conditions	Degree
Gold	2^i+1	$\gcd(i,n)=1,\ 1 \leq i \leq \frac{n-1}{2}$	2
Welch	2^t+3	$n = 2t+1$	3
Kasami	$2^{2i}-2^i+1$	$\gcd(i,n)=1,\ 1 \leq i \leq \frac{n-1}{2}$	$i+1$

Table 1: Some known AB power functions x^d defined on $\mathbb{F}_{2^n}$ [1]

2.1 Gold case

To clarify our approach we consider as an example the Gold function $F(x) = x^3$ defined on $\mathbb{F}_{2^3}$. By identifying $\mathbb{F}_{2^3}$ with $\mathbb{F}_2^3$, one can consider it as a function over the vector space $\mathbb{F}_2^3$. With $F_i(\mathbf{x}) = \mathbf{v}_i \cdot F(\mathbf{x})$, where $\mathbf{v}_1, \ldots, \mathbf{v}_{2^3-1} \in \mathbb{F}_2^3 \setminus \{\mathbf{0}\}$ are ordered lexicographically, we denote the component functions of F. In Table 2, we list the truth tables of the component functions F_i of F as well as their dual functions $\tilde{F}_i$ on $\mathbb{F}_2^3$ and their corresponding Walsh spectra. In [5], it was proved that for any n, the Walsh support of any quadratic function on $\mathbb{F}_2^n$ is a flat on $\mathbb{F}_2^n$ of even dimension. Since all Gold functions are quadratic, the following proposition summarizes these observations and gives a more general result that includes the Gold case.

Proposition 2.1. *Let $F : \mathbb{F}_2^n \to \mathbb{F}_2^n$ be an AB function. Suppose that the Walsh supports S_i of the component functions F_i of F are affine subspaces of dimension $n-1$. Then the component functions of the dual $\tilde{F}$ are linear functions defined on $\mathbb{F}_2^n$.*

Proof. First we consider the Walsh-Haddamard transform of an arbitrary component function of F^*.
Case I: Suppose that $\mathbf{u} \neq \mathbf{0}$.

$$\begin{aligned} W_{\tilde{F}_i}(\mathbf{u}) &= \sum_{\mathbf{x}\in\mathbb{F}_2^n} (-1)^{\tilde{F}_i(\mathbf{x})\oplus\mathbf{u}\cdot\mathbf{x}} = \sum_{\mathbf{x}\in\mathbb{F}_2^n} (-1)^{\tilde{F}_i(\mathbf{x})}(-1)^{\mathbf{u}\cdot\mathbf{x}} \\ &= \sum_{\mathbf{x}\notin S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} - \sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} = \sum_{\mathbf{x}\notin S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} \\ &+ \sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} - \sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} - \sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} \\ &= \sum_{\mathbf{x}\in\mathbb{F}_2^n} (-1)^{\mathbf{u}\cdot\mathbf{x}} - 2\sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} = -2\sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}}, \end{aligned}$$

Since every AB function is a permutation (see e.g. [1, 4]), then $\mathbf{0} \notin S_i$. Now, if we represent S_i as $S_i = \mathbf{a} + V$, where $\mathbf{a} \notin V$ and V is a linear subspace in $\mathbb{F}_2^n$ of dimension $n-1$, then $S_i^C = V$. Thus, denoting by $G = -2\sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}}$ we have:

$$\begin{aligned} G &= 2\sum_{\mathbf{x}\notin S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} - 2\sum_{\mathbf{x}\notin S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} - 2\sum_{\mathbf{x}\in S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} \\ &= 2\sum_{\mathbf{x}\notin S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} - 2\sum_{\mathbf{x}\in\mathbb{F}_2^n} (-1)^{\mathbf{u}\cdot\mathbf{x}} = 2\sum_{\mathbf{x}\notin S_i} (-1)^{\mathbf{u}\cdot\mathbf{x}} \\ &= 2\sum_{\mathbf{x}\in S_i^C} (-1)^{\mathbf{u}\cdot\mathbf{x}} = 2\sum_{\mathbf{x}\in V} (-1)^{\mathbf{u}\cdot\mathbf{x}} \\ &= \begin{cases} 0, & \mathbf{u} \notin V^\perp \\ 2\cdot 2^{\dim V}, & \textit{otherwise} \end{cases} = \begin{cases} 0, & \mathbf{u} \notin V^\perp \\ 2^n, & \textit{otherwise} \end{cases} \end{aligned}$$

where $V^\perp = \{\mathbf{x} \in \mathbb{F}_2^n : \mathbf{x}\cdot\mathbf{v} = 0, \forall \mathbf{v} \in V\}$.
Case II: Suppose that $\mathbf{u} = \mathbf{0}$.

$$W_{\tilde{F}_i}(\mathbf{0}) = \sum_{\mathbf{x}\in\mathbb{F}_2^n} (-1)^{\tilde{F}_i(\mathbf{x})} = \sum_{\mathbf{x}\in S_i^C} 1 - \sum_{\mathbf{x}\in S_i} 1 = |S_i^C| - |S_i| = 0.$$

So, for every $\mathbf{u} \in \mathbb{F}_2^n$ we have

$$W_{\tilde{F}_i}(\mathbf{u}) = \begin{cases} 0, & \mathbf{u} \notin V^\perp \vee \mathbf{u} = \mathbf{0} \\ 2^n, & \textit{otherwise} \end{cases}$$

Since V is of dimension $n-1$, $V^\perp$ is of dimension 1, i.e., $W_{\tilde{F}_i}$ is non-zero at only one vector. $\square$

Remark 1. *If the Walsh support of a semi-bent function f is not necessarily a flat on $\mathbb{F}_2^n$, the Walsh coefficients of its dual $\tilde{f}$ on $\mathbb{F}_2^n$ equal*

$$W_{\tilde{f}}(\mathbf{u}) = \begin{cases} 0, & \mathbf{u} = \mathbf{0} \\ -2\sum_{\mathbf{x}\in S_f} (-1)^{\mathbf{u}\cdot\mathbf{x}}, & \textit{otherwise} \end{cases}$$

2.2 Welch and Kasami case

Let us now consider the Welch power function $F(x) = x^{2^t+3}$ on $\mathbb{F}_2^n$, where $t = \frac{n-1}{2}$, for which the duals of the component functions are given in Table 3. This leads us to the following conjecture.

n	d	Walsh spectra of $\tilde{F}$	Comment
3	5	$\{0, 8\}$	linear
5	7	$\{0, \pm 8\}$	AB
7	11	$\{0, \pm 16\}$	AB
9	19	$\{0, \pm 2^5, \pm 2^6\}$	5-valued Walsh spectra
11	35	$\{0, \pm 2^6, \pm 2^7\}$	5-valued Walsh spectra
13	67	$\{0, \pm 2^7, \pm 2^8\}$	5-valued Walsh spectra
15	131	$\{0, \pm 2^8, \pm 2^9\}$	5-valued Walsh spectra
17	259	$\{0, \pm 2^9, \pm 2^{10}\}$	5-valued Walsh spectra

Table 3: Walsh coefficients of duals of the Welch functions

Conjecture 2.1. *Let $F(x) = x^{2^{\frac{n-1}{2}}+3}$ be the Welch function defined on $\mathbb{F}_{2^n}$, $n \geq 9$ odd. Then the Walsh coefficients of the duals of the component functions $\tilde{F}_i$ are $0, \pm 2^{\frac{n+1}{2}}$ or $\pm 2^{\frac{n+3}{2}}$.*

$\mathbf{v}_i$	T_{F_i}	S_{F_i}	Duals $\tilde{F}_i$ on $\mathbb{F}_2^3$	$S_{\tilde{F}_i}$
$(0,0,1)$	$(0,1,1,0,1,0,1,0)$	$(0,-4,0,4,0,4,0,4)$	$(0,1,0,1,0,1,0,1)$	$(0,8,0,0,0,0,0,0)$
$(0,1,0)$	$(0,0,1,0,0,1,1,1)$	$(0,0,4,4,4,-4,0,0)$	$(0,0,1,1,1,1,0,0)$	$(0,0,0,0,0,0,8,0)$
$(0,1,1)$	$(0,1,0,0,1,1,0,1)$	$(0,4,-4,0,4,0,0,4)$	$(0,1,1,0,1,0,0,1)$	$(0,0,0,0,0,0,0,8)$
$(1,0,0)$	$(0,0,0,1,1,1,1,0)$	$(0,0,0,0,4,4,4,-4)$	$(0,0,0,0,1,1,1,1)$	$(0,0,0,0,8,0,0,0)$
$(1,0,1)$	$(0,1,1,1,0,1,0,0)$	$(0,4,0,4,-4,0,4,0)$	$(0,1,0,1,1,0,1,0)$	$(0,0,0,0,0,8,0,0)$
$(1,1,0)$	$(0,0,1,1,1,0,0,1)$	$(0,0,4,-4,0,0,4,4)$	$(0,0,1,1,0,0,1,1)$	$(0,0,8,0,0,0,0,0)$
$(1,1,1)$	$(0,1,0,1,0,0,1,1)$	$(0,4,4,0,0,4,-4,0)$	$(0,1,1,0,0,1,1,0)$	$(0,0,0,8,0,0,0,0)$

Table 2: Component functions and their duals for the Gold function x^3 on $\mathbb{F}_{2^3}$.

On the other hand, for the Kasami case, there seems not to be any regularity about the spectra of dual components. In Table 4 we give some observations for certain n.

n	d	Walsh coefficients of $\tilde{F}$	Comment	Degree
5	13	$\{0, \pm 8\}$	AB	3
7	13	$\{0, \pm 16\}$	AB	3
7	57	$\{0, \pm 16\}$	AB	4
9	13	$\{0, \pm 2^5, -2^6\}$	4-val	3
9	241	$\{0, \pm 2^5, \pm 2^6\}$	5-val	5
11	13	$\{0, \pm 2^6, \pm 2^7\}$	5-val	3
11	57	$\{0, \pm 2^6\}$	AB	4
11	241	$\{0, \pm 2^6\}$	AB	5
11	993	$\{0, \pm 2^6, \pm 2^7\}$	5-val	6
13	13	$\{0, \pm 2^7, \pm 2^8\}$	5-val	3
13	57	$\{0, \pm 2^7\}$	AB	4
13	241	$\{0, \pm 2^7\}$	AB	5
13	993	$\{0, \pm 2^7, \pm 2^8\}$	5-val	6
13	4033	$\{0, \pm 2^7, \pm 2^8\}$	5-val	7

Table 4: Walsh spectra of the duals - Kasami case

2.3 Vectorial bent functions from AB

The classical definition of a dual that we used previously does not take into account the signs of Walsh coefficients and in general such a dual is not balanced. This was the main reason for introducing another definition of a dual of an s-plateaued function f as follows [7].
With $S_f = \{\mathbf{x} \in \mathbb{F}_2^n : W_f(\mathbf{x}) \neq 0\}$ we denote the Walsh support of the function f. Its dual function f^* on S_f of cardinality 2^{n-s} is defined as $f^* : S_f \to \mathbb{F}_2$ by

$$W_f(\omega) = 2^{\frac{n+s}{2}}(-1)^{f^*(\omega)},$$

for $\omega \in S_f$. To specify the dual function as $f^* : \mathbb{F}_2^{n-s} \to \mathbb{F}_2$ we use the concept of *lexicographic ordering.* That is, a subset $E = \{\mathbf{e}_0, \ldots, \mathbf{e}_{2^{n-s}-1}\} \subset \mathbb{F}_2^n$ is ordered lexicographically if $|\mathbf{e}_i| < |\mathbf{e}_{i+1}|$ for any $i \in [0, 2^{n-s}-2]$, where $|\mathbf{e}_i|$ denotes the integer representation of $\mathbf{e}_i \in \mathbb{F}_2^n$. More precisely, for $\mathbf{e}_i = (e_{i,0}, \ldots, e_{i,n-1})$ we have $|\mathbf{e}_i| = \sum_{j=0}^{n-1} e_{i,n-1-j}2^j$, thus having the most significant bit of $\mathbf{e}_i$ on the left-hand side.
Since S_f is not ordered in general, *we will always represent it* as $S_f = \mathbf{v} \oplus E$, where E is lexicographically ordered for some fixed $\mathbf{v} \in S_f$ and $\mathbf{e}_0 = \mathbf{0}_n$. For instance, if

$$S_f = \{(0,1,0), (0,1,1), (1,0,0), (1,0,1)\},$$

by fixing $\mathbf{v} = (0,1,1) \in S_f$, then

$$E = \{\mathbf{e}_0, \mathbf{e}_1, \mathbf{e}_2, \mathbf{e}_3\} = \{(0,0,0), (0,0,1), (1,1,0), (1,1,1)\}$$

is ordered lexicographically and consequently S_f is "ordered" as $S_f = \{\omega_0, \omega_1, \omega_2, \omega_3\} = \{(0,1,1), (0,1,0), (1,0,1), (1,0,0)\}$. This way we can make a direct correspondence between $\mathbb{F}_2^{n-s}$ and S_f through E so that for $\mathbb{F}_2^{n-s} = \{\mathbf{x}_0, \mathbf{x}_1, \ldots, \mathbf{x}_{2^{n-s}-1}\}$, where $\mathbb{F}_2^{n-s}$ is lexicographically ordered, we have

$$f^*(\omega_j) \rightsquigarrow f^*(\mathbf{e}_j) \rightsquigarrow f^*(\mathbf{x}_j), \quad \mathbf{x}_j \in \mathbb{F}_2^{n-s}, \tag{3}$$

where $\mathbf{x}_j \in E$, $j \in [0, 2^{n-s}-1]$, i.e., we set that $S_f = \{\omega_0, \ldots, \omega_{2^{n-s}-1}\}$ is ordered so that $S_i = \mathbf{v} \oplus \mathbf{e}_i$, and $E = \{\mathbf{e}_0, \ldots, \mathbf{e}_{2^{n-s}-1}\}$ is ordered lexicographically.

Following the result of Hodžić *et al.* it is known that if $S_f = \mathbf{v} \oplus E$, where E is a linear subspace of $\mathbb{F}_2^n$, with ordering described in Section 1, then f is a semi-bent function on $\mathbb{F}_2^n$ if and only if the dual f^* is bent on $\mathbb{F}_2^{n-1}$. In this way, since all coordinate functions f_i of Gold AB functions are semi-bent on $\mathbb{F}_2^n$ and all Walsh supports S_{f_i} are even dimensional flats, one could construct bent functions $f_i^*, i \in \{0, 1, \ldots, n-1\}$, on $\mathbb{F}_2^{n-1}$ and check if (f_i^*, f_j^*) form a bent vectorial Boolean function $\mathbb{F}_2^{n-1} \to \mathbb{F}_2^2$. More generally, if we consider $k \leq \frac{n-1}{2}$ bent Boolean functions $f_{i_1}^*, f_{i_2}^*, \ldots, f_{i_k}^*$, where $i_j \in \{0, \ldots, n-1\}$, can they form a bent vectorial function. With β_k we will denote the number of bent vectorial Boolean functions $(f_{i_1}^*, \ldots, f_{i_k}^*)$ composed of the duals f_i^*. In Table 5 we give the computational results obtained in `MAGMA`. (DNE=Does not exist; NC=Not computed)

n	d	β_2	β_3	β_4	β_5	β_6
5	3	5	DNE	DNE	DNE	DNE
5	5	3	DNE	DNE	DNE	DNE
7	3	13	4	DNE	DNE	DNE
7	5	7	1	DNE	DNE	DNE
7	9	13	6	DNE	DNE	DNE
9	3	14	1	0	DNE	DNE
9	5	19	6	0	DNE	DNE
9	17	15	1	0	DNE	DNE
11	3	25	4	NC	NC	DNE
11	5	24	4	NC	NC	DNE
11	9	36	20	NC	NC	DNE
11	17	29	14	NC	NC	DNE
11	33	30	13	NC	NC	DNE

Table 5: Number of bent VBF from Gold AB

Notice that the supports of the Welch and Kasami component functions are in general not flats in $\mathbb{F}_2^n$ and therefore the same approach cannot be easily applied to these classes.

Let us consider the Gold function $F(x) = x^5$ on $\mathbb{F}_{2^5}$ whose coordinate functions are $f_1, \ldots, f_5$. Let $\mathcal{W}_i^*$ be the Walsh spectra of the duals f_i^*, for $i \in \{1, \ldots, n\}$. Since the duals are bent, we have that $W_i^*(\mathbf{u}) = \pm 2^2$, for all $\mathbf{u} \in \mathbb{F}_2^4$. With $\mathcal{W}_{ij}^*$ we denote the product of the Walsh spectra $\mathcal{W}_i^*$ and $\mathcal{W}_j^*$, defined as

$$\mathcal{W}_{ij}^* = 2^{-\frac{n-1}{2}} \cdot (\mathcal{W}_i^* \odot \mathcal{W}_j^*),$$

where "$\odot$" denotes the component-wise multiplication of the Walsh spectra given as integer-valued vectors of length 2^{n-1}. In Table 6 we provide the spectra of $\mathcal{W}_{ij}^*$ for $1 \le i < j \le 5$. The inverse Walsh transform of a bent Boolean function

i	j	$\mathcal{W}_{ij}^*$
1	2	$(4, 4, 4, -4, 4, 4, -4, 4, -4, 4, -4, -4, -4, 4, 4, 4)$
1	3	$(4, 4, 4, -4, 4, -4, 4, 4, -4, -4, -4, 4, -4, 4, -4, -4)$
1	4	$(4, 4, 4, -4, 4, 4, -4, 4, 4, -4, -4, -4, -4, 4, -4, -4)$
1	5	$(4, -4, -4, 4, 4, -4, -4, 4, 4, 4, -4, -4, 4, 4, -4, -4)$
2	3	$(4, 4, 4, 4, 4, -4, -4, 4, 4, -4, 4, -4, 4, 4, -4, -4)$
2	4	$(4, 4, 4, 4, 4, 4, 4, 4, -4, -4, 4, 4, 4, 4, -4, -4)$
2	5	$(4, -4, -4, -4, 4, -4, 4, 4, -4, 4, 4, 4, -4, 4, -4, -4)$
3	4	$(4, 4, 4, 4, 4, -4, -4, 4, -4, 4, 4, -4, 4, 4, 4, 4)$
3	5	$(4, -4, -4, -4, 4, 4, -4, 4, -4, -4, 4, -4, -4, 4, 4, 4)$
4	5	$(4, -4, -4, -4, 4, -4, 4, 4, 4, -4, 4, 4, -4, 4, 4, 4)$

Table 6: Products $\mathcal{W}_{ij}^*$ of the Walsh spectra $\mathcal{W}_i^*$ and $\mathcal{W}_j^*$

(2) can be generalized, that is, for a given Walsh spectra $\mathcal{W} = (w_0, \ldots, w_{2^n-1})$ and fixed $\mathbf{u} \in \mathbb{F}_2^n$ one can define an integer valued function $W^{-1} : \mathbb{F}_2^n \to \mathbb{Z}$ as

$$W^{-1}(\mathbf{u}) = 2^{-n} \sum_{\mathbf{x} \in \mathbb{F}_2^n} w_{\mathbf{x}_{int}} (-1)^{\mathbf{x} \cdot \mathbf{u}}, \tag{4}$$

where $\mathbf{x}_{int}$ represents the integer representation of $\mathbf{x}$ and $w_{\mathbf{x}_{int}} \in \mathcal{W}$. With $\mathcal{W}^{-1} = (W^{-1}(\mathbf{u}_0), \ldots, W^{-1}(\mathbf{u}_{2^n-1}))$, $\mathbf{u}_k \in \mathbb{F}_2^n$, we denote the inverse Walsh spectra (in short IWS) of $\mathcal{W} = (w_0, \ldots, w_{2^n-1})$. In Table 7 we give the IWS of the spectra $\mathcal{W}_{ij}^*$.

i	j	$\mathcal{W}_{ij}^{*,-1}$
1	2	$(1, -1, 1, -1, -1, 1, 1, -1, 1, 1, 1, 1, 1, 1, -1, -1)$
1	3	$(0, 0, 0, 0, 0, 0, 0, 0, 2, 2, 0, 0, 0, 0, 2, -2)$
1	4	$(0, 0, 2, 0, 0, 2, 0, 0, 2, 0, 0, 0, 0, 0, 0, -2)$
1	5	$(0, 0, 2, 2, 0, 0, 0, 0, 0, 0, -2, 2, 0, 0, 0, 0)$
2	3	$(1, 1, 1, 1, 1, 1, -1, -1, 1, -1, -1, 1, 1, -1, 1, -1)$
2	4	$(2, 0, 0, 0, 0, 0, -2, 0, 2, 0, 0, 0, 0, 0, 2, 0)$
2	5	$(0, 0, 0, 0, 0, 0, 0, 0, 0, 2, 0, 2, -2, 0, 2, 0)$
3	4	$(2, 0, 0, 0, 0, 0, 0, -2, 0, 0, 0, 2, 2, 0, 0, 0)$
3	5	$(0, 0, 0, 0, -2, 2, 0, 0, 0, 0, 2, 2, 0, 0, 0, 0)$
4	5	$(1, 1, -1, 1, -1, 1, 1, 1, -1, 1, 1, 1, -1, -1, 1, -1)$

Table 7: The IWS of $\mathcal{W}_{ij}^*$

We notice three IWS that have values ± 1. From Table 5 we know that for $(n, d) = (5, 5)$ there are exactly three pairs (f_i^*, f_j^*) of bent vectorial functions mapping from $\mathbb{F}_2^4 \to \mathbb{F}_2^2$. The coordinates ij of $f_{ij}^* = f_i^* \oplus f_j^*$ correspond exactly to the coordinates ij of the three Walsh spectra $\mathcal{W}_{ij}^*$ for which the IWS have values ± 1. We obtained the same results for $(n, d) = (5, 3)$ and $(n, d) = (7, 9)$ leading us to the following conjecture.

CONJECTURE 2.2. *Let $F(x) = x^d$, $d = 2^i + 1$, $\gcd(i, n) = 1$, $1 \le i \le \frac{n-1}{2}$, be the Gold function defined on $\mathbb{F}_{2^n}$. With $f_1, \ldots, f_n$ we denote the truth tables of its coordinate functions and with $f_1^*, \ldots, f_n^*$ their corresponding duals defined on $\mathbb{F}_2^{n-1}$. Let $\mathcal{W}_{i,j}^{*,-1}$ denote the IWS, as described previously. Then, $f_{ij}^* = f_i^* \oplus f_j^*$, $1 \le i < j \le n$, is bent if and only if $|\mathcal{W}_{ij}^{*,-1}| = \mathbf{1}$.*

3. CONCLUSION

In the last few decades a lot of research has been done in the field of vectorial Boolean functions and understanding their structure and properties. However, many problems still remain open. In our future research we wish to get a better understanding of these duals and their connection with the original function from which they were derived.

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A new graph decomposition method for bipartite graphs

[Extended Abstract]

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ABSTRACT

We introduce a new graph decomposition method, which works for relatively small or sparse graphs, and can be used to substitute the Regularity lemma of Szemerédi in some graph embedding problems.

Categories and Subject Descriptors

G.2.2 [**Graph theory**]: Extremal graph theory; Regularity; Trees

General Terms

Graph theory

Keywords

regularity, graph decomposition, embedding

1. INTRODUCTION

All graphs considered in this paper are simple. The Szemerédi Regularity lemma [10] is one of the most powerful tools of graph[1] theory. It is also used in many areas outside graph theory, for example in number theory and algorithms.

Theorem 1 (Szemerédi). *For every $\varepsilon > 0$ there exists a $n_0 = n_0(\varepsilon) > 0$ such that if G is a simple graph on $n \geq n_0$ vertices then G admits an ε-regular equipartition of its vertex set.*

We will give a short introduction to the necessary notions in the next section. Here we only mention that ε-regularity is a notion of quasirandomness, and equipartition means, roughly, the partition of the vast majority of the vertex set of G into equal sized subsets so that all, but an ε proportion of the pairs of subsets span an ε-regular bipartite subgraph of G.

The dependence of n_0 on ε in Theorem 1 is determined by a *tower function* T evaluated at $1/\varepsilon^5$, where T can be defined inductively as follows: $T(1) = 2$, and for $i > 1$ we have $T(i) = 2^{T(i-1)}$. Hence, the value of n_0 makes the Regularity lemma essentially impractical. It is also well-known that we cannot hope for a much better bound, since as was proven by Gowers [4], there are graphs for which the number of clusters in the Regularity lemma is necessarily a tower function of $1/\varepsilon$. Note also that the lemma is only meaningful for so called dense graphs, that is, graphs that contain a constant proportion of the possible edges.

In this paper we present a new graph decomposition method for bipartite graphs, which can be applied for graphs of practical size and for graphs having vanishing density. While the Regularity lemma is useful in many areas of mathematics and computer science, our contribution may not be so widely applicable. Still, it can be used for finding certain subgraphs in a host graph. As an illustration, we will give the details of a tree embedding algorithm that uses this graph decomposition method.

Let us mention that Gowers in [5] presented a decomposition for bipartite graphs that is somewhat similar to the one discussed here, and used it for a problem in number theory. That decomposition has different parameters and a much longer and harder proof. Due to the importance of the Regularity lemma, other researchers also found weakened versions (eg. [1], [3]) in which the dependence of ε and n_0 is not determined by a tower function. These are important developments with several applications, still, none of them seems to be so widely applicable as the original one. One can find more details in [2]. The so called absorption method [11] is also a choice for avoiding the use of the Regularity lemma in some embedding problems.

The outline of the paper is as follows. First, we provide the necessary notions for the decomposition and then describe the decomposition method in the next section. In the subsequent section we provide an application, namely, we show that we can find a large subtree in a graph on n vertices having $\Omega(n^2 \log\log n/\log n)$ edges.

2. DEFINITIONS, MAIN RESULT

Given a graph G with vertex set V and edge set E, we let $deg_G(v)$ denote the degree of $v \in V$. If it is clear from the context, the subscription may be omitted. The neighborhood of v is denoted by $N(v)$, so $deg(v) = |N(v)|$. The

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[1]There are also hypergraph versions that play crucial role in extremal hypergraph theory and combinatorial number theory, see eg., [6] or [9].

minimum degree of G is denoted by $\delta(G)$. If $S \subset V$, then $deg(v;S) = |N(v) \cap S|$. The set of edges between two disjoint sets $S, T \subset V$ is denoted by $E(S,T)$, and we let $e(S,T) = |E(S,T)|$. We also let $e(G) = |E(G)|$.

Let $G = G(A,B)$ be a bipartite graph. The *density* $d_G(A,B)$ or, if G is clear from the context, $d(A,B)$, is defined as follows:

$$d(A,B) = d_G(A,B) = \frac{e(G)}{|A| \cdot |B|}.$$

Given a number $\varepsilon \in (0,1)$ we say that $G = G(A,B)$ is an *ε-regular pair* if the following holds for every $A' \subset A$, $|A'| \geq \varepsilon|A|$ and $B' \subset B$, $|B'| \geq \varepsilon|B|$:

$$|d_G(A,B) - d_G(A',B')| \leq \varepsilon.$$

The ε-regular equipartition of a graph G on n vertices means that $V(G) = V_0 \cup V_1 \cup \ldots \cup V_k$ such that $V_i \cap V_j = \emptyset$ for $i \neq j$, $|V_0| \leq \varepsilon n$, $||V_i| - |V_j|| \leq 1$ for every $1 \leq i,j \leq k$ and all but at most εk^2 pairs V_iV_j are ε-regular for $1 \leq i,j$. The V_i sets are called clusters, and V_0 is the exceptional cluster.

Roughly speaking, the Regularity lemma asserts that every graph can be well approximated by a collection of quasirandom graphs that are defined between the non-exceptional clusters. Unfortunately, by the result of Gowers [4], in general the number of non-exceptional clusters is a tower function of $1/\varepsilon$.

While our goal is to provide an alternative for the Regularity lemma, we will also make use of the regularity concept. Our definition is slightly more permissive than the usual one above, this enables us to give a very short proof of our decomposition, and it is still powerful enough to be applicable in several embedding problems. It is called *lower regularity*, and is used by other researchers as well.

Definition 2. *Given a bipartite graph $G = G(A,B)$ we say that G is a lower $(\varepsilon, \eta, \gamma)$-regular pair, if for any $A' \subset A, B' \subset B$ with $|A'| \geq \varepsilon|A|$, $|B'| \geq \eta|B|$ we have $e(A',B') \geq \gamma \cdot |A'| \cdot |B'|$.*

Note that in the usual definition of an ε-regular pair one has $\varepsilon = \eta$, and the edge density between two sufficiently large subsets is between $d_G - \varepsilon$ and $d_G + \varepsilon$. We want to have flexibility in this notion, and allow sub-pairs with relatively low density, and the $\varepsilon \neq \eta$ case, too.

We are ready to state our main result, the precise formulation is as follows.

Theorem 3. *Let $G = G(A,B)$ be a bipartite graph with vertex classes A and B such that $|A| = n$ and $|B| = m$, and every vertex of A has at least δm neighbors in B. Let $0 < \varepsilon, \eta, \gamma < 1$ be numbers so that $\eta \leq 1/6$ and $\gamma \leq \min\{\eta/4, \delta/20\}$. Then there exists a partition $A = A_0 \cup A_1 \cup \ldots \cup A_k$, and k not necessarily disjoint subsets $B_1, \ldots, B_k$ of B, such that $|A_i| \geq \varepsilon \cdot \exp\left(-2\log(\frac{1}{\varepsilon})\log(\frac{2}{\delta})/\eta\right) n$ for $i \geq 1$, $|A_0| \leq \epsilon n$, the subgraphs $G[A_i, B_i]$ for $1 \leq i \leq k$ are all lower $(\varepsilon, \eta, \gamma)$-regular, and*

$$\sum_{i=1}^{k} e(G[A_i, B_i]) \geq e(G) - (\varepsilon + 2\gamma)nm.$$

Moreover,

$$k \leq \frac{2}{\varepsilon\delta} e^{2\log(\frac{1}{\varepsilon})\log(\frac{2}{\delta})/\eta}.$$

3. PROOF OF THEOREM 3

Let us remark that we will not be concerned with floor signs, divisibility, and so on in the proof. This makes the notation simpler, easier to follow.

As we have seen, edge density plays an important role in regularity. We need a simple fact which is called *convexity of density* (see eg. in [7]), the proof is left for the reader.

Claim 4. *Let $F = F(A,B)$ be a bipartite graph, and let $1 \leq k \leq |A|$ and $1 \leq m \leq |B|$. Then*

$$d_F(A,B) = \frac{1}{\binom{|A|}{k}\binom{|B|}{m}} \sum_{X \in \binom{A}{k}, Y \in \binom{B}{m}} d(X,Y).$$

In order to prove Theorem 3 we need a lemma that is the basic building block of our decomposition method.

Lemma 5. *Let $F = F(A,B)$ be a bipartite graph with vertex classes A and B such that $|A| = a$ and $|B| = b$, and every vertex of A has at least δb neighbors in B. Let $0 < \varepsilon, \eta, \gamma < 1$ be numbers so that $\eta \leq 1/6$ and $\gamma \leq \min\{\eta/4, \delta/20\}$. Then F contains a lower $(\varepsilon, \eta, \gamma)$-regular pair $F[X,Y]$ such that $|X| \geq \exp\left(-2\log(\frac{2}{\varepsilon})\log(\frac{2}{\delta})/\eta\right) a$ and $|Y| \geq (\delta(1-\eta) - 2\gamma)b$.*

Proof: We prove the lemma by finding two sequences of sets $X_0 = A, X_1, \ldots, X_l$ and $Y_0 = B, Y_1, \ldots, Y_l$ such that for every $1 \leq i \leq l$ we have $X_i \subset X_{i-1}$, $Y_i \subset Y_{i-1}$,

$$\varepsilon|X_{i-1}|/2 \leq |X_i| \leq \varepsilon|X_{i-1}|$$

and

$$|Y_i| = (1-\eta)|Y_{i-1}|,$$

moreover, the last pair $F[X_l, Y_l]$ is lower $(\varepsilon, \eta, \gamma)$-regular. Hence, we may choose $X = X_l$ and $Y = Y_l$.

We find the set sequences $\{X_i\}_{i \geq 1}$ and $\{Y_i\}_{i \geq 1}$ by the help of an iterative procedure. This procedure stops in the lth step if $F[X_l, Y_l]$ is lower $(\varepsilon, \eta, \gamma)$-regular. We have another stopping rule: if $|Y_l| \leq (\delta(1+\eta/2) - 2\gamma)b$ for some l, we stop. Later we will see that in this case we have found what is desired, $F[X_l, Y_l]$ must be a lower $(\varepsilon, \eta, \gamma)$-regular pair.

In the beginning we check, if $F[X_0, Y_0]$ is a lower $(\varepsilon, \eta, \gamma)$-regular pair. If it is, we stop. If not then X_0 has a subset X_1' precisely of size $\varepsilon|X_0|$ and Y_0 has a subset Y_1' precisely of size $\eta|Y_0|$ such that $e(F[X_1', Y_1']) < \gamma|X_1'| \cdot |Y_1'|$, here we used Claim 4 in order to obtain the sizes of X_1' and Y_1'.

Let X_1'' be the set of those vertices of X_1' that have more than $2\gamma|Y_1'|$ neighbors in $|Y_1'|$. Simple counting shows that $|X_1''| \leq |X_1'|/2$. Let $X_1 = X_1' - X_1''$, those vertices of X_1' that have less than $2\gamma|Y_1'|$ neighbors in $|Y_1'|$. By the above we have $|X_1'|/2 \leq |X_1| \leq |X_1'|$. Set $Y_1 = Y_0 - Y_1'$.

For $i \geq 2$ the above is generalized. If $F[X_{i-1}, Y_{i-1}]$ is not a lower $(\varepsilon, \eta, \gamma)$-regular pair then we do the following. First find $X_i' \subset X_{i-1}$ and $Y_i' \subset Y_{i-1}$ such that $|X_i'| = \varepsilon|X_{i-1}|$ and $|Y_i'| = \eta|Y_{i-1}|$ and $e(F[X_i', Y_i']) < \gamma|X_i'| \cdot |Y_i'|$. Similarly to the above we define $X_i \subset X_i'$ to be the set of those vertices of X_i' that have less than $2\gamma|Y_i'|$ neighbors in Y_i'. As before, we have $|X_i'|/2 \le |X_i| \le |X_i'|$. Finally, we let $Y_i = Y_{i-1} - Y_i'$.

Using induction one can easily verify that the claimed bounds for $|X_i|$ and $|Y_i|$ hold for every i. It might not be so clear that this process stops in a relatively few iteration steps. For that we first find an upper bound for the number of edges that connect the vertices of X_i with $B - Y_i$. If $u \in X_i$ then u have at most $2\gamma(|Y_1'| + \ldots + |Y_i'|) \le 2\gamma b$ neighbors in $B - Y_i$ using that $Y_s' \cap Y_t' = \emptyset$ for every $s \ne t$.

Next we show that if $(\delta(1+\eta/2) - 2\gamma)(1-\eta)b < |Y_l| \le (\delta(1+\eta/2) - 2\gamma)b$ then $F[X_l, Y_l]$ must be lower regular. Assume that $u \in X_l$. Then $deg(u; Y_l) \ge (\delta - 2\gamma)b$, using our argument above, hence, the number of *non-neighbors* of u in Y_l is at most $(\delta(1+\eta/2) - 2\gamma)b - (\delta - 2\gamma)b = \delta\eta b/2$. Let $Y' \subset Y_l$ be arbitrary with $|Y'| = \eta|Y_l|$. Then

$$\frac{5}{6}\eta(\delta(1+\eta/2) - 2\gamma)b \le |Y'| \le \eta(\delta(1+\eta/2) - 2\gamma)b,$$

using that $\eta \le 1/6$. We have

$$deg(u; Y') \ge |Y'| - \delta\eta b/2 \ge \frac{5}{6}\eta(\delta(1+\eta/2) - 2\gamma)b - \delta\eta b/2.$$

Using the upper bounds we imposed on η and γ, one easily obtains that

$$deg(u; Y') \ge (\delta\eta/3 + 5\delta\eta^2/12 - 5/3\gamma\eta)b \ge \gamma|Y'|.$$

Hence, for every $X' \subset X_l$ and $Y' \subset Y_l$ with $|Y'| = \eta|Y_l|$ we have

$$e(X', Y') \ge \gamma|X'| \cdot |Y'|,$$

that is, if the procedure stopped because we applied the stopping rule, then the resulting pair must always be lower $(\varepsilon, \eta, \gamma)$-regular. Of course, this means that no matter how the procedure stops, it finds a lower regular pair.

Next we upper bound the number of iteration steps. In every step the Y-side shrinks by a factor of $(1-\eta)$. We also have that $|Y_l| > (\delta(1+\eta/2) - 2\gamma)(1-\eta)b$. Putting these together we get that

$$(1-\eta)^l > (\delta(1+\eta/2) - 2\gamma)(1-\eta) > \delta/2.$$

Hence,

$$l < \frac{\log(2/\delta)}{\log(1/(1-\eta))} < 2\frac{\log(2/\delta)}{\eta},$$

here we used elemantary calculus (in particular, the Taylor series expansion of $\log(1+x)$) and our condition that η is less than $1/6$.

What is left is to show the lower bound for $|X_l|$. Note, that $|X_i|/|X_{i-1}| \ge \varepsilon/2$ for every $i \ge 1$. Hence,

$$|X_l| \ge \left(\frac{\varepsilon}{2}\right)^l a = e^{-2\log(2/\varepsilon)\log(2/\delta)/\eta} a.$$

□

We are ready to prove the main result of the paper.

Proof (of Theorem 3): The proof is based on iteratively applying Lemma 5. First we apply Lemma 5 for G and find a lower $(\varepsilon, \eta, \gamma)$-regular pair $G[X_l, Y_l]$, where $X_l \subset A$ and $Y_l \subset B$. Let $A_1 = X_l$ and $B_1 = Y_l$. Next we repeat this procedure for the graph $G[A - A_1, B]$. Similarly to the above we define the A_2 and B_2 sets, where $A_2 \subset A - A_1$, $B_2 \subset B$, and $G[A_2, B_2]$ is a lower $(\varepsilon, \eta, \gamma)$-regular pair.

Continue this way, finding the lower regular pairs $G[A_i, B_i]$ using Lemma 3 such that $A_i \subset A - (A_1 \cup \ldots \cup A_{i-1})$, $B_i \subset B$, and $G[A_i, B_i]$ is a lower $(\varepsilon, \eta, \gamma)$-regular pair. We stop when

$$|A - (A_1 \cup \ldots \cup A_i)| < \varepsilon|A|.$$

At this point set $A_0 = A - (A_1 \cup \ldots \cup A_i)$.

Let us now prove the upper bound for the number of pairs in the decomposition. As we have shown earlier $|A_i| \ge \exp\left(-2\log(\frac{2}{\varepsilon})\log(\frac{2}{\delta})/\eta\right) n$ for $i \ge 1$. The number of edges in an A_iB_i pair is at least $|A_i|(\delta - 2\gamma)m > |A_i|\delta m/2$. For any $1 \le i \ne j \le k$ the edge sets of the pairs A_iB_i and A_jB_j are disjoint, and the total number of edges in lower regular pairs is at most nm. Hence, we have

$$k \le \frac{2nme^{2\log(\frac{1}{\varepsilon})\log(\frac{2}{\delta})/\eta}}{\varepsilon\delta nm} = \frac{2}{\varepsilon\delta}e^{2\log(\frac{1}{\varepsilon})\log(\frac{2}{\delta})/\eta}.$$

There is only one question left, bounding the total number of edges that belong to the lower regular pairs. Assume first that $u \in A - A_0$. We saw earlier in Lemma 3 that u lost at most $2\gamma|B|$ edges. This explains the $2\gamma mn$ term in the theorem. If $u \in A_0$, none of the edges incident to it belongs to any of the lower regular pairs, however, $|A_0| \le \varepsilon n$, therefore, the total number of edges incident to vertices of A_0 is at most εnm. With this we found the decomposition of G what was desired. □

Let us finish this section with a remark. Without the lower bound for the sizes of the A_i sets, the Theorem 3 would be trivial: every vertex $v \in A$ could be a "subset" A_v (a singleton), and its neighborhood $N(v)$ is the corresponding B_v. The result is interesting only when the A_i sets are large. For example, let G be the following. It is a sparse bipartite graph with vertex classes A and B such that $|A| = |B| = n$. Set $\varepsilon = \eta = 1/10$, $\delta = \log\log n/\log n$, and $\gamma = \delta/20$. Then G has $O(n^2 \log\log n/\log n)$ edges, and the A_i sets for $i \ge 1$ have size $\Omega(n/(\log n)^c)$, where $c < 60$, and every (A_i, B_i) pair is a lower $(0.1, 0.1, \log\log n/(20\log n))$-regular pair.

4. AN APPLICATION

The main advantage of Theorem 3 is that, as the above example shows, it can be applied for graphs having "real-life" size, or foe relatively sparse graphs, unlike the Szemerédi Regularity lemma. Therefore, it may extend the scope when usual methods for graph embedding (eg. counting lemma or the Blow-up lemma [8]) can be applied.

Below in Proposition 6 we show how to embed an almost spanning tree into *one* lower regular pair. This can be used to approximately tile the edge set of a sufficiently dense graph G by large edge-disjoint subtrees. The rough sketch of this approximate decomposition is as follows. Apply Theorem 3 for the graph G, and then using Proposition 6 find one-one almost spanning subtree in the lower regular pairs. Delete the edges used for the subtrees. If the resulting graph has sufficiently many edges then one can use Theorem 3 again, and then Proposition 6 for every lower regular pair. The process stops when the remaining vacant subgraph of G is too sparse, and therefore one cannot find many large degree vertices in it. Hence, with this method one can tile the vast majority of edges of a graph having sufficiently large density. Due to the length of the proof we do not give every detail in this extended abstract.

Given a tree T rooted at r its *level sets* are defined as follows: $L_1 = r$, $L_2 = N(r)$, in general, $L_{i+1} = N^i(r)$, etc., where $N^i(r)$ denotes those vertices of T that are exactly at distance i from r in T.

Proposition 6. *Let $0 < \varepsilon, \eta, \gamma < 1/10$ such that $\eta = 4\gamma$ and $\varepsilon = \gamma^2/10$. Assume $G[A, B]$ is a lower $(\varepsilon, \eta, \gamma)$-regular pair. Let T be a tree rooted at r, having color classes X and Y such that $r \in X$, $|X| \leq (1 - 10\gamma)|A|$ and $|Y| \leq (1 - 10\gamma)|B|$. Assume further that for every $i \geq 1$ we have $|L_{2i}| \leq \varepsilon|A|$ and $|L_{2i+1}| \leq \eta|B|$. Then $T \subset G[A, B]$.*

Let us remark that T does not have to have bounded degree, unlike in many tree embedding results. In fact, it can have vertices with linearly large degrees, if δ and the other parameters are constants. The statement holds for every G for which Lemma 5 can be applied, hence, G can have $o(n^2)$ edges.

We need the following simple claim, the proof is left for the reader.

Claim 7. *Let $F = F(U, V)$ be a lower $(\varepsilon, \eta, \gamma)$-regular pair. Let $U' \subset U$ and $V' \subset V$ such that $|U'| \geq \varepsilon|U|$ and $|V'| \geq \eta|V|$. Then U' can have at most $\varepsilon|U|$ vertices that have less than $\gamma|V'|$ neighbors in V'. Similarly, V' can have at most $\eta|V|$ vertices that have less than $\gamma|U'|$ neighbors in U'.*

Proof of the theorem: We prove the theorem via an embedding algorithm. Let $X = \{x_1, \ldots, x_k\}$ and $Y = \{y_1, \ldots, y_m\}$, where $r = x_1$. We will find the images of the vertices of T so that we embed height-2 subtrees of T in every step, having vertices from Y in the middle level.

Denote $\varphi : V(T) \longrightarrow A \cup B$ the edge-preserving mapping that we construct. Let A^f, respectively, B^f denote the *free* (ie. vacant) vertices of A, respectively, B. These sets are shrinking as the embedding of T proceeds, but due to the conditions of Proposition 6 we always have that $|A^f| \geq 10\gamma|A|$ and $|B^f| \geq 10\gamma|B|$. Divide A^f randomly into three disjoint, approximately equal-sized subsets A_1^f, A_2^f and A_3^f. Let $B_1' \subset B^f$ be the set of those vertices that have less than $\gamma|A|$ neighbors in A_1^f, the sets B_2' and B_3' are defined analogously. Then $|B_1'|, |B_2'|, |B_3'| \leq \eta|B|$.

Let v be an arbitrary vertex of, say, A_1^f that has at least $\gamma|B^f - B_1' - B_2' - B_3'|$ neighbors in $B^f - B_1' - B_2' - B_3'$. By Claim 7 we know that A_1^f has many such vertices. By the definition of the B_i' sets we have that every vertex in $N(v)$ has at least $\gamma|A_i^f|/4$ neighbors in A_i^f for $i = 1, 2, 3$. Pick the largest of the A_i^f sets, say, it is A_2^f. Then the height-2 subtree originating at r will be embedded so that the neighbors of r will be mapped onto $N(v)$ arbitrarily ($|L_2|$ is smaller, than $|N(v)|$), and by construction every vertex of $N(v)$ will have many neighbors in A_2^f. Now we redetermine the subsets B_1', B_2', B_3', as some vertices have become covered in A and in B. For the third level of the height-2 subtree originating at r we take those vertices of A_2^f that are neighboring with at least a γ proportion of $B^f - B_1' - B_2' - B_3'$. Note that for every $\varphi(y)$ where y is in the middle level we have many choices: except at most $\varepsilon|A|$ vertices of A_2^f the neighborhood $N(\varphi(y))$ contains vertices with large degrees into $B^f - B_1' - B_2' - B_3'$. This means that we are able to map the third level. Next we continue this process so that we embed the height-2 subtrees originating at the vertices of the third level one-by-one.

There is only one missing detail here, the reason why we divided A^f randomly in the beginning: if we have three A_i^f sets, then the *active level* belongs to one of them, say, it is A_i^f. Then we map the vertices of T that are exactly two levels below them into the larger A_j^f-set, where $j \in \{1, 2, 3\} - i$. This way we never eat up any of the A_i^f sets at any point in time. Since the color classes of T are sufficiently small, this procedure never gets stuck. $\square$

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A polynomial-time algorithm for recognizing subgraph-symmetry-compressible graphs

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ABSTRACT

Symmetries in graphs represent a natural mechanism to reduce redundancies in graph representations. We present a class of graphs that can be compressed using symmetries and an extension of this class that encompasses many more graphs from practice. We call the extended class subgraph-symmetry-compressible graphs. For this class we demonstrate that it can be recognized in polynomial time.

Categories and Subject Descriptors

F.2.2 [**Analysis of Algorithms and Problem Complexity**]: Nonnumerical Algorithms and Problems

General Terms

Theory

Keywords

graph theory, compression, symmetries

1. INTRODUCTION

Due to enormous quantities of data, data compression is a very important building block of systems that gather, transfer, and save the information. One type of data that is becoming more and more important are graphs. This paper is a part of the exploration of how to use symmetries as a mechanism that could reduce the amount of data in such structures.

Symmetries are mathematically defined as graph automorphisms, and we will use these two terms synonymously. Based on this notion we formally define how the symmetry can be used to uniquely represent the graph, and what it means that a graph representation is smaller than some other representation. Based on this concepts we define two classes of graphs: 1) symmetry-compressible graphs and 2) subgraph symmetry-compressible graphs. This two graph classes have already been defined in our previous work [3]. This paper focuses on the question of computational complexity of subgraph symmetry-compressible graphs. We establish that the problem of recognizing this class of graph can be solved in polynomial time and we describe a practical algorithm for it.

The paper is structured as follows. The next section gives some preliminaries and introduces the concept of symmetry-compressible and subgraph symmetry-compressible graphs. Section 3 states a few basic theorems about symmetry--compressible graphs which will be used in the main result of this paper. Section 4 constructs the main properties of $\mathcal{SSC}$ graphs, which are used in Section 5 to describe a polynomial-time algorithm.

2. DEFINITIONS

We represent an undirected graph as a set of edges, $G = \{(u, v)\}$, where u, v are members of the set of vertices. The set of all vertices is denoted as $V(G)$.

An automorphism of a graph is a bijective mapping (a permutation) of $V(G)$, which preserves the connectivity of the graph. All automorphisms of a graph G form a group, denoted by $Aut(G)$. We work with two related representations of the symmetries. The standard representation are permutations of the vertex set, i.e., bijective functions $\pi : V(G) \to V(G)$. But we also require an alternative representation of an automorphism π, the permutation of the edges. The edge permutation, induced by the vertex permutation π, is defined as $\overline{\pi}((u, v)) = (\pi(u), \pi(v))$.

Permutations are considered in the standard cycle notation, i.e., as a set of disjoint cycles (e.g. (123)(45)(6)). This set contains also the cycles with only one element (identities of the permutation). The notation $cyc(\pi)$ denotes the set of all the cycles of the permutation π. Same goes for the edge permutation $\overline{\pi}$. To obtain the cycle which contains a vertex v (or edge e), we use $cyc(\pi, v)$ ($cyc(\overline{\pi}, e)$ for edges).

Since graphs are represented as a set of pairs, in order to have a comparable representation, also permutations will be represented as a set of pairs. Trivially, since it is a function, a symmetry can be represented by $|V(G)|$ pairs. But many redundancies can be removed in such a representation. Namely, the identities can be omitted, and one pair from each cycle can also be left out. The size (of the representation) is expressed in terms of the cycle sizes as

$|\pi| = \sum_{c \in cyc(\pi)} (|c| - 1)$.

Now we can define the two classes of graph, the first one being the class of graphs that can be more efficiently represented by using one automorphism.

DEFINITION 1 (SYMMETRY COMPRESSIBLE GRAPHS). *A graph G is symmetry compressible ($G \in \mathcal{SC}$) if $\exists \pi \in Aut(G)$: $|\pi| + |G^\pi| < |G|$.*

Where G^π is the *required part* of the graph (under the symmetry π) and is defined as $G^\pi = \{e \in G \mid e = \min_{f \in cyc(\overline{\pi}, e)} f\}$. In general, the required part of the graph is the set of edges that are extracted from the cycles of $\overline{\pi}$ so that there is exactly one edge from each cycle in G^π. This makes it possible to reconstruct the original graph if we know π.

The second class of graph is the class of graphs that contains a symmetry-compressible graph as a subgraph.

DEFINITION 2 (SUBGRAPH $\mathcal{SSC}$). *A graph is subgraph symmetry-compressible ($G \in \mathcal{SSC}$) if $\exists H \subseteq G$ and $H \in \mathcal{SC}$.*

3. BASIC RESULTS ON SC GRAPHS

This section provides a few basic results about symmetry-compressible graphs. We will provide the relevant theorems without proofs. The complete proofs are available in [3].

The first theorem demonstrates the relation between π and $\overline{\pi}$ (moved vertices and moved edges) for symmetry-compressible graphs. The next theorem shows the condition when symmetries between two different connected components compress the graph (it trivially generalizes to more components). The next theorem shows that trees (forests to be precise) are not symmetry-compressible. And finally, we explore the compressibility of cycle graphs.

THEOREM 1. $G \in \mathcal{SC} \iff \exists \pi \in Aut(G) : |\pi| < |\overline{\pi}|$

THEOREM 2. *Let us assume G is composed of two connected components $G_1 \notin \mathcal{SC}$ and $G_2 \notin \mathcal{SC}$, and there is a symmetry π mapping the component G_1 onto G_2. Then $G \in \mathcal{SC} \iff |G_1| > |V(G_1)|$.*

THEOREM 3. *If the graph T is a forest then $T \notin \mathcal{SC}$.*

THEOREM 4. *Even cycles $C_k, (k = 2i)$ are symmetry compressible, whereas odd cycles $C_k, (k = 2i + 1)$ are not.*

Using these basic results, we can now explore in more detail the properties of $\mathcal{SSC}$ graphs.

4. CHARACTERIZATION OF SSC GRAPHS

The main result of this section will establish that the $\overline{\mathcal{SSC}}$ graph class can be specified by a forbidden graph characterization. More precisely, a graph is not in $\mathcal{SSC}$ if and only if it does not contain any of the following subgraphs: even cycle, compressible symmetric-handcuff, and compressible handcuff pair.

DEFINITION 3 (HANDCUFF GRAPHS). *A graph is a $H^k_{c_1,c_2}$-handcuff if it consists of two cycles of lengths c_1 and c_2, connected by a path of length k. We will call the path connecting the two cycles also a* chain *- with an odd (even) length an odd (even) chain. If $c_1 = c_2$ we call it a* symmetric handcuff*).*

LEMMA 1. *Handcuff graphs with at least one even cycle are symmetry-compressible.*

PROOF. This follows from Theorem 4, since we can apply the reflective symmetry to only that cycle, leaving the rest of handcuff fixed and thus getting a smaller representation of the entire graph. □

Because of this result we will focus mostly on handcuff graphs which contain only odd cycles.

LEMMA 2. *Symmetric handcuffs $H^{2l}_{2k+1,2k+1}$ (with even chain) are symmetry-compressible, whereas $H^{2l+1}_{2k+1,2k+1}$ are not.*

PROOF. We consider the symmetry of $H^c_{2k+1,2k+1}$ which maps one cycle onto another. In the case where $c = 2l$ the pivot of the symmetry is a node, but when $c = 2l + 1$ the pivot is an edge.

- ($c = 2l$) The number of vertices $|V(H^c_{2k+1,2k+1})| = (4k+2)+(2l-1)$, the size of the symmetry π is therefore $|\pi| = \frac{(4k+2)+(2l-1)-1}{2} = \frac{2(2k+l)}{2} = 2k+l$ and the size of the residual graph under π is $|(H^{2l}_{2k+1,2k+1})^\pi| = 2k + 1 + l$. We see that we obtain a smaller representation:
$$|\pi| + |(H^{2l}_{2k+1,2k+1})^\pi| = 2k + l + 2k + 1 + l = $$
$$= 4k + 2l + 1 < 2(2k + 1) + 2l = |H^{2l}_{2k+1,2k+1}|$$
- ($c = 2l + 1$) In this case the size of the symmetry is $|\pi| = 2k + 1 + l$, and the size of the residual graph is $|(H^{2l+1}_{2k+1,2k+1})^\pi| = 2k + l + 2$. This representation is the same in size as the original graph:
$$|\pi| + |(H^{2l+1}_{2k+1,2k+1})^\pi| = 2k + l + 1 + 2k + l + 2 =$$
$$= 4k + 2l + 3 \not< H^{2l+1}_{2k+1,2k+1} = 4k + 2l + 3$$

□

DEFINITION 4 (PAIR OF HANDCUFFS). *A pair of handcuffs is the graph $(H^c_{k,l}, H^c_{k,l})$.*

LEMMA 3. *A pair of handcuffs is symmetry-compressible.*

PROOF. This follows directly from Theorem 2, since $|H^c_{k,l}| > |V(H^c_{k,l})|$. □

DEFINITION 5 (MINIMAL $\mathcal{SC}$ GRAPH). *A graph $G \in \mathcal{SC}$, π being its compressing symmetry, such that $\forall e \in G : \overline{\pi}(e) \neq e$, is called a* minimal $\mathcal{SC}$ graph.

In the following analysis of $\mathcal{SSC}$ graphs we will focus mostly on the subgraphs that are minimal $\mathcal{SC}$ graphs because of the following lemma.

LEMMA 4. *All $G \in \mathcal{SC}$ contain a minimal $\mathcal{SC}$ subgraph.*

PROOF. Let $G \in \mathcal{SC}$, π its compressing symmetry, and $F \subseteq G$ such that $\forall e \in F : \overline{\pi}(e) = e$ - the edges fixed by symmetry π. We can show that the minimal $\mathcal{SC}$ subgraph is simply $H = G \setminus F$. Notice that by removing edges that are fixed by the symmetry π the graph $G \setminus F$ remains symmetric under the symmetry π. Notice also that the edges not moved by π are also present in G^π. So since we know that

$$|\pi| + |G^\pi| < |G| \Longrightarrow |\pi| + |G^\pi \setminus F| < |G \setminus F|.$$

□

In the following lemma we will require to identify graphs without even cycles. The most useful property of these graphs (for our application) is the following lemma.

LEMMA 5. *A graph has no even cycles if and only if each block in its block tree decomposition is either an odd cycle or K_2.*

The detailed proof of this lemma can be found in [1].

LEMMA 6. *If a graph has no even cycles and no pairs of handcuffs then for any subgraph $G' = G_1 \cup G_2, G1, G_2 \subset G, G_1 \cap G_2 = \emptyset$ there is no compressing symmetry $\pi \in Aut(G')$ that maps G_1 onto G_2.*

PROOF. Let us assume the opposite, i.e., G has two disjoint subgraphs $G_1, G_2 \subset G$ with a compressing symmetry π mapping G_1 onto G_2. From Theorem 2 we know that for two components, the necessary condition to be in $\mathcal{SC}$ is that $|V(G_1)| < |G_1|$. For this inequality to hold, G_1 needs at least two more edges than a tree would have. When adding edges to a tree, cycles are created, in this case at least two. And these two cycles have to be disjoint, otherwise an even cycle is created (which we assumed is absent in this graph). But if there are two disjoint cycles in a connected component, they are connected by a chain, forming a handcuff subgraph. And an isomorphic handcuff is also present in G_2, together forming a handcuff pair (which we also assumed is absent from the graph). □

Finally, we join these lemmas to identify three graph types that characterize the class $\mathcal{SSC}$.

THEOREM 5. *If a graph G has no even cycles C_{2i}, no handcuff pairs $(H^c_{k,l}, H^c_{k,l})$, and no symmetric handcuffs with even chain $H^{2i}_{k,k}$, then $G \notin \mathcal{SSC}$.*

PROOF. From the previous lemma we already know that if there is no even cycles and no handcuff pairs, then any minimal $\mathcal{SC}$ subgraph has to be connected. We prove that no such connected subgraph can exists, again by contradiction. Let $H \subseteq G$ be a connected minimal $\mathcal{SC}$ subgraph. Remember that H can be viewed as a tree where some vertexes can be substituted by odd cycles (see Lemma 5). We also know H is not a tree, so it has at least one cycle. Let us examine two possibilities:

- (H has only one cycle) The symmetry π has to map this one cycle onto itself. And since this is a minimal $\mathcal{SC}$ graph, all edges are moved by π, therefore the only possible symmetry is the rotational symmetry (the reflective symmetry would leave one edge fixed). H must be an odd cycle C_k, each vertex of this cycle having a tree T attached to it. The entire size fo the graph is $k + k|T|$. The size of the symmetry $|\pi| = |T|(k-1)+k-1$ and the size of $|H^\pi| = |T|+1$. So $|\pi|+|H^\pi| = |T|(k-1)+k-1+|T|+1 = k|T|+k \not< |H|$.
- (H has at least two cycles) Because of the aforementioned structure of H, only one cycle can be mapped onto itself by π. So at least one cycle must be mapped into another cycle, i.e., there are at least two cycles with the same size (lets call them C_1, C_2). Since H is connected these two cycles form a symmetric handcuff. And now we can show that the chain in this handcuff is of even length. There are again two possibilities for the pivot of the symmetry π, either the pivot is a 1) single vertex, or 2) an odd cycle. In case of 1), the distance of C_1 and C_2 has to be equal, therefore the length of the entire chain is even. In case of 2), the path between C_1 and C_2 passes over an odd cycle. We can make the chain either of odd length or even length by choosing one part or the other part of the cycle. So a symmetric handcuff with even chain is certainly a subgraph, even though we assumed it is not.

□

5. ALGORITHM

In this section we provide further details of the algorithm that follows from the forbidden graph characterization that we proved in the previous section.

LEMMA 7. *Checking if a graph contains an even cycle can be done in polynomial time.*

PROOF. From [2], we know that a block decomposition can be done in linear time. When we have a block decomposition, we check every block. If the block is anything other than K_2 or C_{2k+1}, the graph contains an even cycle $\longrightarrow$ the graph is $\in \mathcal{SSC}$. It is trivial to check if the block is only one edge or C_{2k+1} - for the latter the number of vertices and edges has to be the same and odd. □

LEMMA 8. *Every connected graph G, having ≥ 3 edge disjoint k cycles, contains a symmetric handcuff subgraph, i.e., $G \in \mathcal{SSC}$.*

PROOF. We will prove this for the case when we have 3 disjoint cycles, for more it trivially follows.

Lets call the three cycles C_1, C_2, C_3. Since they are in a connected graph, there is a path between each pair of these cycles. Now we need to show that there is at least one even chain between a pair of cycles. There are two cases:
1) C_2 is not on the path between C_1 and C_3.
2) C_2 is on the path between C_1 and C_3.
When 1), there are two options to traverse C_2 when going from C_1 to C_3, i.e., an odd path across the cycle and an even path across the cycle. Which means we can always construct an even path between C_1 and C_3. When 2), the three cycles have a mutual junction (let us call this vertex j) of their chains. Let us denote the distances from the cycles to this junction as p_1, p_2, and p_3 respectively. If p_1 is odd, then if either p_2 or p_3 are odd we had an even path between C_1 and C_2 or C_3. But if both p_2 and p_3 are even, then the path between C_2 and C_3 is even. A very similar argument holds if p_1 is even. □

THEOREM 6. *In graphs containing no even cycles, checking if they contain symmetric handcuffs can be done in polynomial time.*

PROOF. From the above lemma it follows that we need to focus only on the case where there are exactly two cycles with the same cardinality. In the block decomposition tree, there is a unique path between these two cycles. If this path passes a block containing a cycle, then we have a symmetric handcuff. This follows from the fact that we have two choices of how to pass the cycle. One is of even length and one is of odd length. As a consequence, there is always a path of even length between the two cycles, making the handcuff symmetric. If the unique path in the decomposition tree passes no cycle, then it is unique also in the original graph, and it is trivial to check the parity of its length. □

Now we define an auxiliary problem, which will be used for recognizing our last family of forbidden graphs, i.e. handcuff pairs.

DEFINITION 6. *Pair choice problem We define a problem where a sequences of pairs is given:* $a = \binom{a_1^0}{a_1^1}\binom{a_2^0}{a_2^1}\cdots\binom{a_n^0}{a_n^1}$ *and an integer* K.

The decision problem is whether a binary vector exists: $x \in \{0,1\}^n$ *such that* $\sum_{i=1}^n a_i^{x_i} = K$?

We can show that the problem of finding handcuff pairs in a graph can be reduced to the pair choice problem in polynomial time. The Pair-choice problem is an NP-complete problem, since the subset-sum problem can easily be reduced to the pair choice problem. But we can show how the limited versions of the pair choice problem can be solved in polynomial time with dynamic programming, which can be succinctly expressed with the following Bellmann equations:

$$s(0,0) = 1,$$
$$s(i,k) = s(i-1, k-a_i^0) \vee s(i-1, k-a_i^1),$$

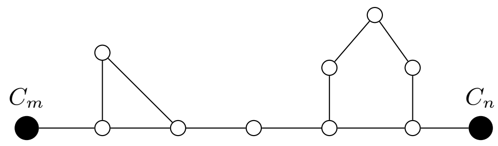

Figure 1: An example of a path between two cycles (the black vertices). To check if, e.g. there is a chain of size 7, we transform this subgraph into pairs $\binom{5}{4}, \binom{5}{2}$ **.**

where $s(i,k)$ denotes the solution if only the first i pairs are taken into account, and the goal sum is k. This algorithm is polynomial ($O(nK)$), if the goal sum K is polynomial in n. We can demonstrate that the problem of identifying handcuff pairs can be reduced to an instance of the pair choice problem, which can be solved in polynomial-time using the above dynamic programming.

THEOREM 7. *In graphs containing no even cycles, and no symmetric handcuffs checking if they contain handcuff pairs* $(H_{k,l}^c, H_{k,l}^c)$ *can be done in polynomial time.*

PROOF. In the tree of cycles, which we have when there are no even cycles in the graph, there can be only $O(n)$ cycles. For each pair of pairs of cycles, i.e. $(C_k, C_l), (C_k, C_l)$, we check all the possible distances between the cycles in a pair. This can be done by transforming every pair of cycles into a pair choice problem in the following way. First, notice there is a unique path between these cycles in the block decomposition. For each block that is also a cycle in the original graph, we create a pair, which represents the length of two possible paths across the cycle. An example of this reduction can be seen in Figure 1. In this way we can check all possible length paths between the start and end cycle. If the pars have a distance that coincides, than we have found a handcuff pair. □

6. CONCLUSIONS

This article answers an open question about recognizing a special kind of graphs, namely the subgraph symmetry compressible graphs. We showed that this problem is solvable in polynomial time, which is also practically useful information since it can be used in compression algorithms. A remaining open question is the time complexity of $\mathcal{SC}$ graphs. Since this problem is more closely related to the graph isomorphism problem, we believe it is at least GI-hard. In our future work we will focus on the above open question and on developing practical compression algorithms based on the described concepts of $\mathcal{SC}$ and $\mathcal{SSC}$ graphs.

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PSEUDORANDOM NUMBER GENERATORS BASED ON COMPOSITIONS OF AUTOMATA

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ABSTRACT

This paper is devoted to propose a novel PRNG based on compositions (temporal products of special Gluškov products) of abstract automata. Its utility shall be shown through a simple example. However, several questions are subject of future work, such as the analysis of further properties of the PRNG, as well as related statistical testing.

Keywords

pseudorandom number generator, automata network, products of automata

1. INTRODUCTION

Certain cryptographical applications of abstract automata compositions has already been considered in [1, 2, 3]. On the line of this research, we propose a new pseudorandom number generator based on compositions of abstract automata.

For all notions and notation not defined here we refer to the monographs [4, 5, 6, 9, 10].

2. PRELIMINARIES

Let us start with some standard concepts and notations. By an (abstract) *pseudorandom number generator* we mean a system $\mathcal{PRNG} = (K, S, s_0, f, U, g)$, where K, S, U are finite nonempty sets, the so-called *key space*, *state space*, and *output space*, respectively, $s_0 \in S$ is the *seed*, $f : S \to S$ is the *state transition function*, and $g : K \times S \to U$ is the *output function*. We will say that the *pseudorandom sequence* $u_1, u_2, \ldots, (u_1, u_2, \ldots \in U)$ generated by the $\mathcal{PRNG}$ if we have $u_n = g(k, s_n)$, where $s_n = f(s_{n-1})$ $(n \in \{1, 2 \ldots\})$.

An *automaton* will be meant to be a deterministic finite automaton without outputs. In more details, an automaton is an algebraic structure $\mathcal{A} = (A, \Sigma, \delta)$ consisting of the nonempty and finite *state set* A, the nonempty and finite *input set* Σ, and a *transition function* $\delta : A \times \Sigma \to A$. The elements of the state set are the *states*, whereas the elements of the input set are the *input signals*.

The transition matrix of an automaton is a matrix with rows corresponding to each input and columns corresponding to each state. Given an entry corresponding to a row indicated by an input $x \in \Sigma$ and a column indicated by a state $a \in A$ the state $\delta(a, x)$ is put into the entry. If all rows of the transition matrix are permutations of the state set then we call it a *permutation automaton*.

3. THEORETICAL BACKGROUND

Next we recall some definitions. (See also [1].)

Let $\mathcal{A}_i = (A_i, \Sigma_i, \delta_i)$ be automata where $i \in \{1, \ldots, n\}$, $n \geq 1$. Take a finite nonvoid set Σ and a *feedback function* $\varphi_i : A_1 \times \cdots \times A_n \times \Sigma \to \Sigma_i$ for every $i \in \{1, \ldots, n\}$. The *Gluškov-type product* [7] of the automata $\mathcal{A}_i$ with respect to the feedback functions φ_i $(i \in \{1, \ldots, n\})$ is defined to be the automaton $\mathcal{A} = \mathcal{A}_1 \times \cdots \times \mathcal{A}_n(\Sigma, (\varphi_1, \ldots, \varphi_n))$ with state set $A = A_1 \times \cdots \times A_n$, input set Σ, transition function δ, where the latter one is given by $\delta((a_1, \ldots, a_n), x) = (\delta_1(a_1, \varphi_1(a_1, \ldots, a_n, x)), \ldots, \delta_n(a_n, \varphi_n(a_1, \ldots, a_n, x)))$ for all

$(a_1,\ldots,a_n) \in A$ and $x \in \Sigma$. In particular, if $\mathcal{A}_1 = \ldots = \mathcal{A}_n$ then we say that $\mathcal{A}$ is a *Gluškov-type power.*

Let $\mathcal{A}_t = (A, \Sigma_t, \delta_t)$, $t = 1, 2$, be automata having a common state set A. Take a finite nonvoid set Σ and a mapping φ of Σ into $\Sigma_1 \times \Sigma_2$. Then the automaton $\mathcal{A} = (A, \Sigma, \delta)$ is a *temporal product* (t-product, see [8]) of $\mathcal{A}_1$ and $\mathcal{A}_2$ with respect to Σ and φ if for any $a \in A$ and $x \in \Sigma$, $\delta(a,x) = \delta_2(\delta_1(a,x_1),x_2)$, where $(x_1,x_2) = \varphi(x)$. The concept of temporal product is generalized in a natural way to an arbitrary finite family of $n > 0$ automata $\mathcal{A}_t$ $(t = 1,\ldots,n)$, all having the same state set A, such that for any mapping $\varphi : \Sigma \to \prod_{t=1}^{n} \Sigma_t$, one defines $\delta(a,x) = \delta_n(\cdots \delta_2(\delta_1(a,x_1),x_2),\cdots,x_n)$ when $\varphi(x) = (x_1,\ldots,x_n)$. In particular, a temporal product of automata with a single factor is just a (one-to-many) relabeling of the input letters of some input-subautomaton of its factor.

Given a function $f : X_1 \times \cdots \times X_n \to Y$, we say that f is *really independent of its i-th variable* if for every pair $(x_1,\ldots,x_n), (x_1,\ldots,x_{i-1},x_i',x_{i+1},\ldots,x_n) \in X_1 \times \cdots \times X_n$ we have $f(x_1,\ldots,x_n) = f(x_1,\ldots,x_{i-1},x_i',x_{i+1},\ldots,x_n)$. Otherwise we say that f *really depends on its i-th variable.*

A (finite) *directed graph* (or, in short, a *digraph*) $\mathcal{D} = (V,E)$ (of order $n > 0$) is a pair consisting of sets of *vertices* $V = \{v_1,\ldots,v_n\}$ and *edges* $E \subseteq V \times V$. Elements of V are sometimes called *nodes.* If $|V| = n$ then we also say that $\mathcal{D}$ is a digraph of order n. In what follows we will assume that V is an ordered set of integers $1,\ldots n$ for some positive integer n. Given a digraph $\mathcal{D} = (V,E)$ we say that the above defined Gluškov product is a $\mathcal{D}$-product if for every pair $i,j \in \{1,\ldots,n\}$ we have that $(i,j) \notin E$ implies that the feedback function φ_i is really independent of its j-th variable. Now assume that Σ is the set of all binary strings with a given length $\ell > 0$, n is a positive integer power of 2, $\mathcal{A}_1 = (\Sigma, \Sigma \times \Sigma, \delta_{\mathcal{A}_1})$ is a permutation automaton such that for every $a,x,x',y,y' \in \Sigma$, we have $\delta_{\mathcal{A}_1}(a,(x,y)) \neq \delta_{\mathcal{A}_1}(a(x',y))$, $\delta_{\mathcal{A}_1}(a,(x,y)) \neq \delta_{\mathcal{A}_1}(a(x,y'))$, and let $\mathcal{A}_i = (\Sigma, \Sigma \times \Sigma, \delta_{\mathcal{A}_i}), i = 2,\ldots,n$ be copies of $\mathcal{A}_1$. Consider the following simple bipartite digraphs:

$\mathcal{D}_1 = (\{1,\ldots,n\}, \{(n/2+1,1),(n/2+2,2),\ldots,(n,n/2)\})$,
$\mathcal{D}_2 = (\{1,\ldots,n\}, \{(n/4+1,1),(n/4+2,2),\ldots,(n/2,n/4),$
$(3n/4+1,n/2+1),(3n/4+2,n/2+2),\ldots,(n,3n/4)\})$, $\ldots$,
$\mathcal{D}_{log_2 n-1} = (\{1,\ldots,n\}, \{(3,1),(4,2),(7,5),(8,6),\ldots,$
$(n-1,n-3),(n,n-2)\})$,
$\mathcal{D}_{log_2 n} = (\{1,\ldots,n\}, \{(2,1),(4,3),\ldots,(n,n-1)\})$,
$\mathcal{D}_{log_2 n+1} = \mathcal{D}_1, \ldots, \mathcal{D}_{2log_2 n} = \mathcal{D}_{log_2 n}$.

For every digraph $\mathcal{D} = (V,E)$ with $\mathcal{D} \in \{\mathcal{D}_1,\ldots,\mathcal{D}_{2log_2 n}\}$ let V_1 be the set of all incoming edges and let V_2 be the set of all outgoing edges, and define furthermore the Gluškov-type product (called *two-phase $\mathcal{D}$-product*) $\mathcal{A}_{\mathcal{D}} = \mathcal{A}_1 \times \cdots \times \mathcal{A}_n(\Sigma^n,(\varphi_1,\ldots,\varphi_n))$ of $\mathcal{A}_1,\ldots,\mathcal{A}_n$ so that for every $(a_1,\ldots,a_n),(x_1,\ldots,x_n) \in \Sigma^n, i \in \{1,\ldots,n\}$ we have $\varphi_i(a_1,\ldots,a_n,(x_1,\ldots,x_n)) = (a_j \oplus x_j, x_i)$ if $(j,i) \in V_1$ and $a_j \oplus x_j$ is the bitwise addition modulo 2 of a_j and x_j, $\varphi_i(a_1,\ldots,a_n,(x_1,\ldots,x_n)) = (a_j' \oplus x_j, x_i)$ if $(j,i) \in V_2$, where a_j' denotes the state into which $\varphi_j(a_1,\ldots,a_n,(x_1,\ldots,x_n))$ takes the automaton from its state a_j, and $a_j' \oplus x_j$ is the bitwise addition modulo 2 of a_j' and x_j. [1]

Let $\mathcal{B} = (\Sigma^n, (\Sigma^n)^{2log_2 n}, \delta_{\mathcal{B}})$ be the temporal product of $\mathcal{A}_{\mathcal{D}_1},\ldots,\mathcal{A}_{\mathcal{D}_{2log_2 n}}$ with respect to $(\Sigma^n)^{2log_2 n}$ and the identity map $\varphi : (\Sigma^n)^{2log_2 n} \to (\Sigma^n)^{2log_2 n}$. We say that $\mathcal{B}$ is a *key-automaton* with respect to $\mathcal{A}_1,\ldots,\mathcal{A}_n$.[2] Obviously, $\mathcal{B}$ is unambigously defined by the transition matrix of $\mathcal{A}_1$.

Theorem. *Every key automaton transition function can be applied as an output function of a pseudorandom number generator.*

Proof. Let $\mathcal{B} = (\Sigma^n, (\Sigma^n)^{2log_2 n}, \delta_{\mathcal{B}})$ be an above defined key automaton. Moreover, let $f : \Sigma^n \to \Sigma^n$ be a bijective function. Consider two random words $u_0, v_0 \in \Sigma^n$. For every positive integer k let $u_k = f(u_{k-1})$. Define the output function g such that for every positive integer k, we have $g(v_0,u_k) = \delta_{\mathcal{B}}(u_k, v_0^{2log_2 n})$. Then we can get the system $\mathcal{PRNG} = (K,S,s_0,f,U,g)$, where $K(=\{v_0\})$ is a singleton set, $S = U = \Sigma^n$ and $s_0 = u_0$.

This completes the proof.

Remarks. It is shown in [1] that every key automaton is a permutation automaton. In other words, for every triplet $u_1,u_2,x \in \Sigma^n$, $u_1 \neq u_2$ implies $\delta_{\mathcal{B}}(u_1,x^{2log_2 n}) \neq \delta_{\mathcal{B}}(u_2,x^{2log_2 n})$. Therefore, for every seed $u_0 \in \Sigma^n$ and key $v_0 \in \Sigma^n$ the length of the period of $\mathcal{PRNG}$ (i.e. the minimal nonnegative integer k for which u_0 and $g(u_k,v_0)$ coincide) is equal to the minimal number m for which $u_0 = f(u_m)$. Consequently, if f generates a full cycle –i.e. $\{u_k \mid u_k = f(u_{k-1}, k \in \{1,2,\ldots\}\} = \Sigma^n$– then, of course, the length of the period of $\mathcal{PRNG}$ does not depend on u_0 or v_0.

In [1] it is also shown that a small change in either the state blocks or the input blocks results in a significant change in the next state of the state transitions. In other words, for every triplet $u_0',u_0'',v_0 \in \Sigma^n$, having $u_0' \neq u_0''$ results significant change in $\delta_{\mathcal{B}}(u_0', v_0^{2log_2 n})$ and $\delta(u_0'', v_0^{2log_2 n})$. On the other hand, if f generates a full cycle and Σ^n is not a singleton then for every pair $u_0',u_0'' \in \Sigma^n$ we have that $u_0' \neq u_0''$ obviously implies $u_k' \neq u_k''$ whenever $u_k' = f(u_{k-1}'), u_k'' = f(u_{k-1}''), k \in \{1,2,\ldots\}$ But then the pairs $\delta_{\mathcal{B}}(u_k', v_0^{2log_2 n})$ and $\delta_{\mathcal{B}}(u_k'', v_0^{2log_2 n})$ with $u_k' = f(u_{k-1}'), u_k'' = f(u_{k-1}''), k \in \{1,2,\ldots\}$ should also have significant differences.

4. EXAMPLE

Consider the following transition table of an automaton $\mathcal{A} = (\{0,1\},\{0,1\}^2,\delta)$:

δ	0	1
00	0	1
01	1	0
10	1	0
11	0	1

[1]We note that for every $j \in V_2$ there exists a unique $i \in V_1$ with $(j,i) \in E$, and conversely, for every $i \in V_1$ there exists a unique $j \in V_2$ with $(j,i) \in E$. Therefore, all of $\varphi_1,\ldots,\varphi_n$ are well-defined.

[2]Recall that n should be a power of 2.

Let $n = 4$ and assume that all of $\mathcal{A}_1, \mathcal{A}_2, \mathcal{A}_3, \mathcal{A}_4$ coincide with $\mathcal{A}$. Then $log_2 n)(= log_2 4) = 2$ and thus

$\mathcal{D}_1 = (\{1, \ldots, 4\}, \{(3, 1), (4, 2)\})$,

$\mathcal{D}_2 = (\{1, \ldots, 4\}, \{(2, 1), (4, 3)\}$.

Let $v_0 = (1, 0, 1, 0)$ be a fixed input signal of the key automaton $\mathcal{B}$ which is the temporal product of $\mathcal{A}_{\mathcal{D}_1}$ and $\mathcal{A}_{\mathcal{D}_2}$. Assume that $\mathcal{B}$ is in the state $u_k = (0, 1, 1, 0)$. Thus we have $(a_1, a_2, a_3, a_4) = (0, 1, 1, 0)$, $(x_1, x_2, x_3, x_4) = (1, 0, 1, 0)$.

Denote by $\varphi_i, a_i, a'_i, x_i, i \in \{1, 2, 3, 4\}$ the feedback functions, the state components, the next state components, and the input components of $\mathcal{A}_{\mathcal{D}_1}$, respectively. Then $\varphi_1((0, 1, 1, 0), 1, 0, 1, 0) = (a_3 \oplus x_3, x_1) = (1 \oplus 1, 1) = (1, 1)$, $\varphi_2((0, 1, 1, 0), 1, 0, 1, 0) = (a_4 \oplus x_4, x_2) = (0 \oplus 0, 1) = (0, 1)$, moreover $\delta(0, (1, 1)) = 0(= a'_1)$ and $\delta(1, (0, 1)) = 0(= a'_2))$ and thus $\varphi_3((0, 1, 1, 0), 1, 0, 1, 0) = (a'_1 \oplus x_1, x_3) = (0 \oplus 1, 1) = (1, 1)$, $\varphi_4((0, 1, 1, 0), 1, 0, 1, 0) = (a'_2 \oplus x_2, x_4) = (0 \oplus 0, 0) = (0, 0)$. Hence, $\delta(1, (1, 1)) = 1(= a'_3)$ and $\delta(0, (0, 0)) = 0(= a'_4)$.

Next we denote by $\varphi_i, a_i, a'_i, x_i, i \in \{1, 2, 3, 4\}$ the feedback functions, the state components, the next state components, and the input components of $\mathcal{A}_{\mathcal{D}_2}$, respectively. Recall that (a_1, a_2, a_3, a_4) coincides with the new state of $\mathcal{A}_{\mathcal{D}_1}$. Thus $(a'_1, a'_2, a'_3, a'_4) = (0, 1, 1, 0)$, and again $(x_1, x_2, x_3, x_4) = (1, 0, 1, 0)$.

Then $\varphi_1((0, 0, 1, 0), 1, 0, 1, 0) = (a_2 \oplus x_2, x_1) = (0 \oplus 0, 1) = (0, 1)$, $\varphi_3((0, 0, 1, 0), 1, 0, 1, 0) = (a_4 \oplus x_4, x_3) = (0 \oplus 0, 1) = (0, 1)$, moreover $\delta(0, (0, 1)) = 1(= a'_1)$ and $\delta(0, (0, 1)) = 0(= a'_3))$, and thus $\varphi_2((0, 0, 1, 0), 1, 0, 1, 0) = (a'_1 \oplus x_1, x_2) = (1 \oplus 1, 0) = (1, 0)$, $\varphi_4((0, 0, 1, 0)1, 0, 1, 0) = (a'_3 \oplus x_3, x_4) = (0 \oplus 1, 0) = (1, 0)$. Hence $\delta(0, (1, 0)) = 1(= a'_2)$ and $\delta(0, (1, 0)) = 1(= a'_4)$.

Now let $(a_1, a_2, a_3, a_4) = (1, 1, 0, 1)$ and again $(x_1, x_2, x_3, x_4) = (1, 0, 1, 0)$. Repeating the above procedure we get the output $(a'_1, a'_2, a'_3, a'_4) = g((a_1, a_2, a_3, a_4), (a_1, a_2, a_3, a_4))$ in the following way.

Then $\varphi_1((1, 1, 0, 1), 1, 0, 1, 0) = (a_3 \oplus x_3, x_1) = (0 \oplus 1, 1) = (1, 1)$, $\varphi_2((1, 1, 0, 1), 1, 0, 1, 0) = (a_4 \oplus x_4, x_2) = (1 \oplus 0, 1) = (1, 1)$, moreover $\delta(1, (1, 1)) = 1(= a'_1)$ and $\delta(1, (1, 1)) = 1(= a'_2))$, and thus $\varphi_3((1, 1, 0, 1), 1, 0, 1, 0) = (a'_1 \oplus x_1, x_3) = (1 \oplus 1, 1) = (0, 1)$, $\varphi_4((1, 1, 0, 1), 1, 0, 1, 0) = (a'_2 \oplus x_2, x_4) = (1 \oplus 0, 0) = (1, 0)$. Hence $\delta(0, (0, 1)) = 1(= a'_3)$ and $\delta(1, (1, 0)) = 0(= a'_4)$.

Now we have $(a'_1, a'_2, a'_3, a'_4) = (1, 1, 1, 0)$, and again $(x_1, x_2, x_3, x_4) = (1, 0, 1, 0)$. Then $\varphi_1((1, 1, 1, 0), 1, 0, 1, 0) = (a_2 \oplus x_2, x_1) = (1 \oplus 0, 1) = (1, 1)$, $\varphi_3((1, 1, 1, 0), 1, 0, 1, 0) = (a_4 \oplus x_4, x_3) = (0 \oplus 0, 1) = (0, 1)$, moreover $\delta(1, (1, 1)) = 1(= a'_1)$ and $\delta(1, (0, 1)) = 0(= a'_3))$, and thus $\varphi_2((1, 1, 1, 1, 0), 1, 0, 1, 0) = (a'_1 \oplus x_1, x_2) = (1 \oplus 1, 0) = (0, 0)$, $\varphi_4((1, 1, 1, 0)1, 0, 1, 0) = (a'_3 \oplus x_3, x_4) = (0 \oplus 1, 0) = (1, 0)$. Thus $\delta(1, (0, 0)) = 1(= a'_2)$ and $\delta(0, (1, 0)) = 1(= a'_4)$.

Hence the actual pseudorandom output is $g((a_1, a_2, a_3, a_4), (x_1, x_2, x_3, x_4)) = g((0, 1, 1, 0), (1, 0, 1, 0)) = (1, 1, 0, 1)$.

5. SOME TECHNICAL COMMENTS

Using the above mentioned parameters with 256 possible states (1 byte long states) we need 16 automata having a transition matrix $2^{16} = 65536$ lines and $2^8 = 256$ columns. Each cell of the automaton contains 1 byte long data (one state). The size of the matrix is 16 megabytes and the number of the possible matrixes are $256!^{65536}$, where the exclamation mark means the factorial operation.

6. CONCLUSION AND FUTURE WORK

This paper is devoted to propose a novel PRNG based on the compositions (temporal products of special Gluškov products) of abstract automata. Through a simple example we have shown its utility. However, several questions are still open for future work: a serious security analysis, evaluations regarding the randomness, a rigorous machine-independent investigation and discussion over how the PRNG proposed in this article compares to the ones in the literature. Of course, the interesting case is the one where the state transition function has a low computational complexity. (For example, when it is a linear congruential generator.)

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Simulation Framework for Evaluating Production Networks

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ABSTRACT
The manuscript presents the ongoing development of an agent-based production network simulation framework. The simulation is intended to analyze the high level (strategic and tactical) planning problems decomposed into simple subproblems, similarly to the practical approach applied by the Enterprise Resource Planning (ERP) systems. The background, the goals and the design of the framework are described, and some preliminary experiments with the current phase of the development are shown.

Keywords
Logistics optimization, agent-based simulation, robustness

1. INTRODUCTION
In recent years the shortening product life cycles and the increasing product variety have led to complex production networks with dynamic structure, fluctuating demand, embedded in volatile environments. Handling such complex and uncertain problems with exact mathematical optimization models is time-consuming and usually impractical.

There are two main difficulties in creating practical planning models. On the one hand, some parameters or dynamics are unknown or uncertain, therefore they are only estimated or approximated. For example, the demand curve usually assumes a simple relationship between the price and the demand, and completely disregards other important factors that influence the market, such as sudden changes in customers' preferences. On the other hand, if a model contains too many details, it can result in an *overfitted* solution. In this case the plan might be optimal considering fixed parameters, however, any change in the environment—e.g., a late supply or inappropriate quality—can cause a major change in the execution. Due to these difficulties, the realization usually diverges from the plan or the forecast.

In the industrial practice, commonly the basic planning algorithms that are built into the ERP systems are used. These general algorithms neglect several details of the problem, but usually result in plans that have more room for adaptation and are more flexible to changes. Furthermore, they are readily available, do not require additional software and interface development, and frequently provide comparable results to specialized optimization algorithms [5]. For example, the scheduling algorithm of SAP APO computes the order finish date simply by adding the production time to the start time, where the production time is a sum of the setup time, of the processing time multiplied by the quantity and of the interoperation time [9]. This approach disregards the capacity and the load of the resources, as well as the possibilities of unexpected disturbances.

The goal of our current research is to develop a testbed for studying production networks in a simulated volatile environment. The desired characteristics of the simulation framework are to be general, modular and flexible. It should allow modeling dynamic production networks in uncertain environments, with a wide range of products, both mass produced and customized. The decision problems considered are focused on the strategic and tactical levels. Each node can apply different planning algorithms that are available in ERP systems. The performance of the network and the nodes should be evaluated according to multiple criteria, thus we are going to model various network footprints and strategies (see [6]). The first application of the developed framework is to study the fields of *resilience*, *pricing* and *trust* in production networks.

Resilience corresponds to balancing *robustness* and *agility* in supply chains [1]. Agility is the capability to react to changes, while robustness is resulted by a proactive strategy enabling to cope with turbulences without taking further actions. Monostori [7] introduced measures of structural and operational robustness of supply chains, and described a framework for evaluating robustness, complexity and efficiency. A supply chain simulation for evaluating robustness and coordination is presented in [2].

Two types of uncertainty are especially relevant in supply chains: *stochastic events* and *low probability high impact disruptions* [10]. The former ones can be forecasted based on historic data and/or expert knowledge. These include factors such as demand fluctuation, production and transportation times, as well as raw material and transportation prices. The disruptions, however, are rare, thus traditional forecast-

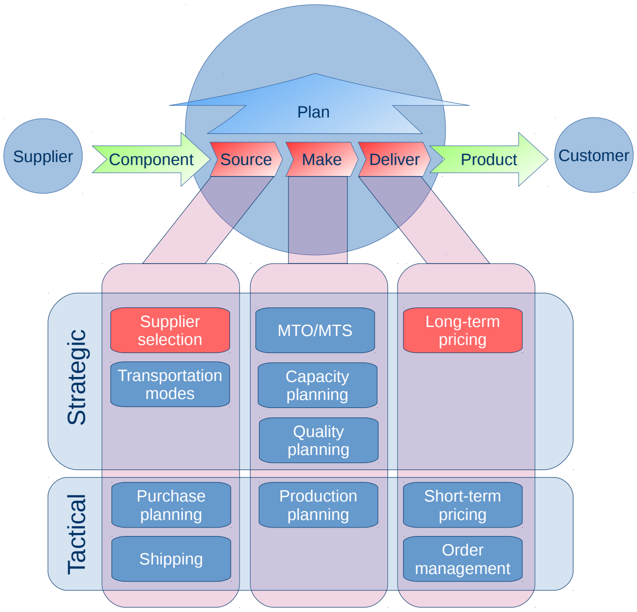

Figure 1: Decision problems at each node of the network.

ing techniques are inappropriate to handle them. These include events such as sudden disturbances at supply chain members, unexpected damages, and natural disasters.

Pricing is also important in influencing the market demand, and eventually, the profitability of the companies [11].

There are several approaches for collaboration in production networks decreasing the undesirable effects such as double marginalization or the bullwhip effect, see e.g., [12]. However, identifying the benefits of collaboration is still a challenge in supply chain management, and particularly in supply chain simulation [8]. Trust is a precondition of successful collaboration, but it is rarely considered formally in decision models, because it consists of a complex belief of dependability, competence and integrity. One of the few exceptions can be found in [4], where trust in a supplier is measured as its average order fill rate, i.e., the number of supplied goods divided by the number of ordered goods. The authors have observed that using trust based supplier selection, the robustness of the supply chain network increases.

2. THE SIMULATION FRAMEWORK

The simulation model is intended to be as general as possible. We consider a network consisting of nodes that are similar in the sense that each of them creates products, consumes components and has the same decision problems illustrated in Fig. 1. However, the specific products, components and applied decision algorithms can be different. This characterization of the nodes is based on the high level model of the Supply Chain Operations Reference (SCOR) and the supply chain planning matrix, see [3]. The dynamic nature of the network is also taken into consideration, i.e., nodes can enter and exit, choose different sources of materials, therefore changing the network structure.

As Fig. 1 shows, our model considers the higher strategic and tactical planning levels and does not include operational problems such as shop floor control. These long- or medium-term plans are more exposed to the uncertainties that are in the focus of our study. The strategic problems usually consider a one period planning horizon, oftentimes a year. This is then divided into shorter periods for the tactical decisions, where the horizon usually consists of multiple shorter periods, e.g., weeks. The main decisions considered in our model include capacity investment, supplier selection (including single and dual sourcing), transportation modes (e.g., air, water, land), Make-to-Stock (MTS) or Make-to-Order (MTO) production, pricing, quality control, order management, inventory control and procurement decisions. It is assumed that these decisions are made sequentially and not simultaneously, which is often the case in the practice. This is also true along the supply chains, where it is common to assume Stackelberg-games, i.e., when the leader decides first, then the follower reacts. The two strategic tasks indicated in the figure with red color are the ones we have started to implement and study first.

Most decision problems have the minimal cost or the maximal profit as their objective. But besides cost, there are usually multiple important criteria that are considered in practice, such as resource utilization. We consider three types of Key Performance Indicators (KPIs) that cover the most important aspects of the performance. The first type includes *financial* indicators, such as profit and total cost, which describe the economic sustainability. The second type is related to the *manufacturing efficiency*, e.g., the Overall Equipment Effectiveness (OEE). The last type measures *supply chain related* indicators, including service level, item fill rate, inventory turnover and lead time between order placement and delivery.

The description of the network is based on data generally available in Enterprise Information Systems (EIS). The first type of the data consists of information about the resources, i.e., the network nodes. These include for example the location of the nodes, their capabilities, costs and available transportation modes. The second type is related to the materials, including bills-of-materials (BOMs), demand forecasts, inventories and prices. The third type describes the process, such as the production times and costs. Finally, the fourth type is related to the operations, e.g., the realized demand or the purchase orders.

The simulation includes uncertainties in form of stochastic variables such as demand, component quality, production and transportation times, material and transportation prices. Besides, it also allows to generate sudden disturbances like perished shipments, resource outage and other unexpected events.

Fig. 2 shows an overview of the system architecture. The network model is given in an SQLite database which represents the different information systems containing the available data. The simulation model is automatically built, which then provides the run-time behavior of the network, including disturbances. The decision making functions are implemented separately, in a modular way. This enables the customization of the simulated system and also facilitates

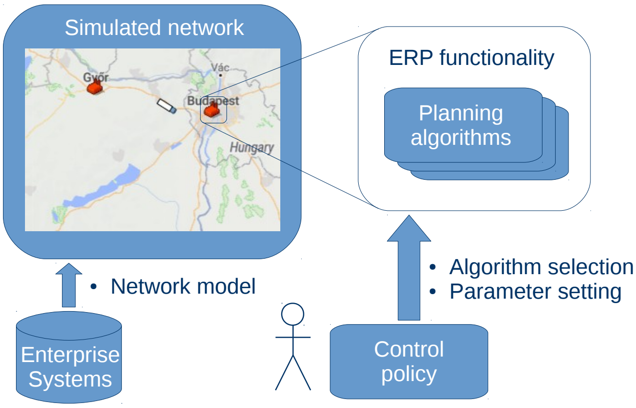

Figure 2: Overview of the architecture.

changing, analyzing and comparing different planning and optimization rules. This way it can be used to find trade-offs between different KPIs, such as cost and service level.

The simulations help to visualize and evaluate the consequences of the decisions in the network, and to analyze typical scenarios, such as a new product introduction. The simulation system is being developed with the AnyLogic tool [13], which provides the possibility of applying any optimization algorithms implemented in the Java language.

3. SUPPLIER SELECTION AND PRICING PROBLEMS

In the following the notations for the formal decision problems are introduced. The models are assumed to be deterministic, but in the simulation most of the parameters can be randomized in order to investigate the impact of the different kinds of uncertainties. Furthermore, since this study focuses on two strategic level decision problems, we omit the parts of the model that are not required for these tasks, such as the time-dependent prices and the transportation modes. We also simplify our trust model for this study.

Let N_i $(i = 1..n)$ denote the nodes in the network and ρ_{ij} is the distance between N_i and N_j. The transportation cost between N_i and N_j is $\rho_{ij} C^{(t)}$. The transportation mode and quality level (Q_i) are considered to be already given, since these optimization problems are ignored here.

The materials are denoted by M_k $(k = 1..m)$. The production portfolio is described by Y_{ik}, which equals 1 if N_i produces M_k, otherwise 0. The relationship between the materials is described by the BOMs: B_{kl} is the number of M_l directly required for producing one unit of M_k. The same material can be viewed as a product and as a component by different nodes of the supply network (see Fig. 1). Unit price of M_k at N_i (as the supplier) is P_{ik}. The $C^{(p)}_{ik}$ is the unit production cost of M_k at N_i. In this study we assume MTO production throughout the network, therefore we omit the input (components) and output (products) inventories from this description. The time required for the production of one unit of M_k is $T^{(p)}_k$.

For each required component one or more supplier(s) should be selected. Let Z_{ijk} denote the ratio of the component demand for M_k that N_j orders from N_i. The total demand for a component should be divided among its selected suppliers, i.e., $\forall j, k : \sum_{i=1}^{n} Z_{ijk} = 1$. This way a node can decide that a component should be supplied by only one supplier (single sourcing), two suppliers with 50%-50% share, or any other possibility. The set of the selected suppliers is called the *supplier basis* of the node. For each supplier in the basis a $C^{(b)}$ one time cost occurs that can represent the cost for building the connection between the nodes, e.g., sharing product designs or connecting data interfaces.

The demand of M_k at N_i at time t is modeled with the isoelastic function $D_{ikt} = D_k P_{ik}^{-r_k}$, where $r_k > 1$ is the price elasticity and D_k is the maximum demand of M_k.

The supplier selection is based on the cost of the purchase and the trust towards the suppliers. The cost consists of the distance-based transportation cost and the price paid for the components[1]. This latter assumes already known unit prices of the components, i.e., the suppliers should decide about the prices first. However, the demand for the components can only be estimated without the knowledge of any downstream pricing or supplier selection decisions. The trust is considered in a simplified way for this study: if the node does not trust in the suppliers, it chooses the dual sourcing strategy instead of the single one.

The pricing decision depends on whether the product has a market demand or used as a component for another product. In case of a market product, the profit—disregarding the constant transportation costs—is $D_{ikt}(P_{ik} - C^{(p)}_{ik} - C^{(a)})$, where $C^{(a)}$ denotes the total value of the consumed components determined by the previous supplier selection. Using the isoelastic demand function, the optimal price can be derived and is given by $P^*_{ik} = r_k(C^{(p)}_{ik} + C^{(a)})/(r_k - 1)$. In case of pricing a component, the demand should be estimated in the same way as for the supplier selection problem. Then the price is determined that provides a desired percent of profit rate considering the estimated demand, the production price, the total value of the components and the total transportation cost.

4. PRELIMINARY EXPERIMENTS

In the preliminary experimental study a simple network has been analyzed in order to evaluate the simulation framework. Only the supplier selection and the pricing decisions are included in the study, thus the other decisions are not implemented or only simple rules are applied, such as the lot-for-lot ordering policy. Five nodes are considered: one end product manufacturer and four component suppliers—two suppliers for both of the two components required for the product. Each material is produced only to orders, i.e., no inventories are included. The quality of the production in a node is considered to influence the production time: with probability Q_i the produced goods have acceptable quality, otherwise additional rework is needed increasing the production time.

[1]Note that in practice sometimes an even simpler rule is applied considering only the component prices.

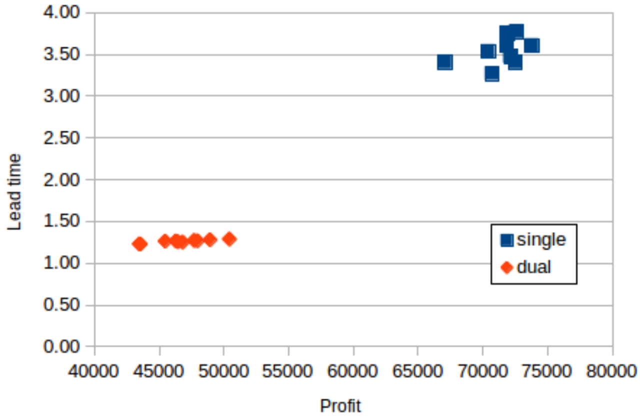

Figure 3: Performance using different sourcing strategies.

The trust is included in a straightforward way: the end product manufacturer either trusts the suppliers and has a single supplier for each component, or does not trust them and applies dual sourcing. In both cases the decision about the supplier basis depends on the estimated transportation and purchasing costs described in the previous section.

The KPIs considered are the average lead time—i.e., the time between receiving a customer order and satisfying it—and the total profit. Both indicators are computed during simulation runs over a one year horizon.

Fig. 3 illustrates the KPIs of the end product manufacturer during 20 runs, half of them using single, the other half dual sourcing strategies. The analysis shows the inversely proportional relationship between the costs and the lead times. Purchasing only from the most inexpensive suppliers results in lower costs, which leads to a lower product price, higher demand and eventually, higher profit. However, dual sourcing performs better regarding to the lead time: the lower component demand is further divided between the suppliers who work in parallel, thus the components are available more quickly reducing the lead time. The simulations support human decision makers to estimate the effects of their decisions on the KPIs, which is even more important when multiple complex decision problems are considered and the performance of the network is hard to be analyzed exactly.

5. CONCLUSION AND FUTURE WORK

The paper reports an ongoing work of developing a simulation framework for analyzing the robustness of production networks. The simulation model considers the common strategic and tactical decision problems at each node. Preliminary experiments are also demonstrated focusing on the supplier selection and the product pricing problems.

The next step of the development is to implement several basic decision making algorithms for each problem. The framework then will be used for evaluating these algorithms in different scenarios, e.g., new product introduction. Furthermore, by implementing simple contract types such as buyback or quantity discount, the effects of supply chain collaboration can be analyzed.

The simulation system will be also deployed at our experimental smart factory. That highly digitized production environment allows us to run simulations based on real data available from the Manufacturing Execution System (MES). The demonstration use case will enable analyzing the resilience and efficiency of the network consisting of the factory and its component suppliers.

6. ACKNOWLEDGMENTS

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Process network solution of an extended multi-mode resource-constrained project scheduling problem with alternatives

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When dealing with project scheduling problems, generally there are four basic parameters considered in connection with the activities, i.e. duration, resource constraints, logical connections to the other activities within the project including presence of precedence, and the mode of execution. As a special subfield, the multimode resource-constrained project scheduling problem (MRCPSP) has emerged and has gained significant attention recently. Here, the term multimode usually refers to the fact that each activity within the project can be executed within multiple duration time considering multiple resource allocations. When considering the resources that activities require, there are renewable resources, for example manpower, and nonrenewable resources, for example an overall budget. Obviously, these resources are always limited to some extent. In principle, when considering this kind of problems, during the project the resource requirements of the activities do not change over the time. Moreover, each activity must be performed in only one of the possible modes, and mode switching is not allowed during execution.
A well known example of the above mentioned problem class is a large scale hydropower construction project, that was published by Xu and Feng (2014). They model the hydropower construction as three parallel subprojects, where uncertainties, fuzzy random environment and hybrid particle swarm optimization algorithms were considered, generating a single fixed real value as the duration of the activities, helping to minimize time and cost for the overall project. In the current paper the MRCPSP is extended, namely MRCPSP problems are considered where each activity may be executed in parallel in two different modes. First it is shown how a directed bipartite process network should be generated that represents the original MRCPSP issue. Second, the corresponding mathematical programming model is formulated. It is explained and illustrated, how multimode activities, called alternatives, may be executed in parallel to each other and yet be considered together. Time optimal and cost optimal mathematical programming models are given. Finally, the aforementioned hydropower construction project is presented as illustration.

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On the Combination of Finite State Transducers and Finite Automata with Translucent Letter

[Extended Abstract]

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ABSTRACT

In this paper, we study Transduced-Input Non-deterministic Finite Automata with Translucent Letters, i.e., T-inputNFAwtl and some closure properties of the class of languages accepted by this model. Finite automata with translucent letters are extensions of the usual finite state automata allowing to proceed the input not strictly left to right manner. T-inputFAwtl is a further extension of finite automata with translucent letters. The input is preprocessed by a finite state transducer and given to finite automata with translucent letters, i.e., FAwtl. However, T-inputFAwtl has more expressive power than FAwtl, because this new model accepts some linguistically important not context-free languages which are not accepted by FAwtl. In this paper, we show that the language class accepted by T-inputNFAwtl is closed under union (if the same transducer is used), and it is closed under intersection with regular languages.

Categories and Subject Descriptors

F.4.3 [**Formal Languages**]

General Terms

Theory, Automata, Languages

Keywords

t-input automata, automata with translucent letters, closure properties, Mealy automata, formal languages, finite state machines

1. INTRODUCTION

One of the main and most powerful branches of theoretical computer science includes automata theory and formal languages. With ongoing development in this field, the main purpose of studying automata theory is to develop such computational models which are simple and have more expressive power than the ones which are already developed. Instead of developing a really new model, we combine two relatively simple finite-state machines, i.e., Mealy machines and finite state automata, to obtain a still finite state model with a relatively large accepting power.

Finite automata are used in text processing, formal linguistics, and hardware design etc. The language class accepted by finite automata is the class of regular languages. Finite automata with translucent letter (FAwtl) is a more powerful model [15]. In each state there are some input letters which are translucent. The automaton reads and erases the first visible input letter on the tape. To understand this in detail, one can read a closely related model: cooperative distributed systems of restarting automata [16, 17]. The accepted language is closed under regular operations: union, concatenation and Kleene star and contains all rational trace languages [14, 16]. Its relation to linguistics is studied in [12, 13]. The language class accepted by FAwtl is a superset of the class of regular languages and includes some non-context-free languages.

Here we study T-inputFAwtl, it is the extension of the finite automata with translucent letters. Mealy machines are finite-state machines transforming the input to an output. In our model, first, the input is transduced and, then, it is given to a deterministic or non-deterministic FAwtl for deciding the acceptance. We have proved in [11] that the important mildly context-sensitive, not context-free languages, the multiple agreement $\{a^nb^nc^n\}$, the cross dependencies $\{a^nb^mc^nd^m\}$ and the marked copy $\{wcw|w \in \{a,b\}^*\}$ are accepted by T-inputDFAwtl. These three languages are belonging to the linguistically important mildly context-sensitive language classes [4, 10]. There are many other models, which have generating/accepting power including these languages [1, 5, 18], but our model is finite state, and therefore, with a moderate complexity.

In this paper, we are concentrating on some closure properties. In the next section we present some formal definitions and an example. In Section 3 the main results are presented, while Section 4 concludes the paper.

2. NOTATIONS AND DEFINITIONS

In this section we will recall the definitions and fix our notations. We assume that the reader already knows the basic concepts of finite automata and formal languages. For any further details, one can read standard textbooks, e.g., [2, 3, 8, 19].

A non-deterministic finite automaton (or finite state machine), an NFA, is a 5-tuple $A = (Q, \Sigma, I, F, \delta)$, where Q is the finite set of internal states, Σ is the finite alphabet of input letters, $I \subseteq Q$ is the set of initial states, $F \subseteq Q$ is the set of final (or accepting) states and δ is the transition relation of the form $Q \times \Sigma \to 2^Q$. If $|I| = 1$ and $|\delta(q, a)| \leq 1$ holds for all $q \in Q$, $a \in \Sigma$, then A is a deterministic finite automaton, a DFA. The transition relation can be extended to words $w \in \Sigma^*$, as usual. A word w is accepted by A if $q_f \in \delta(q_0, w)$, where $q_f \in F, q_0 \in I$, i.e., $\delta(q_0, w)$ includes an accepting state. The set of all accepted words form the language $L(A)$ accepted by A. Finite automata are usually represented by their graphs [2, 3, 8, 19].

A deterministic *finite state transducer* (FST), a Mealy automaton [9], is deterministic finite automaton which is transforming the input to output (and does not accept a language). Formally, it is a system $T = (Q, \Sigma, \Delta, q_0, \gamma)$, where Q and Σ are the same as at DFA, $q_0 \in Q$ is the initial state. Δ is the finite set of output symbols and γ is the transition function of the form $Q \times \Sigma$ to $Q \times \Delta$. Originally T is in its initial state, the input tape contains an input word $w \in \Sigma^*$ and the output tape is empty. When T reads a letter from the input tape, it writes an output letter to the output tape (concatenating it to the previously written letters if any) and changes its state accordingly. By $T(w) \in \Delta^*$ we denote the output produced by T on input w. FSTs can also be represented by their graphs.

Now we recall the concept of non-deterministic finite automaton with translucent letters (NFAwtl) from [12, 13, 14, 15, 16, 17]. Formally, it is a septuple $A = (Q, \Sigma, \$, \tau, I, F, \delta)$, where Q, Σ, I and F are the same as at NFA, $\$ \notin \Sigma$ is a special symbol that is used as an end marker of the input, τ is the translucency mapping of the form $Q \to 2^\Sigma$ and $\delta : Q \times \Sigma \to 2^Q$ is the transition relation that satisfies the following condition: $\forall q \in Q, \forall a \in \tau(q) : \delta(q, a) = \emptyset$. For each state $q \in Q$, the letters from the set $\tau(q)$ are translucent for q. A is called DFAwtl (deterministic FAwtl), if $|I| = 1$ and $|\delta(q, a)| \leq 1$ holds for all $q \in Q$, $a \in \Sigma$. The automaton A starts the process from an initial state and the whole input w with end marker, i.e., $w\$$ is on the input tape. If A is in a state q and its tape content is of the form $uav\$$ such that $u \in (\tau(q))^*$, $a \notin \tau(q)$, $v \in \Sigma^*$, A erases the first occurrence of the non-translucent letter a, obtaining the tape content $uv\$$ and changing the state to a state in $\delta(q, a)$. Whenever, there is no transition is defined on letter a, A could not continue the computation and rejects. Otherwise, if the tape content is $u\$$ such that $u \in (\tau(q))^*$ in a state q, the input w is accepted if $q \in F$ and rejected if $q \notin F$. The set of accepted words w is the accepted language $L(A)$. An NFAwtl may not process the input strictly from left to right and may accept a word without reading/erasing all of its letters due to the translucency mapping. Deterministic and non-deterministic FAwtl can also be given by their graphs [12, 13, 15].

Further, the model FAwtl is extended in such a way that the input is preprocessed by an FST. This new model is introduced recently in [11] and it is motivated by [6, 7] where various types of pushdown automata had such a preprocessed input. The formal definition of our new cascade/combo automata is as follows.

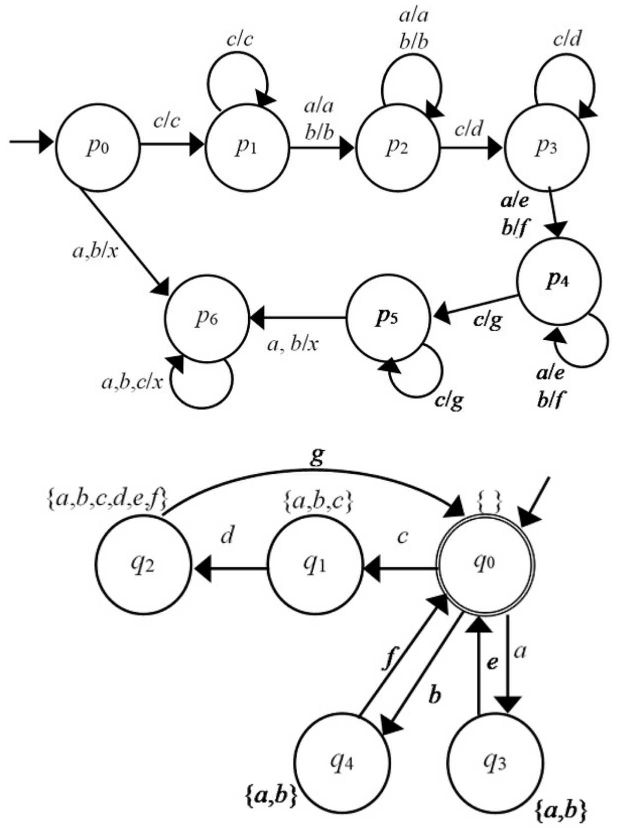

Figure 1: The T-inputDFAwtl that accepts the language L_c.

Definition 1. *Let A be an NFAwtl and $T = (Q, \Sigma, \Delta, q_0, \gamma)$ be a Mealy machine such that the output alphabet Δ of T is the same as the input alphabet of A. Then, the pair (T, A) is called a transduced-input non-deterministic finite automaton with translucent letters, i.e. T-inputNFAwtl shorty. The language accepted by the combined automata (T, A) is defined as*

$$L(T, A) = \{w \in \Sigma^* | T(w) \in L(A)\}.$$

It is shown in [11] that this type of combo machines accept three important non-context-free languages where both the Mealy machine T and the FAwtl A are deterministic. Now we give another example for a T-inputNFAwtl.

Example 1. The language $L_c = \{c^n w c^n w c^n | w \in \{a, b\}^+$ and $n > 0\}$ is accepted by the T-inputNFAwtl presented graphically in Figure 1. The figure shows the graphical representation of the transducer T (up) and the NFAwtl A (bottom). The Mealy automaton T has the following roles:

- It checks if the input is of the form $c^+(a + b)^+c^+(a +$

$b)^+c^+$; particularly if there are three factors of letter c in the input word, moreover, they are separated by non-empty words over $\{a, b\}$. Whenever the form of the input does not match, T puts at least one x to the output tape noticing this fact.

- T rewrites the second and third blocks of c's to d's and g's, respectively.
- It also rewrites the second block over $\{a, b\}$ by the alphabetic morphism $h(a) = e$, $h(b) = f$, in this way the original letters a and b are mapped to e and f, respectively, on the output tape of T in this block.

At the NFAwtl A, the set of translucent letters is shown at each state. Observe that in fact, A is also deterministic, it is a DFAwtl. It works as follows. In its initial state, which is also the only final state, there is no translucent letter, thus it must read the first letter of the word T passes to it. By the transitions of its first three states, it erases a letter c, a letter d and a letter g, thus in this cycle it checks if the number of c's and d's and g's are the same. If in the original input the format was appropriate, and the number of the c's in each of the three blocks were the same, then and only then, all c's, d's and g's are erased by A. Otherwise, either it gets stuck (if there were more c's in the first block than in any of the other blocks) or some d's and/or g's are left (if the first block of c's was shorter than the other blocks). In the second phase of the computation states q_0, q_3 and q_4 are used (in an accepting run). A erases the first letter of the remaining input, and depending on if it is an a or a b, q_3 or q_4 is reached. From this state the original letters a and b are both translucent, and the first letter of the other block, an e or an f is read such that it must fits to the previously read original letter. Observe that A cannot read any letter x. Therefore, it follows that (T, A) accepts the language L_c.

For instance, the input word *cabcabc* is in the language L_c. T preprocesses it as follows. The preprocessing starts at state p_0. The first c is kept in the transduced input as c, and state p_1 is reached. Then the first a is kept in the transduced input as a, then b has also been kept, and state p_2 is reached. After that c is rewritten to d, and state p_3 is reached. Here, the next letter, a, is rewritten to e, similarly b is transformed to f, and state p_4 is reached. Then c is transduced to g, and p_5 is reached. Thus, the word $cabdefg$ is obtained and passed to A with the end marker \$. In its initial state q_0 nothing is translucent, therefore first letter c is read and state q_1 is reached with remaining input $abdefg\$$. Here a, b and c are translucent, thus A reads d (which is the image of the second c) by changing its state to q_2 with remaining input $abefg\$$. Here again a, b, c, and also d, e, f are translucent, therefore A reads g (which in fact refers for the third block of c's) by changing its state back to q_0 with remaining input $abef\$$. Here nothing is translucent, and now the first letter is a. A reads it and state q_3 is reached with remaining input $bef\$$. Here a and b are translucent, thus, e is read from the remaining input and A moves into the state q_0 with remaining input $bf\$$. Here, there is no translucent letter, b is read and state q_4 is reached. Here a and b are translucent, the last letter f is read and A moves into its accepting state q_0 with a fully processed input. Thus, the string *cabcabc* is accepted by (T, A).

On the other hand, for example the input word *abcabc* is preprocessed by the Mealy automaton T to *xxxxxx*. It is clearly not accepted by A. The word *abcabc* is not in the language L_c. Observe that A cannot read any letter x because no transition is defined with letter x. It is used as a kind of failure symbol.

To present some closure property results in Section 3 we need to recall that all NFAwtl can be converted into normal form. In [16] (Theorem 6.5) it is proven that every NFAwtl A has an equivalent NFAwtl A' accepting the same language with special properties.

DEFINITION 2. *An NFAwtl A is in normal form if the following conditions hold*
– In each state there is exactly 1 letter for which transitions are allowed.
– The last occurrence of each letter $a \in \Sigma$ of the input word is erased in a transition (from a state) such that the translucency mapping is empty.
– Every input letter is processed in an accepting computation.
– The automaton has exactly 1 accepting state.

A kind of extension of the normal form is helpful to prove some of the closure properties shown in the next section.

3. RESULTS

In this section we present two of the closure properties of the language class accepted by T-inputNFAwtl. First, the regular operation union is studied, we show that the language class accepted by NFAwtl is closed under union if the same transducer is used.

THEOREM 1. *Let (T, A_1) and (T, A_2) be T-inputNFAwtl. The union of the languages accepted by (T, A_1) and (T, A_2) is also accepted by a transduced-input non-deterministic finite automaton with translucent letters with transducer T.*

PROOF. Given the T-inputNFAwtl (T, A_1) and (T, A_2), where $T = (Q, \Sigma, \Delta, q_0, \gamma)$ is a Mealy machine and $A_1 = (Q_1, \Delta, \$, \tau_1, I_1, F_1, \delta_1)$, $A_2 = (Q_2, \Delta, \$, \tau_2, I_2, F_2, \delta_2)$ are two NFAwtl, we will construct the combined automaton (T, B), where B is an NFAwtl such that $L(T, A_1) \cup L(T, A_2) = L(T, B)$.

Without loss of generality, we may assume that $Q_1 \cap Q_2 = \emptyset$.

Then, let $B = (Q_1 \cup Q_2, \Delta, \$, \tau, I_1 \cup I_2, F_1 \cup F_2, \delta)$, where $\delta(q) = \begin{cases} \delta_1(q) & \text{if } q \in Q_1 \\ \delta_2(q) & \text{if } q \in Q_2 \end{cases}$ and $\tau(q) = \begin{cases} \tau_1(q) & \text{if } q \in Q_1 \\ \tau_2(q) & \text{if } q \in Q_2. \end{cases}$

Since there is no interference between the computations done by A_1 and A_2 encoded in B, each of the accepting (and non-accepting) computations of A_1 and A_2 has a one-to-one correspondence with an accepting (non-accepting) computation of B, respectively. Thus, $L(B) = L(A_1) \cup L(A_2)$, and therefore, $L(T, A_1) \cup L(T, A_2) = L(T, B)$. $\square$

Now we turn to another interesting closure property, namely we study intersection by regular languages.

THEOREM 2. *The language class accepted by T-input NFAwtl is closed under intersection with regular languages.*

PROOF. We present the idea of the proof. Let T be a deterministic transducer, A is an NFAwtl, and B is a DFA. We want the intersection of the language accepted by the T-inputNFAwtl (T, A) and by B. To do this, the "intersection" of T and B is constructed, i.e., the transducer T' and then, its output is forwarded to A' (which is based on the normal form of the NFAwtl A).

The intersection of the two finite state machines T and B is done by the usual cross-product method, however, here one of the automata is an accepting machine while the other, and as well as the resulted automata, are transducers. In what follows, the accepting states of B must be encoded in the output allowing the NFAwtl A' to check also this condition. Thus, the output alphabet of T is doubled, and whenever, B is in accepting state (which is clearly identified since B is a DFA) in its process, a marked output letter (such as $\overline{a}$) is written in the output tape (instead the original output letter a) allowing to distinguish the positions where the prefix of the input is also in the regular language defined by B or not.

However, since NFAwtl may proceed the input in a not usual left-to-right way, we need to be careful how to know that the input is in both of the languages of (T, A) and B. To do this, we can built A' to fulfill some additional properties.

Without loss of generality, we assume that A is given in normal form as we have recalled in the end of Section 2. The NFAwtl A' should also be in normal form, moreover, it is modified in such a way that it also fulfils the following properties:
– the states of A are doubled, there is a state for transitions for an original input letter and there is also a copy with transitions of its marked version.
– the translucency mapping for each state contains both the original and the marked version of the given letters.
– there is only one accepting state.
– empty translucency mapping when reading the last letter.
– the last input letter must be a marked one.

That is, in the new normal form, in the NFAwtl, all accepting computations erase the entire input word and one can also be sure when the last letter of the input is processed. In this way the condition to be in the language $L(B)$ can also be checked by A'. In this way, (T', A') is a T-inputNFAwtl and $L(T, A) \cap L(B) = L(T', A')$. $\square$

4. CONCLUSIONS

In this paper some closure properties of a relatively new class of languages are studied. Particularly, we have shown that the language class accepted by T-inputNFAwtl is closed under union with same signatures (where same signature means that the same transducer is used for preprocessing). Also, it was shown that the language class of T-inputNFAwtl is closed under intersection with regular languages. Future work includes the investigation of other closure properties with other cases of deterministic/non-deterministic versions of T-inputFAwtl with and without assuming the same signatures.

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On a possible use of optimality conditions in interval Branch and Bound methods*

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ABSTRACT

Interval Branch and Bound methods (IBB) are used when rigorous solutions are needed for Nonlinear Programming (NLP) problems. Nowadays, various implementations of IBB exist, although many of them do not use the Karush-Kuhn-Tucker (KKT) or Fritz-John (FJ) optimality conditions for eliminating non-optimal boxes. When it is used, it is used only in the general form, where an interval linear system of equations needs to be solved. This is rather time-consuming, and in many cases it has a negative outcome: the tested box cannot be removed because with the overestimation on the inclusion of the gradients one can find that the optimality conditions may fulfill. In order to save unnecessary computations, the common rule is to apply such tests only when the box is "small enough". However, depending on the problem at hand "small enough" might be difficult to predict.

The idea in this research is to investigate the use of the optimality conditions from a geometrical point of view and to minimize the computational effort when the optimality conditions cannot be used to discard the given box. In this way, there is no need to predict when to apply the test on optimality conditions and so it may become more efficient. In this paper, we describe a method that checks if the conic hull of the enclosure of the gradients of the active constraints is not full, so the test can have a positive outcome.

Categories and Subject Descriptors

G.1.6 [**Optimization**]: Constrained optimization, Global optimization; G.4 [**Mathematical Software**]: Algorithm design and analysis; G.1.0 [**Mathematics of Computing**]: Numerical Analysis—*Interval arithmetic*

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General Terms

Theory, algorithm, application

Keywords

Interval Branch and Bound, Nonlinear Programming, Optimality conditions

1. INTRODUCTION

There are many applications in physics, chemistry, and even engineering fields, where a rigorous solution of a mathematical program is sought. A Nonlinear Programming problem with difficult constraints can be solved in reasonable time only for low-dimensional instances. We consider the following problem,

$$\begin{aligned} \min_{x\in[a,b]} \ & f(x) \\ \text{s.t. } & g_i(x) \le 0, \quad i = 1,\ldots,m, \end{aligned} \tag{1}$$

where $[a, b] \subseteq \mathbb{R}^n$ denotes a general bound constraint, f and $g_i, i = 1, \ldots, m$ are continuously differentiable nonlinear functions. In order to find the global optimum, spatial Branch and Bound methods are usually used, where the search space is divided into smaller regions, thus the original problem is replaced with smaller sub-problems. For the sub-problems, lower and upper bounds are computed and their feasibility is checked, so suboptimal or unfeasible regions can be removed from the sub-problems. For rigorous computations of the bounds, interval arithmetics is one of the best choices. It guarantees that rounding errors are taken into account automatically, and even approximated parameters can be included with their validated enclosures such that all errors are included. In the literature, these methods are called Interval Branch and Bound methods (IBB).

2. INTERVAL BRANCH AND BOUND METHOD

First, we briefly summarize the fundamental concepts of interval analysis and introduce the prototype IBB algorithm. For more details, the interested reader is referred to [2, 4].

2.1 Interval Arithmetics

Following the usual notation in literature, real numbers and vectors are denoted by $x, y, \ldots$, intervals and interval vectors are denoted by $\mathbf{x} = [\underline{x}, \overline{x}], \mathbf{y} = [\underline{y}, \overline{y}], \ldots$, where components of vectors are distinguished from the vectors by use of subscripts, i.e. $x = (x_1, \ldots, x_n), \overline{x} = (\overline{x}_1, \ldots, \overline{x}_n)$; while matrices are denoted by $A, B, \ldots$. Brackets "[·]" delimit intervals, while parentheses "(·)" vectors and matrices. Underlines will denote lower bounds of intervals and overlines give upper bounds of intervals. The *midpoint* of an interval $\mathbf{x}$ is denoted by $m(\mathbf{x}) = \frac{\underline{x}+\overline{x}}{2}$, its *width* by $w(\mathbf{x}) = \overline{x} - \underline{x}$. The midpoint of an interval vector $\mathbf{x} = (\mathbf{x}_1, \ldots, \mathbf{x}_n)^T$ is given by $m(\mathbf{x}) = (m(\mathbf{x}_1), \ldots, m(\mathbf{x}_n))^T$, whereas its width is to be understood as $w(\mathbf{x}) = \max\{w(\mathbf{x}_i) : i = 1, \ldots, n\}$. The set of intervals will be denoted by $\mathbb{I}$, and the set of n-dimensional interval vectors, also called *boxes*, by $\mathbb{I}^n$.

The *interval arithmetic operations* are defined by

$$\mathbf{x} * \mathbf{y} = \{x * y : x \in \mathbf{x}, y \in \mathbf{y}\} \text{ for } \mathbf{x}, \mathbf{y} \in \mathbb{I}, \qquad (2)$$

where the symbol $*$ stands for $+, -, \cdot$ and $/$, where $\mathbf{x}/\mathbf{y}$ is only defined if $0 \notin \mathbf{y}$. Definition (2) is equivalent to simple constructive rules (see [2, 4]).

Definition 1. A function $\mathbf{f} : \mathbb{I}^n \to \mathbb{I}$ is called an *inclusion function* of $f : \mathbb{R}^n \to \mathbb{R}$ if it fulfills that

$$\{f(x) : x \in \mathbf{x}\} \subseteq \mathbf{f}(\mathbf{x})$$

for all boxes $\mathbf{x} \subset \mathbb{I}^n$ within the domain of f.

Observe that if $\mathbf{f}$ is an inclusion function for f then we can directly obtain lower bounds and upper bounds of f over any box $\mathbf{x}$ within the domain of f just by taking $\underline{\mathbf{f}}(\mathbf{x})$ and $\overline{\mathbf{f}}(\mathbf{x})$, respectively.

For a function h predeclared in some programming language (like sin, exp, etc.), it is not too difficult to obtain a *predeclared* inclusion function $\mathbf{h}$ since the monotonicity intervals of predeclared functions are well known and then we can take $\mathbf{h}(\mathbf{x}) = \{h(x) : x \in \mathbf{x}\}$ for any $\mathbf{x} \in \mathbb{I}$ in the domain of h. For a general function $f(x)$, $x \in \mathbb{R}^n$, the easiest method to obtain an inclusion function is the *natural interval extension*, which is obtained by replacing each occurrence of the variable x with a box $\mathbf{x}$ including it, each occurrence of a predeclared function h with its corresponding inclusion function $\mathbf{h}$, and the real arithmetic operators with the corresponding interval operators. Other inclusion functions have been proposed in the literature, from those the most widely used is the centered form

$$\mathbf{f}_c(\mathbf{x}) = \mathbf{f}(c) + \nabla\mathbf{f}(\mathbf{x})(\mathbf{x} - c),$$

where $c \in \mathbf{x}$ is usually the midpoint, and $\nabla\mathbf{f}(\mathbf{x})$ is the inclusion of the gradient of f over $\mathbf{x}$. It is generally computed by the use of Automatic Differentiation (AD), see [1]. In short, AD use operator overloading to compute the gradient along with the function evaluation, where also higher-order derivatives can be evaluated.

2.2 The prototype Interval Branch and Bound algorithm

In an IBB algorithm, there are five main steps: selection, bounding, discarding, division, and termination (see Algorithm 1). These steps have to be specified for a given implementation and their choices can have a huge effect on the efficiency of the method. Since we are going to focus only on one discarding test, the remaining steps are done as general.

The usual selection rule consists of choosing a box with the smallest lower bound on the objective function $\underline{\mathbf{f}}(\mathbf{x})$ from the list of generated and non-rejected boxes (working list $\mathcal{L}_W$).

For the bounding rule, we have used both the natural interval extension and the centered form, as these are the most widely used inclusion functions.

The branching rule applied here is bisecting the two widest dimensions of the actual box in one step, generating four boxes at once.

The termination rule is either based on the width of the box, $w(\mathbf{x})$ or on the width of the inclusion of the objective, $w(\mathbf{f}(\mathbf{x}))$ (sometimes both). In this study, $w(\mathbf{x}) < \epsilon$ was used since this is the most general rule for termination.

The general discarding tests are the midpoint and cut-off tests, these are always included in an IBB method. Namely, if the current upper bound of the minimum, $\tilde{f}$ is smaller then the lower bound $\underline{\mathbf{f}}(\mathbf{x})$, the box can be discarded as it cannot contain the global minimum. Monotonicity test, non-convexity test, and the interval Newton method can be used when no constraints are present, in the opposite case feasibility tests and the KKT or FJ optimality conditions can be applied.

The feasibility test works as follows. A box $\mathbf{x}$ is feasible if it satisfies all the constraints, i.e. $\overline{\mathbf{g}}_i(\mathbf{x}) \le 0$, $\forall i = 1, \ldots, m$, infeasible if it does not satisfy at least one of the constraints, $\exists j, \underline{\mathbf{g}}_j(\mathbf{x}) > 0$, and *undetermined* otherwise. The feasibility test discards boxes that are infeasible, and marks those boxes as feasible which satisfy all the constraints. It can also provide information about the active constraints, $A = \{i \mid 0 \in \mathbf{g}_i(\mathbf{x}), i = 1, \ldots, m\}$. Notice that to apply this test we just need an inclusion function $\mathbf{g}_i$ for each constraints.

In the next section, we will discuss in more detail the KKT and FJ optimality conditions, what we will study later on from a geometric perspective.

3. OPTIMALITY CONDITIONS

Necessary optimality conditions can be used to discard regions of the search space which fail to fulfill them. In unconstrained optimization, it is enough to check the monotonicity of the objective function. The box with the objective being monotonous can either be discarded or shrank to the facet with its minimizer that belongs to the boundary of the search space. For the constrained case it becomes much more complicated.

For problem (1) the Fritz-John optimality conditions state that for any local optimizer point x there exist multipliers $\mu_i \ge 0, i = 0, \ldots, m$, such that

$$\mu_0 \nabla f(x) + \sum_{i=1}^{m} \mu_i \nabla g_i(x) = 0 \qquad (3)$$

$$\mu_i g_i(x) = 0 \qquad i = 1, \ldots, m \qquad (4)$$

The case when $\mu_0 > 0$ is equivalent to the Karush-Kuhn-Tucker conditions when constraint qualifications hold, while $\mu_0 = 0$ means that the Mangasarian–Fromovitz constraint qualification (MFCQ) does not hold.

Algorithm 1: Prototype Interval Branch and Bound

$\mathcal{L}_{\mathcal{W}} \leftarrow [a,b]$, $\mathcal{L}_{\mathcal{S}} \leftarrow \emptyset$
while *(* $\mathcal{L}_{\mathcal{W}} \neq \emptyset$ *)* **do**
  Select a box $\mathbf{x}$ from $\mathcal{L}_{\mathcal{W}}$ `// Selection Rule`
  Compute bounds for $\mathbf{f}(\mathbf{x}), \mathbf{g_j}(\mathbf{x}), j = 1, \ldots, m$ `// Bounding Rule`
  if *(*$\mathbf{x}$ *cannot be discarded)* **then** `// Discarding Tests`
    Divide $\mathbf{x}$ into subboxes $\mathbf{x}_1, \ldots, \mathbf{x}_s$ `// Division Rule`
  for $i = 1$ *to* s **do**
    if *(*$\mathbf{x}_i$ *satisfies the termination criterion)* **then** `// Termination Rule`
      Store $\mathbf{x}_i$ in $\mathcal{L}_{\mathcal{S}}$
    else
      Store $\mathbf{x}_i$ in $\mathcal{L}_{\mathcal{W}}$
return $\mathcal{L}_{\mathcal{S}}$

Conditions (4) can be omitted if in (3) only active constraints are considered (constraint g_i is active at x if $g_i(x) = 0$).

The straightforward extension of these optimality conditions is to solve the interval valued system of equations

$$\boldsymbol{\mu}_0 \nabla \mathbf{f}(\mathbf{x}) + \sum_{i=1}^{m} \boldsymbol{\mu}_i \nabla \mathbf{g}_i(\mathbf{x}) = 0 \qquad (5)$$

$$\boldsymbol{\mu}_i \mathbf{g}_i(\mathbf{x}) = 0 \qquad i = 1, \ldots, m \qquad (6)$$

for a given box $\mathbf{x}$ with $\boldsymbol{\mu}_i = [0, M]$ (using a big enough M [2]). By solving such an interval valued system of equations, we either discard the box, if no solution exists, or narrow it to the solution box otherwise. However, if the enclosures of the gradients are too wide we cannot remove any part of the box.

3.1 Geometrical interpretation of the optimality conditions

Many textbooks give a nice figure to show the graphical meaning of the optimality conditions such as Figure 1 taken from [3].

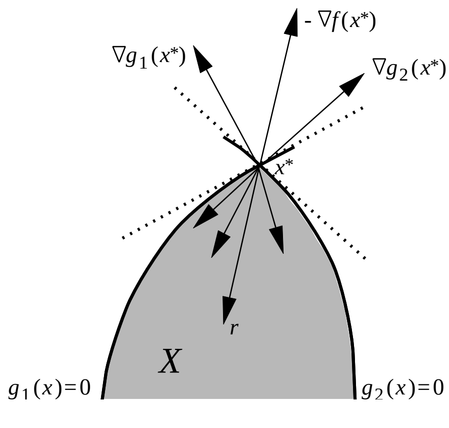

Figure 1: Graphical meaning of the optimality conditions, r is a feasible direction.

We can see the feasible directions, like r, in the gray feasible area, and the gradient vectors at the optimizer point x^*. Graphically, the necessary condition is that $-\nabla f(x)$ has to be in the conic hull of the gradients $\nabla g_i(x)$ of the active constraints.

In the interval world, instead of point x^*, we have a box $\mathbf{x}$, and instead of the gradients, enclosures of the gradients are given. The graphical interpretation can be seen in Figure 2. Let us note that in this case if the enclosure of a gradient contains 0 in its interior, it contains all directions. It follows that even if one constraint i fulfills that $0 \in \mathrm{int}(\nabla \mathbf{g}_i(\mathbf{x}))$ the conic hull is full, so it will contain all directions of $\nabla \mathbf{f}(\mathbf{x})$ (int refers to the interior of a set).

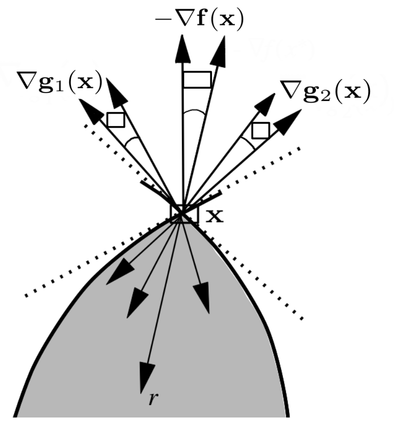

Figure 2: Graphical interpretation of the optimality conditions with enclosures of the gradients.

If $\mathrm{int}(\nabla \mathbf{f}(\mathbf{x}))$ contains 0, so its conic hull is full, there are always directions which are contained in the conic hull C of the active gradients. Thus, the box cannot be removed, although it may be narrowed by propagating the gradients in $\nabla \mathbf{f}(\mathbf{x})$ which are not in C.

4. GEOMETRIC OPTIMALITY TEST

Instead of solving directly the interval-valued linear system (3)-(4), we want to build a method which returns as soon as we know that the test cannot succeed.

The final procedure will build the conic hull of the gradients of the active constraints and will check the intersection of $\nabla \mathbf{f}(\mathbf{x})$ with this conic hull. If the intersection is empty, the box can be deleted as no point exists in it which could fulfill the optimality conditions.

To achieve this, we first seek the normal vector of the hyperplane which separates the gradient boxes of the active constraints from the origin. Taking the conical projection of the boxes on this hyperplane, one can compute the convex hull of the projected boxes to get the conic hull of the original boxes. If no separating hyperplane exists, the test cannot remove any part of the box, so we stop. Otherwise, the normal vector of the hyperplane, v, will be computed. Here, we only discuss this phase, because it already can speed up the IBB algorithm by skipping the calculation of the solution of an interval-valued system of equations.

The separating hyperplane search method is described in Algorithm 2. As a first step in line 3, we check and store the active constraints into the index set A. In fact, we only need to check if the box $\mathbf{x}$ is undetermined for a given constraint. Then, in line 4, if either one of the gradients of the active constraints or the gradient of the objective function contains 0, we stop. We do this, because in the first case no discarding is possible, while in the second case chances to reduce the box are too small. In steps 6-9 we collect for each direction j the monotonous constraints into sets M_j^+ and M_j^- depending on the sign of the gradient in dimension j. In lines 10-12, if for a direction j all active constraints are either monotone increasing or monotone decreasing, then the separating hyperplane exists and v_j is either the minimal lower bound or the maximal upper bound of the gradient's enclosures.

Algorithm 2: Separating hyperplane search $\mathbf{x}$

1 `SeparatingHyperplane(`$\mathbf{x}, \nabla \mathbf{g}_i(\mathbf{x})$`)`
2 $v = 0$
3 $A = \{i = 1, \ldots, m \mid 0 \in \mathbf{g}_i(\mathbf{x})\}$ `// set of active constraints`
4 **if** $\exists i \in A, 0 \in \mathrm{int}(\nabla \mathbf{g}_i(\mathbf{x}))$ **or** $0 \in \mathrm{int}(\nabla \mathbf{f}(\mathbf{x}))$ **then**
5 **return** false
6 **for** $\forall j \in D := \{1, \ldots, n\}$ **do**
7 $M_j^+ = \{i \in A \mid \nabla_j \mathbf{g}_i(\mathbf{x}) > 0\}$
8 $M_j^- = \{i \in A \mid \nabla_j \mathbf{g}_i(\mathbf{x}) < 0\}$
9 $M_j = M_j^+ \cup M_j^-$
10 **if** $\exists j : M_j^+ = A$ (**or** $\exists j : M_j^- = A$) **then**
11 $v_j = \min_{i \in M_j^+} \underline{\nabla_j \mathbf{g}_i}(\mathbf{x})$ (**or** $\max_{i \in M_j^-} \overline{\nabla_j \mathbf{g}_i}(\mathbf{x})$)
12 **return** v
13 $Conf = \{j : |M_j^+| > 0 \text{ and } |M_j^-| > 0\}$
14 **for** $j \in Conf$ **do**
15 **if** $\nexists (l \in D, *, \times \in \{+, -\}) : M_j^* \subseteq M_l^\times$ **then**
16 **return** false `// conic hull is full`
17 **if** $M_j \subseteq M_l^+$ **then**
18 $v_l = \min_{i,k}\{\underline{\nabla_l \mathbf{g}_i}(\mathbf{x}), \underline{\nabla_l \mathbf{g}_k}(\mathbf{x})\}$
19 **if** $M_j \subseteq M_l^-$ **then**
20 $v_l = \max_{i,k}\{\overline{\nabla_l \mathbf{g}_i}(\mathbf{x}), \overline{\nabla_l \mathbf{g}_k}(\mathbf{x})\}$
21 **if** $\exists (l \in D, *, \times \in \{+, -\}) : M_j^* \subseteq M_l^\times$ **then** `// Translate the case to the positive quadrant`
22 $v_j = 1$
23 $\mathbf{G}_{ij} = * \nabla_j \mathbf{g}_i(\mathbf{x}) \ \forall i \in M_j$ `//` $* \in \{+, -\}$
24 $\mathbf{G}_{il} = \times \nabla_l \mathbf{g}_i(\mathbf{x}) \ \forall i \in M_l$ `//` $\times \in \{+, -\}$
25 **if** $v_l = \min_{i \in M_j^*, k \in M_l^\times} \left\{ \frac{\mathbf{G}_{kj}}{\overline{\underline{\mathbf{G}_{kl}}}} - \frac{\mathbf{G}_{ij}}{\overline{\underline{\mathbf{G}_{il}}}} \right\} > 0$ **then** **return** v **else return** false

In line 13 the conflicting directions are collected to $Conf$, that is, a coordinate direction where there are both monotone increasing and monotone decreasing constraints. From line 14 to 25 we try to resolve these conflicting cases if possible and return if not as follows.

First of all, in lines 15-16, a conflicting direction j can only be resolved if a monotonous direction l exists where all M_j^+ or M_j^- constraints are included in M_l^+ or M_l^-. If no such monotonous direction exists, there is no separating hyperplane, thus the conic hull is full and the test cannot delete any part of the box $\mathbf{x}$. On the positive side, if there is a coordinate direction j where all conflicting constraints are all monotone increasing (resp. decreasing), then v_l can be set to be the maximal upper bound (resp. the minimal lower bound) of the involved constraints (see lines 17-20).

In the last part, lines 21-25, we deal with the case where all the monotone increasing (or decreasing) constraints are also monotone increasing (or decreasing) in another direction, that is, $M_j^+ \subseteq M_l^+$, or $M_j^- \subseteq M_l^+$, or $M_j^- \subseteq M_l^+$, or $M_j^- \subseteq M_l^-$. Here it is easier to handle everything in one case, so we translate it to the positive quadrant, and check if $v_l > 0$. If this is the case, the conflict can be solved.

5. SUMMARY

We have built a procedure which tests if the conic hull of the gradients of the active constraints can be generated such that it is not full. If the procedure returns v, we can take further steps trying to discard parts of the examined box, while if the procedure returns false, we already know that the optimality test could not discard any part of the box. We expect that this method can be efficiently used as a filter before any optimality test.

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On the membership problem for some classes of random context grammars

[Extended Abstract]

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ABSTRACT

In this paper we show that the (uniform) membership problem for permitting random context grammars is NP-hard. A similar result is shown for a restricted class of forbidding random context grammars.

Keywords

Random context grammars, membership problem, complexity, NP-hardness

1. INTRODUCTION

Given a class $\mathcal{F}$ of formal language representations, one of the most important questions concerning $\mathcal{F}$ is the complexity of its (uniform) membership problem which sounds as follows. Given a formal language representation $F \in \mathcal{F}$ and a string w, decide if w is in the language represented by F. Clearly, for practical applications a polynomial-time solvable membership problem is desirable.

In this work we investigate the complexity of the membership problem for some classes of *random context grammars* (RCGs, for short) [9]. These grammars are such extensions of context-free grammars, where two sets of nonterminals, a permitting set P and a forbidding one Q, are associated to every context-free rule. Then a rule is applicable if it is applicable in the context-free sense, and nonterminals in Q do not occur while every nonterminal in P does occur in the current sentential form. If in an RCG each rule is associated with an empty forbidding set (resp. permitting set), then the grammar is called a *permitting* (resp. *forbidding*) RCG. These grammars were widely investigated as they are simple yet powerful extensions of context-free grammars (see e.g. [1, 2, 3, 4, 5, 6, 10] and the references therein).

It is known that the membership problem for forbidding RCGs is NP-hard even if the use of erasing rules are not allowed (see e.g. Chapter 3 in [7] and the references therein). On the other hand, to the best of our knowledge, it is not known if there is a polynomial-time algorithm to solve the membership problem for permitting RCGs. In this work we show that there is no such an algorithm unless P = NP. In fact, we are going to show that there is an efficient reduction of the 3-PARTITION problem, a well known NP-complete problem, to the membership problem of permitting RCGs with no erasing rules.

There is a restriction of RCGs where different rules with the same nonterminal on the left-hand side should be associated with the same permitting and forbidding sets. Moreover, one of these sets is always a singleton and the other one is empty [6]. We refer to this variant in this paper as *restricted random context grammars*. It is shown in [1] that for every permitting RCG G an equivalent restricted permitting RCG G' can be efficiently constructed such that G employs erasing rules if and only if G' does. Using this and the NP-hardness of the membership problem for permitting RCGs we can easily conclude that the membership problem for restricted permitting RCGs with no erasing rules is NP-hard, too.

It is known that restricted forbidding RCGs are equivalent to forbidding RCGs if erasing rules are allowed to use [5]. Moreover, the construction presented in [5] is an efficient one. Thus, in this case the NP-hardness of the membership problem for the restricted variant follows from the known NP-hardness of this problem for the unrestricted variant. On the other hand, it is open whether the mentioned equivalence holds also when erasing rules are not allowed to use. Nevertheless, we can show that the membership problem for the restricted variant is NP-hard even in this case. More precisely, we show that the membership problem for restricted fRCGs without erasing rules is NP-hard by giving an efficient reduction of the 3-PARTITION problem to this membership problem.

2. PRELIMINARIES

We assume that the reader is familiar with the basic concepts of the theory of formal languages. For a comprehensive guide we refer to [8].

$\mathbb{N}$ denotes the set of natural numbers and, for a number $i \geq 1$, $[i]$ denotes the set $\{1, 2, \ldots, i\}$. For a word $w \in \Sigma^*$, where Σ is an alphabet, $|w|$ denotes the number of symbols in

w. Let $a \in \Sigma$. Then $|w|_a$ denotes the number of occurrences of a in w.

The 3-PARTITION problem is defined as follows. Given a multiset $H = \{n_1, \ldots, n_{3m}\}$ of positive integers, for some $m \geq 1$. Decide if there is a partition of H into m triplets $H_1, \ldots, H_m$ such that the sum of the numbers in each H_i ($i \in [m]$) is equal.

A *random context grammar* (*RCG* for short) is a 4-tuple $G = (V, \Sigma, R, S)$, where V and Σ are disjoint alphabets of the *nonterminal* and *terminal symbols*, respectively, $S \in V$ is the *start symbol*, and R is a finite set of *production rules*. The rules in R are of the form $(A \to \alpha, P, Q)$, where $A \in V, \alpha \in (V \cup \Sigma^*)$ (that is, $A \to \alpha$ is a usual context-free rule) and $P, Q \subseteq V$. P and Q are called the *permitting* and *forbidding sets* of the corresponding rule, respectively. For a rule $r : (A \to \alpha, P, Q)$, A and α are called the *left-* and *right-hand side* of r, respectively. Moreover, if $\alpha = \varepsilon$, then r is an *erasing rule*. If, for every rule in R, the permitting (resp. forbidding) set is empty, then G is a *forbidding RCG*, or *fRCG* for short (resp. *permitting RCG*, a *pRCG* for short). For the sake of readability, in pRCGs (resp. in fRCGs) we will drop the (empty) forbidding (resp. permitting) sets from the rules.

The *derivation relation* of G is defined as follows. For every word $u_1, u_2, \alpha \in (V \cup \Sigma)^*$ and $A \in V$, $u_1 A u_2 \Rightarrow_G u_1 \alpha u_2$ if and only if there is a rule $(A \to \alpha, P, Q) \in R$ such that

1) for every nonterminal $B \in P$, $|u_1 A u_2|_B \geq 1$, and
2) for every $B \in Q$, $|u_1 A u_2|_B = 0$.

We will drop G from $\Rightarrow_G$ if G is clear from the context. The *reflexive, transitive closure of* $\Rightarrow$ is denoted by $\Rightarrow^*$ and the *language generated by* G is $L(G) := \{u \in \Sigma^* \mid S \Rightarrow^* u\}$. A word $\alpha \in (\Sigma \cup V)^*$ is called a *sentential form* if $S \Rightarrow^* \alpha$. Any derivation of the form $S \Rightarrow^* u$, where $u \in L(G)$ is called a *successful* derivation. G is called ε-free, if the rule set of G contains no erasing rules.

Next we recall a restriction on RCGs introduced in [6]. A random context grammar $G = (V, \Sigma, R, S)$ is called *restricted* (G is an *rRCG* for short) if

1) for every rule $(A \to \alpha, P, Q)$ in R, $|P| + |Q| = 1$ and,
2) for any two rules $r_1 : (A \to \alpha_1, P_1, Q_1)$ and $r_2 : (A \to \alpha_2, P_2, Q_2)$ in R, we have $P_1 = P_2$ and $Q_1 = Q_2$.

Throughout the paper we will often combine the above introduced abbreviations concerning random context grammars. For example, rfRCG abbreviates that "restricted forbidding random context grammar".

3. THE MAIN RESULTS

Here we show that the membership problem for ε-free permitting RCGs as well as for ε-free restricted forbidding RCGs is NP-hard. We do this by giving efficient reductions of the 3-PARTITION problem. This problem is a well known strongly NP-complete problem, which means that it is NP-complete even if the numbers of the input instances are encoded in unary. The usefulness of this is that in this case we can implement the sum of two numbers simply with the concatenation of the words representing these numbers.

THEOREM 1. *The membership problem for ε-free pRCGs is NP-hard.*

PROOF. Consider an instance $\mathcal{I}$ of 3-PARTITION, where $H = \{n_1, \ldots, n_{3m}\}$. We construct a permitting random context grammar $G_{\mathcal{I}}$ as follows. Let $G_{\mathcal{I}} = (V, \Sigma, R, S_0)$, where

- $V = \{A_1, \ldots, A_{3m}, S_0, S_1, \ldots, S_{3m}\}$
- $\Sigma = \{a, \bullet, \lhd\}$
- $R = R_1 \cup R_2 \cup R_3 \cup R_4$, where
  - $R_1 = \{(S_{i-1} \to A_j S_i, \emptyset) \mid i, j \in [3m], i \not\equiv 0 \pmod 3\}$,
  - $R_2 = \{(S_{i-1} \to A_j \bullet S_i, \emptyset) \mid i, j \in [3m], i \equiv 0 \pmod 3\}$,
  - $R_3 = \{(S_{3m} \to \lhd, \{A_1, \ldots, A_{3m}\})\}$, and
  - $R_4 = \{(A_i \to a^{n_i}, \emptyset\}) \mid i \in [3m]\}$.

Consider now a successful derivation $\mathcal{C}$ of $G_{\mathcal{I}}$. We claim that $\mathcal{C}$ can be divided into the following three parts.

- In the first part, $G_{\mathcal{I}}$ applies rules from $R_1 \cup R_2$,
- in the next part the only rule in R_3 is used,
- in the final part rules from R_4 are applied.

Next we prove this claim. Denote r the only rule in R_3. It is clear that $G_{\mathcal{I}}$ applies exactly $3m$ rules from $R_1 \cup R_2$ until S_{3m} appears and no rules from $R_1 \cup R_2$ are applied after that. Thus there are exactly $3m$ nonterminals from $\{A_1, \ldots, A_{3m}\}$ in the sentential form when S_{3m} appears. Moreover, to apply r all the nonterminals in $\{A_1, \ldots, A_{3m}\}$ must be present in the current sentential form. Thus, there is exactly one copy of each nonterminal form $\{A_1, \ldots, A_{3m}\}$ in the sentential form when r is applied. Therefore no rules from R_4 can be applied before the rule r is applied which finishes the proof of the claim.

Consequently, at the end of the first part of $\mathcal{C}$ the sentential form has the form

$$A_{i_1} A_{i_2} A_{i_3} \bullet A_{i_4} A_{i_5} A_{i_6} \bullet \ldots \bullet A_{i_{3m-2}} A_{i_{3m-1}} A_{i_{3m}} \bullet S_{3m},$$

where $i_1, \ldots, i_{3m}$ is a permutation of $[3m]$. Then $G_{\mathcal{I}}$ replaces S_{3m} by $\lhd$ during the second part of $\mathcal{C}$ and then replaces the nonterminals A_i ($i \in [3m]$) with a^{n_i} during the last part. It follows that $G_{\mathcal{I}}$ generates the following language:

$$L(G_{\mathcal{I}}) = \{a^{n_{i_1} + n_{i_2} + n_{i_3}} \bullet a^{n_{i_4} + n_{i_5} + n_{i_6}} \bullet \ldots$$
$$\ldots \bullet a^{n_{i_{3m-2}} + n_{i_{3m-1}} + n_{i_{3m}}} \bullet \lhd$$
$$\mid i_1, \ldots, i_{3m} \text{ is a permutation of } [3m]\}.$$

In this way the words in $L(G_\mathcal{I})$ encode exactly those sequences of numbers which correspond to the sums of the numbers occurring in the triplets in the possible partitions of H. Therefore, $\mathcal{I}$ is a positive instance of 3-PARTITION if and only if $L(G_\mathcal{I})$ contains the word

$$w = a^k \bullet a^k \bullet \ldots \bullet a^k \bullet \lhd,$$

where a^k occurs $3m$ times in w and $k = \frac{\sum_{i=1}^{3m} n_i}{m}$. That is, we reduced the decision of whether $\mathcal{I}$ is a positive instance or not to the decision of whether w belongs to $L(G_\mathcal{I})$ or not. To finish the proof it is enough to note that the construction of $G_\mathcal{I}$ and w can be carried out by a polynomial-time deterministic Turing machine. $\square$

In [1] it was shown that for every ε-free pRCG an equivalent ε-free restricted pRCG can be constructed. Looking at that construction one can see that it is in fact a polynomial-time construction. Using this, Theorem 1, and the fact that polynomial-time reductions are closed under composition, we get that 3-PARTITION can be reduced efficiently to the membership problem for ε-free restricted permitting RCGs. This yields the following result.

COROLLARY 1. *The membership problem for ε-free rpRCGs is NP-hard.*

Next we show a similar result concerning restricted forbidding RCGs.

THEOREM 2. *The membership problem for ε-free rfRCGs is NP-hard.*

PROOF. Consider an instance $\mathcal{I}$ of 3-PARTITION, where $H = \{n_1, \ldots, n_{3m}\}$. We construct an rfRCG $G_\mathcal{I}$ as follows. The basic concept is similar to the one used in the proof of Theorem 1. However, here we can use in the rules only one forbidding nonterminal instead of a set of permitting nonterminals. Therefore we will also use the concept of *complementary pairs of nonterminals* introduced in [5]. Roughly, these are such pairs of nonterminals which cannot occur together in a sentential form since otherwise the derivation cannot be successful. According to this, some rules of $G_\mathcal{I}$ will introduce not only those nonterminals that were already used in the proof of Theorem 1 but also the complementary pairs of certain nonterminals. We will distinguish these complementary pairs from the original nonterminals using the $^-$ sign.

Let $G_\mathcal{I} = (V, \Sigma, R, S_0)$, where

- $V = \{A_1, \ldots, A_{3m}, \bar{A}_1, \ldots, \bar{A}_{3m}, S_0, \ldots, S_{3m}, \bar{S}_0, \ldots, \bar{S}_{3m}\}$
- $\Sigma = \{a, \bullet, \lhd\}$
- $R = R_1 \cup R_2 \cup \ldots \cup R_5$, where
  - $R_1 = \{(S_{i-1} \to A_j S_i, \{\bar{S}_{i-1}\}) \mid i, j \in [3m], i \not\equiv 0 \pmod 3\}$,
  - $R_2 = \{(S_{i-1} \to A_j \bullet S_i, \{\bar{S}_{i-1}\}) \mid i, j \in [3m], i \equiv 0 \pmod 3\}$,
  - $R_3 = \{(S_{3m} \to \lhd, \{\bar{S}_{3m}\})\}$,
  - $R_4 = \{(A_i \to a^{n_i} \bar{A}_i \bar{S}_1 \ldots \bar{S}_{3m}, \{\bar{A}_i\}) \mid i \in [3m]\}$,
  - $R_5 = \{(\bar{S}_i \to a, \{S_i\}) \mid i \in [3m]\} \cup (\bar{A}_i \to a, \{A_i\}) \mid i \in [3m]\}$.

Let us consider a successful derivation $\mathcal{C}$ of $G_\mathcal{I}$. We claim that $\mathcal{C}$ can be divided into the following two parts:

- in the first part, only rules from $R_1 \cup R_2 \cup R_3$ are used, while
- in the second part, only rules from $R_4 \cup R_5$ are used.

We prove this claim as follows. The rules in R_4 cannot be used until an S_j ($j \in [3m]$) is in the sentential form. Indeed, if a rule $(A_i \to a^{n_i} \bar{A}_i \bar{S}_1 \ldots \bar{S}_{3m}, \{\bar{A}_i\})$ was applied while an S_j was in the sentential form, then S_j and $\bar{S}_j$ would occur at the same time and none of them could be removed any more (notice that $\bar{S}_j$ forbids the application of rules with S_j on the left-hand side and vice versa). Furthermore, rules in R_5 cannot be used before the rules in R_4 since only rules in R_4 introduce nonterminals $\bar{A}_i$ or $\bar{S}_i$. Consequently, the rules in $R_4 \cup R_5$ cannot be used before the rules in $R_1 \cup R_2 \cup R_3$ which proves our claim.

One can see that at the end of the first part of $\mathcal{C}$ the sentential form has the form

$$w = A_{i_1} A_{i_2} A_{i_3} \bullet A_{i_4} A_{i_5} A_{i_6} \bullet \ldots \bullet A_{i_{3m-2}} A_{i_{3m-1}} A_{i_{3m}} \bullet \lhd,$$

where $i_1, \ldots, i_{3m} \in [3m]$. Assume now that there is an $i \in [3m]$ such that w contains more than one occurrence of A_i. In this case, when one A_i is rewritten by the corresponding rule in R_4 the sentential form contains both $\bar{A}_i$ and A_i. However then the derivation cannot be successful as neither of these two nonterminals can be rewritten by any rule. Consequently, $i_1, \ldots, i_{3m}$ must be a permutation of $[3m]$.

During the second part of $\mathcal{C}$, $G_\mathcal{I}$ rewrites a nonterminal A_i ($i \in [3m]$) to $a^{n_i} a^{3m+1}$ using rules both from R_4 and R_5. Thus $G_\mathcal{I}$ generates the following language:

$$\begin{aligned} L(G_\mathcal{I}) = \{ & a^{n_{i_1}} a^{3m+1} a^{n_{i_2}} a^{3m+1} a^{n_{i_3}} a^{3m+1} \bullet \ldots \\ & \bullet a^{n_{i_{3m-2}}} a^{3m+1} a^{n_{i_{3m-1}}} a^{3m+1} a^{n_{i_{3m}}} a^{3m+1} \bullet \lhd \mid \\ & i_1, \ldots, i_{3m} \text{ is a permutation of } [3m]\}. \end{aligned}$$

Clearly, $L(G_\mathcal{I})$ can be written in the following form, where we underlined certain parts of the words:

$$\begin{aligned} L(G_\mathcal{I}) = \{ & a^{n_{i_1}+n_{i_2}+n_{i_3}} \underline{a^{3(3m+1)}} \bullet \ldots \\ & \bullet a^{n_{i_{3m-2}}+n_{i_{3m-1}}+n_{i_{3m}}} \underline{a^{3(3m+1)}} \mid \\ & i_1, \ldots, i_{3m} \text{ is a permutation of } [3m]\}. \end{aligned}$$

If we remove the underlined subwords from the words above, then we get the same language that was already considered in the proof of Theorem 1. Thus we can conclude that the words in $L(G_\mathcal{I})$ encode all the possible 3-partitions of H.

Now consider the word

$$w = a^{k+3(3m+1)} \bullet \ldots \bullet a^{k+3(3m+1)} \bullet \lhd$$

containing the sub-word $a^{k+3(3m+1)}\bullet$ $3m$ times, where $k = \frac{\sum_{i=1}^{3m} n_i}{m}$. One can see that $\mathcal{I}$ is a positive instance of 3-PARTITION if and only if $w \in L(G_\mathcal{I})$. Since $G_\mathcal{I}$ and w can be constructed by a polynomial-time Turing machine, we could give an efficient reduction of the 3-PARTITION problem to the membership problem for ε-free rfRCGs. Thus this latter problem is NP-hard which we wanted to prove. □

4. CONCLUSIONS

We have shown that the membership problem for ε-free permitting random context grammars and for ε-free restricted forbidding random context grammars is NP-hard. On the other hand, as far as we know, it remains an open question whether the complexity of this problem for these classes of RCGs is in NP or not.

To give an NP upper bound on the complexity of this problem seems to be not trivial as it is discussed below. Consider an ε-free RCG $G = (V, \Sigma, R, S)$. Since G is ε-free, the lengths of the sentential forms in a derivation of G are monotonically increasing. Consider a derivation *der* of G and those steps in *der*, where the length of the sentential form grows. Let us call these steps *growing steps*. Assume that *der* is a derivation of a word $w \in \Sigma^*$ with length n. Clearly *der* can contain at most n growing steps. Let us call those parts of *der* which are between two consecutive growing steps *nonincreasing parts*. Notice that in a nonincreasing part, G can apply only rules of the form $(A \to u, P, Q)$, where $u \in V \cup \Sigma$.

Assume now that *der* is one of the shortest derivations of w. Clearly, to give a polynomial upper bound on the length of *der* it is enough to give such an upper bound on the lengths of its nonincreasing parts. If G is a context-free grammar (that is, every rule of G has empty permitting and forbidding sets), then giving such an upper bound is not difficult. Indeed, in this case we can rearrange the order of the rules applied in a nonincreasing part of *der* such that those rules which are applied on the same position of the sentential form are applied right after each other. Let us rearrange the rules in this way in all the nonincreasing parts of *der* and denote the yielded derivation by der'. Clearly, der' is a valid derivation of w. Let us consider a nonincreasing part der'' of der' such that all the rules in der'' are applied on the same position of the sentential form. Clearly the length of der'' is upper-bounded by $|V|$ since otherwise there would be two different rewriting steps in der'' where the same nonterminal is rewritten and thus der'' could be shortened contradicting the fact that der' is one of the shortest derivations of w. Using this we can easily conclude that the length of der' is polynomially bounded by $n \cdot |V|$.

However, if G is an RCG, then the order of the rules in *der* cannot be freely rearranged since the application of the rules depends also on context conditions. Therefore it is not clear how can one shorten a nonincreasing part der' of *der* even if der' is longer than $n \cdot |V|$. Thus, giving a polynomial upper bound on the length of the derivations of G is not possible using the method described above even if we consider only pRCGs or rfRCGs. A further investigation of this question is a topic for our future work.

5. ACKNOWLEDGEMENTS

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Portfolio selection based on a configuration model and hierarchical clustering for asset graphs

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ABSTRACT

In this paper we present a null model based clustering method for asset graphs constructed of correlation matrices of financial asset time series. Firstly, we utilize a standard configuration model of the correlation matrix that provides the null model for comparison with the original one. Based on this comparison we define a distance matrix – called asset graph – on which we perform hierarchical clustering procedures. We apply this method to find clusters of similar assets in correlation based graphs obtained form various stock market data sets. We evaluate the performance of the procedure through the Markowitz portfolio selection problem by providing a simple asset allocation strategy based on the obtained cluster structure.

Categories and Subject Descriptors

I.6 [**Simulation and Modeling**]: Applications
; G.1.6 [**Optimization**]: Nonlinear programming

Keywords

Correlation matrix, Complex networks, Clustering, Portfolio selection

1. INTRODUCTION

Correlation matrices are of central importance in financial economics, especially in portfolio theory. Correlations among various assets' returns is used to determine the relative amount of capital should be invested in different assets in order to minimize the investor's risk [4]. Graphs can be easily constructed from correlation matrices in different ways. In asset graphs a node represents a company and a weighted edge between two nodes indicates, for instance, the equal-time Pearson correlation coefficient between their corresponding stock prices [3, 9, 11]. Considering correlation matrices as graphs, a wide range of tools in network analysis, like centrality measures, frequent sub-graph search or community detection, becomes available [1]. Nevertheless, the direct conversion to graphs is not evident, since the problem of information content of correlation matrices plays a key role in applications, especially in risk management. The estimation of the correlation matrix is associated with a significant level of a statistical uncertainty (sometimes called noise) due to the finite length of the asset return time series [15]. Recently, several approaches, that appeared especially in the 'Econophysics' and 'Complex Networks Analysis' literature, have been developed to handle this issue, e.g. [2, 6, 13, 14]. The idea is to filter the 'information core' of the correlation matrix that is robust against statistical uncertainty. One approach is based on random matrix theory and the idea is to compare the empirical correlation matrix with a null model matrix. The null model matrix is defined as the correlation matrix of the same number of random time series of the same length as the empirical one. A barely different approach, preferably used in the finance literature, is the principal component analysis [5]. Other filtering methods perform hierarchical clustering procedures such as single-linkage clustering [9] or average-linage clustering [13].

In this work we follow a standard null model approach for correlation matrices, but consider the information filtering problem as a graph based data mining task. We should emphasize, that in [8] the authors showed that treating the original correlation matrix as a weighted graph directly and apply modularity maximization for clustering using a standard null model approach may lead to biased results. This is due to the fact that the configuration null model doesn't necessarily give enough importance to node pairs with stronger correlations, however this is often desired in clustering algorithms. They also provided several versions of the modularity function for correlation matrices. We choose a much simpler way: we filter the original correlation matrix using a null model matrix and transform the filtered matrix to a distance matrix in a proper way. Then a hierarchical clustering procedure on the distance matrix is performed, regarded as a heuristic to maximize a modularity-like function.

The paper is organized as follows. In Section 2 we briefly describe some ways to construct asset graphs from correlation matrices, and present a heuristic for community detection (i.e. clustering) for these graphs. In Section 3 we present our experiments in various stock market data sets through the Markowitz portfolio selection problem by providing an asset allocation strategy based on the obtained cluster structure. Finally, we summarize in Section 4.

2. METHODS

Let $X_i \equiv \{x_i(t) : t = 0, 1, \ldots, T\}$ be a time series represents the value of some unit i ($i = 1, 2, \ldots n$) at time t. Particularly, in financial markets i is an asset and $x_i(t)$ is the logarithmic return of it, i.e. $x_i(t) = \log P_i(t)/P_i(t-1)$, where $P_i(t)$ is the price of asset i at time t. The system of n assets is often investigated via the correlation matrix $\mathbf{C}$ that statistically measures the pairwise dependencies, where C_{ij} is the Pearson correlation coefficient of assets i and j. It is calculated as

$$C_{ij} = \frac{\mathrm{Cov}(X_i, X_j)}{\sqrt{\mathrm{Var}(X_i) \cdot \mathrm{Var}(X_j)}},$$

where

$$\mathrm{Cov}(X_i, X_j) = \overline{X_i \cdot X_j} - \overline{X_i} \cdot \overline{X_j}$$

is the covariance of X_i and X_j, $\mathrm{Var}(X_i) = \mathrm{Cov}(X_i, X_i) = \sigma_i^2$ is the auto-covariance of X_i and $\overline{X_i}$ denotes the temporal average of the observations of X_i, i.e.

$$\overline{X_i} = \frac{1}{T} \sum_{t=0}^{T} x_i(t),$$

$$\overline{X_i X_j} = \frac{1}{T} \sum_{t=0}^{T} x_i(t) x_j(t).$$

We assume that X_i is standardized as $(X_i - \overline{X_i})/\sigma_i$.

2.1 Asset graphs

Since the correlation matrix $\mathbf{C}$ is a symmetric $n \times n$ matrix, it can be viewed as the adjacency matrix of a weighted graph. In this graph, nodes represent the assets and edges represent correlation coefficient of asset pairs. In the literature, $\mathbf{C}$ is often transformed into a distance matrix $\mathbf{D}$ with entries $D_{ij} = \sqrt{2(1 - C_{ij})}$. This is motivated by the hypothesis that ultrametric spaces[1] are meaningful in economic perspective [10].

A simple filtering technique is to threshold the values of $\mathbf{C}$ (or $\mathbf{D}$), leaving only those edges that are greater than an arbitrarily chosen value. Although the method effectively discards the weakest correlations, that are likely to caused by random fluctuations in the time series, using an inappropriate threshold value may hide important structural features of the asset graph.

A different technique, that does not require to choose a global threshold value is the minimal spanning tree approach. It reduces the number of edges of the graph from $n \cdot (n-1)/2$ to $n - 1$. The procedure is closely related to agglomerative hierarchical clustering performed with the single-linkage distance definition [9]. The approach assumes that the original correlations are approximated well by the filtered ones, and similarly to the threshold based filtering it discards all the weaker correlations. To discard less information, one can use the planar maximally filtered graph approach [14]. The method retains both the correlations used to create the minimal spanning tree and additional information as well, provided that the result is a planar graph.

An important technique, based on fundamental results of random matrix theory, decomposes the correlation matrix $\mathbf{C}$ into a 'structured' and a 'random' part [7]. This is done by comparing eigenvalues of the empirical correlation matrix with the correlation matrix of the same number of random time series of the same length. The latter is known to be given by the Marchenko-Pastur distribution [12]. We use a similar technique in this work, but we choose a so-called configuration model to construct the null model matrix that will be compared with the original one.

2.2 Configuration model and community detection in graphs

A null model correlation matrix $\mathbf{C}^0$ is an $n \times n$ matrix, where C^0_{ij} is the mean value of the correlation between assets i and j under some null model benchmark. For example, under the assumption that every asset is uncorrelated then $\mathbf{C}^0$ would be the $n \times n$ identity matrix. Here, we use a configuration model as null model to generate C^0_{ij} by replacing edges (of the correlation graph) independently at random. The assumption is that the generated $\mathbf{C}^0$ correlation matrix preserves the *strength* of each asset i, i.e. $C_i = \sum_j C_{ij}$ is fixed as much as possible, while randomizing the 'correlation structure'.

We consider $\mathbf{C}' = |\mathbf{C} - \mathbf{C}^0|$ as the filtered (i.e. 'cleaned') correlation matrix. Then we define the re-scaled $\mathbf{D}_c = -\mathbf{C}' + |\min \mathbf{C}'| + |\max \mathbf{C}'|$ distance matrix, that may be interpreted as a weighted graph related to the correlation matrix. Here smaller distance between two nodes refers larger correlation between the corresponding assets. We then apply hierarchical clustering to $\mathbf{D}_c$. This method can be regarded as a heuristic to maximize a modularity-type function, used for clustering, given as $\sum_{i,j} [C_{ij} - C^0_{ij}] \delta_{ij}$, where $\delta_{ij} = 1$ if i and j assigned to the same cluster, and $\delta_{ij} = 0$ otherwise. Hierarchical clustering results in a *dendrogram* that can we cut at an arbitrary level h from the root to get h clusters of stocks.

3. EXPERIMENTS

Correlation (covariance) matrices often used in portfolio optimization (a widely-used model will be described). The performance of the different noise filtering procedures is generally measured via various performance metrics of composed portfolios using filtered correlation matrices.

3.1 Data sets

For our experiments we have relied on the daily closure price time series of three different stock data sets available at *Yahoo! Finance*. The selection of the stocks was based on global indices in two cases (FTSE100 and DOW30), and we also chose the 30 stocks that were active for the longest period among the available time series data. For the sake of simplicity, we refer to these data sets as "FTSE" ($n = 32$ stocks, 1183 records from 16-05-2011 to 27-01-2016), "DOW" ($n = 29$ stocks, 2849 records from 19-03-2008 to 12-07-2019) and "Active30" ($n = 30$ stocks, 5398 records from 19-01-1995 to 27-06-2016).

3.2 Markowitz portfolio selection

The Markowitz portfolio selection problem is an optimization problem where the investor would like to create an opti-

[1] Ultrametric spaces are defined by an ultrametric distance that satisfy the axioms (i) $D_{ij} = 0 \Leftrightarrow i = j$, (ii) $D_{ij} = D_{ji}$ and (iii) $D_{ij} \le \max\{D_{ik}, D_{kj}\}, \forall(i, j, k)$.

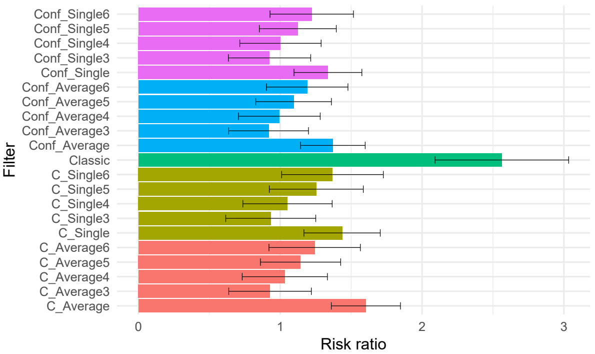

Figure 1: Risk ratios on the 'FTSE' dataset. The lower, the better.

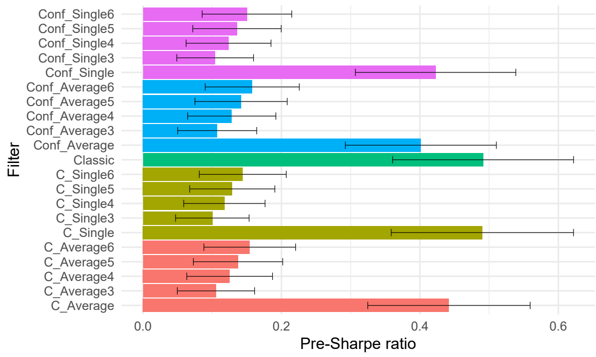

Figure 2: Sharpe ratios on the 'FTSE' dataset. The greater, the better.

mal portfolio of assets with minimum risk, given an expected return in advance. The portfolio is represented as a vector $\mathbf{p}$ that consists of the fraction of wealth to be invested in each asset. We also assume that $\sum_i p_i = 1$, i.e. 100% of wealth is invested. For example $\mathbf{p} = (0.2, 0.8)$ means investing 20% of our wealth in stock #1 and 80% in stock #2. To reach the optimum, the portfolio has to satisfy two conditions. Firstly, it has to achieve an expected return $\overline{r}_p = \sum_i p_i \overline{X}_i$, where $\overline{X}_i$ is the mean log-return of stock i, greater than a specified value R (this is an arbitrary choice). Secondly, it has to provide minimal risk, measured as $\sigma_p^2 = \mathbf{p}\boldsymbol{\Sigma}\mathbf{p}^T$, where $\boldsymbol{\Sigma}$ is the covariance (i.e. not normalized correlation) matrix of the assets considered. Negative p_i weights, also referred to as *short-selling*, are allowed.

3.3 Methodology

We used the following rolling window approach to calculate the correlation (and covariance) matrices from the time series data and perform the optimizations described previously. In each dataset we calculated the correlation matrix on the time range $[t_0, t_0 + \Delta T]$, performed a filtering procedure, in a similar way as in [13], and the optimization which gave us a portfolio $\mathbf{p}$. This meant four main optimizations per each t_0 starting day: optimization without filtering ("Classic"), filtering using hierarchical clustering on (i) asset graph $\mathbf{D}$ ("C_Single", "C_Average") and (ii) on configuration model based asset graph $\mathbf{D}_c$ ("Conf_Single", "Conf_Average"). In case of clustering procedures, our portfolio selection strategy was choosing only one asset from each cluster at random and performed portfolio optimization considering only the pre-selected assets. We then evaluated the performance of the portfolios on the interval $[t_0 + \Delta T, t_0 + 2 \cdot \Delta T]$, where $t_0 \in \{0, 30, 60, \dots\}$ and $\Delta T = 100$.

For each portfolio $\mathbf{p} = (p_1, p_2, \dots)$ we calculated the realized return as

$$\sum_{i=1}^{n} p_i \frac{P_i(t_0 + 2\Delta T) - P_i(t_0 + \Delta T)}{P_i(t_0 + \Delta T)},$$

the Pre-Sharpe ratio $(\overline{r}_p / \hat{\sigma}_p^2)$, and the risk ratio $(\sigma_p^2 / \hat{\sigma}_p^2)$, that is the fraction of the 'realized' and estimated risk. We calculated the mean of each metric but trimmed the data by 20% (10% on the lower and 10% on the upper end) to remove possible outlier values.

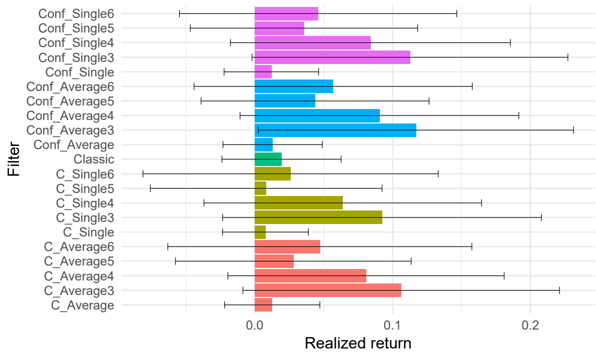

Figure 3: Realized returns on the 'FTSE' dataset. The greater, the better.

3.4 Results

Our experiments show that the resulting portfolios in general had significant improvements in all metrics when filtering methods were applied to the correlation (and hence covariance) matrix. The configuration model based approach provided lower realized risk and lower difference between estimated and realized risks than the other filtering methods (Fig. 1). The risk estimation was even better when we only used one stock per cluster (using 3 or 4 clusters provided the best risk ratios), but the estimated risk increased (the increase of the estimated risk brought it closer to the realized one). In these cases we chose a random element of the cluster, hence it was not guaranteed that we chose the assets with the lowest risk overall. Regarding Sharpe ratios (Fig. 2), it can be noted that the single-linkage clustering was the closest one to the original Markowitz-model, although when using only one stock per cluster, the value significantly decreased (due to the fact that the estimated return did not grow, but the risk increased). The configuration model performed similarly, albeit a bit worse than the other methods.

Regarding realized returns, as Fig. 3 shows, the cluster-based asset selection improved performance. When looking at the results of all the clustering-based approaches, the configuration model provided the highest realized returns with 3 clusters (and thus 3 stocks). The worst performer was the single-linkage clustering. Filtering procedures show a similar shape over time and outperform the classic method

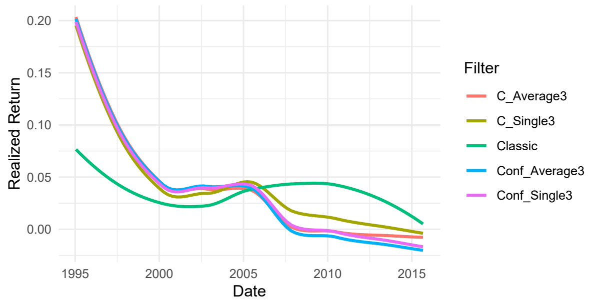

Figure 4: Realized returns of three filters on the 'Active30' dataset from 19-01-1995 to 31-08-2015.

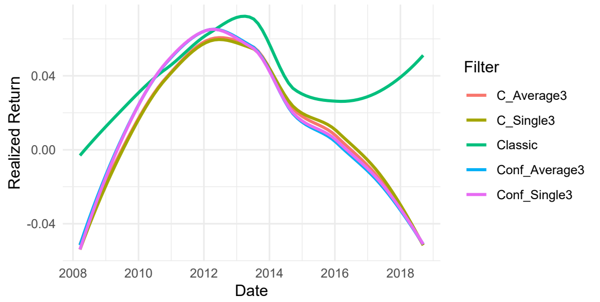

Figure 5: Realized returns of three filters on the 'DOW' dataset from 19-03-2008 to 12-09-2018.

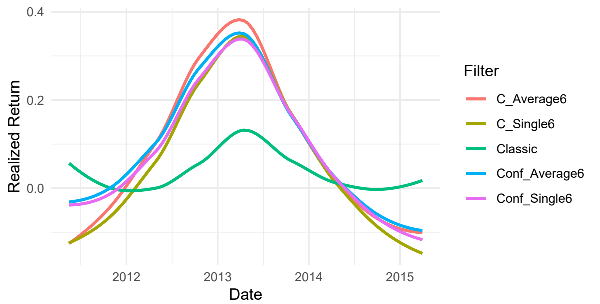

Figure 6: Realized returns of three filters on the 'FTSE' dataset from 16-05-2011 to 01-04-2015.

in certain intervals (Figs. 4-6). However, understanding the shape of the curves and the underlying causes are worth further investigation.

4. SUMMARY

In this work, by combining techniques used to investigate correlation matrices and used in graph based data mining, we performed clustering procedures for asset graphs constructed of filtered correlation matrices of financial asset time series. We provided an asset allocation strategy based on the obtained cluster structure and using Markowitz' portfolio optimization. The above discussion of our findings shows that the utilized methodology is able to provide reliable portfolios in terms of risk estimation and is competitive with classical methods in terms of return realization as well. Defining asset graphs based on different filtering procedures and cluster based asset selection strategies leave open many questions for further investigations.

Acknowledgments

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Empirical Study of S-graph Approaches for Limited-Wait Storage Policy

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ABSTRACT
Storage limitations of intermediate materials add an additional layer of complexity to the scheduling of batch chemical processes. Not only the storage capacities have to be taken into account, the properties of the intermediates in question often pose limitations on the storage time as well. In this paper, different techniques are discussed, which allow proper modeling of such timing limitations within the S-graph framework. The introduced techniques were implemented and tested on literature examples and case studies, to identify the most efficient one.

Keywords
scheduling, limited-wait storage policy, S-graph

1. INTRODUCTION
In case of multi-stage production recipes, storing the intermediates is an inherent burden of batch plants, while it is not an issue for their continuous counterparts. Storage operations cause more complexity during both planning and operation, however, they can have a huge impact on the optimal schedule. The storage policy may vary for different intermediates, and usually it has two dimensions: the facility's capacity for storing the material in question, and the time limitations on the storage operation. This paper focuses on the second issue.

Storage time of an intermediate is sometimes limited by some physical or chemical property, which is important for a subsequent step, but fades over time, e.g., temperature, homogeneity. This is referred to as Limited-Wait (LW) case, and Zero-Wait (ZW) in its extreme, when the intermediate has to be processed immediately. In the case of absence of any such limitations, the intermediate is considered to have Unlimited-Wait (UW) policy.

The way to address LW policy depends on the method used for scheduling. In this paper we focus on the S-graph framework, and compare the various techniques that can tackle these kinds of timing limitations. The S-graph is a directed graph model of the scheduling problem, and the framework applies branch-and-bound algorithms to find the optimal schedule.

The paper is structured as follows: in Section 2, a small motivational example is shown. Section 3 provides the problem definition, and a short overview of related publications. In Section 4, the different approaches of tackling LW policy in the S-graph framework are briefly introduced. Section 5 shows empirical test results of the approaches of Section 4.

2. MOTIVATIONAL EXAMPLE
To illustrate the influence of storage time limitations on the quality of the optimal schedule, a small motivational example is presented. The example entails 3 products, A, B, and C, which are produced via 3 units: $U1$, $U2$, and $U3$. The details of the recipe are shown in Figure 1.

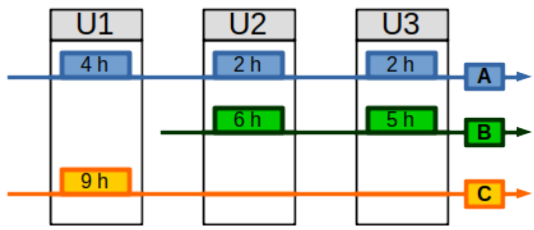

Figure 1: Motivational example

For this example, and for the rest of the paper, the objective function to be considered is the minimization of makespan, and it is also assumed, that the facility has enough storage space for any intermediate. The optimal makespan of the motivational example depends on the time limitations posed on the 3 intermediate materials. For the sake of simplicity, all of the materials are assumed to have the same time limit for this example.

The optimal makespan in the UW case is 13 hours, as shown in Figure 2. This schedule, however, needs to store the intermediates of product A. The first storage operation requires

2 hours, and the second 3 hours. If the limit on storage time is set to 2 hours, the makespan is increased to 14 hours, as shown in the second part of Figure 2.

Naturally, as the limits get lower, the makespan may increase. In the extreme case, i.e., in the case of ZW policy, the makespan is 17 hours, as shown in the third part of Figure 2.

3. PROBLEM DEFINITION AND LITERATURE OVERVIEW

Although the approaches presented in Section 4 may address a wider range of scheduling problems, for the sake of simplicity, the considered problem class has the following features:

- multipurpose recipe, i.e., recipes for products are sequential, but the order of the units are not necessarily the same
- a task may have several suitable non-identical units with different processing times
- the facility is equipped with enough capacity to store all of the intermediates
- cleaning-, transfer-, and changeover times are negligible
- all of the raw materials are available from the start
- preemption is not allowed
- the goal is to minimize the overall production time, i.e., the makespan
- for each intermediate, a non-negative upper time limit is given for its storage time, that may be 0 or infinity

The first papers to investigate zero-wait policies date back to the 70's (see e.g., [4, 16]). Zero-wait constraints are also thoroughly investigated for shop problems with more than 400 papers [1]. Batch process scheduling gained the attention of both engineers and optimization experts in the 90's and numerous methods have been presented since then to solve these industrial scheduling problems [9, 2]. The variety of the proposed approaches stretch from Mixed Integer Linear Programming (MILP) formulations [15] through state space exploration techniques (Timed Automata, Timed Petri Nets) to directed graph based approaches [17, 6].

LW constraints have been addressed in many different ways in the literature. Some MILP models can easily express them via linear constraints [14, 8], other approaches apply heuristics to solve such problem classes [5, 18], or rely on a separate branch-and-bound technique [3].

The S-graph framework was originally introduced to address problems with UW policy [17]. Since then the framework has been extended to tackle many different problem classes, some of which required LW or ZW constraints on intermediates [12]. The goal of this paper is to empirically compare different options, developed previously [10] or new, and find the most efficient one.

4. APPROACHES FOR LW POLICY WITH THE S-GRAPH FRAMEWORK

The S-graph framework uses weighted directed arcs to express timing constraints within the events represented by the vertices, that are either the starting time of tasks or the shipping of products. An arc leading from node n_i to $n_{i'}$ with the weight of $w_{i,i'}$ encodes, that the starting time of task i' must be at least $w_{i,i'}$ later than the starting of task i.

These type of arcs are used to express both the production precedences and the scheduling decisions made by the algorithms. Unlike all of these, limited-wait constraints enforce not a lower but upper bound on the starting of a task, thus, they can not immediately be expressed with the available tools of the framework. The following two subsections briefly introduce two possible extensions.

4.1 Combinatorial approach

The LW constraints enforce an upper bound on the starting time of a subsequent task in the form

$$ST_{i+1} \leq ST_i + pt_i + LW_i$$

where ST_i, ST_{i+1} are the starting times of two subsequent tasks in the production of some products, pt_i is the processing time of task i, and LW_i is the maximal time, the intermediate produced by task i can be stored. This constraint can easily be converted to the form

$$ST_i \geq ST_{i+1} + (-pt_i - LW_i)$$

This way, the constraint can be expressed by a regular S-graph arc leading from n_{i+1} to n_i, which have the negative weight of $-pt_i - LW_i$. The introduction of negative-weighted arcs, however, require slight modifications on the longest path method that is used for providing lower bound on the makespan, and to report infeasible schedules when finding cycles in the graph.

After introducing the negative "backward arcs", cycles now naturally occur in the graph, and only those with positive total weight are the sign of infeasibility. Some of the 0 weighted cycles also represent an infeasible schedule, which phenomenon is called the cross-transfer [11].

The advantage of this approach is to have only a minor overhead compared to the original algorithm. Moreover, the longest paths in the graph can be cached in a difference-bound-matrix[7], which allows quick updates and constant time lookup in the implementation. On the other hand, the bounds can be weak farther from the leafs.

4.2 Bounding LP approach

The S-graph model shows a lot of similarity with the general precedence MILP models found in the literature. Both of these approaches address the scheduling problems as assignment and sequencing decisions, thus there is a one-to-one relation between different components of the two sides. It is not the goal of this paper to detail such precedence based MILP models, however, to ease further explanations, three

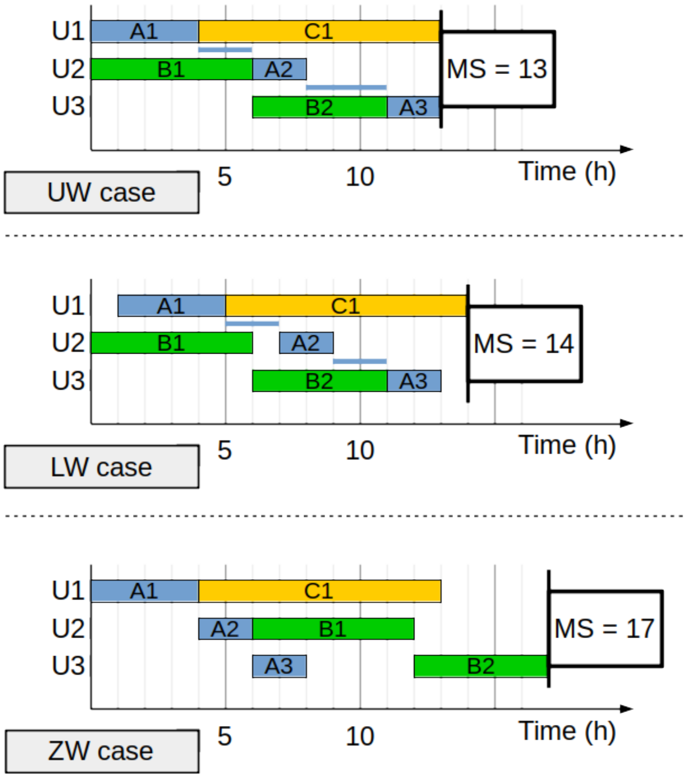

Figure 2: Optimal schedule of the motivational example for UW, LW and ZW policies

typical timing constraints are shown here.

$$ST_{i+1} \geq ST_i + \sum_{j \in J_i} pt_{i,j} \cdot Y_{i,j} \tag{1}$$

This equation expresses that the starting time of task $i+1$, that is the subsequent task of i, must start at least as much later, as the processing time of task i in the selected unit j. ST_i and ST_{i+1} are continuous variables for the starting times, and $Y_{i,j}$ is a binary assignment variable. The sequencing of tasks assigned to the same unit are expressed by:

$$ST_i \geq ST_{i'} + pt_{i',j} - M \cdot (3 - X_{i',i} - Y_{i',j} - Y_{i,j}) \tag{2}$$

where $X_{i',i}$ is the binary sequencing variable, that takes the value of 1 if i' precedes i in any unit. In such a model, the LW constraints can be easily expressed in the form:

$$ST_{i+1} \leq ST_i + \sum_{j \in J_i} pt_{i,j} \cdot Y_{i,j} + LW_i \tag{3}$$

This MILP model can be integrated into the S-graph solution algorithm the following way:

- At the root of the branch-and-bound tree, the precedence based model of the problem is generated, and the sequencing, assignment variables are relaxed to be continuous variables from the interval $[0, 1]$.
- When scheduling decisions are made by the S-graph algorithm to create child subproblems, the LP problem is copied, and the relaxed binary variables related to those decisions get fixed in the LP model of the child.
- Instead of calling the longest path algorithm to provide bound, the relaxed LP model is solved.

The advantage of this approach is better bounds close to the top of the tree, where the assignment decisions are not yet made. However, the bounding step requires much more computation, not to mention the overhead for allocating, copying, destroying the LP models in the memory. To increase the efficiency of this approach, instead of copying the LP model for each node, only one instance could be stored (per thread), and the bounding step only modifies the intervals of the decided binary variables. Moreover, a child may use the solution of the parent node with the dual-simplex algorithm.

5. EMPIRICAL RESULTS

All of the approaches mentioned in Section 4 have been implemented, and thoroughly tested. Here, we show the results for a literature example [13], which reflect our overall experience. 13 test cases were considered, and each approach ran with a 1 hour time limit. The computational results are shown in Table 1.

Although the results vary, it is obvious that the combinatorial approach with the negatively weighted arcs far outperform the LP bound based approaches. The latter two sometimes exceeded the time limit as indicated in the table. Surprisingly, the basic LP bound approach with copying

Table 1: Test results

		CPU times (s)		
Test case	Makespan (h)	Negative arcs	LP bound basic	LP bound advanced
1	118	1223.88	-	-
2	84	2.32	224.21	188.87
3	33	8.76	472.53	415.92
4	133	0.22	10.78	13.32
5	148	1.31	97.61	86.34
6	72	0.19	2.67	49.73
7	97	9.20	743.96	694.80
8	89	27.64	3009.87	2454.94
9	33	1520.99	-	-
10	153	131.23	630.68	-
11	154	497.82	942.72	634.81
12	76	2.27	160.23	441.31
13	162	75.28	-	-

the LP model, and not using the parents solution actually proved to be faster than the more sophisticated one.

6. CONCLUSIONS

Three different methods were presented for addressing LW constraints in the S-graph framework: a combinatorial technique with negatively weighted arcs, and an updated longest path algorithm, and two approaches using the relaxed LP model of a precedence based MILP formulation as bounding function. The empirical tests clearly showed, that the combinatorial approach outperforms the LP bound based techniques in all of the test cases. Thus, future extensions of the S-graph framework should rely on this technique to tackle LW or ZW constraints.

7. ACKNOWLEDGMENTS

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Visualization of 3D Earth using GIS services

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ABSTRACT

In this paper, a method is presented for rendering a 3D digital Earth. The method works in three steps. Firstly, the world map is partitioned into square tiles and multiple levels of detail. Then, the transformation from 3D to 2D is reversed, vertices are calculated, and connected into triangles. In the final step, the vertices are offset to model the Earth's terrain. The RAM usage and FPS of the proposed method were measured in regard to the number of GIS map layers. Experimental results have shown that the proposed method is suitable for real-time visualization of the Earth, even when multiple map layers are used.

Categories and Subject Descriptors

I.3.5 [**Computer Graphics**]: Computational Geometry and Object Modelling;
I.3.7 [**Computer Graphics**]: Three-Dimensional Graphics and Realism

General Terms

Computer Graphics

Keywords

3D Computer Graphics, Visualization, Digital Earth

1. INTRODUCTION

A 3D computer model of the Earth has a lot of practical applications. The motivation behind it and the technology needed for its realization were discussed by the US Senator Al Gore as early as 1998 [1]. In his speech, he also presented some practical use cases for such an application. The model could be used for political purposes, crime-fighting purposes, biodiversity preservation, climate change prediction, and educational purposes. At the time, however, the technology to realise such an application was very limited. The sub-meter precision that Gore envisioned requires a Central Processing Unit (CPU) that is capable of processing a lot of data to generate the triangles for visualization. A powerful Graphics Processing Unit (GPU) is also needed to store these triangles and visualize them in real time, while storing maps for texturing the triangles requires huge amounts of storage space (for example, if a 1m × 1m area was represented by a single pixel, 120 MB of data would be needed just to cover the equatorial line).

In 2011, Goodchild published an overview of the existing technologies related to Gore's 1998 speech [2]. He compared the functionalities of geobrowsers (for example, Google Earth) and GIS (Geographic information systems), and provided the reasons why the former were used more widely. He viewed powerful visualization as the main advantage of the geobrowsers over GIS, as GIS contained mainly information without aerial images of the Earth. The second, and also very important advantage of geobrowsers, is the ease of use, the "child-of-ten standard", which means that a child of ten years can learn to use a geobrowser within ten minutes without any previous knowledge. The GIS, on the other hand, required advanced geographical knowledge to really understand the presented data.

For detailed real-time Earth visualization a lot of data have to be processed, which is a problem, even for modern hardware. The resolution of distant data can be lowered to decrease the number of rendered vertices. Since faraway objects are displayed smaller on the screen, they appear the same to users, even if most of the details are not displayed. This concept is called the Level Of Detail (LOD). Many different approaches have been used to implement LOD for real-time rendering. Pajarola [3] proposed adaptive triangulation based on a restricted quadtree. In [4] the domain is tiled, and a discrete set of LODs is generated for each tile. However, the whole terrain should be preprocessed to avoid mesh re-triangulation at run-time. The approach with tiling is also used in [5], where adaptive rendering is used (i.e. on slower hardware less triangles are being drawn). This results in less detailed terrain, but the frame rate is not affected by the capability of the device. Another adaptive rendering method was proposed by Cai, Li and Su [6], where the terrain is divided into several blocks, which are preprocessed for faster visualization. An interesting approach to tiled visualization is also described in [7], where fractal noise displacement is used to synthesise a more detailed view than that stored. Larsen and Christensen proposed a method [8] for efficient visualization of polygonal surface data. It is based on compact regular grid representation, and requires minimal preprocessing. However, none of the previously mentioned approaches visualise the terrain planet wide. Cignoni et al. addressed planet wide visualization in the P-BDAM algorithm (together with similar algorithms described in [9, 10, 11]).

In this paper, a method is presented for rendering a 3D model of the Earth by using a Digital Terrain Model (DTM) data. The main contribution of the method is the approach to rendering the 3D digital Earth using GIS layers. The method consists of three steps. In the first step, the world map is partitioned into square tiles, which are obtained from the GIS web services. The vertices are generated and connected into triangles according to the tiles in the second step. In the final step, the vertices are offset to model the terrain. The results of the method are considered in terms of RAM (Random-Sccess Memory) usage and FPS (Frames Per Second). According to the results, the proposed method is suitable for real-time visualization of a 3D digital Earth.

This paper is structured as follows. The proposed method for visualization is presented in the next Section. The results of the proposed method are given in Section 3. The paper is summarised in Section 4.

2. PROPOSED METHOD

The description of the proposed method is divided into two parts. The tiling system of the world map in 3D is presented in the first part. The second part discusses the modelling of the 3D terrain.

2.1 Tile System

A transformation is needed to map rectangular surfaces of textures to the surface of the Earth, because its shape is close to a spheroid. The most commonly used is Mercator projection, which projects the surface of the Earth onto a cylinder with base radius of the same length as the equatorial radius of the Earth. This, of course, introduces distortions to the map, which stretch the objects that are close to the poles.

In this paper, a square map is used, partitioned into 20 layers of increasing quality. The first layer contains one texture or tile. That tile is then partitioned in a quad-tree-like fashion. That way, the second layer contains 4 tiles, the third layer contains 16 tiles, etc. Textures for the tiles are obtained from the web using the GIS Web Map Service (WMS). The textures are partitioned and prepared for tiling by the server. The vertices can then be generated to be spaced equally across a tile or the 3D world. In both cases, a transformation is applied to either map vertices to tiles, or to map tiles to vertices. The transformation is done only in the direction of the Y-axis, since the Mercator projection retains the length ratios across the same line of latitude. The transformation that maps tiles to vertices is given in Eq. 1, where v is the Y-coordinate on the texture, Y is the Y-coordinate of the vertex and $M = 2\,\mathrm{atan}\,(\sinh \pi)$.

$$v = 0.5 - \frac{\mathrm{asinh}\left(\tan\left(\frac{M}{\pi}\,\mathrm{asin}\,Y\right)\right)}{\pi} \tag{1}$$

When mapping vertices to tiles, Eq. 2 is used to calculate the Y-coordinate of the vertex, $V.Y$, where Y is the Y-coordinate on the world map in the range [-0.5, 0.5]. The X and Z-coordinates of the vertex can then be calculated from its Y-coordinate and X-coordinate on the world map using trigonometric functions.

$$V.Y = \sin\left(\frac{\pi}{M}\,\mathrm{atan}\,(\sinh(2\pi Y))\right) \tag{2}$$

All data necessary for visualization can be calculated after estimating all vertices. However, as the number of tiles grows exponentially with each level of detail, it is sensible to render just a few of them. Calculation of which tiles are needed for rendering can be done by the following procedure. Firstly, the position of the camera is normalised to the surface of the Earth. Then, the viewing direction is projected onto a plane perpendicular to the Earth at the previously normalised point according to Eq. 3, where $\vec{r}$ is the projected viewing direction, $\vec{p}$ is the vector from centre of the sphere to the position of the normalised point, and $\vec{d}$ is the viewing direction vector. The projected vector is then split into its vertical ($\vec{v}$) and horizontal ($\vec{h}$) components using Eq. 4 and 5, respectively, where $\vec{u} = (0, 1, 0)$.

$$\vec{r} = \vec{p} \times \left(\vec{d} \times \vec{p}\right) \tag{3}$$

$$\vec{v} = \vec{r}.y \tag{4}$$

$$\vec{h} = \mathrm{sgn}\,(\vec{r} \cdot (-\vec{p} \times \vec{u}))\,(-\vec{p} \times \vec{u}) \tag{5}$$

Finally, the index is calculated of the farthest visible tile. The farthest visible point on the sphere can be obtained by rotating the directional vector of the camera around an axis perpendicular to the vectors of the camera's direction and the vector between the position of the camera and centre of the sphere, then calculating the tangent point on the sphere. The angle of rotation is calculated from Eq. 6, where $\vec{l}$ is the vector of the viewing direction, $\vec{c}$ is the vector from the centre of the sphere to the camera, and r is the radius of the sphere. The tangent point $\vec{t}$ can then be calculated using Eq. 7, where $\vec{p}$ is the position of the camera, $\vec{d}$ is the direction of the camera, and r is the radius of the sphere. The Equation assumes that the centre of the sphere is located at the point $(0, 0, 0)$. If the sphere is displaced, its centre should be subtracted from $\vec{p}$ and then added to $\vec{t}$.

$$\phi = \mathrm{acos} - \frac{\vec{l} \cdot \vec{c}}{\|\vec{l}\|\|\vec{c}\|} - \mathrm{asin}\,\frac{r}{\|\vec{c}\|} \tag{6}$$

$$\vec{t} = \vec{p} + \vec{d}\left(\vec{d} \cdot \vec{p} - \sqrt{\left(\vec{d} \cdot \vec{p}\right)^2 + r^2 - \vec{p} \cdot \vec{p}}\right) \tag{7}$$

Assuming the sphere is positioned in the centre of the coordinate system with north pole oriented towards positive Y axis and Prime Meridian towards positive Z axis, the indices of the tile covering any position of the sphere can be calculated using Eq. 8 and 9, where l is the level of detail, $\vec{p}$ is the position we are calculating the tile indices for, and M is the same constant as used in the Eq. 1.

$$tx = \left\lfloor 2^{l-1}\left(1 + \frac{1}{\pi}\,\mathrm{atan}\,\frac{\vec{p}.x}{\vec{p}.z}\right)\right\rfloor \tag{8}$$

$$ty = 2^l - 1 - \left\lfloor 2^{l-1}\left(1 + \frac{1}{\pi}\,\mathrm{asinh}\left(\tan\left(\frac{M}{\pi}\,\mathrm{asin}\,\frac{\vec{p}.y}{\|\vec{p}\|}\right)\right)\right)\right\rfloor \tag{9}$$

2.2 3D Terrain

Two types of textures are used to render a 3D surface:

- Colour textures, which affect the colour of pixels, and
- Elevation textures, which are needed to displace vertices and, thus, form the 3D terrain.

Both texture types are retrieved from the GIS server (e.g. GeoServer) through WMS and the Web Coverage Service (WCS) respectively. WMS and WCS are specifications created by the Open Geospatial Consortium for requesting georeferenced data. While WMS is the most widely used Standard for retrieving map products from the GIS server, WCS can provide more information (e.g. terrain heights). Which textures are needed for a particular camera position is determined by the Tile System (see subsection 2.1). Colour textures are used in the fragment shader of the graphics pipeline (Fig. 1) to display a map, satellite image, or any geographically related data on the surface of the Earth. Elevation textures contain only one channel - elevation (E) of some point on the Earth).

In the vertex buffer of the graphics pipeline, the distance

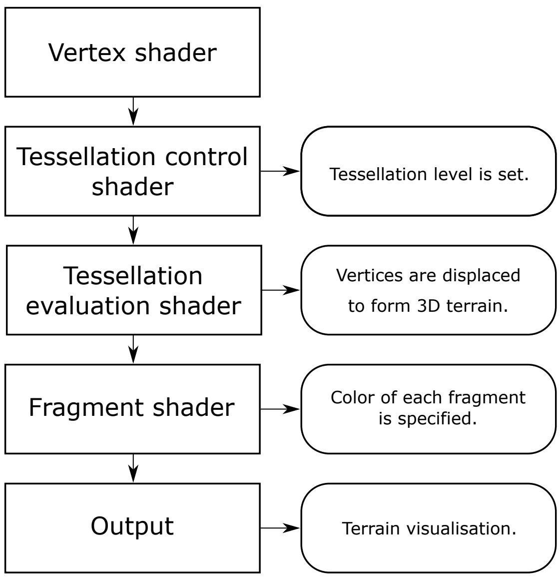

Figure 1: The outline of the graphic pipeline. On the left side, the stages of used pipeline are shown while on the right the proposed implementation is shown.

between each vertex and the centre of the digital Earth is 1. Thus, without elevation textures, the Earth is represented as a perfect sphere. On the GPU, vertices are displaced based on Eq. 10 to get new position $\vec{v'}$. The original vertex position is denoted by $\vec{v}$, and the radius of the sphere (3D Earth) is denoted by R.

$$\vec{v'} = \vec{v}\left(1 + \frac{E}{R}\right) \tag{10}$$

Displacement of vertices is realised in the tessellation stage of the graphics pipeline. Consequently, elevation textures can be received independently of colour textures, since no local preprocessing is needed for displacing vertices. Thus, the source of elevation textures can be added or removed during the programme execution. When the elevation texture is retrieved, the terrain will be elevated immediately. If the source of the elevation textures does not cover the entire Earth, only the provided area will be elevated. Furthermore, the tessellation level can be changed during visualization to change the resolution of visualized data dynamically without the need of vertex buffer recalculation on the CPU (see Fig. 2).

Since geometry is created on the GPU global memory, it

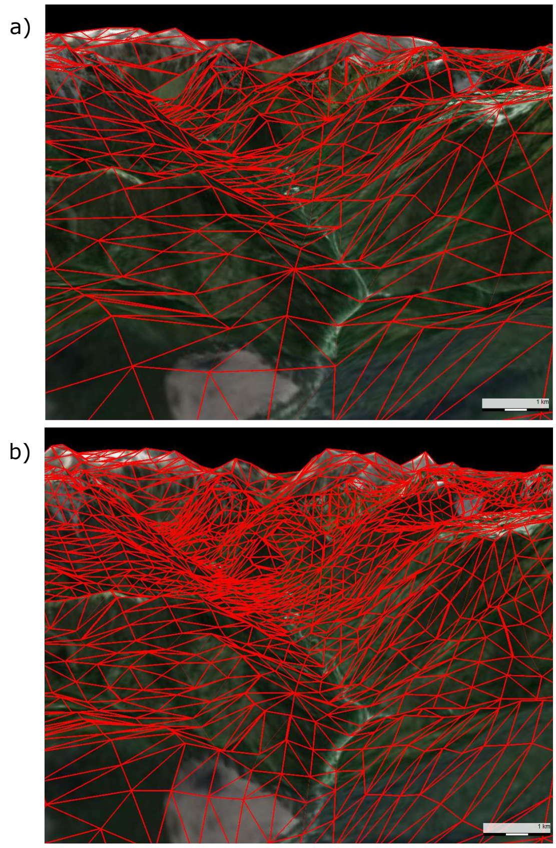

Figure 2: Display of resulting terrain with two different resolutions. In a) the middle resolution of terrain is shown (tessellation level 4), while b) shows rendered terrain in high resolution (tessellation level 8). For clarity's sake, the triangles boundaries are displayed in red.

does not exist on the host memory. Nevertheless, the position and height of a point on the surface can be retrieved from the GPU for each pixel on the screen. After obtaining the depth component of the corresponding pixel, unprojecting can be done to obtain fragment coordinates in the world space ($\vec{p'}$). After that, Eq. 11 is used to get elevation in metres:

$$E = (\|\vec{p'}\| - 1)R \tag{11}$$

Eq. 12 and Eq. 13 are used to retrieve longitude (lon), latitude (lat).

$$lon = \frac{180}{\pi} \operatorname{atan} \frac{\vec{p'}.x}{\vec{p'}.z} \tag{12}$$

$$lat = \frac{360}{\pi^2} \operatorname{asin}\left(\frac{\vec{p'}.y}{\|\vec{p'}\|}\right) \operatorname{atan}(\sinh \pi) \tag{13}$$

3. RESULTS

The results of the proposed method are presented in this section. The RAM (Random Access Memory) usage was measured and FPS (Frames Per Second) was calculated when rendering the Earth with different numbers of GIS map layers. For calculating the FPS, the average time needed to process and draw each frame on the screen was measured, and then inverted to obtain the FPS. Measurements were done on a computer with the following configuration: Intel Core i5-3570K 3.40 GHz CPU, GeForce GTX 1060 6GB, 32 GB of RAM, and Windows 10 Education operating system. The graph of average results is shown in Fig. 3. As seen,

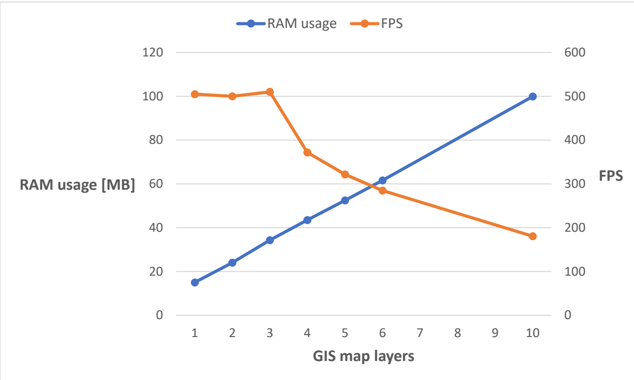

Figure 3: RAM usage and FPS when rendering different number of GIS map layers with the proposed method

the RAM usage increases linearly with the number of GIS map layers, with each layer increasing the usage by approximately 9 MB. On the other hand, FPS tends to decrease when more than three layers are rendered. This happens because FPS is inversely proportional to rendering time. The rendering time increases by approximately half a millisecond each time a layer is added, which results in lower and lower FPS drops when more layers are added.

The results have shown that the proposed method is suitable for real-time rendering of a 3D Earth on modern personal computers. Therefore, the proposed method could be used as a standalone application (i.e. a geobrowser), or as a visualization option for larger applications.

4. CONCLUSION

In this paper, a new method is proposed for tile-based, planet wide terrain visualization. At first, the position and visual quality of needed tiles are calculated, based on camera position. Then, two types of tiles are retrieved from the GIS server in the form of textures. Colour textures define the colour of each pixel in the viewing frustum. Elevation textures affect the elevation of each vertex. Since terrain is formed on the GPU, the proposed method needs almost no preprocessing.

The performed experiments proved that adding additional layers does not decrease performance significantly, and that modern GPUs can visualise several layers real-time. Therefore, the proposed method could be used in multiple applications, such as visualization of maps with multiple layers (e.g. visualization of land usage, annual weather analysis, etc.). For future work, the method could be improved to support separate elevation sources for each colour source. With this feature, several completely different terrains could be visualised at the same time.

5. ACKNOWLEDGEMENTS

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A simulator to study the stability of network centrality measures

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ABSTRACT
Measuring nodes' importance in a network and ranking them accordingly is a relevant task regarding many applications. Generally, this measurement is done by a real-valued function that evaluates the nodes, called node centrality measure. Nodes with the largest values by a centrality measure usually give the highest contribution in explaining some structural and functional behavior of the network. The stability of centrality measures against perturbations in the network is of high practical importance, especially in the analysis of real network data that often contains some amount of noise. In this paper, by utilizing a simulator we implemented in R, a formal definition of stability introduced in [13] and various perturbation methods are used to experimentally analyze the stability of some commonly used node centrality measures.

Keywords
Network science, Centrality measures, Stability, R language

1. INTRODUCTION
In a complex network, being social (e.g. Facebook friendship), economical (e.g. international trade), biological (e.g. protein-protein interaction) or technological (e.g. transportation) network, the position of the nodes in the topology of the underlying graph is of central importance. Central nodes in this graph topology often have major impact, whereas peripheral nodes usually have limited effect on the structure and functioning of the network. Thus, identifying the central and most important nodes helps in better understanding the networks from many different perspectives. Node centrality measures are metrics designed to identify these important nodes. However, the importance of a node can be interpreted in many different ways, therefore, depending on the applications, many centrality measures have been developed and effectively applied in various domains [7]. The most commonly used centrality measures are degree [11, 14], closeness [1, 12], eigenvector [2], betweenness [8], PageRank [4] and HITS [10]. Degree centrality measures the importance of a node simply by the number of its neighbors. Closeness centrality shows the average shortest path length from the node to every other node in the network. Eigenvector centrality, and similarly PageRank, of a node is computed (iteratively) as a function of the importance of its neighbors. Betweenness centrality measures the relative number of shortest paths in the network that go through a node.

The stability of centrality measures has often been investigated in an empirical way by comparing the network with one obtained by modifying the original one according to some randomisation procedure [3, 6, 15]. Recently Segarra and Ribeiro gave a formal definition for the stability of centrality measures and proved that degree, closeness and eigenvector centrality are stable whereas betweenness centrality is not [13]. In this work we experimentally investigate the stability of degree and eigenvector centrality measures on various data sets, and under two different perturbation processes. By doing so we introduce our simulation environment which is implemented in R and available online as an interactive tool.

This paper is organized as follows. In Section 2 we will briefly discuss the definition of stability for centrality measures and introduce the main notations used in the paper. In Section 3 we will present a simulation environment written in R and describe the data sets used in our experiments. In Section 4 we will describe the two perturbation processes, discuss our results and draw some succinct conclusions.

2. NODE CENTRALITY AND STABILITY
Let us consider a network represented by a graph $G = (V, E)$, where V is the set of nodes and E is the set of edges (i.e. pairs of nodes) of the network. Centrality measure is a real-valued function $C^G : V_G \to \mathbb{R}_{\geq 0}$, that assigns a non-negative number to each node of network G. Here we will

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not give the formal definitions of the investigated centrality measures that can be found e.g. in [7]. We use the definition of stability introduced in [13] as follows. A node centrality measure C is said to be stable if

$$|C^G(x) - C^H(x)| \leq K_G \cdot d(G, H) \tag{1}$$

holds for every node $x \in V$, where G and H are two graphs over the same node set V, K_G is a constant, and $d(\cdot, \cdot)$ is a distance function between two graphs.

The definition says that a centrality measure is stable if the maximum change in node centrality is bounded by a constant times the distance of the two graphs. This constant value must be universal to any perturbed version of the initial graph. Furthermore, the constant value does not depend on the presence of normalization of centrality values. Note that the definition is similar to the definition of Lipschitz-continuity, applied in a discrete space. In order to make the above inequality meaningful a graph distance $d : G \times H \to \mathbb{R}_{\geq 0}$ should be specified. Here, the distance of two graphs with identical node set V is defined as

$$d(G, H) = \sum_{i,j} |A^G_{ij} - A^H_{ij}|,$$

where A denotes the (weighted) adjacency matrix of the network.

It is of empirical interest to study how graph H occurs from a given graph G and how it affects the constant K_G in formula (1). In Section 3 different graph perturbation methods using various input graphs and data sets in order to examine the ranges of K_G are discussed.

2.1 Theoretical values in stability concepts

Segarra and Ribeiro showed that using the stability concept (1) the degree, closeness and eigenvector centrality measures are stable, whereas betweenness centrality is not [13]. The theoretical K_G values for the three stable measures were determined. Given a directed and weighted graph G, $K_G = 1$ for degree centrality. This is because the distance of the two adjacency matrices will be at least the maximum difference of the degree centrality value. Furthermore this theoretical value for undirected weighted graphs can be reduced to 1/2 due to the symmetry of the adjacency matrices. For closeness centrality it was proved that the theoretical bound K_G is equal to the number of nodes, hence it is not a universal constant. The eigenvector centrality is stable and the constant K_G can be computed as $4/(\lambda_1 - \lambda_2)$, where λ_1 and λ_2 are the greatest and second greatest eigenvalue of the adjacency matrix of graph G, respectively.

Although there exist some theoretical results for the constant K_G, it could still be interesting to analyze its actual value in real networks under natural perturbation scenarios. In the next section we describe our simulation environment and data sets used for experimental analysis.

3. SIMULATION ENVIRONMENT

R is an open-source programming language developed by the R Foundation and can be widely used for statistical computations and representations. The functions which are mainly used in our project for graph manipulation and related computations, generating synthetic graphs and graph visualization are part of the `igraph` package. We also use the `plotly` library which is an online analytical and data visualization tool. It can be easily integrated in various developer environments, thus combined with R can be widely used for data visualization.

With the help of these tools we designed and implemented a versatile simulation environment that we use to perform our experiments. The simulator can handle various network data structures, while the output of a simulation can be various plots, data tables, statistics depending on the user defined parameters. A version of the simulator with limited functionality that uses the data as input as discussed below is available online at:

`https://kardosorsi.shinyapps.io/stability`

The interested readers are cordially invited to visit our website and try out different experiments. The full version of the simulator is available upon request.

3.1 Data sets

We have performed a wide-range of experiments on various synthetic and real data sets using different types of perturbations. In the following two experiments are elaborated in more detail.

S&P 500

Firstly, a correlation based financial graph was used. The main motivation behind using stock data was to obtain the perturbation method directly from real-life processes. The experiments were performed using the daily closing prices of stocks of the S&P 500 in the period of 01/01/1995 – 31/12/2018, including the assets of 330 leading U.S. companies[1]. We used a time-window of 200 days to construct correlation matrices from stock return time series on that interval with starting points $T_0 = 01/01/1995$, $T_k = T_0 + k\Delta T$ with $\Delta T = 50$, $k = 1, 2, \ldots$. This way we obtained 116 consecutive networks, with the fixed set of 330 nodes and weighted edges represent the correlation coefficient of each pair of assets on the corresponding time interval. Here, the changes in edge weights between each consecutive network pairs simulates the perturbation process.

Cooper-Frieze graph process

Secondly, we implemented the Cooper-Frieze graph evolution process based on a general model of web graphs proposed in [5]. That is a general model of a random graph process to generate a graph of power-law degree distribution as follows. Starting from an initial graph G_0 at time $t = 0$, the process evolves randomly by the addition of new nodes and/or edges at each time step $t = 1, 2, \ldots$. The following six parameters of the process provide a high-level of freedom in graph generation. With probability $\alpha \in [0, 1]$ and $1 - \alpha$ a new node is created or an existing node generates edges, respectively. With probability $p = (p_i : i \geq 1)$ a new node generates i edges. For new nodes, with probability $\beta \in [0, 1]$ the terminal node of a new edge is made uniformly at random and with $1 - \beta$ according to degree (i.e. new edges are

[1]We selected those assets from the $S\&P$ 500 list that were complete in the considered time period.

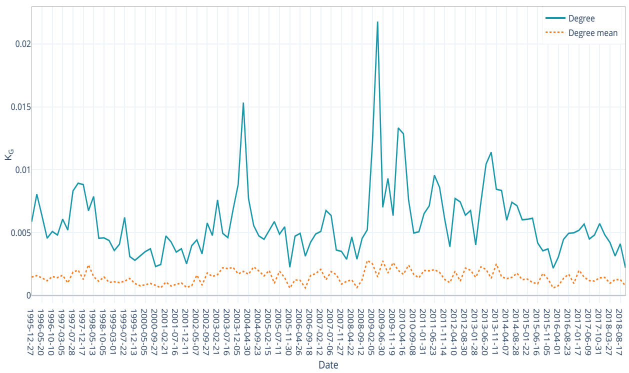

Figure 1: K_G constant values for degree centrality measure during the perturbation simulation.

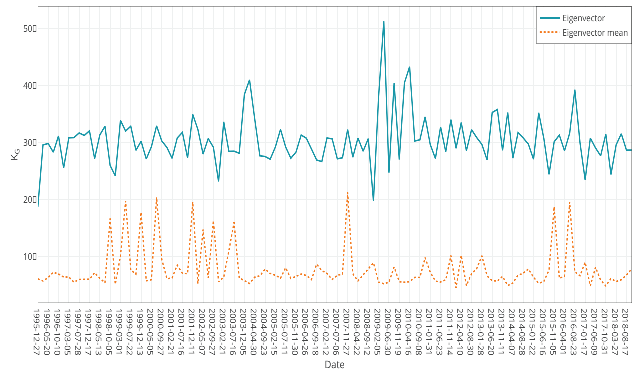

Figure 2: K_G constant values for eigenvector centrality measure during the perturbation simulation.

preferentially attached). If an already existing node generates an edge, where the number of edges given by probability $q = (q_i : i \geq 1)$, the initial node is selected uniformly with probability δ and according to the degree with $1 - \delta$. The parameter γ has similar role for existing nodes as β had in the case of new nodes. Using this process we are able to simulate a graph perturbation process. The initial graph (at time $t = 0$) can be set as an input parameter and then in every time step $t = 1, 2, \ldots$ a new (perturbed) graph is created by the evolutionary graph process.

4. RESULTS AND DISCUSSION

Two main perturbation categories are examined. The first category is the *graph structure perturbation* that can be raised from real-life data (like stock correlations) or synthetic perturbation obtained by rewiring edges selected uniformly at random. The other group is raised from *graph evolution*. Here we will present our experiments on the $S\&P$ 500 data set for the structure perturbation and on Cooper-Frieze networks for the graph evolution. Results are shown on consecutive graphs as discussed in Section 3. During our experiments reported here the degree and eigenvector centrality measures were considered[2].

Graph structure perturbation. At the global level, an interesting result is provided by the behavior of the K_G constant value regarding both degree and eigenvector centrality measures over time, see Figure 1 and Figure 2, respectively. The mean values for centrality C are calculated as

$$\frac{1}{|V|} \sum_{x \in V} |C^G(x) - C^H(x)|. \qquad (2)$$

We can observe that for both centrality measures are very stable, only very slight changes in their values are observed. Interestingly, these changes happen in periods of crisis. The increases around 2004, 2007-2008 and 2010-2011 can be noticed. The 2007-2008 period can be associated with the Lehman Brothers failure, whereas the 2010-2011 may reflect the Sovereign debt crisis. It is a well-known stylized fact in finance that assets correlation increases in times of financial distress. Note that these actual K_G values are way lower than their theoretical bounds.

[2]Note that a more detailed presentation of our results will be part of a paper planned to be published later.

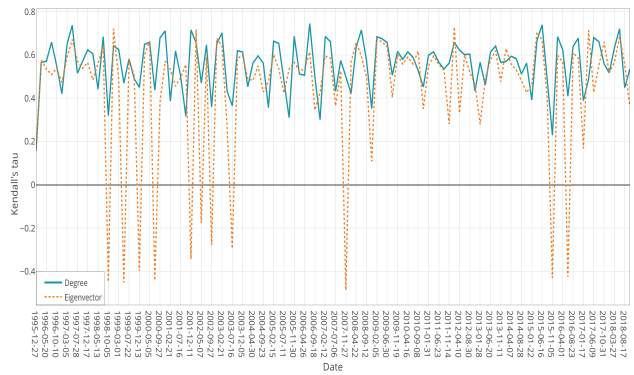

Figure 3: Kendall's tau coefficient between rank by different centrality measures during perturbation

The other interesting aspect in analyzing the stability of the different network centrality measures is the order or ranking provided by the metrics. The Kendall rank correlation coefficient [9] is used to measure the ordinal association between two measured quantities. The coefficient results in high value when observations have a similar rank (i.e. relative position label of the observations within the variable: 1st, 2nd, 3rd, etc.) between the two variables. The simulator can be parametrized in order to visualize the correlation between the order by centrality measures for the different measures respectively. Therefore it is possible to analyze the correlation between the two rank vectors during the graph perturbation procedure. On Figure 3 the Kendall correlation coefficients are reported. The degree centrality stays quite stable in the range of $0.35 - 0.7$, whereas the eigenvector centrality shows some seemingly radical changes over time. We can observe that these extreme changes in ranking shown on Figure 3 are related to the higher K_G constant values regarding the average change in centrality measures presented on Figure 2.

Graph evolution. The other aspect that we wanted to study in our experiments was the graph perturbation caused by some evolutionary process. The concept behind this was that studying the maximum of the difference in centrality measures during graph evolution can be an interesting ap-

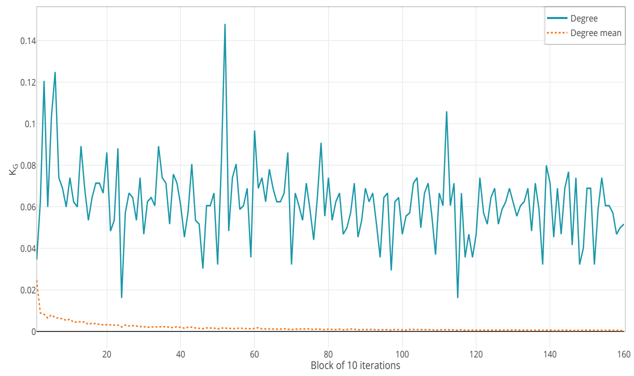

Figure 4: K_G constant values for degree centrality measure during the graph evolution process

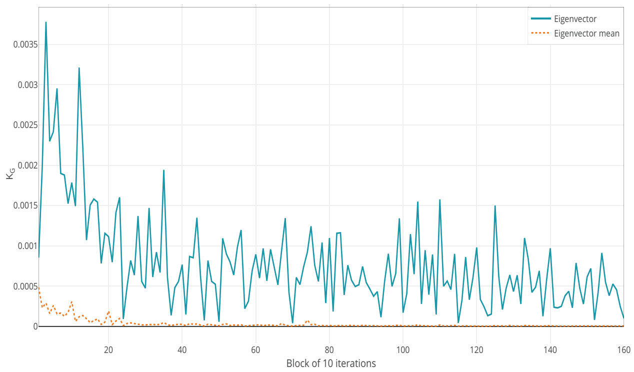

Figure 5: K_G constant values for eigenvector centrality measure during the graph evolution process

proach regarding many real-life applications. The perturbation behind evolution relies on the fact that in these networks new vertices can connect to the initial graph with one or more edges, also new edges can appear between existing nodes in the network.

For these experiments the perturbed versions of the initial graph were provided by the Cooper–Frieze graph process. In the reported results a graph of two nodes connected with an edge as initial input graph was used. We started to measure the centrality stability values after the 100th iteration by blocks of ten iterations. Thus, at the end of an iteration block consisting of 10 time steps t, a perturbed graph is produced with new nodes and edges compared to the graph from the previous block.

As it can be seen on Figures 4 and 5 the empirical values of K_G bound are about one order magnitude higher than those for the *S&P* dataset. Note that they are still much lower than their theoretical values and they show only slight fluctuation. Moreover, the mean values (calculated as (2) converges to zero by the growth of the size of the network. Similar convergence can be noticed on Figure 6 regarding the Kendall's correlation which shows the evidence that even the nodes ranking remain practically unchanged during the graph evolution process.

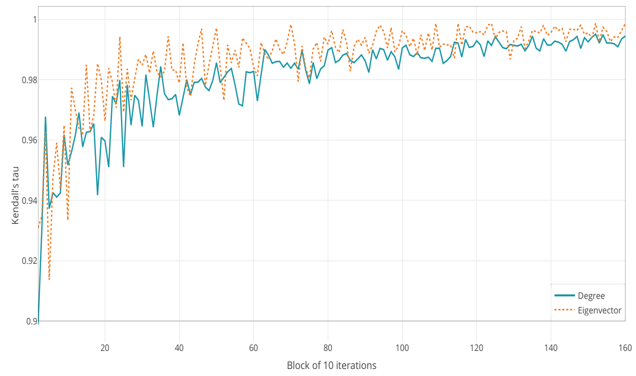

Figure 6: Kendall's tau coefficient between rank by different centrality measures during the graph evolution process

Acknowledgments

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An ILP Formulation for a Variant of the University Timetabling Problem *

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ABSTRACT

We consider a variant the university timetabling problem, the problem of assigning courses to time intervals with respect to certain conditions. We define a natural generalization of the actual timetabling problem for the Faculty of Mathematics, Natural Sciences and Information Technologies at the University of Primorska. We develop a mathematical model based on integer linear programming for solving this NP-complete problem. The model is implemented using programming language Zimpl and evaluated using Gurobi. A timetable representing the result of the implementation is compared with the one made by hand.

Keywords

university timetabling, integer linear programming, mathematical modelling

1. INTRODUCTION

Research considering the timetabling problems started during the 1950s and until now there are many papers considering various timetabling problems (see, e.g., [6, 9, 16, 17, 18]). One of the most basic variants of the problem known as TIMETABLE DESIGN is defined in monograph by Garey and Johnson [10, SS19]. The problem is known to be NP-complete.

In this work we consider a variant of the university timetabling problem, that is, the problem of scheduling a sequence of teaching sessions involving lecturers and students in a predetermined period of time, normally within a week, while satisfying a set of constraints [17]. The problem can have additional constraints, which are desired to be satisfied, but do not necessarily have to hold. For that reason, constraints are divided into two groups: hard constraints and soft constraints. Hard constraints must be satisfied by a feasible timetable, while soft constraints represent requirements that are desirable to be satisfied, but their violation has no influence to the feasibility of the solution. Every institution has its own set of constraints that should be satisfied when constructing a timetable, so for that reason a general solution for university timetabling problems does not exist. There are some commercial solutions for the university timetabling problem (see, for example, [2, 3]). However, since there is no general solution for the problem, models developed in commercial solutions often have to be adapted in order to satisfy the conditions of a specific institution. Differences may be large, and their modeling and implementation represent a difficult and time-consuming process.

An overview of the computational complexity of a number of university timetabling problems can be found in [13]. For example, timetabling problems concerning just time slots and courses, involving lecturers, students, and an unbounded number of classrooms of unlimited capacity can be solved in polynomial time. Furthermore, there are examples of problems concerning lectures of the same length for which the number of steps needed for solving the problem is significantly reduced in comparison with the same problems having the lectures of distinct length [7].

One of the first ideas for modelling a timetabling problem using integer linear programming was developed for a school timetable during the 1960s by Lawrie [12]. After that the number of papers presenting similar models grew rapidly. Nowadays, powerful software is available for solving integer linear programs (ILPs), so ILP is again one of the main approaches for solving combinatorial optimization problems, including timetabling problems. There are various models in literature, depending on constraints and preferences of corresponding institutions. One of them is available in papers by Daskalaki et al. [8] and Daskalaki and Birbas [7], where a huge set of constraints is represented using linear inequalities. A nice summary of types of constraints used in the literature is given by Aizam and Caccetta (see [5]), while a good description of elements of objective function is available in a paper by Pereira and Costa (see [15]). One of the difficulties when using this approach is a big number of variables and constraints for larger instances of problem. Also, it is often not trivial to model some very specific constraint, which is not part of requirements at other institutions, and sometimes at all to understand the timetable from the obtained solution, which is typically a binary vector of large dimension.

Our contribution. Although the university timetabling problem is solved for many institutions (see e.g. [5, 7, 8]), it seems that these solutions cannot be easily adapted for

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an arbitrary new institution. Based on the description of the teaching process at the proposed institution, we introduce the FAMNIT TIMETABLE DESIGN problem, that is, the timetabling problem for the Faculty of Mathematics, Natural Sciences and Information Technologies at the University of Primorska (UP FAMNIT). This problem is NP-complete, see [14]. We develop in Section 3 an integer linear programming model for the problem. The model is implemented with real data input from the Spring semester of academic year 2016/17 using the programming software Zimpl (see [11]) and Gurobi Optimizer (see [1]). Section 4 contains results of implementation.

2. THE PROBLEM

In order to model a timetabling problem for some concrete institution, we have to describe rules and requirements of the institution that are relevant for the timetable. In this work we construct a timetable for five working days. We introduce a number of soft constraints. They are a measure for the quality of timetable and represent a part of the objective function, but have no influence to the existence of a feasible solution. We describe them in Section 3.3. The FAMNIT TIMETABLE DESIGN problem is formulated as a decision problem that checks if there exists a feasible solution of the system, i.e., a timetable that satisfies all the hard constraints.

FAMNIT TIMETABLE DESIGN
Instance: a finite set D of *days*; a finite set T of *time slots* (d, h) (day, hour), linearly ordered with respect to the time line within a 5-day week; we define addition in T so that given a time slot t and a number $i \in \mathbb{N}$, time slot $t' = t + i$ is defined as a time slot being the $(t+i)$-th element of the linear order of set T; for each $d \in D$; a finite set $T_d \subseteq T$ of time slots at day $d \in D$; a finite set M of *meetings*; a finite set S of *student groups*; a finite set L of *lecturers*; a finite set R of *rooms*; a finite set K of *locations*; subsets $T_\ell \subseteq T$ and $T_m \subseteq T$ of available hours for each lecturer $\ell \in L$ and meeting $m \in M$, respectively (for every meeting the lecturer is known, so T_m depends on lecturer's availability); a subset $T_r \subseteq T$ of available hours for each room $r \in R$; a subset $T_{AM} \subseteq T$ of morning time slots; subsets $M_s \subseteq M$ and $M_\ell \subseteq M$ of meetings incident with each student subgroup $s \in S$ and lecturer $\ell \in L$, respectively; a subset $R_m \subseteq R$ of available rooms for each meeting $m \in M$; a subset $M_k \subseteq M$ of meetings that take place at location $k \in K$ (in our case $k \in \{1, 2\}$); for each lecturer $\ell \in L$, the maximum number $\rho_\ell \in \mathbb{N}$ of hours ℓ can teach per day; a finite set N of *parts* of a day (e.g., morning, noon, evening,...); the set $T_n \subseteq T$ of all time slots at n-th part of day d, over all $d \in D$; a set $S' \subseteq S$ of student subgroups that can only have lectures within a single part of a day; a set $S_{\text{Ext}} \subseteq S$ of student groups consisting of students of external programs; a set $G \subseteq M \times T \times R$ of pre-scheduled triples; a set $F \subseteq M \times T \times R$ of unacceptable triples; for any meeting m there is a vector p_m, with element $p_m(i) = k$, if a block of duration i of meeting m has to be repeated k times per week; for any meeting m, the set H_m of all block lengths appearing in the division of meeting m, that is, $H_m = \{i \mid p_m(i) \neq 0\}$.

Question:
Is there a timetable that schedules all meetings, that is, a function $f : M \times T \times R \to \{0, 1\}$ (where $f(m, t, r) = 1$ means that meeting m is assigned to time slot t and room r) that schedules the desired number of hours of all meetings and satisfies certain constraints. Due to space limitation, constraints are presented in Section 3 (see also [14, Sec. 4.2]).

3. THE ILP FORMULATION

In this section we describe an integer linear programming model for the problem.

3.1 Variables of the ILP

There are three sets of binary variables. For every triple of a meeting $m \in M$, a time slot $t \in T$, and a room $r \in R_m$ that is acceptable for that meeting, there is one corresponding variable $x_{m,t,r}$. This variable will take value 1 if meeting m is scheduled at time slot t in classroom r, and 0 otherwise. For every triple of a meeting $m \in M$, a time slot $t \in T$ and a predefined length $i \in H_m$ of individual blocks of meeting m we define a variable $y_{m,t,i}$.

The variable will take value 1 if time slot t is the first appearance of i consecutive hours of m, and 0 otherwise. In the last set of variables we have the so called z-variables, auxiliary variables for modeling some hard and soft constraints. For each constraint type p and the corresponding index set I_p, we define a variable $z_{p,i}$ for every $i \in I_p$. These variables appear in the modeling of hard constraints of type F (Section 3.2) and soft constraints of types S_2 and S_3 (Section 3.3).

3.2 Constraints of the ILP

There are six types of constraints.
A) Every meeting has to be assigned to available resources. In this group we have three types of constraints: lecturers cannot have lectures at unacceptable time slots, classrooms can only be used at specified time slots, every meeting has to take place in an acceptable classroom. The last constraint is satisfied by variable definition. The remaining two yield the following linear equations:

$$\sum_{m \in M_\ell} \sum_{t \in T \setminus T_m} \sum_{r \in R_m} x_{m,t,r} = 0, \quad \forall \ell \in L,$$
$$\sum_{m \in M_r} \sum_{t \in T \setminus T_r} x_{m,t,r} = 0, \quad \forall r \in R.$$

B) Overlapping is not permitted. In this group we have the following constraints: for every student group at most one meeting and one classroom can be assigned to every teaching period, every member of the teaching staff shall be assigned at most one meeting and one classroom at a time, every classroom can be assigned to at most one meeting at a time. We model them with the following linear inequalities:

$$\sum_{m \in M_s} \sum_{r \in R_m} x_{m,t,r} \leq 1, \quad \forall s \in S, \forall t \in T,$$
$$\sum_{m \in M_\ell} \sum_{r \in R_m} x_{m,t,r} \leq 1, \quad \forall \ell \in L, \forall t \in T,$$
$$\sum_{m \in M} x_{m,t,r} \leq 1, \quad \forall r \in R, \forall t \in T.$$

C) Timetable has to be complete.
C_1) All meetings in the curriculum of each student subgroup should be in the timetable and in the right amount of teaching periods, with respect to weekly duration:

$$\sum_{t \in T} \sum_{r \in R_m} x_{m,t,r} = \sum_i p_m(i) \cdot i \quad \forall m \in M.$$

C_2) A meeting m of duration $i \in H_m$ has to start and finish at the same day, so some variables $y_{m,t,i}$ are defined to have value 0:

$$y_{m,t,i} = 0\,\forall m \in M,\, \forall i \in H_m,\, \forall t = (d,h) \in T : h > \tau - i + 1\,,$$

where τ represents the number of time slots in a day.

C_3) Given a meeting m, at most one time slot can be the first appearance of m in a single day:

$$\sum_{i \in H_m} \sum_{t \in T_d} y_{m,t,i} \leq 1, \quad \forall m \in M,\, \forall d \in D.$$

C_4) A given meeting m of duration i (where i is the index of a nonzero element of vector p_m) has to appear exactly $p_m(i)$ times per week (i.e., in $p_m(i)$ days). All such indices i are contained in H_m, so we have:

$$\sum_{t \in T} y_{m,t,i} = p_m(i), \quad \forall m \in M,\, \forall i \in H_m.$$

C_5) If a course m of duration i is assigned at day d, it has to be assigned to exactly i hours:

$$i \cdot \sum_{t \in T_d} y_{m,t,i} \leq \sum_{r \in R_m} \sum_{t \in T_d} x_{m,t,r}, \quad \forall m \in M, \forall d \in D, \forall i \in H_m.$$

C_6) Appearances of meeting m of duration i in a single day should be consecutive:

$$y_{m,t,i} \leq \textstyle\sum_{r \in R_m} x_{m,t+j,r}$$
$$\forall t = (d,h) \in T, \forall m \in M, \forall i \in H_m, \forall j \in \{0, \ldots, i-1\}.$$

C_7) All consecutive hours of one meeting should take place in the same classroom:

$$x_{m,t,r} + x_{m,t+1,r'} \leq 1\,\forall m \in M, \forall t \in T,\, \forall r, r' \in R_m \text{ s.t. } r \neq r'.$$

D) Pre-scheduled meetings:

$$x_{m,t,r} = 1, \quad \forall (m,t,r) \in G.$$

E) Every lecturer ℓ can have at most ρ_ℓ time slots of teaching obligations per day:

$$\sum_{t \in T_d} \sum_{m \in M_\ell} \sum_{r \in R_m} x_{m,t,r} \leq \rho_\ell, \quad \forall \ell \in L, \quad \forall d \in D.$$

F) Student requirements. Students of external interdisciplinary programs should have lectures just in the morning, or in the evening, but not both. We define the variable $z_{F,s,d}$ to have value 1 if condition F is violated for parameters $s \in S, d \in D$; and 0 otherwise.

$$\sum_{m \in M_s} \sum_{t \in T_d \setminus T_{AM}} \sum_{i \in H_m} y_{m,t,i} \leq 2 \cdot z_{F,s,d}, \forall d \in D, \forall s \in S_{\text{Ext}},$$

$$\sum_{m \in M_s} \sum_{t \in T_d \setminus T_{AM}} \sum_{i \in H_m} y_{m,t,i} \leq 2 - 2z_{F,s,d}, \forall d \in D, \forall s \in S_{\text{Ext}}.$$

Moreover, it is desired for every student subgroup not to have meetings at two distinct locations in a day:

$$\textstyle\sum_{i \in H_m} y_{m,t,i} + \sum_{i \in H_{m'}} y_{m',t',i} \leq 1, \forall d \in D, \forall s \in S,$$
$$\forall \{t, t'\} \in T_d, \forall m \in M_{k_1} \cap M_s, \forall m' \in M_{k_2} \cap M_s.$$

3.3 Soft constraints

Among all the implicitly generated feasible solutions, we would like to find one that satisfies as many soft constraints as possible. For that reason we define an objective function with a penalty $w_p > 0$ for violation of constraint p. Some of the soft constraints are modeled using auxiliary variables, namely $z_{p,i}$, for a constraint of type p and for every $i \in I_p$, where I_p is the index set relevant for constraints of type p. The variable $z_{p,i}$ has value 1 if the constraint of type p is not satisfied for element i of the index set I_p, and 0 otherwise. Here we briefly describe a set of soft constraint in order to define the objective function.

S_1) **Minimize use of payable classrooms.** Some classrooms are available for lecturing, but for an additional payment, so we want to minimize the use of these classrooms.

S_2) **Compact timetable.** Teaching obligations of teaching staff should be reasonably grouped during the day: it is not desirable for one teacher to have some teaching hours in the morning and then again at the evening, with a long break in between. For simplicity we denote by L_+ the set of teachers teaching more than one session.

S_3) **Requirements related to students.** For some Master's study programs it is desirable to offer lectures only within the afternoons time slots $T_{PM} \subset T$. We denote by M_{PM} the set of meetings relevant to these programs. Another constraint related to students' preferences concerns minimization of lectures scheduled at Friday afternoon. A third constraint in this group of constraints concerns upper bound on number of teaching hours related to one student group in a day.

S_4) **Requirements related to lecturers.** Every lecturer ℓ can have some preferences among the time slots in T_ℓ and it is desired to take these preferences into account when constructing timetable.

3.4 The objective function

Putting together the above constraints, we formulate the objective function of the ILP model as follows:

$$\sum_{t \in T_r} \sum_{m \in M} \sum_{r \in R_m} w_{S_1,r,t} \cdot x_{m,t,r} + \sum_{\ell \in L_+} \sum_{d \in D} w_{S_2,\ell,d} \cdot z_{S_2,\ell,d} +$$
$$\sum_{m \in M_{PM}} \sum_{t \in T \setminus T_{PM}} \sum_{i \in H_m} w_{S_3,m} \cdot y_{m,t,i} +$$
$$\sum_{m \in M} \sum_{t \in T_5 \cap T_{PM}} \sum_{r \in R_m} w_{S_3,m,t} \cdot x_{m,t,r} +$$
$$\sum_{d \in D} \sum_{s \in S} w_{S_3,s,d} \cdot z_{S_3,s,d} + \sum_{\ell \in L} \sum_{m \in M_\ell} \sum_{t \in T} \sum_{r \in R_m} w_{S_4,\ell,t} \cdot x_{m,t,r}.$$

4. RESULTS

The ILP model was implemented using the open source programming software Zimpl [4], and evaluated using the Gurobi Optimization software [1]. The specifications of computer used for the computations are: RAM `32GB DDR3 1800Mhz` and CPU: `Intel i7-3820 3.60GHz`. In order to find an optimal solution of the proposed model, we used input data for the Spring Semester of the academic year 2016/17 at UP FAMNIT: 17 distinct study programs that

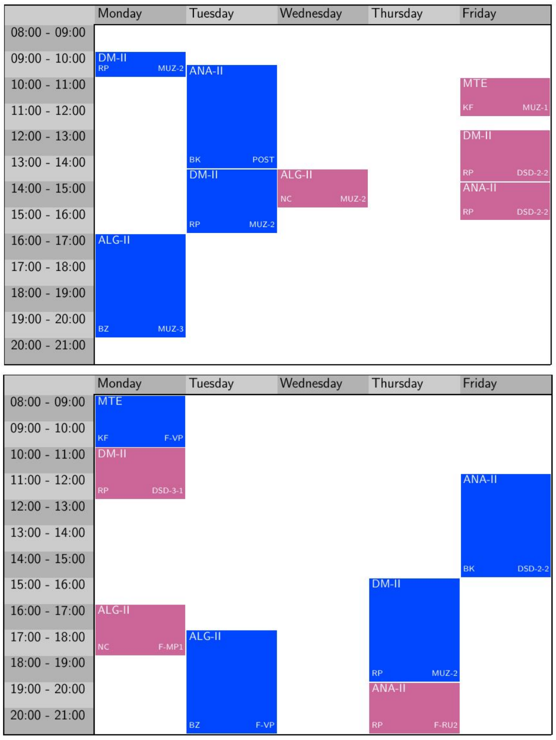

Figure 1: Timetable for one of the student groups prepared manually (top) and by solver (bottom).

in total define 48 student groups, 185 meetings, 26 classrooms, and 65 time slots, and 118 lecturers. The timetable is prepared for 5 working days and $\tau = 13$ sixty-minutes time slots within a day.

Using Zimpl we generated an `.lp` file representing the proposed model for real data in ILP standard form, containing $171,455$ variables and $2,752,376$ constraints, where $7,780,635$ entries of corresponding matrix are nonzero. The resulting `.lp` file represents the input for the solver. As expected, since all variables of the ILP are constrained to be binary, the complexity of the problem is very large. For that reason finding an optimal solution of the problem was a time-consuming process; within 48 hours no feasible solution was found. We then simplified the objective function so that just the first term of the objective function remained in the model. For this simplified objective function, we got an optimal solution in about $20,000s$.

In order to give the reader some feeling about the quality of results obtained by the implementation, in Figure 1 we display timetables produced by hand for the academic year 2016/17 and by solver, respectively, for one of the student groups.

5. CONCLUSION AND FURTHER WORK

The solution obtained here can be far from the optimum in general. Nevertheless, the automated approach produced a timetable that could be used for the desired application. It can be computed faster than the manually prepared one and it seems to have good compactness properties. In summary, this work is a good first step in the process of automating the approach to the timetabling problem at UP FAMNIT. Furthermore, as the problem is rather general, its ILP formulation or parts of it may be applicable to other institutions as well. Tasks for future research include simplifying the model to reduce the number of variables, automating the data preparation for the model, and improving the formulation of the objective function so that a reasonably good solution for the whole model can be obtained more efficiently.

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Energy usage minimization with the S-graph framework

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ABSTRACT
This paper proposes an extension of the S-graph framework for minimizing energy usage. The S-graph framework is a methodology for solving batch process scheduling problems. It was originally developed for makespan minimization of chemical batch processes. Since then, the framework has been extended to various scheduling problems arising in different applications.

The hereby presented extension aims to incorporate sustainability metrics, as objectives and constraints, into the S-graph framework. The proposed approach can be used to minimize total energy consumption while satisfying demand within a given time horizon, waste limitations, and energy availability.

Keywords
scheduling, combinatorial optimization, sustainability

1. INTRODUCTION
Production scheduling is an optimization problem where timing and resource allocation decisions have to be made for a set of given production tasks, while satisfying certain feasibility constraints. The objective of optimization is, in most cases, to minimize makespan (total completion time), but other frequent objectives include throughput and profit maximization, and cost, tardiness, and cycle time minimization.

In this work, the objective is to minimize energy usage, which is a special case of cost minimization, where only the energy costs are considered. Apart from the objective of minimizing energy consumption, the aim to sustainable production is also reflected in a constraint limiting the total waste produced. Both energy usage and waste production is influenced by machine assignment and operation mode selection.

Considering energy usage and waste production has been an important aspect of planning and scheduling of chemical batch processing systems[2] for a long time. But optimizing sustainability and energy efficiency in various production systems has gained an increased attention in recent years[1, 5]. The aim of this work is to extend the already versatile S-graph framework to be able to solve such problems as well.

2. PROBLEM DEFINITION
The given inputs of the problem are the recipes of the products (P) that have to be produced, the available machines (M), the length of the time horizon (H), the upper limit of total waste production (W^U), and hourly energy availability (E^U). The recipe of product $p \in P$ defines the set of tasks (T^p) to be carried out, their precedence relations ($R \subset T^p \times T^p$), and their timing and resource parameters.

The set of machines that can execute task t is denoted by M_t. The possible operation modes of executing t by $m \in M_t$ is denoted by O_{tm}. The following task parameters are dependent on the assigned machine and operation mode ($o \in O_{tm}$):

- Duration: d_o
- Hourly energy usage: e_o
- Waste produced: w_o

A solution of the problem assigns a starting time (s_t), machine (m_t), and operation mode (o_t) to each task. A solution is feasible if the following constraints are satisfied:

- Execution periods of tasks assigned to the same machine do not overlap.
- Precedence relations are satisfied, i.e., if $(t, t') \in R$, t' cannot be started before t is finished.
- Every task is finished at time H or earlier.
- Total waste production is at most W^U.
- At any moment, the total energy usage of the tasks being executed is at most E^U.

The goal is to find a solution with minimal total energy usage among the feasible ones.

3. PREVIOUS WORK

This section explains the basics and the recent advancements of the S-graph framework that the proposed approach is based on.

3.1 The S-graph framework

The original S-graph framework[4] was developed for minimizing makespan. The approach uses directed graphs to model (partial) schedules. Task nodes (N^T) and product nodes (N^P) represent the events of starting a task and completing a product, respectively. Arcs denote the order of events, where arc weights are the lower bounds of the time difference between them.

Solution starts with the so-called recipe graph, which only contains recipe arcs (A_1), which denote the technological order (R). Then a branch-and-bound algorithm is used to make assignment and scheduling decisions. Scheduling decisions introduce new ordering between tasks which are modeled by adding schedule arcs (A_2) to the graph. The detailed method of adding these arcs to the graph based on different storage policies, can be found in [4].

An S-graph is denoted as $G(N, A_1, A_2)$, where $N = N^T \cup N^P$. If a cycle is present in the directed graph $(N, A_1 \cup A_2)$, the schedule is infeasible. Otherwise, the length of the longest path in G is a lower bound on the makespan on schedules reachable from it, since scheduling decisions can only add new arcs to G and increase arc weights.

Figure 1 shows an example recipe graph with 3 products, each consisting of 3 consecutive tasks. One fully scheduled S-graph of this example is shown in Figure 2. (Weights of 0 are omitted from schedule arcs.) In a complete schedule, the processing order of tasks assigned to the same machine must be decided by the directed arcs. In Figure 2 for example, the task order of machine E1 is 1-9-7.

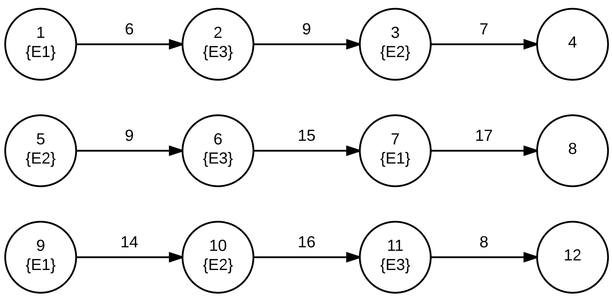

Figure 1: A recipe graph

3.2 MMRCPSP with S-graphs

The limited energy availability constraint is equivalent to the resource constraints used in the well-known Resource-Constrained Project Scheduling Problem (RCPSP), as energy can be regarded as a renewable resource. The S-graph framework has been previously extended[6] to the Multi-Mode RCPSP (MMRCPSP), where tasks can have multiple possible operation modes with varying duration and resource usage, just like in the currently investigated problem.

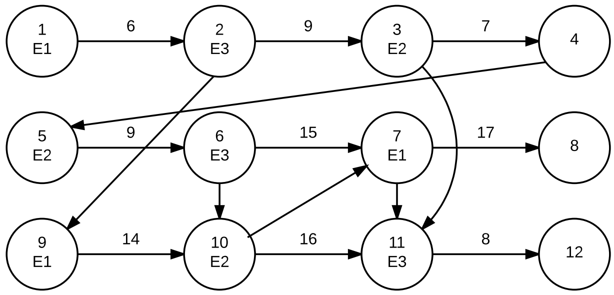

Figure 2: A fully scheduled S-graph

In a resource-feasible schedule, the total resource usage of tasks being executed at the same time cannot exceed the resource capacity. To avoid situations where the capacity may be exceeded, each minimal violating set of task-mode assignments is identified at the start. During the solution process, scheduling arcs are inserted in such a way that a violating set of tasks will not be executed at the same time.

3.3 Minimizing a cost function

Even though the original objective of the S-graph framework is makespan minimization, it can be used for cost minimization with a modified bounding method, while timing information can be used for feasibility constraints or cost calculation. This modification was shown[3] on a crew scheduling problem with routing and lateness penalties. Because of travel and penalty costs, that approach used a bounding method to approximate costs of future decisions. For the current problem, approximation is simpler, as only energy costs are considered, and cost is not affected by timing related decisions, only by unit assignments and operation mode selections.

4. PROPOSED APPROACH

The amount of consumed energy depends on the chosen machines and operation modes only, while timing decisions affect the feasibility of a solution. A two-step optimization method could be used to sort the solutions of the assignment problem by increasing energy usage, then try to find a feasible schedule for each, in order. The first feasible schedule found would be the optimal solution. This approach is good if the problem is not very tightly constrained, and a feasible schedule can be found among the first subproblems. However, there is a lot of redundancy in finding a feasible schedule for subproblems with very similar task-machine-mode assignments.

In the following, an integrated approach is presented, where assignment and scheduling decisions are made at the same level. This approach consists of 3 major modifications to the original S-graph solution method. They are detailed in the following subsections.

1. Minimal Resource Incompatible Sets (MRISs) are generated at the start of the solution process, and their status is maintained in the search according to the decisions made by branching.

2. The branch procedure makes assignment and scheduling decisions until the machine and operation mode is determined for each task, and every remaining MRIS is resolved by additional scheduling arcs to prevent parallel executions of their members.
3. Lower bound of a partial schedule is calculated by summing up the energy usages of previously assigned tasks in the chosen operation modes, and considering the minimum energy usage of unassigned tasks among their possible machine and mode assignments.

4.1 Generating incompatible sets

A Resource Incompatible Set is a set of task-machine-mode triplets, whose total resource (energy) usage exceeds available resource capacity, and the tasks are unique. It is an MRIS if no proper subset of it has the same property. Therefore, choosing any 2 tasks from an MRIS and prohibiting their parallel execution avoids resource violation by that particular MRIS (and possibly by other ones as well).

For efficient generation of the MRISs, a constraint programming (CP) model is used. Finding all feasible solutions of the following CP model provides all MRISs:

$$\sum_{m \in M_t} \sum_{o \in O_{tm}} x_{tmo} \leq 1 \quad \forall t \in T \tag{1}$$

$$\mathit{waste} = \sum_{t \in T} \sum_{m \in M_t} \sum_{o \in O_{tm}} x_{tmo} \cdot w_o \tag{2}$$

$$\mathit{usage} = \sum_{t \in T} \sum_{m \in M_t} \sum_{o \in O_{tm}} x_{tmo} \cdot e_o \tag{3}$$

$$\mathit{waste} > W^U \Rightarrow \mathit{infeasible} \tag{4}$$

$$\mathit{usage} > E^U \Rightarrow \mathit{incompatible} \tag{5}$$

$$\mathit{infeasible} \vee \mathit{incompatible} \tag{6}$$

$$\mathit{incompatible} \Rightarrow \sum_{t \in T : m \in M_t} \sum_{o \in O_{tm}} x_{tmo} \leq 1 \quad \forall m \in M \tag{7}$$

$$x_{tmo} \cdot (\mathit{usage} - e_o) \leq E^U \quad \forall t \in T, m \in M_t, o \in O_{tm} \tag{8}$$

$$x_{tmo} \cdot (\mathit{waste} - w_o) \leq W^U \quad \forall t \in T, m \in M_t, o \in O_{tm} \tag{9}$$

In the model, x_{tmo} is the binary membership variable. Constraint (1) ensures that each task appears with at most 1 machine and operation mode assignment in a set. Total waste production and hourly energy usage of the set are denoted by *waste* and *usage* respectively.

Constraints (4-6) state that an MRIS is *infeasible* due to exceeding the waste limit, or *incompatible* due to their hourly energy usage. The mode assignment of tasks in an *infeasible* MRIS is forbidden, at least one task must be executed in a different operation mode. The mode assignments of an *incompatible* MRIS are prohibited, but the tasks cannot be executed in parallel in the given operation modes. As a machine cannot execute multiple tasks in parallel, only those *incompatible* MRISs are considered, where each task is assigned to a different machine, as stated in Constraint (7). Constraints (8-9) ensure that the set is minimal, i.e., removing any member would resolve the incompatibility.

If an MRIS is a singleton, the assignment it contains is forbidden. If a task has no permitted assignments, the problem is infeasible.

Note that machines could be modeled as renewable resources (just like the hourly energy capacity) with 1 unit as capacity and usage for each task. However, that would result in many MRISs with only 2 members, as a machine cannot process more than 1 task simultaneously. Also, the same 2 tasks would be present in multiple MRISs, which only differ in the operation modes. Therefore, machine assignment is handled separately from other resources such as energy and waste.

4.2 Branch-and-bound algorithm

The main solution procedure of the original S-graph approach is only slightly modified, the major differences are in the branching method and bound calculation.

procedure SOLVE
  $\mathcal{I} :=$ **generateMRISs()**
  $S := \{(G(N, A_1, \emptyset), N^T, \mathcal{I}, \emptyset, \emptyset)\}$
  $\mathit{opt} := \infty$
  repeat
    $(G(N, A_1, A_2), N^U, \mathcal{I}', L, X) :=$ **takeOne**(S)
    $b :=$ BOUND$(G(N, A_1, A_2), N^U, L, X)$
    if $b < \mathit{opt} \wedge$ **maxPath**$(G(N, A_1, A_2)) \leq H$ **then**
      if $N^U = \mathcal{I}' = \emptyset$ **then**
        $\mathit{opt} := b$
        $\mathit{optimal\_solution} := (G(N, A_1, A_2), X)$
      else
        $S := S \cup$ BRANCH$(G(N, A_1, A_2), N^U, \mathcal{I}', L, X)$
      end if
    end if
  until $S = \emptyset$
  if $\mathit{opt} \neq \infty$ **then**
    return *optimal_solution*
  end if
end procedure

Remaining decisions consist of both unassigned tasks (N^U) and unresolved MRISs ($\mathcal{I}'$). The longest path is used to determine feasibility, not the objective bound. L contains the most recent (m, t) task assignment for each machine, or $(m, \emptyset)$ if m will not be assigned to any more tasks. X stores the (t, m, o) task-machine-mode assignments.

procedure BOUND$(G(N, A_1, A_2), N^U, L, X)$
  $\mathit{bound} := 0$
  for all $(t, m, o) \in X$ **do**
    $\mathit{bound} := \mathit{bound} + e_o$
  end for
  for all $t \in N^U$ **do**
    $\mathit{bound} := \mathit{bound} + \min_{\forall m \in M_t, (m, \emptyset) \notin L, o \in O_{tm}} (e_o)$
  end for
  return *bound*
end procedure

The bounding function simply sums up the energy usage of the assignments previously made, and increases it with the minimum possible usage of unassigned tasks.

Initially, the BRANCH procedure works in a similar way to the method proposed by Sanmartí et al. [4]: A machine is selected, and new branches are created where a suitable task is added to the end of the machine's production queue (L). In the investigated problem, operation modes introduce new assignment decisions. In the new approach, when the task is assigned to the machine, the operation mode is decided as well, and the resulting (t, m, o) triplet is added to X. This method creates $|O_{tm}|$ new branches for each task $t \in N^U$ that can be executed by the selected machine m, instead of only 1 per task.

Based on the assignment decisions made during branching, the set of MRISs (I) is updated by removing those that are resolved. An MRIS is resolved when either of these conditions are met:

1. It contains the currently scheduled task with a different machine or mode assignment.
2. A new path is created between 2 task nodes that are contained in the *incompatible* MRIS.

Furthermore, *infeasible* MRISs are checked to detect infeasible assignments.

After every task is assigned to a machine and operation mode, the only remaining MRISs are the *incompatible* ones, that contain the same assignments that have been made at the branching steps leading to the current node. In such a node, the Branch procedure selects one of the remaining MRISs, and introduces precedence relations between its members. A new branch is created for every ordered pair of the member tasks, where a schedule arc is added between the respective task nodes.

5. CONCLUSIONS

Previous extensions of the S-graph framework have been combined and further extended to provide a theoretical approach for solving energy minimization problems. The presented method can be generalized further to handle limits for separate waste types, additional utilities and resources, and multiple cost coefficients in the objective function.

6. ACKNOWLEDGMENTS

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Statistics-based chain code compression with decreased sensitivity to shape artefacts

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ABSTRACT
Chain codes compactly represent raster curves. To further improve the compression, several statistics-based techniques assign shorter extra codes to frequent pairs of consecutive symbols. We systematically extend this concept to sequences of up to six symbols. A curve may thus be described by exponentially many overlapped chains, and the dynamic programming is proposed to determine the optimal one. We also propose utilization of multiple averaged hard coded pseudo-statistical models, since the exact statistical models of individual curves are huge and may also significantly differ from each other. A competitive compression efficiency is assured in this way and, as a pleasant side effect, it is less affected by the shape, rasterization algorithm, noise, and resolution, than in other contemporary methods.

Categories and Subject Descriptors
F.2 [**Theory of Computation**]: Analysis of Algorithms and Problem Complexity; I.4.2 [**Computing Methodologies**]: Image Processing and Computer Vision—*Compresssion (Coding)*

General Terms
Algorithms, Performance, Theory

Keywords
Chain code, dynamic programming, pseudo-statistical model

1. INTRODUCTION
Chain codes compactly describe raster curves. More than half a century ago, Freeman [3] used symbols $s_i \in [0 .. 7]$ to represent each curve pixel p_i with the azimuth direction from its predecessor p_{i-1}, measured anticlockwise from the positive x-axis. Several alternative chain codes were later introduced, but the concept remains the same as in the pioneering Freeman chain codes in eight or four directions (F8 and F4): symbols from a small alphabet are assigned to subsequent primitives along a curve. A primitive may refer to a curve pixel (as in F8), a vertex between the considered curve pixel and adjacent pixels (Vertex Chain Code – VCC [2], or Three-Orthogonal chain code – 3OT [10]), an edge separating the curve pixel from a background pixel (Differential Chain Code – DCC [9], or a rectangular cell of pixels (in quasi-lossless representation from [9]). Meanwhile, a symbol models some local geometric relation e.g. relative position of the observed primitive with respect to the previous one.

All these basic representations are efficient, as they use only 2 or 3 bits per primitive instead of coding grid coordinates with, e.g., $2 \cdot 16$ bits per pixel. Nevertheless, numerous methods have been proposed to additionally compress raster curves. Statistical coding is often utilized when the symbols' probability distribution is significantly non-uniform. Further advances in statistics-based approaches were achieved by introducing extra symbols for frequent pairs of primitives [8, 7], or by utilization of multiple statistical models in the context-based approaches [1]. On the other hand, non-statistical methods perform various string transformations [11, 12], e.g. Burrows-Wheeler Transform (BWT) or Move-To-Front Transform (MTFT) to increase the number of zeros and prepare the data for run-length encoding (RLE) and/or binary arithmetic coding (BAC).

In this paper, we introduce a new statistics-based approach where symbols may represent sequences of up to six primitives. Our aim was to achieve a competitive compression efficiency, but an interesting pleasant side effect was brought into focus during the method development. Namely, influences of the curve shape, rasterization, noise, geometric transformations, and image resolution on the compression ratio are significantly reduced in comparison to other contemporary methods. This problem has been so far addressed indirectly within the context-based approaches, while it was completely neglected in other related works. Section 2 illustrates the overall idea of the proposed approach, while Section 3 describes the preparation and utilisation of multiple averaged hard coded pseudo-statistical models, crucial for the minimization of the aforementioned influences. Section 4 experimentally confirms the compression efficiency and the reduced dependence on artefacts of the input curve. Finally, Section 5 briefly summarizes the presented work, and discusses some challenges for the future research.

2. NEW CHAIN CODE METHOD

Some years after F8 and F4, Freeman proposed the chain-difference coding (CDC) [4]. A pixel p_i is coded with the angle difference $\angle(p_i - p_{i-1}, p_{i-1} - p_{i-2})$. Unlike F8 where all symbols have practically the same probabilities, the 0° angle difference is usually much more frequent than other 7 symbols, providing a good basis for statistical coding. However, some tens of bits have to be spent to store the best-fitted statistical model (BFSM) for an individual curve, which is, particularly with shorter curves, not negligible. Liu and Žalik [6] presented the directional difference chain coding (DDCC), where CDC BFSMs of over 1000 training curves are averaged into a suboptimal hard-coded statistical model (HCSM), which is then used for compression in non-training use cases. Some years later, the compressed DDCC (C_DDCC) [7] was introduced, where three extra symbols for usually frequent pairs (±45°, ∓45°) and for sequences of 12 to 27 zeros were added to HCSM. We take a step forward by systematically extending the DDCC coding scheme with extra codes for sequences of up to six symbols. The proposed method consists of two separate phases.

1. The training phase provides a representative repertoire of training curves, extracts the BFSM for each curve, classifies BFSMs with respect to some measurable curve artefacts, and then derives HCSMs by separately averaging BFSMs within the classes. The detailed description follows in Section 3.
2. The exploitation phase analyses the input curve in order to heuristically select the most appropriate of the stored HCSMs. The chosen HCSM is then utilized to compress the curve. The main challenge in designing this phase is the strategy for determination of the optimal sequence (chain) of codes, which is emphasized in the following paragraphs.

The existing chain code techniques construct the chain of codes by a greedy algorithm. A raster curve is parsed primitive by primitive, and each of them is immediately coded either alone or as a member of some longer pattern. If different possibilities for coding a primitive exist, the predefined priority is decisive. In C_DDCC, for example, extra codes for (±45°, ∓45°) pairs have higher priority than the corresponding single-pixel codes. However, such priority-based greedy algorithms cannot be simply adjusted to efficiently handle higher number of extra codes for longer patterns of symbols. In the proposed approach, each pixel can be coded with its own code or, theoretically, with one of 20 codes of longer sequences. These include two pairs, three triplets and so on till six sextets. A longer context of patterns before and behind the considered symbol determines which of these possibilities shall be used to code the pixel. We therefore have a combinatorial optimization problem where we look for an optimal chain from a large set of multiply overlapped chains. Unlike greedy algorithms, we found dynamic programming capable to provide an optimal choice. Its utilization also facilitates the so-called context dilution problem [1, 7]. Namely, introduction of extra codes for longer patterns of symbols usually extends the codes of several symbols and other patterns.

The proposed dynamic programming approach is adaptation of the so-called exon chaining algorithm from the field of bioinformatics, the simplest of the so-called similarity-based gene prediction approaches [5]. The vertices $v_1, ..., v_n$ of the weighted dynamic programming graph represent pixels along the curve, and edges correspond to chain codes. An edge from v_i to v_{i+1} represents a single-pixel code of v_i, and an edge from v_i to $v_j, i < j-1$, represents a joint code of pixels $v_i, ..., v_{j-1}$. Weights $w_{i,j}$ represent bit lengths of the corresponding Huffman codes. Let $IN(i)$ represent the set of left ends of all graph edges with the right end v_i. The dynamic programming algorithm computes the total weight $s_i = \min_{v_j \in IN(i)}(s_j + w_{j,i})$ of the shortest path from v_1 to $v_i, 1 < i \leq n$. The vertex $pred_i \in IN(i)$, participating to the minimum, is also memorized. The s_n represents the total bit length of the optimal chain, and the chain itself is then reconstructed by following the vertices $pred_i$ from v_n backwards to v_1. Bold edges in Fig. 1 represent the optimal chain for the given example. Patterns $v_1v_2, v_3..v_5$, and $v_6..v_9$ are coded with $4+6+8 = 18$ bits. Although the number of multiply overlapped sequences is exponential (Theorem 1), the optimization runs in linear time (Theorem 2).

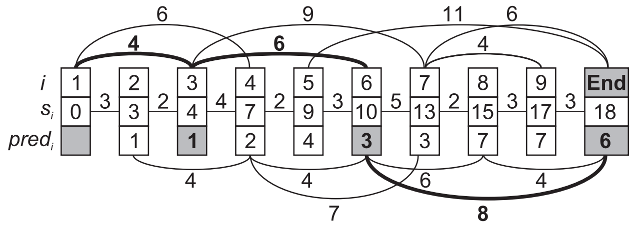

Figure 1: The dynamic programming graph with the optimal chain in bold style.

THEOREM 1. *There are exponentially many multiply overlapped chain code sequences if extra codes for patterns of up to six pixels are used.*

PROOF. Let c_i represent the number of different sequences to code $v_1, ..., v_i$. Each sequence ends with a code for k vertices, $1 \leq k \leq min(i, 6)$, preceded with one of $c_i - k$ possible sequences coding $v_1, ..., v_{i-k}$. Obviously, $c_1 = c_0 = 1, c_2 = c_0 + c_1 = 2, c_3 = c_0 + c_1 + c_2 = 4$, etc. In comparison to the well-known Fibonacci sequence, we have $c_0 = Fib_0, c_1 = Fib_1, c_2 = Fib_2$, and $c_i = Fib_i + f(i), i > 2, f(i) > 0$. As the Fibonacci sequence has the proven exponential growth, the sequence c_i also grows (at least) exponentially. □

THEOREM 2. *Optimal chain detection, based on the dynamic programming, runs in $O(n)$ time.*

PROOF. The cardinality $|IN(i)|, 1 < i \leq n$, cannot exceed 6, as each v_i may only represent the end of patterns of length from 1 to 6. Computation of $s_i, 1 < i \leq n$ thus requires $O(6n) = O(n)$ time. □

3. TRAINING PHASE

To reduce the size of the statistical model and the context dilution effect, we limit the length of patterns with attached codes to 6 pixels. Even in this way, the statistical model

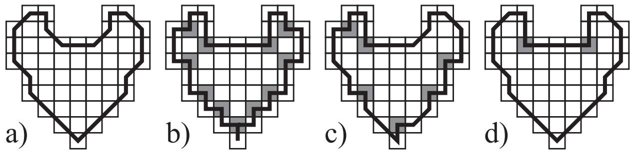

Figure 2: Different levels of forcing the 4-connectivity: a) 0%, b) 100%, c) 50%, and d) special scenario where 4-connectivity requires adjacent edges at least 2 pixels long.

derived from the basic DDCC scheme can theoretically contain $8 + 8^2 + \ldots + 8^6 = 299,592$ entries. Although many of these patterns never appear in practice, and even if we manage to further reduce the model size (to some tens entries in practice), there is the only possibility to use an averaged statistical model (or more of them). Its derivation requires a careful consideration of the following important issues.

3.1 Training set

Whatever averaged statistical model we construct, it cannot equivalently replace the BFSMs of any curve. Although the relative compression ratio to F8 only slightly varies in C_DDCC (between 0.46 and 0.55) and similarly in other existing methods, we must be aware that the training sets and testing use cases in their presentations usually followed some curve creation and rasterization methodology and, thus, they had some evident common artefacts. In C_DDCC tests, for example, there were a huge probability of shorter sequences of $0°$ symbols, relatively high probabilities of $(\pm 45°, \mp 45°)$ pairs, and rather low probabilities of $\pm 90°$ symbols. As the distributions of longer patterns from a bigger repertoire are much less predictable, we decided to use multiple averaged statistical models and, consequently, to cluster the training set and testing use cases with regard to some chosen measurable artefacts. In this manner, the method gains generality, as the compression efficiency becomes less dependent on the curve creation and rasterization methodology. To provide an adequate training set and a relevant mixture of testing use cases, we have implemented a tool with functionalities of image rotation and scaling, manual inversions of binary values of selected pixels, and extraction of the bounding contour of the presented binary object. In this last operation, the parameter "Force 4-connectivity" controls the amount of $\pm 90°$ symbols along the diagonal edges (Fig. 2) and, thus, simulates different rasterization methodologies. Basic shapes used in the training set and testing use cases are shown in Fig. 3, but we actually used a variety of instances of these shapes in different resolutions and orientations, and with different levels of forcing the 4-connectivity.

3.2 Statistical model reduction

To reduce huge amount of data in each BFSM and to mitigate the context dilution effect, a pattern $P = x_1..x_k$ is inserted in the statistical model only if its probability $p_{1..k}$ is higher than the product of probabilities (weighted with w_2) of any sequence of shorter patterns whose concatenation forms P. To prevent insertion of too low probabilities, we use additional threshold w_1. The following statement considers patterns of length $k = 3$.

Figure 3: Examples of training and testing objects.

if $(p_{123} > max(w_1, w_2 * max(p_1p_2p_3, p_1p_{23}, p_{12}p_3)))$
then insert $(x_1x_2x_3, w_3 * 3 * p_{123})$ into BFSM.

For patterns of lengths 2, 4, 5 and 6, additional $1 + 7 + 15 + 31$ products have to be tested. Obviously, the method must first evaluate shorter patterns, as their probabilities are used in acceptance criteria for longer ones. Single-pixel symbols are unconditionally included in the BFSM to provide terminability of the dynamic programming optimization. In current tests, the weights w_1, w_2 and w_3 are set to 0.02, 1.0 and 1.0, respectively, while we intend to determine them heuristically in the future.

3.3 Statistical vs. pseudo-statistical model

We do not wish (and neither we are able) to distribute the probabilities of particular symbols and patterns among different longer patterns, as this would actually lead to the priority-based greedy approach, which we intentionally try to avoid. This means that each symbol participates to probabilities of all the patterns, which include it. We therefore do not deal with true statistical models, as we use weighted probabilities (multiplied with $w_3 * k$). Furthermore, the sum of weighted probabilities in such *pseudo-statistical model* may be theoretically as high as $(1 + 2 + 3 + 4 + 5 + 6) * w_3 = 21w_3$. Nevertheless, all weighted probabilities are involved in a single Huffman tree construction. The best fitted and averaged pseudo-statistical models will be labelled BFPSMs and APSMs in continuation.

3.4 Averaging the pseudo-statistical models

Averaging is a two-stage process. The BFPSMs of the training set curves are first classified with regard to some measured curve artefacts. In each class, the corresponding APSM is then constructed by using the same acceptance criteria as in the BFPSM reduction. During the determination of the BFPSM, we have computed several features of the considered curve that will be used in the future to experimentally select optimal classification criteria. Currently, we use three criteria listed below, each with a single threshold, partitioning the BFPSMs into two classes.

- *Average turn per pixel.* Each $\pm 45°$ symbol participates 1 to this value, $\pm 90°$ symbols participate 2, $\pm 135°$ symbols participate 3, and each $180°$ symbol partici-

Table 1: Compression rate in bits per pixel (*bpp*) of the state-of-the-art (SOTA) and the new method

Object	Transform	Pixels	bpp (SOTA)	bpp (new method)
Bird	100, 0, 0	4080	1.11	**1.03**
Butterfly	100, 0, 0	1122	1.45	**1.33**
Car	100, 0, 0	541	1.48	**1.25**
Circle	100, 0, 0	1831	1.13	**0.99**
Horse	100, 0, 0	2143	1.51	**1.39**
Bird	100, 50, 70	671	1.60	**1.31**
Butterfly	140, 45, 100	2681	1.68	**1.21**
Car	200, 33, 50	1472	1.84	**1.49**
Circle	20, 0, 0	308	1.39	**1.06**
Horse	50, 15, 20	1284	1.93	**1.51**

pates 4. The total sum is then divided with the curve length in pixels. This feature separates smooth curves from more winding and noisy ones. It is also strongly correlated with the (expectedly high) probabilities of 0° symbols and their longer runs.

- *Probability of* $(\pm 45^\circ, \mp 45^\circ)$ *pairs* is higher in curves with oblique segments than in those with mostly axis-aligned and/or ideally diagonal segments.
- *Probability of* $\pm 90^\circ$ *symbols* is closely correlated with the value "Force 4-connectivity", although the latter only controls the amount of concave right angles and does not affect the convex ones.

Three single-threshold criteria result in 8 classes. To mitigate impacts of suboptimal training set, classification criteria and thresholds selection, we use soft borders between the APSMs. Before averaging, each class is extended with the weighted probabilities from BFPSMs of all "adjacent" classes, distinct in one criterion from the considered class.

4. RESULTS

Table 1 shows typical results of our early testings of the proposed method on different instances of some objects from Fig 3. With the basic "user friendly" configurations (the top five lines), the new algorithm is for $10-15\%$ more efficient than the compared methods (3OT, VCC, C_DDCC, and best of MTFT+ARLE [11] variants). This difference increases to $25-40\%$, when more sophisticated configurations with the scaling factor, rotation angle, and/or amount of additional 4-connectivity pixels different from $100\%, 0^\circ, 100\%$, respectively (see column Transform), are considered.

5. CONCLUSIONS

In this paper, we introduce a new statistics-based cain code compression methodology by using multiple averaged pseudo-statistical models correlated with some measurable curve artefacts, and by heuristically selecting the most appropriate model prior to the compression. Furthermore, the introduced models contain systematically inserted extra codes for patterns of up to six symbols, and the dynamic programming approach replaces the common greedy method in order to determine the optimal chain of patterns and corresponding codes. The first results are promising, but there is a plenty of work left in order to ultimately affirm the proposed methodology. Our future goals include among others:

- direct comparison to modern non-statistical methods both, on "standard" and less "user-friendly" cases,
- adaptation of the introduced methodology to other basic chain code representations (VCC, 3OT, F4, F8, and NAD - normalised angle-difference chain code [11]),
- experimentation with varying the classification criteria, number and values of particular classification thresholds, weights in the pattern acceptance criteria, etc.,
- improving the training set and preparation of rich repertoire of benchmarks, and
- RLE codes for longer patterns of zeros.

6. ACKNOWLEDGMENTS

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Conflict Resolving - A Maximum Independent Set Heuristics for Solving MaxSAT

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ABSTRACT
Many combinatorial optimization problems of practical relevance can be formulated as Maximum Satisfiability problems (MaxSAT). There is an easy polynomial reduction from SAT and hence MaxSAT to the Maximum Independent Set Problem (MIS). We propose a fast heuristic algorithm for the MIS called Conflict Resolving (CR) and apply it to transformed MaxSAT instances. The algorithm on the transformed instances performs equally well and sometimes even better than MaxSAT solvers directly applied to the MaxSAT instances do. We prove this with experimental results where we compare our approach to state-of-the-art MaxSAT solvers submitted for the MaxSAT challenges of 2018 and 2019 in the incomplete track.

Categories and Subject Descriptors
H.4 [**Information Systems Applications**]: Miscellaneous; G.2.3 [**Mathematics of Computing**]: Applications; J.6 [**Computer Applications**]: Computer-Aided Engineering

General Terms
Algorithm, Applications

Keywords
Heuristics, Optimization, SAT, Maximum Independent Set

1. INTRODUCTION
There is a wide interest in algorithms that solve SAT and MaxSAT because many practical combinatorial optimization problems can be encoded as such. For example, the Periodic Event Scheduling Problem can be encoded in SAT and solved with the help of fast SAT solvers[8]. Moreover, there are applications in data analysis [4], model checking [5], finding bounds on Ramsey numbers [10] and many more. In this paper, we propose a novel approach for solving MaxSAT instances by reducing them to the Maximum Independent Set Problem (MIS). The reduction to MIS has been studied before [9] but we are the first ones to benefit from the fast MIS heuristic CR. There are also heuristic algorithms for the SAT problems itself [11] but even though our reduction makes the problem instances bigger, with our approach we are compatible and on some instances even better than state-of-the-art SAT solvers.

In the very broad problem class of SAT, one deals with a Boolean formula and the task is to determine whether or not there exists an interpretation of the formula. That is an assignment of true or false to all literals such that the formula evaluates to true. A formula is in conjunctive normal form (CNF) if the literals are grouped in clauses where they are connected with *or* and the clauses are connected with *and*. All SAT instances can be formulated in CNF so we can assume a formula is in CNF. The task is then to fulfill all or as many clauses as possible. The latter case is called the MaxSAT problem. A clause is fulfilled if it evaluates to true. Note that we apply a heuristics so we cannot guarantee optimality for the MIS and hence, not all clauses might be fulfilled. This is why we focus on the MaxSAT problem.

The outline of this paper will be as follows. In the following section, we explain the reduction from SAT to MIS. Then, in Section 3, we sketch our heuristic algorithm. In Section 4, we give experimental results on recent MaxSAT challenges and finally, we give a conclusion and an outlook in Section 5.

2. REDUCTION FROM SAT TO MIS
Given an undirected graph, an independent set is a set of vertices such that no two of them share an edge. It is well known that the MIS is NP-complete [7].

The SAT problem can be reduced to MIS in the following way [9]. Each pair of one clause and one literal gives rise to a vertex. Two vertices are joined by an edge if their literals come from the same clause or if one literal is the negation of the other one. By maximality, an optimal solution of the MIS assigns one literal from each clause, if possible. Hence, a maximum independent set yields an interpretation of the formula where maximally many clauses are fulfilled. For the backwards transformation, each vertex from the independent set stands for some literal which is the value in the

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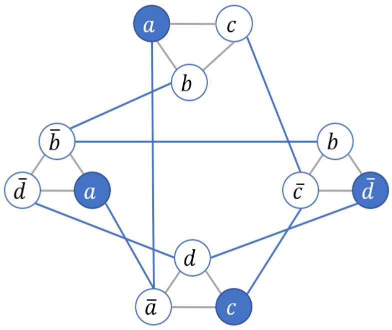

Figure 1: Example SAT to MIS

SAT solution. Note that if a literal is chosen, then its negation cannot be in the independent set which ensures that the MIS solution yields a feasible SAT solution.

Example.

$$(a \vee b \vee c) \wedge (b \vee \bar{c} \vee \bar{d}) \wedge (\bar{a} \vee c \vee d) \wedge (a \vee \bar{b} \vee \bar{d})$$

In this example taken from [6], we are dealing with 4 clauses and 4 literals. In Figure 1, see the graph reduced from the example. In blue, we have marked an independent set of size 4. This implies that all 4 clauses are fulfilled. The SAT solution reads a and c is true, d is false and b can be either true or false, which does not change the objective value.

It is clear that this reduction can be done in polynomial time as there are number of literals times number of clauses many vertices in the reduced graph.

As in our case we cannot guarantee optimal solutions for the MIS, we can only find feasible solutions that fulfill many of the clauses. Hence, we cannot deal with hard clauses that necessarily have to be fulfilled. Therefore, we only consider instances with merely soft clauses which are called MaxSAT instances and are also widely studied.

3. CONFLICT RESOLVING ALGORITHM

We propose a fast heuristic algorithm for solving the MIS called Conflict Resolving (CR). The algorithm locally improves the solution by iteratively picking a non-solution vertex and trying to include this vertex in the solution. Therefore, its solution neighbors have to be replaced by their non-solution neighbors not incident to any other solution vertex. If this step can be performed, the solution size has grown by 1 without violating the property of an independent set.

In Figure 2, see how such an improvement can be performed. The root vertex in the middle is considered to be inserted into the independent set. Therefore, its blue neighbors need to leave the independent set, but must be replaced by one non-solution neighbor each, highlighted with a shallow blue. Of course, the replacement can only be performed if these vertices do not have a second neighbor in the solution set and there is no edge among them not to the root.

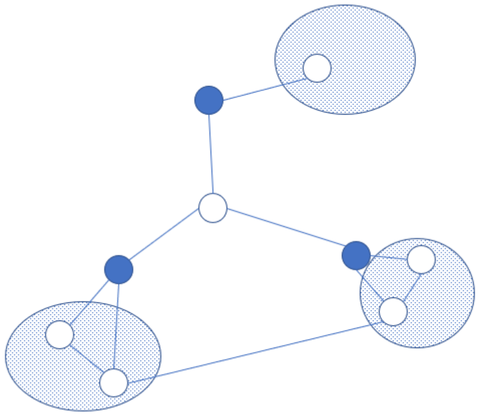

Figure 2: A root vertex to be improved (in the middle), its solution neighbors (blue), and their children, possibly replacing their parents.

After iterating over all non-solution vertices, we have arrived in a local maximum. In order to be able to leave it for a better solution, we additionally deploy a perturbation step in the beginning of the algorithm where a random vertex is forced into the solution, leading to its solution neighbors to leave the solution. Since this might worsen the solution, we embed the algorithm in a simulated annealing framework and allow this worsening only with a probability that gets smaller the later the phase in the algorithm. Else, we restore the previously found best solution.

In Algorithm 1, see the overall procedure of perturbation, improvements and solution checking until some maximum of iterations is reached. This pattern is inspired by a state-of-the-art MIS heuristic proposed by Andrade et al. [3] but they use different solution checking and improvement procedures.

Algorithm 1 ConflictResolving()

while *iteration limit has not been reached* **do**
  Perturb solution by brute force insertion of one vertex
  Improve solution by replacing k by $k+1$ vertices everywhere possible
  Check solution and allow worsening with decreasing probability
end

4. EXPERIMENTAL RESULTS

As testing instances, we use those instances of the MaxSAT Challenges 2018 [1] and 2019 [2] with merely soft clauses. All these instances are derived from various real-world applications such as timetabling or scheduling and general problems such as mincut, treewidth computation and many more.

We have applied the reduction from MaxSAT to MIS and subsequently applied the CR algorithm. The numbers in Tables 1 and 2 show the number of soft clauses violated per instance. Hence, the lowest value is the best result. All runs have a time limit of 300 seconds for the 2018 instances and 60 seconds in the 2019 case. We have performed all our computations on an Intel(R) Core(TM) i7-8700K. As the

Table 1: Results from 2018 with 300 seconds computation time

Benchmark (number of soft clauses)	RC2-B	RC2-A	maxino	MaxHS	Open-WBO-Gluc	Open-WBO-Riss	LMHS	QMax-SAT	CR
maxclique-brock800-2 (800)	782	780	780	782	780	781	781	781	**779**
maxclique-p-hat1000-1 (1000)	991	**990**	**990**	991	**990**	**990**	**990**	**990**	**990**
maxclique-p-hat1000-2 (1000)	958	**954**	955	959	959	960	960	960	**954**
set-covering-scpclr11 (1353)	**23**	**23**	26	**23**	31	30	34	32	33
set-covering-scpclr12 (2542)	**23**	26	26	**23**	33	33	35	35	35
set-covering-scpclr13 (4810)	29	**28**	29	29	35	34	34	34	35
set-covering-scpcyc06 (432)	**60**	**60**	**60**	**60**	72	71	71	74	61
set-covering-scpcyc07 (1120)	150	**144**	151	150	192	203	199	187	151
set-covering-scpcyc08 (2816)	357	**346**	389	356	448	552	573	488	360
set-covering-scpcyc09 (6912)	830	**805**	1285	828	1024	1343	1321	1150	843
set-covering-scpcyc10 (16640)	1916	**1890**	5540	1915	2304	11401	3685	2626	1926
set-covering-scpcyc11 (39424)	4320	**4282**	28160	4320	5120	27951	7495	8779	4371

CR is a randomized algorithm, we started 3 runs each and display the mean here.

See the results in Tables 1 and 2 for instances from 2018 and 2019, respectively. We see that our approach yields compatible results and often even the best solution. While in the 2018 instances, our results are the best for all Maximum Clique (MC) instances and not much behind the winning algorithm of the other ones, in the 2019 challenge we even achieve the best result in almost half of the cases. The only instances where our approach performs poorly are the instances for bounding a Ramsey number, such as ram-k4-n20. We firstly conclude that our approach performs best on MC instances which is a similar problem to MIS. Secondly, CR outperforms other solver when the time is limited as we compete better within 60 than 300 seconds.

5. CONCLUSION AND OUTLOOK

We have seen that reducing MaxSAT instances to MIS and then solving it with CR is similarly good and often even better in terms of good results in short time compared to state-of-the-art MaxSAT solvers.

As an outlook, it would be interesting if we can include hard clauses in our MIS heuristic. We think that this will not be a trivial task as for the MIS, one can always find a feasible solution, the empty set for instance. Finding a feasible solution for SAT, however, is NP-complete. In this respect, exact algorithms might be the better choice.

Finally, there are many problem specific instances from real-world applications that are encoded in SAT. We think that often, it would be even faster to find a direct encoding of the problem as a MIS instead of the proposed reduction. We plan to enable CR to identify instances that can be formulated in MIS directly. For example, in the trivial case, when an originally MIS instance is encoded in SAT, the algorithm should not reduce the SAT encoding as described above, but rather identify the MIS as such and solve it immediately.

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Table 2: Results from 2019 with 60 seconds computation time

Benchmark (number of soft clauses)	Loandra	LinSBPS-2018	SATLike	Open-WBO-g	sls-mcs-lsu	sls-mcs	Open-WBO-ms	CR
brock200-1.clq (1132)	180	180	**179**	179	181	181	180	272.5
brock400-2.clq (1188)	258	257	**252**	261	**252**	**252**	256	287
brock400-3.clq (400)	378	377	375	378	378	378	378	**371**
brock800-1.clq (1022)	212	**205**	**205**	224	**205**	**205**	217	235
brock800-3.clq (800)	781	780	**779**	781	782	782	782	**779**
hamming10-4-1024 (1024)	**984**	992	**984**	986	992	992	989	**984**
MANN-a45-1035 (1035)	693	**690**	695	694	693	693	693	691
MANN-a81-3321 (3321)	2225	**2221**	2225	2235	2225	2225	2225	**2221**
p-hat1000-1.clq (1000)	**990**	**990**	**990**	**990**	**990**	991	991	**990**
p-hat1000-3.clq (1000)	935	935	**932**	945	938	938	947	**932**
p-hat500-2.clq (500)	**464**	465	**464**	466	470	470	468	**464**
p-hat700-1.clq (700)	690	**689**	**689**	**689**	691	691	690	**689**
p-hat700-3.clq (700)	642	641	**638**	645	644	644	645	**638**
ram-k3-n10.ra0 (300)	**4**	**4**	**4**	**4**	**4**	**4**	**4**	**4**
ram-k3-n11.ra0 (495)	**7**	**7**	**7**	**7**	**7**	**7**	**7**	**7**
ram-k3-n12.ra0 (715)	**10**	**10**	**10**	12	**10**	**10**	11	12
ram-k3-n13.ra0 (1001	**16**	**16**	**16**	**16**	**16**	**16**	20)	17
ram-k3-n14.ra0 (1365)	**21**	23	**21**	27	**21**	**21**	27	23
ram-k3-n15.ra0 (1820)	**30**	31	**30**	31	**30**	**30**	35	33
ram-k3-n16.ra0 (2380)	40	40	**39**	41	**39**	**39**	47	43
ram-k3-n17.ra0 (3060)	58	**50**	**50**	51	**50**	**50**	61	65
ram-k3-n18.ra0 (3876)	63	**60**	**60**	92	**60**	**60**	98	80
ram-k3-n19.ra0 (4845)	84	76	**75**	83	**75**	**75**	126	95
ram-k3-n20.ra0 (5985)	102	95	**90**	97	**90**	**90**	124	153
ram-k4-n18.ra0 (6120)	14	11	**9**	31	**9**	**9**	29	22
ram-k4-n19.ra0 (7752)	25	18	**15**	80	**15**	**15**	42	46
ram-k4-n20.ra0 (9690))	37	33	**24**	116	**24**	**24**	67	85
sanr200-0.9.clq (200)	162	160	**158**	162	160	160	161	**158**
sanr400-0.5.clq (400)	388	388	**387**	388	389	389	388	**387**
sanr400-0.7.clq (400)	380	**379**	**379**	380	382	382	381	**379**
scpclr11-maxsat (1353)	29	26	24	36	**23**	**23**	35	32
scpclr12-maxsat (2542)	29	29	28	40	28	**23**	40	35
scpclr13-maxsat (4810)	**28**	29	30	45	30	29	45	35
scpcyc06-maxsat (432)	**60**	62	**60**	73	**60**	61	73	**60**
scpcyc07-maxsat (1120)	**149**	151	158	191	153	154	204	152
scpcyc08-maxsat (2816)	385	410	392	490	366	364	557	**357**
scpcyc09-maxsat (6912)	960	1387	838	1077	838	**831**	1316	839
scpcyc10-maxsat (16640)	2253	5540	1936	2497	1925	**1920**	7728	1930
scpcyc11-maxsat (39424)	5793	28160	4352	28160	4321	**4321**	28160	4379

Combining algorithms for vertex cover and clique search

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ABSTRACT

We look closely to two NP-hard problems, the minimum vertex cover and the maximum clique problem. Strictly from mathematical point of view they are absolutely the same problem. Interestingly some algorithms are better for the first one and other for the second one. Why is there such a difference? Can one make a better algorithm by combining the two approaches?

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous; D.2.8 [**Software Engineering**]: Metrics—*complexity measures, performance measures*

General Terms

Theory

Keywords

minimum vertex cover, maximum clique, kernelization

1. INTRODUCTION

Let $G = (V, E)$ be a finite simple graph. The graph does not contain any double edges and the graph does not contain any loops. Let $G' = (V, E')$ be the complement of G, that is iif $x, y \in V, x \neq y, \{x, y\} \notin E$ then $\{x, y\} \in E'$

The subgraph Δ of G is a clique in G if each two distinct nodes of Δ are adjacent in G. The number of nodes of Δ is called the size of the clique Δ. A clique Δ is a maximum clique in G if G does not contain any clique whose size is bigger then the size of Δ. A usual task is to find the size (and possibly show an example) of a maximum clique. It is an empirical fact that finding cliques in a given graph has many applications inside and outside of computer science [2, 8, 11, 13, 3, 15, 18].

A set of nodes C of G' is a vertex cover of G', that is each edge of the graph G' is incident to at least one node of the set. A vertex cover C is a minimum vertex cover if there is no smaller vertex cover. A usual task is to find the size (and possibly show an example) of a minimum vertex cover.

2. COMPARING VERTEX COVER AND CLIQUE SEARCH

As it is well known, if C is a vertex cover of G' then $V \setminus C$ is an independent set in G', and so a clique in G. Also, vice versa, if Δ is a clique in G, and so an independent set in G', then $V \setminus \Delta$ a vertex cover in G' [10]. Consequently, if C is a minimal vertex cover of G' then $V \setminus C$ is a maximum clique in G, and vice versa. This observation makes the two problems exactly the same from mathematical point of view.[1] Unsurprisingly the decision version of these problems are both listed among Karp's original 21 NP-complete problems [10].

The message of the mathematical equality says that one could freely use a maximum clique search program for finding minimum vertex covers or the other way around. Surprisingly T. Akiba and Y. Iwata in [1] found the opposite. They compared a Branch and Bound algorithm of their own, a known ILP formulation solved by CPLEX and a maximum clique search program MCS by Tomota et al. They used real large sparse network examples that often used in vertex cover comparisons and graphs from the second DIMACS challenge often used in maximum clique comparisons. They found the two approaches (their own and CPLEX being one and MCS the other) work better on "their own" instances. "We first observe that B&R and CPLEX clearly outperform MCS on real sparse networks. (...) In contrast, on DIMACS instances, as it is tailored to these instances, MCS generally works better." Note, that the differences are not small but extremely big, and almost without counterexamples. There were instances that one approach could solve in couple of seconds while the other approach could not solve in 24 hours and vice versa.

To resolve the contradiction one can consider three possibilities: 1) against the above facts there are major differences between the two problems; 2) there are no differences, but the usual tests are different in some ways; 3) there are no differences, but the algorithmic approaches are different. We believe that 2) was true from the beginning, and therefore, as a consequence 3) became true as well. Mainly,

[1]There are differences from point of view of parametrized complexity and approximability, but these differences are out of the scope of this paper.

the clique search programs usually deal with small hard instances, while the vertex cover community deals with huge but somehow easy instances. The vertex cover search is done with lots of preconditioning, nowadays called kernelization. This reduces the original instances to a smaller kernel, which is the really hard part of the problem. So this community is focused on and strong in regard of reducing the problems. The clique search community faces problems that are hard to precondition, so they are much stronger in dealing with the hard problems themselves. If our belief is true, then it explains the extreme difference in the T. Akiba and Y. Iwata paper. The vertex cover solvers far from perfect when dealing with really hard problems. Also, the clique search programs simply do not try to do any preconditioning and so fails to deal with huge graphs.

If our belief is true, then the combination of the two approaches could be good in both scenarios. As it turns out that is exactly the case, as it will be shown. We added to our maximum clique search program [17] – slightly upgraded – some kernelization steps. The resulting program turned out reasonably competitive in both scenarios.

The structure of the paper as follows. First, we detail the used kernelization methods, which should reduce the problem. Second, we shortly describe our maximum clique search program, which deals with the hard kernel. Third, we discuss the results of the combined program.

3. USED KERNELIZATION METHODS

3.1 Dominance

First, we used the method called dominance. That is two nodes v and x are not connected, but the neighborhood of x is included in the neighborhood of v, then v dominates x and x can be deleted.

3.2 The "struction" reduction

Second, we used the subset of the method "struction" [7], namely those transformations that would always reduce the size of the graph. Also, we restricted ourselves to transformations that could be implemented by transformations "in place". That is no new nodes needed to be added to the graph.

Note, that the present program tries to be a simple one, so lots of other methods has been left out: magnets, removing unconfined vertices, twins, funnels, desks, also if the graph consists of several components, etc...

In details, the above two approaches lead to these steps:

- Full $(n-1)$ degree node v: it is in the maximum clique (MC), so not in the minimum vertex cover (MVC).
- $n-2$ degree node v (1 non-neighbor): the non-neighboring node is dominated, so can be deleted (in MVC), node v in MC (not in MVC).
- The non-neighbors of a node v are not connected to each other – no edges in the non-neighborhood: the non-neighboring nodes are dominated, can be deleted (in MVC), node v in the MC (not in MVC).
- Node v has degree $n-3$ (2 non-neighbors), which are connected: these nodes can be folded. (The non connected case is a subcase from the previous.)
- Node v has degree $n-4$ (3 non-neighbors – x, y, z):
  1. x, y are connected, z is a singleton: z is dominated, can be deleted (in MVC), x, y can be folded.
  2. x, y and y, z are connected: the two edges both can be folded.
  3. all three nodes are connected: we can fold the x, y, z triangle according to [7].
- If in the subgraph spanned by the non-neighbors of a node all the nodes are degree 1 nodes – that is it has non intersecting edges: we can fold these edges at once.
- If in the subgraph spanned by the non-neighbors of a node there is a star, that is a central node to which all other nodes are connected: we can fold all edges at once.
- If in the subgraph spanned by the non-neighbors of a node v there are singleton nodes (not connected to any other nodes): these nodes dominated by v and thus can be deleted.

3.3 Chromatic degree

Third, we used the chromatic degree of a node. That is we color the graph by any valid coloring, the chromatic degree of a node is the number of colors appear in its neighborhood. If the chromatic degree is less than $k-1$ that means this node cannot be in a k-clique, and so can be deleted – thus it should be in the minimum vertex cover.

4. MAXIMUM CLIQUE SEARCH

As known from the literature (see [6]) one can often build a more efficient parameterized algorithm than a general one. So we followed this path and build our own program named $k$clique, which instead of solving the maximum clique optimization problem deals with the k-clique decision problem. Based on this program we could build a very simple and yet efficient maximum clique search program, which we call $k$clique-sequence. Here we summarize the main properties of this approach. For more detailed description see [17].

The main idea behind our program is the strong reduction of the size of the search tree. For both branching and bounding the choice of searching for k-clique helps us to reduce the search tree. Because we should decide if a k-clique exists we can always bound by the value of k. In details, for branching we can use the value of k as follows. It is well known, that the number of colors from any coloring gives an upper limit for the clique size. Thus if given the value of k and a coloring with c colors ($c \geq k$), then we can choose the smallest $c-(k-1)$ color classes, and use the nodes in them for branching – as a *branching rule*. As a terminology we will call these nodes a k-clique covering node set (KCCNS), as introduced in [16]. The importance of this comes from the nature of the Branch and Bound algorithms. These algorithms sort out the already examined nodes, meaning that they are not taken into account in the future search. Thus if all these nodes are eliminated, then the remaining nodes can be colored with $(k-1)$ colors, so there cannot be any k-clique present. Note, that without the value of k one cannot make this branching rule, and need to branch on all nodes.

Algorithm 1 summarizes our $k$clique algorithm based on this branching rule.

Algorithm 1 $k$clique

Require: $G = (V, E), P = V$
function kCLIQUE(P, k)
  if $k = 1$ **then return** true
  end if
  KCCNS $\leftarrow$ construct a k-clique covering node set
  for all vertex $p \in$ KCCNS **do**
    if kCLIQUE$(P \cap N(p), k-1)$ **then return** true
    end if
    $P \leftarrow P \setminus \{p\}$
  end for
  return false
end function

We used coloring procedure named DSatur due to Brélaz [4] and also used in addition another technique, the Iterated Coloring presented by Culberson [5]. This technique uses reordering of the color classes and using a sequential coloring several times. The result cannot be worse than the previous coloring in terms of the number of colors, but it can be better. The experiments showed, that in fact the iterated recoloring reduces the number of colors quite well in most of the cases [12]. Thus we started from a Dsatur coloring and performed iterated coloring. Our stopping criteria was if the number of colors did not decreased after 1000 iterations, and we used this method on the top of the search tree.

During the Branch and Bound procedure, when there are less and less nodes as we go down on the search tree, we can reuse the coloring of the previous level, and use the repacking feature of the sequential greedy coloring. We sort the color classes by their size, and start a greedy sequential coloring from the biggest color class. As the k-clique covering node set is actually the $c - (k-1)$ sets of smallest color classes, the nodes from them moved ahead to the bigger color classes. This procedure directly reduces the size of the k-clique covering node set and so the branching factor. Our tests showed, that using this method the size of the search tree is comparable with that when we would use a DSatur coloring at each level while greatly reducing the running time.

From previous results [19] on parallel clique search algorithms we concluded, that the ordering of nodes is even more important than it was thought before. It seems that the sequence of the nodes by which we proceed in the branch has a big effect on the search tree size if pruning is present. This was shown for SAT problems [14]. This effect is used by our algorithm, and so it reduces the search space. We use a very basic reordering rule. We proceed with the nodes with the smallest degree in the remaining subgraph, that is, we used sequence of *increasing* node degrees. By doing this we solve first the easier problems and reduce the sizes of the later ones. Although simple and algorithmically cheap this approach had quite a good effect on the size of the search tree.

The structure of our maximum clique problem is extremely simple. First we find an lower bound for the size of the maximum clique. This is done by a simple greedy clique search algorithm. We set k equal to the obtained number plus one and run our $k$clique program with this parameter. If the result was that the graph do contain a k-clique we increased the value of k by one. Repeating this procedure as a sequence our program finally finds the smallest value of k for which there is no k-clique present. Thus $\omega(G) = k-1$. We call this program $k$clique-sequence, see Algorithm 2. Note, that the program calls Algorithm 1 several times.

Require: $G = (V, E)$
function MAIN
  $k \leftarrow$ an lower bound by greedy clique search
  kCLIQUE-SEQ
  Print $k-1$ as the size of the maximum clique
end function

Algorithm 2 $k$clique-sequence

function kCLIQUE-SEQ
  FOUND $\leftarrow$ true
  while FOUND **do**
    FOUND $\leftarrow$ kCLIQUE(V, k)
    if FOUND **then**
      $k \leftarrow k+1$
    end if
  end while
  return k
end function

5. RESULTS AND EVALUATION

Our new program uses a combined algorithm of preconditioning – kernelization –, and the branch and bound approach for the hard kernel. It was compiled for the 2019 PACE exact vertex cover challenge, but this article tries to answer the question if combining the two approaches would result in a solver good for both set of usual test problems.

First, we should check if it is good for minimum vertex cover. On the 2019 PACE competition, which was open for any contestants, the program resulted in third place (76 solved instances from 100), while the second place solved 77, and the first place 87. We also tried the program against some problems listed in the T. Akiba and Y. Iwata [1] paper. We looked at especially hard cases. Some of those we could not solve because of memory limitations – it is obvious for us, that some engineering refinement of our program could eliminate such problems. But one example showed the advantages of the program clearly. We could solve web-Standford graph in 40 minutes, while the best approach was 18 hours. These results clearly show that this approach is fruitful and maybe the desired one for minimum vertex cover.

Second, we also checked our program against the usual maximum clique finding problems. We found little difference from our previous version, but few due to the fact that we inverted the sequence in $k$clique-sequence. (For detailed comparison see [17].) Some tests run faster, a few slower. In fact the reduction played little to no role in solving these instances, explaining why such reductions are usually not implemented in maximum clique search programs. This result clearly says, that our modified program is still very competitive in maximum clique searching.

Summarizing the above, we could show, that the combination of strong reductions as kernelization and a sophisticated branch and bound program for hard kernels can be among best three minimum vertex cover *and* maximum clique search programs at the same time. We should also point out, that all three winners in the PACE 2019 exact vertex cover competition used the same approach and used reduction with a program that was originally designed for maximum clique search. See for details [9].

6. ACKNOWLEDGEMENTS

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Splitting partitions and clique search algorithms

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ABSTRACT
Dividing a graph into two smaller ones in the course of a clique search algorithm is referred to as branching. In the most commonly used clique search procedures the sizes of the resulting subgraphs may widely differ. In an earlier work a novel branching method, the method of splitting partitions, was suggested to overcome this unbalance. The present paper revisits this branching idea. This time we will describe a practical technique to construct splitting partitions. In order to assess the performance of the procedure we carried out numerical experiments.

Categories and Subject Descriptors
H.4 [**Information Systems Applications**]: Miscellaneous; D.2.8 [**Software Engineering**]: Metrics—*complexity measures, performance measures*

General Terms
Theory

Keywords
maximum clique, branch and bound, parallelization

1. INTRODUCTION
Let $G = (V, E)$ be a finite simple graph. Here V is the set of nodes and E is the set of edges of G. The set of edges E consists of unordered pairs of elements of V. The graph G does not have double edges or loops. Both sets V and E have finitely many elements.

A subgraph Δ of G is called a clique in G if two distinct nodes of Δ are always adjacent in G. If the clique Δ has k nodes we will say that Δ is a k-clique in G. A clique Δ is maximal if it cannot be extended to a larger clique in G by adding a node of G to Δ. A k-clique Δ in G is a maximum clique if G does not contain any $(k + 1)$-clique. A graph G may contain maximal cliques of various sizes. But all the maximum cliques of G have the same size. This well defined number is called the clique number of G and it is denoted by $\omega(G)$.

PROBLEM 1. *Given a finite simple graph $G = (V, E)$. Determine $\omega(G)$.*

PROBLEM 2. *Given a finite simple graph $G = (V, E)$ and given a positive integer k. Decide if G contains a k-clique.*

Problem 1 is referred to as the maximum clique problem. It is an optimization problem and by the complexity theory of the algorithms it belongs to the NP-hard complexity class. Problem 2 is referred to as the k-clique problem. It is a decision problem and by the complexity theory of the algorithms it belongs to the NP-complete complexity class. (For further details see [3].) Both problems have many applications and considered to be important problems in theoretical and practical computer science.

Many clique search algorithms used in practice have the following structure. Using relatively inexpensive methods upper and lower bounds for the clique size of the given graph are established. If the lower and upper estimates are equal, then the clique size of the graph is computed. If there is a gap between the upper and lower estimates, then we divide the clique search instance into smaller instances. In short we carry out an optimality test and when this test is inconclusive a branching takes place.

Let $G = (V, E)$ be a finite simple graph. The ordered triplet (P, Q, R) of the subsets $P, Q, R \subseteq V$ is called a splitting partition of the graph G if the following conditions are satisfied.

(1) $P \cup Q \cup R = V$.

(2) $P \neq \emptyset$, $R \neq \emptyset$.

(3) $P \cap Q = P \cap R = Q \cap R = \emptyset$.

(4) $p \in P$, $r \in R$ implies that the unordered pair $\{p, r\}$ is not an edge of the graph G.

Let H be the subgraph of G induced by the set of nodes $P \cup Q$ and let K be the subgraph of G induced by the set of nodes $Q \cup R$. Let Δ be a clique in G. In [5] it was proved that either Δ is a clique in H or Δ is a clique in K. This

Table 1: The adjacency matrices of the graph in Example 1. In the second adjacency matrix we rearranged the rows and columns to make the splitting partition more visible.

	1	2	3	4	5	6
1	×	•		•	•	
2	•	×	•			
3		•	×	•		•
4	•		•	×	•	
5	•			•	×	
6			•			×

	1	5	2	4	3	6
1	×	•	•	•		
5	•	×		•		
2	•		×		•	
4	•	•		×	•	
3			•	•	×	•
6					•	×

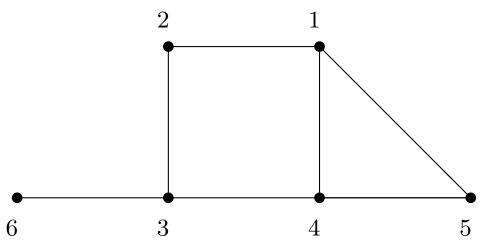

Figure 1: A graphical representation of the graph G in Example 1.

result has the following consequence. If we are looking for a maximum clique in the graph G, then we may restrict our attention to look for a maximum clique in the smaller graphs H and K. The larger are the sizes of the sets P and R the smaller are the subgraph H and K. Thus if we are able to locate a splitting partition in a computationally affordable manner, then this splitting partition maybe used as a branching rule in a maximum clique or in a k-clique search algorithm.

In this paper we will propose a method to locate splitting partitions in a given graph. There is no guarantee that the proposed procedure provides splitting sets with optimal P and R sets. We will carry out numerical experiments to demonstrate that the procedure works reasonably well.

2. THE EDGE AUXILIARY GRAPH

Given a finite simple graph $G = (V, E)$ we construct a new auxiliary graph $\Gamma = (W, F)$. The nodes of Γ are ordered pairs $w = (x, y)$ for which $x, y \in V$, $x \neq y$ and the unordered pair $\{x, y\}$ is not an edge of the graph G. Two distinct nodes $w_1 = (x_1, y_1)$ and $w_2 = (x_2, y_2)$ are adjacent in the graph Γ if any of the following two conditions is satisfied.

(1) $x_1 = x_2$ or $y_1 = y_2$.

(2) $x_1 \neq x_2$, $y_1 \neq y_2$ and the unordered pairs $\{x_1, y_2\}$, $\{x_2, y_1\}$ are not edges of the graph G.

We call the graph Γ the edge auxiliary graph associated with the graph G.

Lemma 1. *If the ordered triplet (P, Q, R) of the subsets $P, Q, R \subseteq V$ forms a splitting partition of the graph G, then the edge auxiliary graph $\Gamma = (W, F)$ contains a k-clique Δ, where $k = |P||R|$.*

Proof. Let us assume that the ordered triplet (P, Q, R) of the subsets $P, Q, R \subseteq V$ forms a splitting partition of the graph G and let us consider the following list

$$(p, r), \quad p \in P, \quad r \in R \tag{1}$$

of ordered pairs. Clearly, the ordered pairs on list (1) are pair-wise distinct and in addition $p \neq r$ holds for each ordered pair. The list (1) contains $k = |P||R|$ ordered pairs. Note that if (p_1, r_1) and (p_2, r_2) are two distinct ordered pairs from the list (1), then they are adjacent nodes of the edge auxiliary graph $\Gamma = (W, F)$. □

Next assume that we have located a k-clique Δ in the edge auxiliary graph $\Gamma = (W, F)$ and the ordered pairs

$$(x_1, y_1), \ldots, (x_k, y_k) \tag{2}$$

are all the nodes of Δ. Let $p_1, \ldots, p_\alpha$ be all the distinct elements among $x_1, \ldots, x_k$ and let $r_1, \ldots, r_\beta$ be all the distinct elements among $y_1, \ldots, y_k$. Set $P = \{p_1, \ldots, p_\alpha\}$, $R = \{r_1, \ldots, r_\beta\}$, $Q = V \setminus (P \cup R)$.

Lemma 2. *With the sets $P, Q, R \subseteq V$ defined above the triplet (P, Q, R) forms a splitting partition of the graph G.*

Proof. Clearly, the conditions (1), (2), (3) in the definition of a splitting partition are satisfied. We need to verify only that condition (4) is also satisfied. Let us consider the following list of ordered pairs

$$\begin{matrix} (p_1, r_1) & \ldots & (p_1, r_\beta) \\ \vdots & \ddots & \vdots \\ (p_\alpha, r_1) & \ldots & (p_\alpha, r_\beta) \end{matrix} \tag{3}$$

arranged into α rows and β columns. The reader will notice that each element of the list (2) appears on list (3). If an ordered pair (p_i, r_j) on list (3) appears on list (2), then we underline the pair (p_i, r_j).

Note that p_1 is equal to the first component of one of the pairs on the list (2). It means that at least one of the pairs of the first row of list (3) is underlined. In general each row of list (3) contains at least one underlined pair. A similar reasoning gives that each column of list (3) contains at least one underlined pair. If the ordered pair (p_i, r_j) on list (3) is underlined, then it is a node of the clique Δ and consequently the associated unordered pair $\{p_i, r_j\}$ is not an edge of the graph G.

We claim that for each ordered pair (p_i, r_j) on list (3) the associated unordered pair $\{p_i, r_j\}$ is not an edge of the graph G.

In order to verify the claim assume on the contrary that there is an ordered pair (p_i, r_j) on list (3) such that the associated unordered pair $\{p_i, r_j\}$ is an edge of the graph G. There is an index t such that the ordered pair (p_i, r_t)

Table 2: The adjacency matrix of the edge auxiliary graph Γ in Example 1.

	1,3	1,6	2,4	2,5	2,6	3,1	3,5	4,2	4,6	5,2	5,3	5,6	6,1	6,2	6,4	6,5
1,3	×	•									•	•				
1,6	•	×			•				•		•	•				
2,4			×	•	•										•	•
2,5			•	×	•		•								•	•
2,6		•	•	•	×				•			•				
3,1						×	•						•			•
3,5				•		•	×						•			•
4,2								×	•	•		•		•		
4,6		•			•			•	×	•		•				
5,2								•	•	×	•			•		
5,3	•	•								•	×	•				
5,6	•	•			•			•	•		•	×				
6,1						•	•						×	•	•	•
6,2								•		•			•	×	•	•
6,4			•	•									•	•	×	•
6,5			•	•		•	•						•	•	•	×

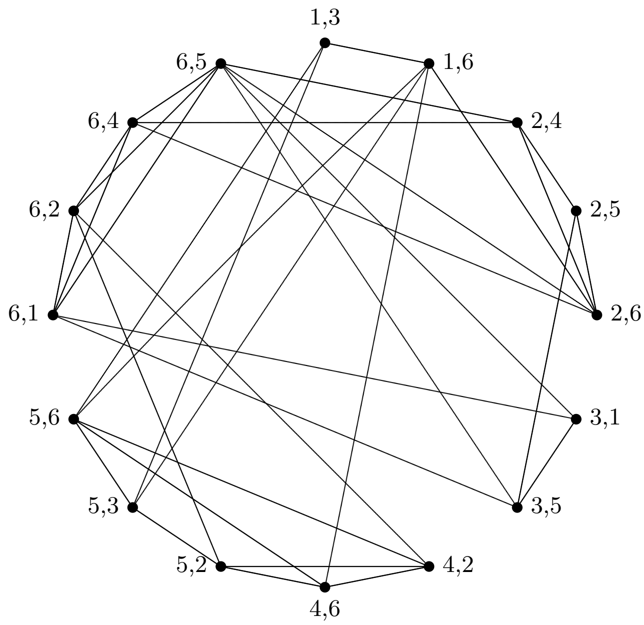

Figure 2: A geometric representation of the edge auxiliary graph Γ in Example 1

on list (3) is underlined. Similarly, there is an index s such that the ordered pair (p_s, r_j) on list (3) is underlined. In this situation the ordered pairs (p_i, r_t) and (p_s, r_j) are nodes of the clique Δ in the edge auxiliary graph Γ. Since the edges (p_i, r_t), (p_s, r_j) are adjacent in Γ, it follows that the unordered pairs $\{p_s, r_t\}$, $\{p_i, r_j\}$ are not edges of the graph G. This contradicts to the fact that the unordered pair $\{p_i, r_j\}$ is an edge of the graph G. $\square$

3. LEGAL COLORING OF THE NODES

In section 2 we have reduced the problem of spotting a splitting partition to the problem of spotting a clique in the edge auxiliary graph. There is a large number of algorithms for locating a not necessarily maximum clique in a given graph. In the literature they came under the name of non-exact clique search algorithms. Coloring of the nodes can be used to locate suboptimal cliques in a straight-forward manner.

The problem of determining the chromatic number of a given graph is an NP-hard problem. (For further details see [3].) It is an empirical fact that legally coloring the nodes of G using not necessarily the optimal number of colors has practical utility. In this paper we will use two approximate coloring algorithms. The first one is is known as the simple greedy node coloring and the second one is the so-called dsatur algorithm. (For further details see [2], [1], [8].)

A legal coloring of the nodes of the finite simple graph $G = (V, E)$ can be conveniently described by a function $f : V \to \{1, \ldots, k\}$. Here the numbers $1, \ldots, k$ stand for the colors and the equation $f(v) = i$ expresses the fact the node v receives color i. The set of nodes $C_i = \{v : \ v \in V, \ f(v) = i\}$ is called the i-th color class. It is the set of nodes of G colored by color i.

It is plain that a color class is an independent set of the graph G. Therefore the elements of a color class form the nodes of a clique in $\overline{G}$ the complement graph of G. So when we are looking for a clique in the edge auxiliary graph to locate a splitting partition we may do this by legally coloring the nodes of the complement of the auxiliary graph. We may pick the elements of any color class as the nodes of a clique.

4. A SMALL SIZE TOY EXAMPLE

In order to illustrate the results presented so far we work out a small size example in details.

EXAMPLE 1. *Let us consider the graph $G = (V, E)$. Here $V = \{1, \ldots, 6\}$. The adjacency matrix of G is depicted in Table 1. Figure 1 shows a geometric representation of G.*

There reader can verify easily that the triplet (P, Q, R) of the subsets

$$P = \{1, 5\}, \quad Q = \{2, 4\}, \quad R = \{3, 6\} \tag{4}$$

is a splitting partition of the graph G. Note that upper right and the lower left two by two sub-matrices are unfilled in the second adjacency matrix in Table 1.

Using the graph G we constructed the edges auxiliary graph Γ. Table 2 displays the adjacency matrix of Γ. The rows and columns of this adjacency matrix are labeled with ordered pairs. In order to avoid an overly cluttered table we suppressed the parentheses when we recorded the ordered pairs. For instance instead of $(1, 3)$ we wrote simply 1, 3. Figure 2 depicts a geometric representation of the edges auxiliary graph Γ.

Next we legally colored the nodes of Γ using the greedy sequential coloring procedure. The color classes are the following

$$\begin{aligned}
C_1 &= \{(1,3),(1,6),(5,3),(5,6)\},\\
C_2 &= \{(2,4),(2,5),(2,6)\},\\
C_3 &= \{(3,1),(3,5),(6,1),(6,5)\},\\
C_4 &= \{(4,2),(4,6),(5,2)\},\\
C_5 &= \{(6,2),(6,4)\}.
\end{aligned}$$

Applying Lemma 2 to the first color class gives the splitting partition based on the subsets (4). Using the fourth color class we get a splitting partition based on the subsets $P = \{4,5\}$, $Q = \{1,3\}$, $R = \{2,6\}$. Although the fourth color class has fewer elements than the first color class the two resulting splitting partitions have the same sizes.

As a last step we legally color the nodes of the edge auxiliary graph Γ. The nodes of Γ can be legally colored using 5 colors. The nodes of a clique must receive pair-wise distinct colors at a legal coloring of the nodes of a graph. This implies that the clique number is less than or equal to the chromatic number for each finite simple graph. Therefore, the clique number of the edge auxiliary graph Γ is at most 5. On the other hand we have located a 4-clique in Γ. The moral of this observation is that a legal coloring of the nodes of the edge auxiliary graph can be used to assess how far is the spotted suboptimal clique, we use to construct a splitting partition, from the optimal clique size.

5. NUMERICAL EXPERIMENTS

For testing purposes we have selected three infinite families of graphs that are connected to the existence and construction of certain error detecting and error correcting codes. The so-called monotonic matrices are in intimate connection with codes over the alphabet $\{1,\ldots,n\}$. Each code words has length three. The problem is to find a code whose inner distance is at least two. (See [6], [7].) The deletion error detecting codes are consisting of binary code words of length n. These words are sent over a noisy channel. Due to transmission error on the receiver side a shorter word may arrive. The task is devise a code that makes possible to detect a one bit deletion error. (For further details see [4].) The Johnson codes we are considering here are binary codes with word length n. Each code word consists of 4 1's and $n-4$ 0's. The Hamming distance of two distinct code words is at least 3.

The results of the numerical experiments are summarized in the Tables 3, 4. We describe the meaning of the entries using the last row of Table 3 as an illustration. A graph G is associated with a monotonic matrix of parameter $n = 6$. The graph has $|V| = 216$ vertices. The associated edge auxiliary graph Γ has $|W| = 11\ 340$ nodes. These numbers occupy the cells in the first three columns of the row. The splitting partition (P,Q,R) we have spotted has the parameters $|P| = \alpha = 9$, $|R| = \beta = 14$ and the last two columns contain these α, β values. This time we used the dsatur coloring procedure to get a legal coloring of the nodes of the edge auxiliary graph Γ.

At this stage we may conclude that the algorithm seems to work in connection with non-trivial size graphs in a reliable manner. Only after working with the algorithm for a longer period of time involving a much wider variety and range of graphs would enable us to assess the merits of the proposed procedure.

Table 3: Monotonic matrices.

n	$\|V\|$	$\|W\|$	α	β
3	27	324	3	4
4	64	1 440	5	6
5	125	4 500	7	10
6	216	11 340	9	14

Table 4: Johnson codes and Deletion error correcting codes.

n	$\|V\|$	$\|W\|$	α	β
6	15	120	2	4
7	35	420	2	5
8	70	1 120	2	6
9	126	2 520	1	20
10	210	5 040	2	8
11	330	9 240	4	4
12	495	15 840	4	5

n	$\|V\|$	$\|W\|$	α	β
3	8	38	3	3
4	16	126	3	4
5	32	382	3	5
6	64	1 086	4	4
7	128	2 942	4	7
8	256	7 678	5	6

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Method for estimating tensiomyography parameters from motion capture data

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ABSTRACT

Tensiomyography is a muscle performance assessment technique that measures its mechanical responses. In this study, we explore a possibility to replace traditional tensiomyography measurement system with motion capture. The proposed method allows for measurement of multiple muscle's points simultaneously, while achieving measurements during a patient's movements. The results show that approximately $5mm$ error is achieved when estimating maximal muscle displacement, while time delay in muscle contraction and contraction time are assessed with upto $20ms$ error. As confirmed by physicians, the introduced errors are with the acceptable margin and, thus, the obtained results are medically valid.

Categories and Subject Descriptors

H.4 [**Information Systems Applications**]: Miscellaneous; I.3.8 [**Computer Graphics**]: Computational Geometry and Object Modeling; J.3 [**Life And Medical Sciences**]:

Keywords

Tensiomyography, marker-based motion capture, 3D points, geometric transformation

1. INTRODUCTION

Tensiomyography (TMG) is a non-invasive mechanomyography method that measures muscle mechanical response based on radial muscle belly displacement induced by electrical stimulus. Measurement unit usually includes an electrical stimulator, data acquisition subunit, a digital sensor, and muscle electrodes [2]. TMG output is a displacement-time curve evaluated with following parameters: Delay time (Td) is a time difference between the electrical impulse and 10% of the contraction, contraction time (Tc) is a time difference between 10% and 90% of the contraction, sustain time (Ts) is a time difference between 50% of the contraction and 50% of the relaxation, and relaxation time (Tr) is a time difference between 90% and 50% of the relaxation and maximal displacement of the muscle contraction (Dm). TMG is used in order to evaluate individual's maximal speed, explosiveness, endurance, and flexibility [13]. It is also applied in training optimization process in order to prevent negative effects of muscle asymmetry and asynchrony on individual's performance [16]. Additionally, after an injury, muscle functional capacity can be assessed using TMG, so that the most effective rehabilitation treatment is administered [17]. In medical research it is used in order to estimate muscle composition [18], for evaluation of muscle atrophy [9], measuring adaptation to different pathologies [10], and in order to determine muscle fiber type composition [6]. However, following TMG drawbacks can be identified: it is a fixed, static tool, which can perform single point measurements [2], [9], reliable measurement is highly dependent on an experienced measurer, since sensor and electrode placement could affect the reliability of the results [18], and measurements are generally performed in a static and relaxed position [2].

In order to address the above-mentioned issues, we propose a method that generates output similar to TMG using a marker-based motion capture. It allows a measurement of multiple points simultaneously, thus reducing the effort required in order to measure muscle contractions. The measurements can be achieved not only in relaxed positions, but also while moving, as control markers are used in order to stabilize limb natural movement in makers. The rest of the paper is organised as follows: a related work is present in Section 2. Section 3 introduces a new method that estimates TMG output from motion capture. The results of proposed method are presented in Section 4. Section 5 concludes the paper.

2. RELATED WORK

Motion capture allows for recording the movement of objects or people. Various marker-based motion capture types exist, such as acoustical systems, mechanical systems, magnetic, and optical systems. All mentioned technologies result in a time series of 3D positions of markers. Focus of this paper is on optical marker-based system. Using cameras, it records motions of special makers attached to an object. There are two types of markers: Passive markers that reflect light generated near cameras lens and active markers that emit their own light. Data captureed from image sensors is used in order to triangulate the 3D positions of a marker between two or more cameras calibrated in order to provide overlapping projections [11]. Motion capture has already been used in the sports, medicine, and entertainment industry for years. In the latter, method for capturing and modelling skin deformation in human motion [14] was proposed. It computes the motion of the skin by segmenting markers into the motion

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of a set of rigid parts and residual deformations in order to animate the natural bending, bulging, and jiggling of the human form. A framework for high-fidelity facial performance acquisition, presented in [12], combines motion capture and 3D data scans in order to automatically select a minimum set of facial expressions by minimizing the reconstruction errors associated with correspondences between the motion capture markers and the face scans.
On the other hand, 3D motion capture Microsoft Kinect was proposed as a tool for gait analysis opposed to Vicon 3D motion capture, used in sport medicine, rehabilitation, and treatment for motor impairments. Captured 3D data was then processed in order to determine the accuracy of each system [15]. Integration of a real-time, interactive biofeedback stimulus from motion capture system was proposed as improvement of anterior cruciate ligament injury prevention and rehabilitation program in [3]. A methodology to preform functional simulations of the hip joint in extreme positions was presented in [4]. The authors of the above mentioned study have shown that active range of motion of the hip joint could be accurately determined with 3D reconstruction from motion capture data, which is difficult to achieve in everyday clinical practice. Hand movement reconstruction based on 3D point transformation of joints was shown as a good tool for clinical application [7]. Marker-based motion capture is frequently used for gait and skeleton analysis in sports medicine as well as for animating 3D objects in entertainment industry. Previously mentioned cases provide a solid foundation for technology used in our example.

3. METHOD

In this section, a method for estimating TMG parameters from 3D motion capture data is presented. The proposed method uses a set of markers in order to trace muscle contraction using motion capture, while TMG parameters are estimated during the following steps:
i) Point stabilization is achieved first in order to compensate for limb natural movements and preserve only those movements that result from muscle contractions.
ii) Construction of displacement-time curves is achieved next by estimating displacement distances from stabilized 3D marker positions. Extraction of TMG parameters is finally achieved based on the estimated displacement-time curve.
Following the description of the mathematical framework, these steps are described in detail.

3.1 Theoretical background

The implementation of the proposed mathematical framework is given in homogeneous coordinate system. This allows for implementing all the used geometric transformations, including translation, by matrix multiplication and, thus, enables efficient utilisation of graphic processing unit (GPU) [8].
Let a set of markers $M = \{{}^t m_i\}$, where ${}^t m_i^T = [{}^t x_i, {}^t y_i, {}^t z_i, 1]$, while i is a markers index and t is the time t of its capture. A vector between points ${}^t m_i$ and ${}^t m_j$ is denoted as ${}^t \vec{v}_{i,j} = {}^t m_i - {}^t m_j$, while its projections to $XY-$ and $XZ-$planes are denoted as ${}^t u_{i,j}^T = ({}^t x_{i,j},\ {}^t y_{i,j}, 1)$ and ${}^t w_i^T = ({}^t x_{i,j},\ {}^t z_{i,j}, 1)$, respectively. A translation for an arbitrary vector ${}^t \vec{v}_T = (x_T,\ y_T,\ z_T)$ is then given by a translation matrix M_T. In addition, rotation matrices $M_{R_y}(\Theta_y)$ and $M_{R_z}(\Theta_z)$ define rotation around $Y-$ and $Z-$axis for given angles Θ_y and Θ_z, respectively [19].

3.2 Point stabilization

In order to account for natural movement of limb, two control markers need to be placed on the limb joints in such a way that they are not affected by the movement of the measured muscles. Thus, they are used for point stabilization and are referred to as control markers defined by the indices $i = 1$ and $i = 2$. A stabilized set of markers can, therefore, be obtained by translating the corresponding control vector ${}^t \vec{v}_{1,2}$ to the origin of a given coordinate system and aligning it with the $X-$axis. Note that latter only requires rotation around $Y-$ and $Z-$axis, while the rotation round $X-$axis can be neglected due to the nature of measurement that limits such limb movements. Thus, a stabilization transformation can be defined by translation for a vector $\vec{v}_T = ({}^t x_1,\ {}^t y_1,\ {}^t z_1)$ and two rotations, defined by rotation angles Θ_y and Θ_z. Note that rotation angles ${}^t\Theta_z$ and ${}^t\Theta_y$ are defined as angles between projected vectors ${}^t \vec{u}_{1,2}$ and ${}^t \vec{w}_{1,2}$ and the $X-$axis, respectively [19]. Point stabilization transformation M_S can then be defined by

$$M_S = M_T({}^t m_1) * M_{R_y}(\Theta_y) * M_{R_z}(\Theta_z) = \begin{bmatrix} cos^t\Theta_y cos^t\Theta_z & -sin^t\Theta_z cos^t\Theta_y & sin^t\Theta_y & {}^t x_1 \\ sin^t\Theta_z & 0 & 0 & {}^t y_1 \\ -sin^t\Theta_y cos^t\Theta_z & sin^t\Theta_y sin^t\Theta_z & cos^t\Theta_y & {}^t z_1 \\ 0 & 0 & 0 & 1 \end{bmatrix}. \quad (1)$$

A stabilized set of markers ${}^T M' = \{{}^t m_i'\}$, where ${}^t m_i' = ({}^t x_i', {}^t y_i', {}^t z_i')$ is, thus, given as:

$${}^t m_i' = M_S * {}^t m_i. \quad (2)$$

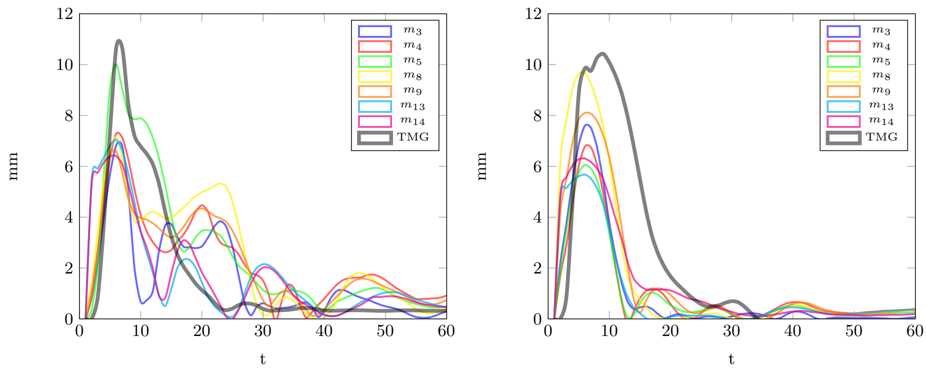
3.3 Construction of displacement-time curves and TMG parameters extraction

The objective of this step is to construct a displacement time curves from ${}^T M'$ and extract the required TMG parameters. As muscle contraction is captured by the movement of stabilised markers, a displacement curve for each marker ${}^t m_i' \in {}^T M'$ is generated by measuring its distance ${}^t d_i$ in time $t > 0$ from its starting point, given at $t = 0$. Formally, a displacement curve is given by a discrete mapping function $D : (t, i) \to \mathbb{R}$ defined by:

$$D(t, i) = \sqrt{({}^0 m_i' - {}^t m_i')^2}. \quad (3)$$

As Eq. 3 cannot produce negative values, it is critical that the initial measurement given at time $t = 0$ is measured in the relax (non-contracted) state of the muscle. $D(t, i)$, thus, provides a set of control points based on which a polynomial interpolation is achieved in order to increase the precision of the estimated TMG parameters. As polynomial interpolation is a well-know problem, it is not further discussed here. Its efficient implementation is described in [5]. Moreover, as explained in Section 1, there are five parameters that can be extracted from a displacement curve, where most of the medically relevant information is contained in maximal contraction Dm, delay time Td, and contraction time Tc. Given an interpolated displacement curve $d_i(t)$, definitions are as follows:

$$\begin{aligned} Dm(i) &= \max_t \ d_i(t), \\ Td(i) &= \arg\min_t(t; d_i(t) \geq 0.1 * Dm(i)), \\ Tc(i) &= Td(i) - \arg\min_t(t; d_i(t) \geq 0.9 * Dm(i)). \end{aligned} \quad (4)$$



(a) (b)

Figure 1: Displacement-time curves from traditional TMG and markers of muscles a) rectus femoris and b) vastus medialis.

Table 1: Results of parameters extraction from selected markers and parameters of traditional TMG.

	Rectus femoris								Vastus medialis							
	TMG	m_3	m_4	m_5	m_8	m_9	m_{13}	m_{14}	TMG	m_3	m_4	m_5	m_8	m_9	m_{13}	m_{14}
Dm (mm)	11.4	6.9	7.5	10.3	7.4	7.0	7.3	6.7	9.9	7.7	7.2	7.2	9.9	8.6	6.2	6.9
Td (ms)	26.1	16.1	7.4	21.7	9.9	17.6	2.2	1.7	25.1	3.9	2.6	7.3	1.0	1.5	2.0	3.1
Tc (ms)	42.9	39.4	44.3	27.8	37.6	27.6	41.4	38.7	30.6	45.7	47.6	38.7	32.5	40.7	38.9	36.5
Dm error		4.5(39%)	3.9(34%)	1.1(10%)	4(35%)	4.4(39%)	4.1(36%)	4.7(41%)		2.2(22%)	2.7(27%)	2.7(27%)	0(0%)	1.3(13%)	3.7(37%)	3(30%)
Td error		10(38%)	18.7(72%)	4.4(17%)	16.2(62%)	8.5(33%)	23.9(92%)	24.4(93%)		21.2(84%)	22.5(90%)	17.8(71%)	24.1(96%)	23.6(94%)	23.1(92%)	22(88%)
Tc error		3.5(8%)	-1.4(3%)	15.1(35%)	5.3(12%)	15.3(36%)	1.5(3%)	4.2(10%)		-15.1(49%)	-17(56%)	-8.1(26%)	-1.9(6%)	-10.1(33%)	-8.3(27%)	-5.9(19%)

4. RESULTS AND DISCUSSION

During the experiment, 3×5 matrix of markers was placed on the quadriceps femoris of the left leg of the tested subject, while two control markers were placed over the trochanter head and lateral condyle (see Fig. 2). Muscles contractions were captured with a Smart-D, BTS s.p.a. motion capture system [1] that consisted of 8 infra-red cameras with 800×600 spatial and 60Hz temporal resolution. Rectus femoris and vastus medialis muscles were stimulated with a single maximal electrical impulse, while control measurements were obtained using a traditional TMG sensor.

The implementation of the proposed method was done using C++ and all the execution times were measured on a workstation with Intel® CoreTM i5$^{\text{TM}}$-8400 CPU, Nvidia GeForce GTX 970 and 16 GB of main memory. As geometrical transformation were implemented on GPU, their computational complexity is $O(n)$, where n is the number of markers (in our case $n = 15$). On the other hand, the complexity of polynomial interpolation which is used in TMG parameter extraction is $O(m^2)$, where m is the number of points used for the interpolation. Thus, the theoretical computational complexity of the proposed method is equal to $O(n * m^2)$.

As shown in Fig. 1, the obtained displacement-time curves display different level of agreement with the control TMG measurement. Higher agreement was detected in cases of markers, placed near to the TMG sensor, namely m_5 in case of rectus femoris and m_8 in case of vastus medialis stimulation. In addition, m_3, m_4, m_9, m_{13}, and m_{14} showed statistically significant correlation (over 0.8) with the control measurements and, thus, TMG parameters extracted from this particular markers were further examined. The obtained results are show in Table 1. When considering Dm and Td of rectus femoris, the lowest error rates were observed in case of m_5 with $1.1mm$ and $4.4ms$ respectively, while error rates between $3.9 - 4.7mm$ in case of Dm and $8.5 - 24.4ms$ in case Td were observed in other cases. On the other hand, Tc related error rates were the lowest in case of m_4 ($-1.4ms$) and the highest in case of m_9 (15.3ms). As with m_5 induced error-rate equal to $5.3ms$. In case of vastus medialis, no Dm error was observed at m_8, while the error rates in other cases ranged between $1.3 - 3.7mm$. On the other hand, m_8 introduced the highest Td error of $24.1ms$. Tc error rates were in the range from $-1.9 - 17ms$, with the smallest related to m_8. According to the evaluation provided by the medical experts, the measured errors were, thus, within the acceptable ranges and can be considered as medically irrelevant. The error of Dm can be explained by the fact that the TMG sensor is slightly pressed into the soft tissue, resulting in small depression at baseline level causing higher value of Dm when a traditional TMG is measured. As expected, there were high errors in Td parameter, since the signals from motion capture and TMG were not properly synchronized. On the other hand, markers m_3 and m_4 registered significant movements, even though they were not placed in the anatomical regions, where contraction of Rectus femoris and Vastus medialis was expected. Such an outcome might have different explanations:

i) strong electrical stimulation can cause the propagation of the electrical stimuli in deeper tissues, causing muscle contraction of adjacent muscles,

ii) the passive mass, represented by inactivated muscles and adipose tissue near the stimulated region can vibrate, causing errors in measurements.

5. CONCLUSION

A new method for estimating TMG parameters from 3D motion capture, proposed in this paper, allows for measurement

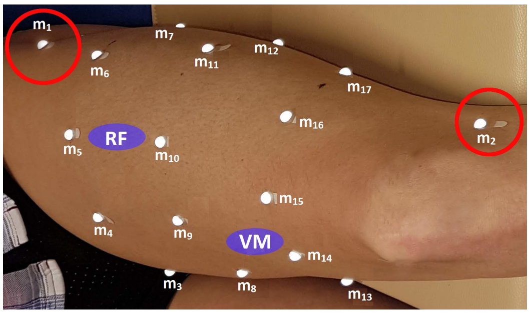


Figure 2: Placement of fifteen markers and two control markers on the subject's leg. Violet area represents placement of TMG sensor during measurement, while red circles indicate control markers.

of TMG parameters at multiple points simultaneously, while measurements can be obtained during the patient's movement. With the error rates of $5mm$ when estimating maximal muscle displacement and upto $20ms$ when estimating delay time and contraction time, the provided results proved to be medically relevant. Nevertheless, selection and a proper placement of markers is required.

One of the future tasks is synchronization of the TMG and motion capture signals that would allow for obtain the exact starting time of muscle contraction and, thus, further improved contraction and delay time assessment. In addition, improved point stabilization with compensating for rotations along X-axis will be considered. Finally, as the described study is only a proof of concept, additional test, together with statistical analysis of the extended results, are required in order to prove its value.

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ParallelGlobal with Low Thread Interactions

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ABSTRACT
Global is an optimization algorithm conceived in the '80s. Since then several papers discussed improvements of the algorithm, but adapting it to a multi-thread execution environment is only a recent branch of development [1]. Our previous work focused on parallel implementation on a single machine but sometimes the use of distributed systems is inevitable. In this paper we introduce a new version of Global which is the first step towards a fully distributed algorithm. While the proposed implementation still works on a single machine, it is easy to see how gossip based information sharing can be built into and be utilized by the algorithm. We show that ParallelGlobal is a feasible way to implement Global on a distributed system. However, further improvements must be made to solve real world problems with the algorithm.

Categories and Subject Descriptors
[**Computing methodologies**]: Optimization algorithms; [**Computing methodologies**]: Parallel algorithms

1. INTRODUCTION
Global is an optimization algorithm built from multiple modules working in an ensemble. While older implementations viewed the algorithm as a whole, the most recent GlobalJ framework handles algorithms as a collection of interlocking modules. GlobalJ has several implementations for local search algorithms and variants of Global. Main characteristics of the single threaded version were established in [4]. In recent years Global was further developed [6] and it has several applications [5, 10] where it aids mostly other research works. To speed up optimization processes we developed an algorithm [1] that is capable of utilizing multiple computational threads of a single machine. It cannot be directly implemented for distributed systems as the millisecond order of magnitude latency in communication would significantly slow down the synchronization of threads. To mitigate this problem we propose ParallelGlobal, a parallel implementation suitable for distributed systems with high latency or even with unreliable communication channels. In this paper we introduce an experimental version whose main purpose is to test the feasibility of the proposed solution. It provides an algorithm skeleton for a real distributed implementation.

2. GLOBAL
Global is a global optimizer designed to solve black box unconstrained optimization problems with low number of function evaluations and probabilistic guarantees [1, 2, 3, 4, 6, 7, 8, 11]. It uses local search algorithms to refine multiple sample points hence Global is a multi-start method. Global also utilizes the *Single Linkage Clustering* algorithm to make an estimation about the value of samples from the aspect of optimization.

2.1 Updated Global Algorithm
While the updated Global algorithm has only minor changes and in a lot of cases performs equally to the original, it is superior in execution order, therefore we consider it as the basis for improvements.

Global has an iterative framework where samples in an iteration compete with samples of previous iterations. The original version contains four phases in every iteration consisting of sampling, reduction, clustering and local search. In the updated algorithm the clustering and local search phases are merged by an implementation alternating between the two.

Algorithm 1 describes the updated Global in detail. In lines 2-5 the algorithm performs the sampling phase. Selection of sample points is stochastic, using uniform distribution in the search space. The generated samples are placed in container S which is a list structure. To find the most promising samples, S is sorted and a reduced set of samples is acquired with the lowest function values. R contains the reduced set, which is removed from S.

When samples are ready to be processed, in lines 6-24 the algorithm alternates between clustering and local searches while there are unprocessed samples left. At 7-15 samples in R are tried against the clustered samples. To determine if $r_i \in R$ is part of cluster C we need the distance threshold d_c. d_c depends on the dimension of the objective function, the number of samples currently known in the clustering process and the $\alpha \in [0, 1]$ parameter. The latter controls the decrease speed of d_c while more samples are added, in order

Algorithm 1 GLOBAL

1: **while** *termination-criteria*() **is not** *true* **do**
2: $S \leftarrow S \cup \{n_i = uniform(lb, ub) : i \in [1, new\ samples]\}$
3: $S \leftarrow sort(F(s_i) < F(s_{i+1})), s_i \in S$
4: $R \leftarrow \{s_i : i \in [1, reduced\ set\ size]\}$
5: $S \leftarrow S \setminus R$
6: **while** R **is not** $\emptyset$ **do**
7: **for** C **in** *clusters* **do**
8: $d_c \leftarrow \left(1 - \alpha^{\frac{1}{|clustered|+|R|-1}}\right)^{\frac{1}{dim(F)}}$
9: $N \leftarrow \left\{r_i : d_c > \|r_i - c_j\|_\infty \wedge F(r_i) > F(c_j)\right\}$
10: **if** N **is not** $\emptyset$ **then**
11: $C \leftarrow C \cup N$
12: $R \leftarrow R \setminus N$
13: **repeat iteration**
14: **end if**
15: **end for**
16: $l \leftarrow$ *local-search*$(r_1 \in R)$
17: $C_l, d_{min} \leftarrow \underset{C \in clusters}{argmin} \left\| l - \underset{c_i \in C,}{argmin}\ F(c_i) \right\|_\infty$
18: **if** $d_{min} < d_c/10$ **then**
19: $C_l \leftarrow C_l \cup \{l, r_1\}$
20: **else**
21: $clusters \leftarrow clusters \cup \{\{l, r_1\}\}$
22: **end if**
23: $R \leftarrow R \setminus \{r_1\}$
24: **end while**
25: **end while**

to adapt to the expected decrease in distance between two random samples. With d_c set, sample pairs ($r_i \in R, c_j \in C$) are evaluated to determine if r_i is part of C. The two criteria are having a clustered sample c_j with lower function value than r_i and it being closer with the infinity norm (Manhattan distance) than d_c. Samples in R satisfying both of them are moved to the current cluster C. When a sample is clustered, all samples in R can potentially be clustered too therefore $r_i \in R$ is rechecked against C. After the *for* cycle finished, samples in R cannot be the part of an existing cluster therefore performing a local search is inevitable.

Local searches are performed in lines 16-23, where l is the local optimum reached from r_1. To determine if l is a newly found local optimum a comparison with the cluster centers is needed. The center of a cluster is the sample in the cluster with the lowest function value. By finding the cluster with the closest center the algorithm can decide if the optimum is already found. If the distance d_{min} to the cluster C_l with the closest center is lower than a tenth of the d_c threshold, it is considered the same local optimum. In this case l and r_1 are added to C_l, otherwise they form a new cluster. Since r_1 is either in an already existing cluster or in a newly created one, we can remove it from R. Lines 6-24 are repeated until R becomes empty. With no unclustered samples left Global finished an iteration. The number of executed iterations is limited by the termination criteria.

3. PARALLEL GLOBAL

Our goal is to derive an implementation from the updated Global which is multi-threaded with low interactions between threads. The necessity for low thread interactions comes from the fact that on huge scale optimization tasks a single computer is not sufficient and in multi-computer environments the communication between machines is relatively slow compared to inter-thread communication. We address this problem by removing the synchronization of computational threads and replacing it with a message based information sharing scheme.

We can view ParallelGlobal as a naive parallelization of Global. The main idea lies in the parallel execution of Global iterations, while sharing information between computational threads. Consequently, inter-thread communication is necessary, however only a few selected data containers have to be shared. Also, the shared containers have independent data points and no deletions, therefore inconsistencies cannot arise from data insertions. These considerations make the algorithm for distributed systems viable.

3.1 ParallelGlobal Worker

Algorithm 2 describes the ParallelGlobal worker which is the implementation of a single computational thread. The worker might run on a machine by itself, or multiple workers can use the multi-threaded environment of a computer.

Algorithm 2 ParallelGlobal

1: **while** *termination-criteria*() **is not** *true* **do**
2: *exchange-data*()
3: $s \leftarrow uniform(lb, ub)$
4: $R \leftarrow reduce\ (\{s\})$
5: $d_c \leftarrow \left(1 - \alpha^{\frac{1}{|clustered|+1-1}}\right)^{\frac{1}{dim(F)}}$
6: **for** C **in** *clusters* **do**
7: $N \leftarrow \left\{r_i : d_c > \|r_i - c_j\|_\infty \wedge F(r_i) > F(c_j)\right\}$
8: $C \leftarrow C \cup N$
9: $R \leftarrow R \setminus N$
10: **end for**
11: $l \leftarrow$ *local-search*$(r_1 \in R)$
12: $C_l, d_{min} \leftarrow \underset{C \in clusters}{argmin} \left\| l - \underset{c_i \in C}{argmin}\ F(c_i) \right\|_\infty$
13: **if** $d_{min} < d_c/10$ **then**
14: $C_l \leftarrow C_l \cup \{l, r_1\}$
15: **else**
16: $clusters \leftarrow clusters \cup \{\{l, r_1\}\}$
17: **end if**
18: **end while**

Similarly to Global, ParallelGlobal also runs in a loop to complete iterations until a termination criterion is met. Unlike Global, the new algorithm needs a data exchange step (line 2). At the start of every iteration, received messages can be processed and new messages can be sent according to a suitable policy. The messages contain evaluated data points arranged into clusters. These clusters can be handled as if they were evaluated locally by clustering the center point (minimum) of the cluster. If the center point corresponds to an existing cluster, the two clusters should be merged while duplicate points are filtered out. Otherwise, the received cluster describes a previously unknown local optimum and it can be added to the existing clusters without modifications.

In lines 3 and 4 happens the sampling and reduction. In previous Global versions sampling and reduction was performed by taking a randomized sample set, then using a sorted sample pool and taking the best samples out. ParallelGlobal cannot utilize a common pool efficiently due to the distributed nature of the system. In this version, for simplicity we envisioned taking a single sample every iteration and using stochastic sample reduction, possibly aided with spatial measures on the samples information value. A more complex but possible solution would be a distributed sample pool. Samples could be transferred between local pools over reliable data connection. This would ensure that a sample is only evaluated by a single worker and would create a bigger variety of samples to choose from.

In lines 5-10 occurs the clustering. It is very similar to the original clustering algorithm. The only change is that we know that no more than one sample is in R. This is also true for the local search (lines 11-17) which is identical with the original local search part.

3.2 Current implementation

The current implementation of ParallelGlobal only simulates the described functionality with some simplification. First, it runs on a single machine with multiple threads as a single program. Second, messaging is simulated by synchronization on the given containers while they are written, but reading operations happen simultaneously. During clusterization, the cluster list is only read to a point determined before the process starts, hence new clusters will be excluded from already started searches. This also resembles the effects of messaging, like delays and losses in information spread. Because no real messaging is present, the *exchange-data*() function is only a placeholder for now. The *reduce*() function is also a placeholder and the subject of further development. Currently, every sample is evaluated by the clustering and local search steps.

4. RESULTS

The algorithm was examined from two aspects; comparison with the updated Global in the number of function evaluations and scaling of run time with additional threads. Numerical results were obtained on the following functions, definitions can be found in [9]. *Ackley*, *Discus*, *Easom*, *Griewank*, *Levy*, *Rastrigin*, *Schaffer*, *Schwefel*, *Shekel-5*, *Shekel-7*, *Shekel-10*, *Shubert*, *Spikes*[1] and *Zakharov*. For the evaluations we used two termination criteria, the maximum number of function evaluations is 10^5 which is a soft condition therefore overshoot is possible. To check whether an optimum point is reached we use the following expression

$$|F(x^*) - F(x)| < 10^{-8} + |F(x^*)| \cdot 10^{-6}$$

where x^* is a known global optimum point and x is the point in question. To emulate computationally more expensive functions we defined the hardness level. A hardness level of h means that the function will be evaluated 10^h times at the requested point. Global is a stochastic optimizer, moreover ParallelGlobal is also affected by the operating systems thread scheduling, consequently run times and the number of function evaluations can differ largely from one optimization process to the other. To reduce the noise induced by this, we obtained data points by averaging the results of 100 runs with every configuration. The algorithm parameterizations were identical except for the number of threads.

[1]Spikes function definition:

$$f(x) = \begin{cases} 1002 + \Pi_{x_i} sin(2\pi x_i), & \text{if } \|x - (15.25, 15.75)\|_2 > \frac{1}{4} \\ 1000, & \text{otherwise} \end{cases}$$

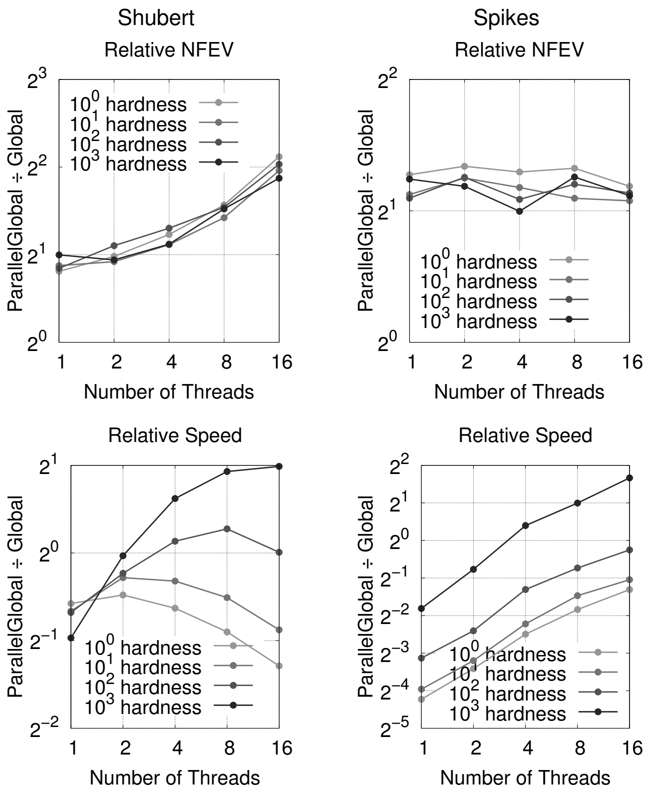

Figure 1: Numeric results on Shubert (left) and Spikes (right) test functions.

On the left side of Figure 1 we show results for the *Shubert* test function, namely the number of function evaluations (NFEV) and the speed of the optimization process, both relative to Global. On the horizontal axes we see the number of threads. The vertical axes show the number of function evaluations and optimization processes run in unit time respectively, both divided by the result of Global on a single core. *Shubert* is a function with many local optima and a flat global trend. In case of Global, NFEV is mostly in the $[500, 2000]$ range with an average of 900. On the top-left graph relative NFEV shows that we have an increase with a factor of two. On a single thread the multiplier of 2 shows that the algorithm is by itself inferior to Global. This static multiplier is explained by the lack of a sample pool which reduces the necessary number of local searches. They create the bulk of the NFEV and while Global uses 1.5 local searches on average ParallelGlobal needs much more. The dynamic growth is also explained by the local searches, combined with multi-threading. Finding the global optimum with local search takes several function evaluations in sequence. Since multiple threads start local searches independently, more evaluations can happen until one of them reaches the global optimum. Moreover when the optimum is found, the program does not terminate immediately, all local searches have to finish. This phenomenon increases the NFEV due to the intrinsic usage of multi-threading and local searches.

The bottom-left graph of Figure 1 shows the speedup with additional threads and different hardness values. While for hardness 0 and 1 the additional threads caused a slowdown due to synchronization time and increased NFEV, on computationally more demanding versions we achieved a significant speedup. The results are promising because for the hardness value of 3 on a single thread a function evaluation took only 650μs on average. With higher evaluation times, the addition of computational power would have more effect.

On the right side of Figure 1, we show the results for the *Spikes* test function which also has many local optima and a flat global trend. ParallelGlobal suffers from the lack of a sample pool on the *Spikes* function too. On the other hand, no dynamic change in NFEV is experienced. Without a sample pool, ParallelGlobal had a much harder time finding the global optimum, which would often exceed the 10^5 NFEV limit. This resulted in close to constant NFEV and no saturation of threads. Based on the relative speed graph, we gain speed linearly with additional CPU power in every hardness level. Since the function is very cheap to evaluate and ParallelGlobal has to do much more evaluations, only hardness 3 gives an advantage to the multi-threaded implementation.

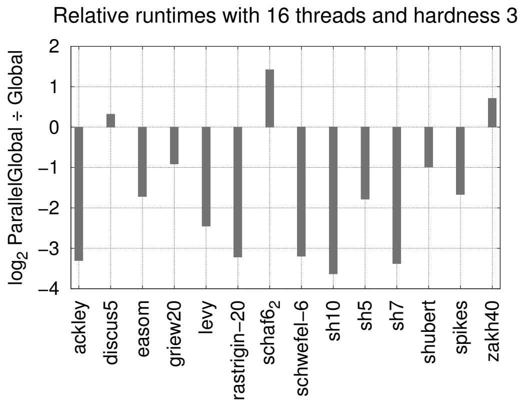

Figure 2: Relative runtimes on all test functions with 16 threads and hardness 3.

On Figure 2 we show relative runtimes for the configuration of 16 threads and hardness 3 on every test function. Since the plot is logarithmic, 0 and values below mean similar and better results compared to Global. On the functions which experienced slowdown either the lack of a sample pool or the intrinsic properties of ParallelGlobal prevented gains in speed. About 50% of the functions with speedup were solved successfully where the NFEV limit had no effects.

5. CONCLUSION

During our work we came to multiple important conclusions about the ParallelGlobal algorithm. The most needed change is the implementation of a distributed sample pool with sample sharing between threads. Having a set of probe points in the search space would ensure that local searches only start from promising regions. This change would probably move the algorithm much closer to the NFEV values of Global.

Many of our results show slowdown with ParallelGlobal, but huge improvements as hardness values increase, *Shubert* function is a good example. To keep our run times manageable we kept the hardness value relatively low. By going up from the current millisecond order to the second or 10 second order in function evaluations we would have a clearer image on how much speedup can we achieve. This would still undershoot the evaluation time of many practical problems, however it would be sufficient for proper testing on distributed systems.

To achieve these changes, first the addition of a distributed framework is needed. Both the sharing of probe samples and cluster information would rely on it. It is also a key for testing on computationally expensive problems.

6. ACKNOWLEDGMENTS

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PREDGOVOR VIVID 2019

Pojmi umetna inteligenca, strojno učenje, nevronske mreže in obsežni podatki pri številnih ljudeh zbujajo velika pričakovanja pa tudi strahove. Malokdo ve, za zakaj pri tem gre. Še manj ljudi zna na tem področju kaj narediti. Zato nas pri vzgoji in izobraževanju tudi v tem smislu čakajo pomembni izzivi.

Nekateri dosežki umetne inteligence so resnično osupljivi. Tako npr. program AlfaZero igra go, šah in shogi bolje kot katerikoli človek ali drug računalniški program. Izhajal je le iz pravil igre in igral s samim seboj. Generiral je ogromne količine podatkov, iz katerih se je učil. Na žalost je to znanje, vsaj za enkrat, pred človekom zaklenjeno v črni škatli. Svojih partij ne zna razložiti na človeku razumljiv način. Spominja nas na odličnega »rokodelca«, ki vrhunsko opravlja svoje delo. Vendar ne zna eksplicitno razložiti, kako dela, kar dela. Za človeka strokovnjaka je značilno, da to kar zna, zna tudi razložiti na ekspliciten simbolični način, kar s pridom uporablja za reševanje drugih problemov.

Zato je pomembno, da umetno inteligenco predstavimo na pravi in uporabni način. Strojno učenje je le eno izmed številnih področij umetne inteligence in nevronske mreže spadajo v to področje. Po mnenju strokovnjakov nevronske mreže uspešno rešujejo 90% problemov razpoznavanja vzorcev, npr. človeških obrazov. Šibkost predstavljata razumevanje in razlaga. Učenci in dijaki lahko tudi praktično spoznajo uporabo nekaterih metod in tehnik umetne inteligence. Tak primer orodja je Orange (https://orange.biolab.si). Za prikaz delovanja globokih nevronskih mrež pri razpoznavanju vzorcev lahko uporabimo katerega izmed demonstracijskih programov na spletu (npr. http://playground.tensorflow.org).

Za zaključek ponovimo, da je pri vzgoji in izobraževanju v informacijski družbi najpomembneje, da vzgajamo kritično misleče strokovnjake, ki imajo znanje in razumejo kako in zakaj delajo to kar delajo. Pri tem nam računalništvo in informatika ponuja lepe možnosti reševanja problemov, od osnovnih konceptov, preko programiranja, do metod umetne inteligence. Za obvladovanje sprememb, ki jih prinaša sodobna digitalna transformacija, igra osrednjo vlogo človek. Morda bolj, kot kdaj koli doslej, tehnologija spreminja nas in odnose med nami.

Uredniški odbor

FOREWORD VIVID 2019

Terms, such as artificial intelligence, machine learning, neural networks and big data give rise to major expectations as well as fears in many people. Only a few people understand what this is all about. Even fewer are able to solve problems in these fields. In this context, education is facing important challenges.

Some of the achievements of artificial intelligence are truly amazing. For example, the AlfaZero program plays go, chess and shogi better than any human being or another computer program. It started with basic rules and then played against itself. It generated large amounts of data from which it learned. Unfortunately, this knowledge is locked in a black box and is not available to humans. It cannot explain its games and moves in a human-understandable way. It reminds us of a great "craftsman" who excels at her/his work. But it cannot explicitly explain how it does what it does. The characteristic of a human craftsman is that (s)he can explain what (s)he knows in an explicit symbolic way, which (s)he can use to solve other problems.

Therefore it is important to present artificial intelligence in the right and useful way. Machine learning is just one of many areas of artificial intelligence, and neural networks are part of this field. According to experts, 90% of the problems of pattern recognition are successfully solved by neural networks, for example, recognizing human faces. Its weaknesses are understandability of the models and explanation of results. Pupils and students can practically learn the use of certain methods and techniques of artificial intelligence. An example of such tools is Orange (https://orange.biolab.si). To demonstrate the performance of deep neural networks for pattern recognition we may use online demonstration programs, such as http://playground.tensorflow.org.

To conclude, in education in the information society, the most important thing is to develop critical thinking in professionals who possess the knowledge and understand how and why they do what they do. In doing so, computer science and informatics offer us a great opportunity to solve problems, from basic concepts through programming to methods of artificial intelligence. A human plays a central role in coping with change management brought by modern digital transformation. Perhaps more than ever before, technology is changing us and relationships among us.

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POVZETEK

Živimo v svetu kjer smo vsakodnevno v stiku z najrazličnejšimi novodobnimi tehnologijami, ki so plod strokovnjakov s tehničnega področja. Računalništvo, elektronika in mehatronika pomembno sooblikujejo naš vsakdan. Kadri s tega področja bodo imeli v prihodnosti pomembno vlogo.

Sprašujemo se kako mladim približati svet tehnike in jim dati priložnost, da se v tem preizkusijo. Zato na Šolskem centru Kranj vsako leto konec avgusta prirejamo Festival inovativnih tehnologij, kjer se lahko osnovnošolci udeležijo različnih izobraževalnih delavnic.

Ena izmed delavnic je obsegala sestavljanje in programiranje robotka. Udeleženci so najprej spoznali vse sestavne dele robotka: plastično ohišje, servo motorje, razvojno ploščo Arduino Nano, piskač in ultrazvočni senzor razdalje. Sledilo je povezovanje elementov in vgrajevanje v ohišje. Po uspešno sestavljenem robotku so nadaljevali s testiranjem delovanja oz. pisanjem preproste programske kode. Vsak udeleženec je napisal svoj program, ki je naložen na mikrokrmilniku in omogoča želeno gibanje oz. obnašanje robotka.

Delavnica je potekala v manjši skupini. Potrebno je bilo izvajati individualizacijo, ker so imeli udeleženci različen nivo predznanja in sposobnosti. Izpostavili bi tudi prednost, da se lahko težavnost delavnice enostavno prilagaja udeležencem.

Odzivi udeležencev so bili pozitivni. Izdelek so ob koncu odnesli domov in ga s ponosom pokazali staršem in prijateljem.

Menimo, da prirejanje tovrstnih delavnic pomembno prispeva k promociji tehnike in otrokom omogoča, da se preizkusijo na različnih tehničnih področjih. Zato bomo na Šolskem centru Kranj z omenjenimi aktivnostmi nadaljevali tudi v bodoče.

Ključne besede

Izobraževalne delavnice, robot, razvojna plošča Arduino Nano, programiranje

ABSTRACT

We live in a world where we are in daily contact with the various modern technologies that are the result of experts in the technical field. Computer science, electronics and mechatronics are an important part of our everyday lives. Staff in this area will play an important role in the future.

We wonder how to bring young people closer to the world of technology and give them the opportunity to try their hand at it. That is why, at the end of August, the Festival of Innovative Technologies is organized annually at the School Center Kranj, where elementary students can attend various educational workshops.

One of the workshops involved the assembly and programming of a robot. Participants first learned about all the components of the robot: a plastic housing, servo motors, an Arduino Nano development board, a buzzer and an ultrasonic distance sensor. This was followed by connecting the elements and installing them in the housing. After successfully assembling the robot, they continued to test their performance by writing a simple program code. Each participant wrote their own program, which is loaded on the microcontroller and enables the desired movement or the behavior of the robot.

The workshop was held in a small group. Individualization had to be carried out because the participants had different levels of knowledge and skills. We would also emphasize that the difficulty of the workshop can be easily adapted to the participants.

Participants' responses were positive. They eventually took the product home and proudly showed it to parents and friends.

We believe that the organization of such workshops is an important contribution to the promotion of the technique and enables children to test themselves in various technical fields. That is why we will continue our activities at the School Center Kranj in the future.

Keywords

Educational workshops, robot, Arduino Nano development board, programming

1. UVOD

Za začetek si poskušajmo odgovoriti na tri ključna vprašanja, ki so še kako pomembna v prihodnosti otrok, ki bodo del informacijske družbe. Veliko vlogo v njej igrajo poklici oz. strokovnjaki s tehničnih področij.

Vprašanja, ki si jih lahko zastavimo so: »V čem sem dober? Kaj me veseli? Kaj okolje potrebuje?«

Odgovor na zadnje vprašanje je jasen. Okolje oz. naša družba potrebuje in bo potrebovala strokovnjake s področja računalništva, elektrotehnike in mehatronike. Na prvi dve vprašanji pa si morajo otroci odgovoriti sami. Mi jim lahko pri tem pomagamo tako, da jim tehnična področja ustrezno predstavimo.

Kako torej mladim predstaviti svet novih tehnologij? Kako jih navdušiti, da bodo v prihodnosti soustvarjali tehnološki razvoj informacijske družbe?

Z izobraževalnimi delavnicami otrokom prikažemo svet tehnike in jim omogočimo, da se preizkusijo v najrazličnejših spretnostih. Tako lahko spoznajo ali jih tovrstno področje zanima in kako uspešni so pri tem.

2. FESTIVAL INOVATIVNIH TEHNOLOGIJ

Na Šolskemu centru Kranj smo tudi letos avgusta organizirali Festival inovativnih tehnologij. Skozi celoten teden so imeli mladi nadobudneži druge in tretje triade OŠ možnost spoznavanja različnih tehničnih področij.

Do sedaj je dogodek potekal tako, da so otroci izbrali delavnico, kjer so tekom tedna nabirali svoje znanje. Letos pa smo udeležencem prvič ponudili možnost izbire dveh delavnic.

Predvsem zato, da dobijo vpogled v različna področja. Načrtovanje in izdelava tiskanih vezij, multimedija, programiranje iger in aplikacij, CADCAM ter programiranje naprav.

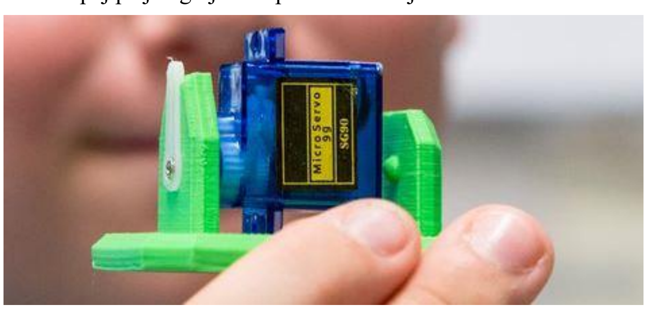
Vsak udeleženec je torej po dva dni sodeloval na dveh delavnicah, ki si jih je sam izbral. Ena izmed teh delavnic je vključevala izdelavo in programiranje robotka.

3. IZVEDBA DELAVNICE

3.1 Priprava in potek

Pred začetkom delavnice je bilo treba za vsakega udeleženca pripraviti vse komponente, ki so pomembne za izgradnjo robotka.

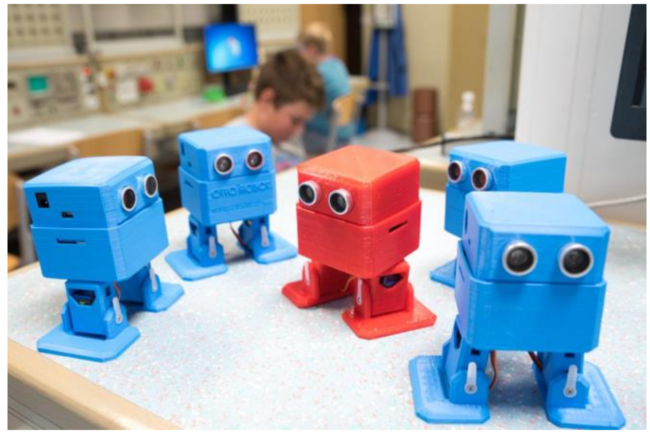
Potrebovali smo ohišje robotka, ki smo ga predhodno natisnili na šolskem 3D tiskalniku. Glavni del, brez katerega zadeva ne bi delovala, je razvojna ploščica Arduino Nano. Nanjo so povezani štirje servo motorji (slika 1), ultrazvočni senzor razdalje in piskač. Vse skupaj pa je vgrajeno v plastično ohišje.



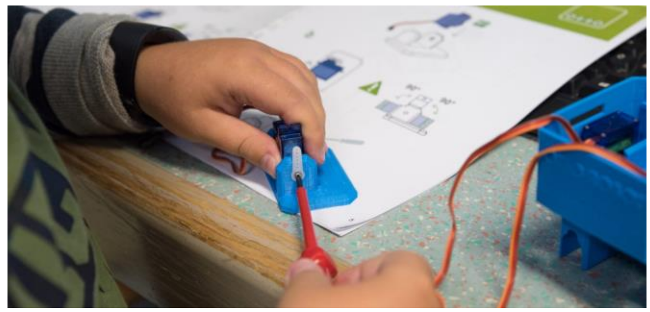
Slika 1: Servo motor

Udeleženci so najprej spoznali vse navedene elemente in njihovo delovanje. Seznanili so se tudi s 3D tiskanjem. Vsak je dobil navodila s katerimi si je lahko pomagal pri izdelavi.

Učitelj je udeležence korak za korakom vodil skozi postopek izdelave (slika 3), opozarjal in dajal povratno informacijo. Kakovostne povratne informacije namreč izboljšajo učenje [1].



Slika 2: Sestavljeni robotki



Slika 3: Sestavljanje robotka

Po uspešnem sestavljanju robotka (slika 2) je sledilo testiranje delovanja in pisanje prve programske kode.

3.2 Programirajmo Arduino

Arduino je razvojna plošča z mikrokrmilnikom ATmega328 [2]. Arduino odlikuje enostavno programiranje, cenovna dostopnost in prosto dostopno programsko okolje. Prav zaradi teh lastnosti je plošča zelo popularna na vseh ravneh izobraževalnega sistema. Obstaja več modelov Arduino razvojnih plošč. V našem primeru je bil uporabljen model Nano (slika 4), predvsem zaradi svoje velikosti oz. primernosti za vgradnjo v ohišje.

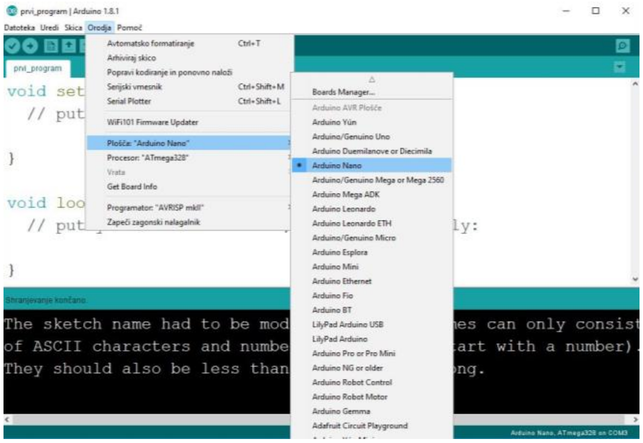
Udeleženci delavnice so se na kratko seznanili tudi z osnovami programiranja in uporabe mikrokrmilnikov, ki so dandanes prisotni na mnogo področjih.

Slika 4: Razvojna plošča Arduino Nano

Programiranje mikrokrmilnika poteka v programskem jeziku Arduino, ki je podoben jeziku C++ oz. Javi. Uporabljali smo že pripravljeno knjižnico *Servo.h*, ki omogoča enostavno krmiljenje servo motorjev. S preprostimi ukazi smo premikali štiri motorje oz. nogi robotka.

3.3 Prvi program

Preden začnemo pisati programsko kodo je potrebno v Arduino IDE (slika 5) izbrati ustrezno ploščo ter serijska vrata.



Slika 5: Arduino programsko okolje

V prvem programu (slika 6) smo robotka s preprostimi ukazi za obračanje servo motorjev postavili v začetno lego. Otroci so ugotavljali kako nastaviti parameter kota zasuka, da se robotek postavi v želeno pozicijo. Eksperimentirali so s podanimi ukazi in napisali program za poljubno gibanje robotka.

```
#include <Servo.h>
Servo LevoStopalo;
Servo DesnoStopalo;
Servo LevaNoga;
Servo DesnaNoga;
void setup() {
  LevoStopalo.attach(4);
  DesnoStopalo.attach(5);
  LevaNoga.attach(2);
  DesnaNoga.attach(3);
  LevoStopalo.write(80);
  DesnoStopalo.write(87);
  LevaNoga.write(78);
  DesnaNoga.write(71);
  pinMode(10,OUTPUT);
  delay(1000);
}
void loop() {
    LevoStopalo.write(110);
    DesnoStopalo.write(57);
    delay(250);
    LevoStopalo.write(80);
    DesnoStopalo.write(87);
    delay(250);
    LevaNoga.write(48);
    DesnaNoga.write(41);
    delay(250);
    LevoStopalo.write(110);
    DesnoStopalo.write(57);
    delay(250);
}
```

Slika 6: Primer prvega programa

3.4 Zaznavanje ovir

Uporabljali smo tudi ultrazvočni senzor razdalje (slika 7), ki je vgrajen v ohišju glave robotka. Deluje tako, da oddajnik pošlje ultrazvočni signal, ki se odbije od ovire nazaj do sprejemnika. S preprosto formulo lahko, ob podani hitrosti zvoka in časa odboja, izračunamo razdaljo. Ob zaznani oviri se je robotek začel premikati, piskač pa je generiral zvočni signal.

Slika 7: Ultrazvočni senzor

V nadaljevanju so otroci samostojno izdelovali vsak svoj program, ki je vključeval premikanje, zaznavanje ovir in generiranje zvočnega signala.

4. REFLEKSIJA

Izvedba delavnice je potekala brez večjih težav. Prednost je bila majhna skupina otrok. Ocenjujemo, da je optimalno število udeležencev od 6 do 8.

Zaradi različnega predznanja in stopnje sposobnosti je bilo potrebno izvajati individualizacijo poteka delavnice. Gre torej za prilagajanje poučevanja posebnostim in potrebam vsakega posameznika [3]. Nekateri potrebujejo več pomoči pri vijačenju in ostali fino motoriki, drugi pri uporabi računalnika in algoritmičnem razmišljanju. Pohvalno je to, da so si otroci pomagali med seboj.

Vsak udeleženec je lahko svojega robotka odnesel domov in tam nadaljeval s programiranjem. Menimo, da je dobro, če udeleženci tovrstnih delavnic na koncu, v kolikor je to možno, dobijo izdelek v last. Naj si bo to izdelana aplikacija, tiskano vezje, robotek ipd. Izdelke bodo gotovo s ponosom pokazali svojim prijateljem, staršem, sorodnikom in jih morda navdušili. Tako se promocija tehnike nadaljuje tudi izven šolskih prostorov.

Otroci so povezovali programske ukaze z reakcijo robotka in si lažje predstavljali kaj je vloga posameznega ukaza.

Pomembna prednost delavnice je v tem, da lahko težavnost prilagajamo nivoju znanja in spretnosti posameznika. Robotka se lahko sestavi vodeno ob mentorstvu učitelja ali samostojno z načrtom iz navodil. Pri programiranju lahko ostanemo zgolj na nivoju osnovnih ukazov za premikanje servo motorjev ali pa dodajamo nove programske strukture kot so npr. *if* stavek ali *for* zanka.

V prihodnosti želimo delavnico posodobiti in otrokom ponuditi nekaj novega. Dodali bomo LED, dva dodatna motorja za roke, možnost upravljanja preko pametnega telefona.

5. ZAKLJUČEK

Na koncu se spet vrnimo na začetek našega razmišljanja. Nam je uspelo udeležence delavnice navdušiti za tehniko? Odzivi otrok so bili pozitivni. Pomembno je, da so se imeli možnost preizkusiti na različnih tehničnih področjih. Hkrati pa so odkrivati ali jih tehnika zanima in kako dobri so v njej.

Na naši šoli bomo vsekakor nadaljevali s tovrstnimi delavnicami in aktivnostmi. Želimo si, da bi čim več otrok navdušili za tehniko ali pa jim vsaj dali možnost, da ta svet spoznajo in se potem odločijo.

6. LITERATURA IN VIRI

[1] Arduino https://www.arduino.cc

[2] Holcar Brunauer, A …(et al). (2016). *Povratna informacija*. Formativno spremljanje v podporo učenju, Zavod Republike Slovenije za šolstvo, Ljubljana

[3] Strmčnik, F. (1993). Učna diferenciacija in individualizacija v naši osnovni šoli. Zavod Republike Slovenije za šolstvo in šport, Ljubljana

Kreativno kodiranje v medijski produkciji

Creative coding in media production

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POVZETEK

Hitro razvijajoči se tehnološki napredek vnaša številne spremembe tudi na področju medijske produkcije. Sledenje sodobnim novim tehnologijam, programskim okoljem in orodjem ter ostalimi specifični znanji vodi do spoznanja, da dijaki srednjih medijskih šol ne pridobivajo ustreznih računalniških znanj. V prispevku so predstavljene aktivnosti za spoznavanje osnovnih računalniških konceptov in pristopov v programiranju, ki jih izvajamo v programski enoti Kreativno kodiranje, z namenom razvijanja računalniškega mišljenja. S poučevanjem ključnih vsebin računalniškega mišljenja po ustreznih zahtevnostnih stopnjah smo skozi reševanje problemov v generativni vizualizaciji ugotovili, da so dijaki razvili algoritmično mišljenje in znanje osnov programiranja, s tem pa pridobili temeljne kompetence na strokovnem področju, ki so veliko trajnejše in splošno uporabnejše od pasivnih, enosmernih postopkov v uporabi različnih tehnologij.

Ključne besede

Računalniško mišljenje, algoritmično mišljenje, računalniški koncepti, osnove programiranja, kreativno kodiranje

ABSTRACT

The rapid technological advances in media production have brought about many changes. Keeping up-to-date with new technologies, software environments and tools, and other specific skills, leads to the realization that secondary schools of media does not have adequate computer skills. This paper presents activities for learning basic computer concepts and programming approaches implemented in the Creative Coding program unit with the purpose of developing computer thinking. By teaching the key contents of computer thinking at the appropriate levels of complexity, through solving problems in generative visualization, we have found that students have developed algorithmic thinking and knowledge of programming basics, thereby acquiring basic competencies in the professional field that are much more durable and generally more useful than passive ones, unidirectional procedures using different technologies.

Keywords

Computational thinking, algorithmic thinking, computational concepts, programming basics, creative coding

1. UVOD

Učinkovita integracija, implementacija ter ustvarjalna in inovativna uporaba sodobnih novih tehnologij v učnem procesu omogoča učitelju kvalitetnejše izvajanje le–tega, dijakom pa doseganje višje kvalitete trajnejšega znanja in večjo motiviranost za delo. Nenehni razvoj novih tehnologij in njihova vpetost v učno ter vzgojno–izobraževalno okolje medijske produkcije prinaša vedno bolj dinamične in ustrezne spremembe za učenje in poučevanje, hkrati pa omogoča učinkovitejše načine pridobivanja novih znanj in kompetenc za prepoznavanje ter zadovoljevanje potreb in izzivov na tržišču ter reševanju konceptualnih problemov v digitalnih okoljih. Smotrna uporaba računalniške opreme in predvsem razumevanje nekaterih ključnih računalniških konceptov predstavljata dve izmed temeljnih kompetenc za uspešno delovanje v izobraževalnem okolju kot tudi v poklicnem in zasebnem življenju. Končni cilj bodočega medijskega tehnika je postati aktivni reševalec problemov in poklicnih izzivov ter odgovoren ustvarjalec digitalnih vsebin, ne le pasivni uporabnik hitro razvijajočih se instant tehnologij informacijske družbe, s katerimi se srečuje pri vsakdanjem šolskem delu, prostem času in za sporazumevanje z drugimi. Tehnološki razvoj rešitev za spreminjanje potreb medijske produkcije vsakodnevno narekuje seznanjanje z vedno novimi, boljšimi ter privlačnejšimi digitalnimi orodji in aplikacijami. Zavedamo se, da dostopnost, ustrezna raba ter učinkovitost digitalnih orodij in aplikacij v artikulaciji učnega procesa na globalni ravni prispevajo k učinkovitemu razvoju sistema kompetenc za razvoj temeljne zmožnosti digitalne pismenosti, ki s svojo konceptualno večplastnostjo med seboj spaja medijsko, tehnološko, informacijsko, vizualno, komunikacijsko in socialno pismenost. Iz tega stališča izhaja, da funkcionalno odzivanje na hitro razvijajoča se digitalna okolja še ne pomeni, da dijaki pridobivajo ustrezno računalniško znanje. Medijski tehnik skozi izobraževalni proces pridobi prenosljive in generične kompetence, s katerimi med drugim obvlada kreativne tehnike in znanja za ustvarjanje različnih vsebin, oblik in doživetij. Mednje sodijo preprosta statična spletišča, naprednejša dinamična (s sistemom za upravljanje s spletnimi vsebinami) spletišča, avtorske in interaktivne animacije, video produkcija, preprosta virtualna 3D-okolja in izdelki, izdelani s tehnologijo 3D-tiska. Smernice v sodobni medijski produkciji za ta namen izpostavljajo uporabo širokega nabora programskih orodij za ustvarjanje oblikovno, pomensko in tehnološko različnih multimedijskih izdelkov. V zadnjem času med temi naletimo na tiste z višjo dodano vrednostjo, ki z lastno izvorno podobo in pomenskostjo sprožajo interakcijo z uporabniki in tako neposredno vplivajo na uporabniško izkušnjo ter njihova čustva in razumevanje ob njihovi uporabi. Za njimi navadno tičijo programiranja v različnih okoljih, determiniranih z jeziki uporabljenih tehnologij.

2. KREATIVNO KODIRANJE

V šolskem letu 2015/16 smo pristopili k izvajanju programske enote Kreativno kodiranje, ki se v obliki modula odprtega kurikula za prečne povezave izvaja dve uri tedensko v tretjem letniku znotraj programa Medijski tehnik. Vsebine enote so zasnovane na temeljnih vsebinah Računalništva in informatike, ki dijaku dajo potrebna računalniška znanja, da poleg uporabe tehnologije slednjo tudi (so)ustvarja, predvsem v povezavi in za potrebe z drugih dejavnosti, ki so v skladu s poklicnimi in panožnimi smernicami na osnovi potreb novih znanj. Iz tega izhaja, da se dijaki ne učijo uporabe programske ali strojne opreme, temveč se spoznavajo z računalniškimi načeli, koncepti in procesi, ki so nenazadnje uporabni tudi v vsakdanjem življenju. Temeljni cilji modula slonijo predvsem na sistematičnemu razvijanju spretnosti in veščin računalniškega mišljenja oziroma njegovih ključnih konceptov, med katerimi za uspešno komuniciranje z računalnikom izpostavljamo pretežno postopkovno ali algoritmično mišljenje. Uvajanje in razvijanje tovrstnega načina mišljenja, ki ga uvrščamo med nujno sestavino sodobne funkcionalne pismenosti, pri dijakih spodbujamo s procesom poučevanja osnov računalniškega programiranja ali kodiranja, kot se v novejšem času raje imenuje. S programiranjem se dijaki med drugim tudi privajajo na sistematično učenje smiselne uporabe računalnika kot orodja in smiselnega sodelovanja z računalnikom pri ustvarjanju nekih novih vsebin. Uvajanje novih tehnologij v učni proces ustvarja nova prožna izobraževalna okolja, ki omogočajo nadaljnji razvoj in uporabo novih metod ter tehnik poučevanja in učenja. Učenje osnov programiranja je večinoma praktično naravnano oziroma je z uporabo problemskega in skupinskega pristopa k reševanju praktičnih problemov osnovano na izdelavi projektov, s katerimi se aktivno spodbuja dobro organizirano sodelovalno učenje. Problemski pristop zahteva, da se dijaki najprej seznanijo s problemom (znanim ali neznanim, večinoma pa povezanim z njihovo strokovno usposobljenostjo), nato pa se prek določenih tehnik in metod, ki zahtevajo optimalne, sistematične in organizirane prijeme, morajo naučiti novih spoznanj, da problem lahko rešijo. Vloga učitelja je usmerjevalna in svetovalna, saj pripravlja in usmerja učni proces, skozi lastni ustvarjalni pristop pa poudarja aktivno vlogo subjekta v raziskovanju premišljene uporabe sodobnih digitalnih tehnologij pri vzpostavitvi prožnega in inovativnega učnega okolja, skozi katera se uvajajo in ovrednotijo spremembe s ciljem dviga kakovosti pouka [1]. Vključevanje spletnih tehnologij in aplikacij kot nepogrešljivih sestavin v procesih izobraževanja ponuja obilo možnosti za poučevanje osnov programiranja, saj nam nudi okolja in orodja, ki ohranjajo učiteljevo vlogo v ustvarjanju prilagodljivih in zadostnih učnih kontekstov ter vodenju učnega procesa, spodbujajo dijakovo ustvarjalnost in omogočajo povratno informacijo. Dijaki ob tem gradijo na razumevanju problema, predstavijo zanj možne rešitve, zbirajo podatke na spletu in se medsebojno posvetujejo z na novo pridobljenim znanjem. Za vsak predstavljen teoretični koncept ali programski konstrukt je na predavanjih prikazana tudi njegova uporaba v konkretnih primerih, vse do stopnje kodiranja in programiranja.

2.1 Koncepti in pristopi računalniškega mišljenja

Računalniško mišljenje temelji na konceptu algoritmičnega mišljenja ter hkrati predstavlja nadgradnjo miselnih pristopov, strategij in podpornih okolij za spodbujanje kritičnega mišljenja in reševanja izzivov s premišljeno uporabo IKT tudi na področju medijske pismenosti. Skozi sistematično urjenje računalniškega mišljenja dijaki spoznavajo, utrjujejo in razvijajo spretnosti v konceptualizaciji reševanja izzivov v poklicnem udejstvovanju od logičnega mišljenja skozi proces analiziranja in napovedovanja možnih rešitev zastavljenih problemov, oblikovanje potrebnih korakov za doseganje jasno zastavljenih ciljev rešitev, razgradnja problemov na manjše, konsinstenčne podprobleme, iskanje podobnosti med njimi, abstrakcija in posploševanje ter analiziranje napak in kritična presoja doseženih rešitev problemov [2]. Ključne vsebine računalniškega mišljenja strukturiramo v konceptualno razumevanje, praktične spretnosti ter operativne pristope in njihova implemetacija v aplikativno področje medijske produkcije. Spodbujanje razvoja ter poučevanje veščin in konceptov računalniškega mišljenja razdelimo v tri zaporedne zahtevnostne faze: osnovno kreativno reševanje problemov, vmesno sistematično algoritmično mišljenje v smeri avtomatizacije rešitev in naprednejša uporaba pridobljenih funkcionalnih znanj v ustvarjanju inovativnih aplikacijah (Tabela 1).

Tabela 1: Ključne vsebine računalniškega mišljenja in zahtevnostne faze

Konceptualno razumevanje	**Praktične spretnosti in veščine**	**Operativni pristopi**
Osnovna faza: **kreativno reševanje problemov**		
Opredelitev problema Razgradnja problema	Prepoznavanje vzorcev Matematično modeliranje Logično mišljenje Večnivojska abstrakcija	Raziskovanje Kreativno oblikovanje Poskusi in napake
Vmesna faza: **sistematično algoritmično mišljenje**		
Podatkovni tipi Nadzor toka podatkov Rekurzivni postopki	Sistematično mišljenje Vpogled v algoritmično mišljenje Izvajanje ustreznih navodil po korakih	Sledenje Simulacija Vztrajnost
Naprednejša faza: **ustvarjanje inovativnih aplikacij**		
Računalniško mišljenje kot splošno uveljavljeno mišljenje	Programiranje Analiza in vrednotenje	Skupinsko delo Sodelovalno učenje Sporazumevalne zmožnosti

2.2 Diagram poteka izvajanja algoritma

Spodbujanje logičnega in ustvarjalnega mišljenja, vključevanje posameznikov zamisli in vedoželjnosti, razvijanje kritične presoje in natančnosti v tehnološko podprtem učnem okolju pomeni dopolnitev in obogatitev učnega procesa. Različna spletna učna okolja, podprta z multimedijskimi gradniki in interaktivnimi nalogami dijakom omogočajo uporabo različnih oblik in metod za predstavitev kvalitativnih in deloma kvantitativnih podatkov, pa tudi zaključkov ob ustreznih rešitvah. V te aktivnosti sodijo nedvomno vizualizacije, s katerimi kreiramo mentalne slike danih konceptov, predstavljenih z grafično reprezentacijo. Mednje sodi shematska vizualna reprezentacija algoritma, s katero dijaki konceptualizirajo možne rešitve danih problemov kot zaporedne faze nekega postopnega procesa. Risanje diagrama poteka predstavlja pomembno logično in miselno aktivnost v snovanju grafičnega opisa smiselnosti algoritma pri analizi problema v smeri načrtovanja nedvoumnih in učinkovito izračunljivih operacij.

Ustvarjen grafični opis jasno kaže medsebojne povezave med posameznimi deli načrta določenih operacij in s tem enoznačno nakazuje smer izvajanja algoritma. Ob tem upoštevamo tri osnovne programske konstrukte, ki določajo osnovno strukturo algoritma: zaporedje, vejitve in zanke, ter druge programske gradnike, s katerimi nazorno ponazorimo celoten tok podatkov. Pomembno je, da diagram poteka ustvarimo v dovolj natančni, jasni in razumljivi obliki, iz katere je razvidna pot do rešitve problema. S tem omogočimo visokonivojski strukturiran zapis algoritma, neodvisen od širokega nabora programskih jezikov.

2.3 Slikovno programiranje

Slikovno programiranje sodi v programiranje, pri katerem označevanje semantike sloni na večrazsežni predstavitvi grafičnih objektov in njihovih medsebojnih prostorskih odnosov v grafičnem razvojnem okolju, hkrati pa zagotavlja bolj sistematično raziskovanje programskih konceptov in običajno vključujejo neko obliko avtomatiziranega označevanja, ki potrjuje pravilnost ustvarjene slikovne kode. Spletna izobraževalna okolja za slikovno programiranje so sama po sebi modificirana, vizualno nazorna, interaktivna, multimedijska in privlačna, saj dijakom lajšajo začetke programiranja ter jih navajajo na logično in algoritmično mišljenje, ki ga dosežejo z interaktivno izkušnjo in eksperimentiranjem. Njihova dostopnost je možna od kjerkoli, kadarkoli, prav tako je omogočena skupna raba ustvarjenih izdelkov. Vsako tovrstno okolje deluje na katerem koli sodobnem brskalniku, nameščenem na namiznih in tabličnih računalnikih. Začetnikom omogočajo, da se osredotočijo na učenje konceptov in spretnosti reševanja problemov, povezanih z načeli računalništva, namesto da se ukvarjajo z odvečnimi sintaktičnimi napakami, ki se za povrh razlikujejo v vsakem programskem jeziku. Ena najvidnejših značilnost teh okolij je izločanje začetniških napak, povezanih s sintaktično pravilnostjo slikovnega programskega jezika, kar uporabnikom omogoča, da se v celoti osredotočijo na logiko problemov in semantično pravilnost njihovih rešitev. Poleg navedenega lahko nekatera okolja samodejno prevajajo slikovno kodo v druge, besedilne programske jezike, s ciljem začetnikom olajšati prehod iz slikovnih na besedilne programske jezike [3]. Osnovni gradniki slikovnega programa, programski stavki, so grafično predstavljeni s splošnimi namenskimi slikovnimi konstrukti, da se prilegajo na načine, ki so sintaktično pravilni in jih na komplementaren način združujemo v specifične sklope, imenovane slikovni izrazi. Sintaktična pravilnost slikovnih kock je določena z obliko, barvo, strukturo in medsebojnimi možnimi povezavami. Dosegljivi so v orodjarni uporabniškega vmesnika, kjer so zaradi lažje prepoznavnosti tematsko organizirani v semantične kategorije in podkategorije, njihov namen pa je označen v naravnem jeziku. Uporabniku, tudi neizkušenemu začetniku, omogočajo udobno uporabo programskega jezika, saj lahko ustvarjajo programske stavke brez tipkanja ukazov, tako da manipulirajo s slikovnimi kockami z vlečenjem po načelu “povleci in spusti” ter oblikujejo dvorazsežno sestavljeno kompozicijo, ki lahko predstavlja rešitev danega problema. Slednje začetnikom ob preprostem delovanju omogoča uporabnost in izboljšuje razumljivost, berljivost ter nenazadnje razčlenjenost in lažje vzdrževanje slikovne programske kode. Vsaka slikovna kocka ima določen pomen in pogosto v svojem jedru skriva kompleksno logiko ali operacije in z njimi povezano slikovno kodo, ki pa se lahko z enakovrednim prevodom preslika v vsak podprt besedilni programski jezik, kar je koristno za zakrivanje sintakse jezika končnega uporabnika. Čas, ki ga dijak potrebuje, da usvoji znanje za uporabo slikovnega programskega okolja je kratek in tako lahko dijaki porabijo večino časa za razvijanje algoritmov, oblikovanje programov ter razumevanje načel programiranja. Sproti pa na zanimiv način spremljajo, katere slikovne kocke so na voljo, kako se deli programa med seboj obnašajo, in kako so ti odnosi izraženi v nekaj pogosto uporabljenih besedilnih programskih jezikih. Ker je slikovna koda zgrajena v urejevalniku slikovne kode, je prikazana tudi v besedilni obliki v zavihkih na vrhu ali na desni strani zaslona v programskem jeziku, ki ga izbere uporabnik. Slikovno programiranje je odlično za začetnike, za pisanje obsežnih programov pa je prepočasno in okorno. Slikovna okolja so ponavadi omejena v svoji funkcionalnosti, kar otežuje analizo podatkov in omejuje vrste težav, ki jih je mogoče rešiti.

2.4 Generativna vizualizacija

Oblikovanje digitalne generativne grafike z algoritmi pomeni generiranja posebnega sklopa jasnih navodil, s katerimi skozi programsko kodo računalniku nakažemo vrsto ustreznih korakov, ki jih skozi računske operacije mora izvesti z namenom ustvarjanja. Digitalna generativna grafika sodi v računalniško generirano umetnost, programirano z uporabo računalnika. Avtorjeva (dijakova) ideja je začrtana v programski kodi, zasnovani na namerni uporabi koncepta tehnonaključnosti kot del avtonomnega ustvarjalnega procesa za vzpostavljanje nepredvidljivih situacij pojavnih oblik. Znanje dijakov sloni na osnovnih konceptih programiranja v vizualnem kontekstu z odprtokodnim programskim in razvojnim okoljem Processing, s katerim lahko ustvarijo od preprostih do grafično bogatih statičnih in dinamičnih vizualizacij ter interaktivnih aplikacij na kreativen in preprost način. Namen tovrstnega kreativnega kodiranja je spodbujanje digitalne pismenosti v povezavi z likovno umetnostjo in vizualne pismenosti z matematičnimi koncepti in tehnologijo, ki vodi, od koncepta prek realizacije do refleksije in je merljiva. Kljub vse večji uporabi digitalnih tehnologij imajo dijaki od zaznave potrebe po znanju do trenutka, ko bi to morali že obvladati, na razpolago zelo malo časa. Zato iščejo najbolj racionalno pot učenja, tako da je prilagojena njim osebno, hkrati pa s tem odkrivajo lastni individualni stil učenja. Ob tem se vzpostavlja vzajemni učinek, učitelj skozi izbrani pedagoški pristop pokaže — dijak ponovi ter obratno, dijak vpraša — učitelj razloži. Od učitelja je odvisno tudi sestavljanje projektnih skupin, saj na takšen način dodatno motivira dijake za skupinsko delo s sodelovalnim učenjem z metodo kodiranja v paru. S tem posameznik izgubi strah ob morebitnih napačnih potezah v reševanju določenega problema, saj se lahko zanese na ostalega dijaka v paru, hkrati pa razvija čut za sprejemanje odgovornosti za opravljanje posameznih delov projektne naloge in komunikacijske zmožnosti za delo v paru.

2.5 Programska okolja in orodja

Nabor programskih okolij in orodij, s katerimi učitelji pri pouku kreativnega kodiranja uvajamo koncepte in pristope računalniškega mišljenja, dijaki pa pri svojem delu dosegajo zastavljene učne cilje iz programiranja in uporabe tehnologije ter izdelajo določene izdelke, sestavljajo Blockly Games [4], Blockly Demo: Code [5], Python [6] in Processing [7].

2.5.1 Blockly Games

Blockly Games je spletna zbirka nalog v obliki interaktivne igre, razdeljene v sedem poglavij in deset nalog v vsakem poglavju, ki se po težavnosti stopnjujejo in jih rešujemo zaporedoma. Izdelana je s pomočjo Googlovega slikovnega okolja Blockly, ki v svojem jedru poudarja učenje in razvijanje osnovnih programerskih konceptov. Ob vsaki pravilno rešeni nalogi se na koncu prikaže ustrezna koda v programskem jeziku Javascript. To kodo dijaki kopirajo in jo v kronološkem zaporedju prilepijo ter uredijo v ustreznem programskem orodju za delo z besedilom, kar jim kasneje služi za lažje razumevanje in berljivost kode v besedilnih programskih jezikov.

2.5.2 Blockly Demo: Code

Po uvodnem spoznavanju zbirke Blockly Games preidemo na samo uporabo okolja Blockly Demo: Code, v katerem že prek različnih preprostih, situacijskih nalog, preverjamo kreativno reševanje problemov in sistematično algoritmično mišljenje ob že usvojenih osnovnih konceptih programiranja. Programi, ustvarjeni v slikovnem okolju, se pretvorijo v enakovredno kodo nekaterih programskih jezikov (Javascript, Python, Lua, PHP in Dart) in tako omogočajo mehkejši prehod od slikovnega k besedilnemu programiranju hitrejše in enostavnejše.

2.5.3 Python

Python je skriptni, objektno orientiran, visoko nivojski programski jezik z dinamično semantiko. Dijakom omogoča pisanje jasnih in berljivih programov, zato je namenjen za učenje programiranja za začetnike. Odlikuje ga širna množica lastnosti, zaradi katerih je pri učiteljih zelo primeren za poučevanje programiranja: berljivost kode, preprostost, razširljivost, dostopnost v različnih operacijskih sistemih, preprost in enostaven uporabniški vmesnik.

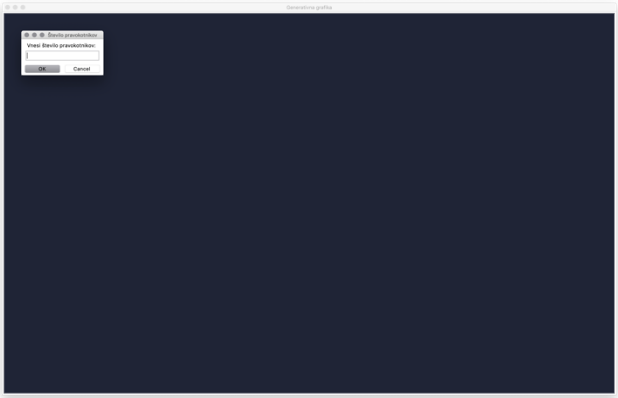
2.5.4 Processing

Processing je objektno usmerjeni odprtokodni programski jezik, integrirano razvojno okolje in spletna skupnost, zasnovan posebej za ustvarjanje in spreminjanje digitalne grafike ter temelji na programskem jeziku Java. Njegov namen je spodbujanje interakcije programske pismenosti z likovno umetnostjo in vizualne pismenosti s tehnologijo. Razvojno okolje omogoča ustvarjanje digitalne generativne grafike in interaktivnosti, vključno vektorske in bitne slike, interaktivnih dogodkov, omrežne komunikacije in objektno programiranje. Okolje Processinga je jezik Java. Programi, spisani v Processingu (imenujejo se programske skicirke), se prevedejo v Javo in zaganjajo kot javanske aplikacije. Pogosto se zaganjajo hitreje kot druga tovrstna programska orodja, kar je še posebej pomembno v mnogih grafičnih aplikacijah. Največja razlika med Processingom in Javo je preprost programski vmesnik v Processingu, ki ne zahteva dodatnih programskih konceptov, kot so razredi, objekti in animacije, a hkrati omogoča naprednim uporabnikom njihovo uporabo. Zato so programi krajši in bolj berljivi. Processing povezuje programske koncepte z načeli in oblikami vizualne pismenosti, gibanja in interakcij, kar predstavlja integracijo programskega jezika in razvojnega okolja v celovit sistem. Namenjen je za učenje osnov programiranja v vizualnem smislu. Processing je verjetno najpogosteje uporabljena platforma generativne umetnosti. Cilj je doseči ravnovesje med jasnostjo (preprostostjo) in naprednimi funkcijami, zato je zelo primeren za začetnike na eni in napredne programerje po drugi strani. Sistem omogoča uporabo ter razvoj računalniške grafike in interakcije, vključno predmetnih in točkovnih slik in risb, obdelavo slik, barve manipulacije, dogodke, komunikacijskega omrežja in objektno usmerjeno programiranje. Prav tako ima možnost, da ustvarja zvok, pošilja in prejema podatke v različnih formatih ter pošilja in prejema 2D in 3D datotek. Kodiranje v Processingu ponuja drugačen način učenja programiranja. Od ostalih programskih jezikov se razlikuje v konceptualnem pristopu, saj omogoča učenje programiranja skozi ustvarjanje interaktivne grafike in tako poskrbi za takojšnjo povratno informacijo o narejenem, kar dijake še dodatno spodbuja za nadaljnje učenje in raziskovanje. Zaradi zmožnosti Processinga, da poda povratno informacijo, je tak način postal popularen pristop za programiranje.

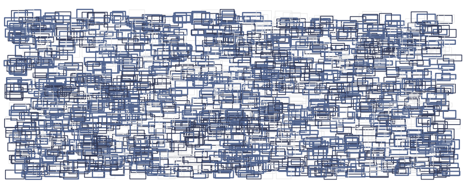
3. IMPLEMENTACIJA PRIMEROV RABE ORODIJ

Predstavljeni so primeri rabe omenjenih orodij Python in Processing, v smislu ustvarjanja dinamične in interaktivne generativne grafike. Prvi primer obravnava izdelavo interaktivno aplikacijo (Slika 1), ki od uporabnika zahteva vnos določenih vhodnih podatkov (Slika 2), končni rezultat je generativna grafika naključno postavljenih geometrijskih objektov (v našem primeru pravokotnikov različnih dimenzij) znotraj določenih meja (Slika 3). Programska koda temelji na konceptu funkcije in želvje grafike v Pythonu.

Slika 1: Programska koda za izris naključno postavljenih pravokotnikov različnih dimenzij znotraj meja ravnine v orodju Python

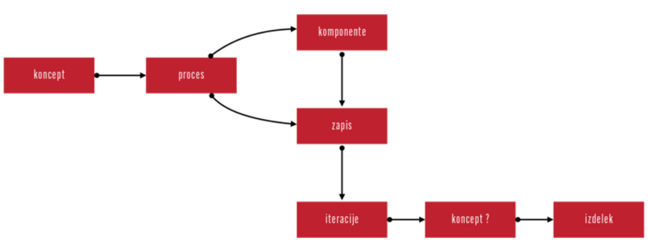


Slika 2: Interaktivna konzola, ki od uporabnika zahteva vnos določenih vhodnih podatkov

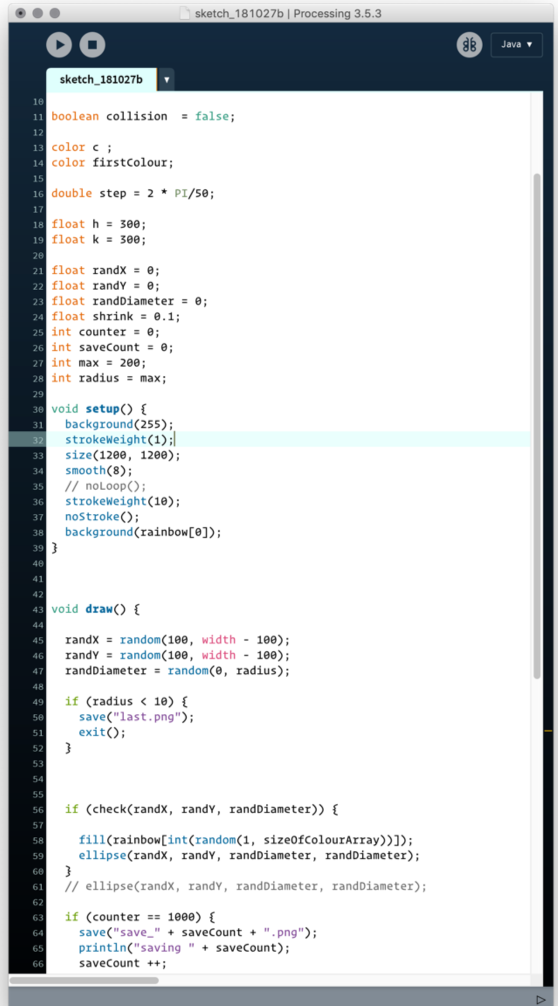


Slika 3: Končni rezultat – generativna grafika

Drugi primer obravnava izdelavo dinamične aplikacije, osnovane na prenosu določenih programskih konceptov (Slika 4) in rabi načela naključnosti za ustvarjanje nepredvidljivih situacij v ravnini. Programska koda v programski skicirki temelji na konceptu osnovnih vgrajenih funkcij *setup()* in *draw()* v Processingu (Slika 5). Končni rezultat je generativna grafika naključno postavljenih geometrijskih objektov (v našem primeru krogov različnih dimenzij) znotraj določenih meja prikaznega okna (Slika 6).



Slika 4: Diagram poteka prenosa določenih programskih konceptov skozi process ustvarjanja generativne grafike v orodju Processing



Slika 5: Programska koda za izris naključno postavljenih krogov različnih dimenzij znotraj meja ravnine v orodju Processing

Slika 6: Končni rezultat – generativna grafika

4. ZAKLJUČEK

V prispevku smo orisali spremljajoče aktivnosti za učenje in poučevanje osnov programiranja medijskih tehnikov Srednje medijske in grafične šole Ljubljana skozi programsko enoto Kreativno kodiranje. Na koncu smo predstavili del primerov uporabe računalniških konceptov in razvijanja postopkovnega načina mišljenja na področju ustvarjanja digitalne generativne grafike.

Ali smo s tem zadostili konceptualnim smernicam in okvirjem za izobraževanje na področju računalništva, ki obsega vse od otrok v vrtcu do konca srednje šole, bomo videli kaj kmalu. Velja namreč, da za učenje programiranja nisi nikoli prestar. Zato predlagamo, da bo programiranje večinoma služilo za izvajanje procesov računalniškega mišljenja.

5. VIRI

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Konceptualni načrt vpetosti ergonomije v I4.0

Concept map of ergonomics integration in I4.0

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POVZETEK

Z vse bolj jasnimi obrisi Industrije 4.0 klasična množična proizvodnja postaja del zgodovine. Sodobni elementi digitalne transformacije nam postopoma omogočajo vpeljavo popolnoma prilagodljive proizvodnje posameznih produktov. Stalna in neprekinjena izmenjava podatkov med ključnimi točkami procesa, obdelovanci, orodji, stroji, roboti in človekom, v nove okvire postavlja tudi ergonomijo. Delovna mesta prihodnosti bodo vsebovala vse tehnološke elemente Industrije 4.0, človek pa se bo še bolj znašel v središču pozornosti. Njegovo sodelovanje s kolaborativnimi roboti bo generiralo nov odnos v sodobnem kibernetskem sistemu regulacijskih zank. Klasični elementi ergonomije bodo z novo tehnologijo lažje dosegljivi in hitreje prilagodljivi. Težje obvladljive človeške faktorje bomo v dobi Industrije 4.0 prepustili kolaborativnim robotom, ki bodo s kiberfizikalnimi sistemi sooblikovali človeku prilagojeno ergonomsko delovno mesto.

Ključne besede

Ergonomija, I4.0, kolaborativni roboti, koncept

ABSTRACT

With the increasingly clear outlines of I4.0, classic mass production is becoming a part of history. Modern elements of digital transformation gradually enable us to introduce fully flexible production of individual products. The constant and continuous exchange of data between key process points, workpieces, tools, machines, robots and humans also puts ergonomics in new frames. Jobs of the future will contain all the technological elements of I4.0, and the man will be in the spotlight even more. His collaboration with collaborative robots will generate a new relationship in the modern cyber system of regulatory loops. The classic elements of ergonomics will be easier to reach and more flexible with new technology. We will leave the more difficult to manage human factors in the I4.0 era to collaborative robots that will co-create a human-friendly ergonomic workplace with cyber-physical systems.

Keywords

Ergonomics, I4.0, collaborative robots, concept

1. UVOD

Konceptualno razmišljanje je sposobnost razumevanja določene situacije na podlagi proučevanja vzorcev in povezav v delujočih sistemih. Porajajoča vprašanja in dejavniki tvorijo konceptualni okvir, ki pa je oblikovan na podlagi preteklih strokovnih izkušenj in usposobljenosti človeka. Za optimalni učinek sta potrebna induktivno sklepanje in ustvarjalnost, saj tako pridemo do boljših zaključkov in večje baze alternativnih rešitev. Pri tem nam lahko pomaga sodobna tehnologija v okvirih Industrije 4.0, kjer ima ergonomija velik vpliv na stalno izboljševanje procesov, na celovito kakovost in na organiziranje delovnih ciklov.

2. ERGONOMIJA

Ergonomija je znanost, ki človeka povezuje z njegovim delom, pri tem pa proučuje anatomska, fiziološka, mehanska, kognitivna in organizacijska načela vplivov na zmogljivost človeka pri delu. Ergonomija je interdisciplinarno proučevanje delovnih obremenitev ter iskanje razbremenitev, kadar obremenitev povzroča neudobje ali celo prekoračuje tolerančno mejo [1].

Hiter razvoj tehnike je vplival tudi na ergonomijo. Najprej so namesto človeka začeli opravljati težko fizično delo stroji, dandanes pa računalnik prevzema velik del rutinskega dela v pisarni. Obremenitev zaradi mišičnega dela se je tako prenesla na obremenjenost čutil in na povečano stopnjo pozornosti.

V šestih desetletjih se je ergonomija spreminjala in širila še na druga področja, kot so bivalno okolje, promet in varnost, v bolnišnice in šole ter v šport in prosti čas. Osnovni namen ergonomije pa ostaja isti: vedno gre namreč za optimiranje nekega sistema s prilagajanjem pogojev sposobnostim in potrebam človeka [2].

Ergonomija obravnava medsebojne vplive med človekom in njegovim okoljem oziroma predmetom, zato se moramo vprašati o podmnožici ergonomije – *vmesnikih med človekom in strojem* (angl. HMI: Human machine interface). V okviru razmišljanja o Industriji 4.0 moramo ta regulacijski krog *uporabniške izkušnje* (angl. User experience design: oblikovanje na podlagi uporabniške izkušnje) postaviti na nivo podjetja, storitev in izdelkov. *Oblikovalska zavest* (angl. Design thinking: razmišljati dizajnersko) mora biti strukturirana in usmerjena proti končnemu uporabniku. Od tu dalje se informacija vrača nazaj v hitrih časovnih odzivih in regulira prvotne zamisli ter jih spreminja v uporabniku še bolj uporabne rešitve [3].

Zdravje in varnost pri delu sta izjemno pomembna elementa, povezana s pravnim sistemom, toda to ne bi smel biti največji motivacijski dejavnik za management, ki je odgovoren za to področje. Ergonomija je marsikdaj razumljena kot visok in nepotreben strošek pri vzpostavljanju sistema za zmanjševanje napak, sistema za ugotavljanje in preprečevanje preobremenitev zaposlenih, sistema preventive za zmanjševanje pojava bolezni itd. Management prevečkrat pozablja, da ergonomija svoj vpliv širi vsaj v treh smereh – v smeri povečevanja učinkovitosti, v smeri dviga motivacije in v smeri zmanjševanja absentizma in predvsem prezentizma. Na tem mestu nam Industrija 4.0 nudi kar nekaj zanesljivih rešitev, predvsem na področju implementacij tehnik optimizacije gibov in na področju razbremenitev kostno-mišičnega sistema pri človeku. Ergonomija je lahko zelo učinkovita v notranji logistiki, ko bremen ni potrebno prelagati, prenašati, dvigovati in spuščati. Manj telesnih naporov z vpeljavo ergonomskih rešitev omogoča hitrejše delovanje procesa (modularna individualno prilagodljiva delovna mesta, transportni vozički, valjčne transportne proge, kolaborativni roboti ...) [4].

3. INDUSTRIJA 4.0

Izraz Industrija 4.0 ali I 4.0 izhaja iz pobude, ki jo je nemška zvezna vlada predstavila na Hannovrskem sejmu leta 2001. Abstraktna ideja o industriji 4.0 je kmalu prerasla v strategijo nemških podjetij, katere cilji so usmerjeni v ustvarjanje pametnih izdelkov, postopkov in procesov ter pametnih tovarn. Strategijo I4.0 je podprla celotna Evropska unija, ki slednjo podpira tudi finančno preko številnih razpisov v okviru evropskega raziskovalnega programa Horizon 2020. Slovenija je cilje I4.0 integrirala v Strategijo pametne specializacije (SPS) [5].

Pametne tovarne so sposobne izdelovati dobrine z večjo učinkovitostjo in so manj podvržene zunanjim vplivom ter zastojem. V pametni tovarni bodo ljudje, stroji, izdelki in drugi viri komunicirali drug z drugim na način, kot to omogočajo socialna omrežja. Objekti v pametni tovarni bodo lahko sami komunicirali s kupci in z dobavno verigo. S tem bodo močno povečali učinkovitost proizvodnega procesa ter poskrbeli za skrajšanje pretočnih časov [6].

I4.0 bo s pomočjo informacijske tehnologije preko omrežij informacijskih sistemov povezala stroje, naprave, procese, delovna sredstva in tudi aktivne upravljalce – ljudi, ki bodo sodelovali v teh sodobnih procesih. Vsa informacijska tehnologija, ki je trenutno v uporabi (tablice, prenosniki, mobilne naprave, oblaki, mreže ...) in rešitve, ki šele prihajajo (inteligentni vid, uporaba dronov, avtonomija upravljanja sistemov, krajšanje delovnega časa ...), se bo kljub skokovitemu razvoju morala ukvarjati tudi z vprašanjem človeških faktorjev, ki se spreminjajo v okvirih evolucije. Človek se bo še naprej moral ukvarjati s težavami zaradi preobremenitev, ki bodo v prihodnosti morda fokusirane v drugačno polje naše biti. Že danes se ukvarjamo s težavami, ki se kažejo v kostno-mišičnih obolenjih. Prav te težave se še vedno vztrajno povečujejo in pomikajo v vse bolj zgodnje življenjsko obdobje. Čeprav v okviru I4.0 govorimo o avtomatizaciji in prepletenosti raznih krmilnih in regulacijskih sistemov, bodo človeški faktorji še vedno postavljali meje zmogljivosti najbolj inteligentnih sesalcev [7].

4. VPETOST ERGONOMIJE V I4.0

Ker bo tradicionalna množična proizvodnja kmalu stvar preteklosti in jo postopoma nadomešča serijska proizvodnja prilagojenih posameznih kosov, je namen inteligentnega povezovanja vseh postaj v verigi dodane vrednosti doseči prilagodljivo in prilagojeno proizvodnjo. Da bi to uspelo, morajo višje in nižje razvrščeni procesi v proizvodnji stalno izmenjevati podatke med seboj in to na vseh stopnjah proizvodnega procesa. To ne pomeni, da se bo industrijsko delovno okolje močno spremenilo, pač pa to pomeni, da nove tehnologije (internet stvari, 3D tisk, avtonomni roboti, simulacije, masovni podatki, navidezna resničnost …) zahtevajo vzporedni razvoj ergonomije in njeno vključevanje na vseh možnih nivojih proizvodnje. Edini način, s katerim lahko proizvodna podjetja v današnjem hitro spreminjajočem se okolju I4.0 ostanejo konkurenčna, je izvajanje fizikalne, kognitivne in organizacijske ergonomije, kot del celovitega pristopa, upoštevajoč procese nenehnega izboljševanja (slika 1).

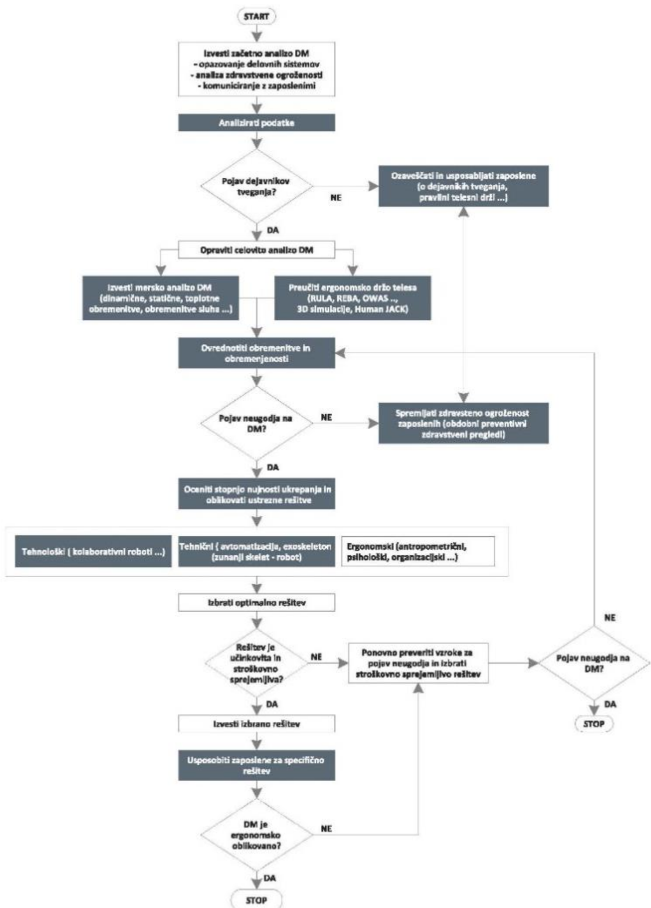
Slika 1: Simbioza ergonomije in I4.0

Ergonomska načela tako še naprej igrajo pomembno vlogo pri oblikovanju delovnih mest, saj v veliki meri pomagajo povečati produktivnost in zdravje zaposlenih. Pri tem je ključnega pomena individualizacija delovnega mesta. Primer so delovni stoli in mize z nastavljivo višino, ki jih je mogoče popolnoma prilagoditi vsakemu telesu. Preoblikovanje stoječega delovnega mesta v sedeče (in obratno) je prav tako enostavno izvedljivo. Še več, prilagojeno pozicioniranje materialov in orodij na delovni mizi preprečuje neenakomerno fizično obremenitev. V delovnih okoljih je pogosto spregledano, da prava osvetlitev delovnega mesta pripomore k povečanju delavčeve koncentracije in s tem pripomore tudi k zmanjšanju tveganja za pojav napak. Modularno zasnovan sistem delovne mize omogoča enostavno prilagajanje tako potrebam delavca, kot zahtevam delovnega procesa. Z uporabo nastavljivih monitorjev (višina, globina, naklon, rotacija), ki zagotavljajo, da je delovni prostor organiziran natančno in po meri delavca, se prepreči nepotrebno fizično naprezanje. Ker se kljub naraščajočemu trendu avtomatizacije nikoli v celoti ne bomo mogli izogniti nalogam ročnega sestavljanja, je ergonomijo v I4.0 potrebno obravnavati kot način zmanjšanja obremenitev zaposlenih. Eno od rešitev predstavljajo sodelovalni ali kolaborativni roboti. Naloga sodelovalnih robotov je, da od delavcev, ki z robotom neposredno komunicirajo, prevzamejo za delavca naporne delovne naloge, npr. dvigovanje in nameščanje težkih obdelovancev. Pomembno pa je, da se pri razmestitvah sodelovalnih robotov upošteva tudi posebno stroge varnostne postopke, s katerimi se zagotovi, da je tveganje za morebitni trk med delavci in stroji čim manjše. Za podporo zaposlenim se uporabljajo tudi kibernetsko-fizikalni sistemi (angl.: cyber-physical systems - CPS), ki služijo tudi kot sredstvo za shranjevanje informacij. Mehanizem lahko samostojno odloči, kateri zaposleni je na podlagi svoje telesne zgradbe primerna izbira za naslednjo delovno fazo in kdo si mora vzeti odmor [8].

5. KOMPETENCE V ERGONOMIJI

Ergonomija povezuje udobje in ugodje, zdravje ter produktivnost, to pa pomeni, da prepleta medicinsko, biološko in inženirsko znanost. Zaposleni so odgovorni za zdravje in kompetence, delodajalci pa za organizacijo in urejanje dela. Tako zaposleni kot delodajalec morata med seboj intenzivno sodelovati. Zaposleni pridobijo znanje o varnem in zdravem načinu življenja na delovnem mestu, ki ga lahko prenesejo tudi v svoj življenjski slog in tako izboljšajo svoje zdravje. Bolj zdrav delavec je bolj zadovoljen, hkrati pa pomeni tudi manjše stroške za delodajalca in zdravstveno zavarovalni sistem zaradi bolniških odsotnosti. Vsaka znanstvena ali strokovna disciplina zahteva definicijo ključnih kompetenc, saj potencialni zaposleni lahko v njih tudi vidi pravi izbor svojega strokovnega profila.

Proaktivna ergonomija vnaprej rešuje probleme zaradi neustreznih človeških faktorjev, medtem, ko reaktivna ergonomija te težave ureja potem, ko so težave že nastopile [4].



Slika 2: Konceptualni načrt vpetosti ergonomije v I4.0

Ključne kompetence iz ergonomije lahko uporabimo na različne načine:

- razvoj kurikuluma (nabor učnih vsebin) v ergonomiji,
- razvoj celovitih in nepristranskih ocen za razvoj kompetenc,
- priznavanje usposobljenosti diplomantov, ki imajo ergonomske kvalifikacije, priznane s strani uradnih ustanov za potrjevanje ergonomije.

Kompetence vključujejo več kot samo znanja in spretnosti, saj vključujejo še sposobnosti zadovoljevanja opredeljenih zahtev in vedenje, kar pa je bistveno za uporabo spretnosti. V ergonomiji je zagotavljanje kompetenc izrazito povezano s ključnimi odgovornostmi, dejavnostmi in nalogami, opredeljenimi pri ocenah tveganja in to za vse, ki so povezani v sistem zagotavljanja varnosti in zdravja pri delu – vključno z managerji. Sistemi za zagotavljanje usposobljenosti morajo upoštevati delovne pogoje - tudi v izrednih razmerah, kjer pa v I4.0 svojo vlogo prevzemajo kolaborativni roboti.

Pomembnost kompetenc v ergonomiji (preučevanje in analiziranje delovnega mesta (DM) glede na ergonomske zahteve za zagotavljanje ustrezne interakcije med delom, proizvodom in okoljem ter človekovimi potrebami, njegovimi zmožnostmi in omejitvami) prikazuje slika 2, ki hkrati predstavlja primer konceptualnega načrta vpetosti ergonomije v I4.0.

6. ZAKLJUČEK

Dejstvo je, da se bo način dela v prihodnosti povsem spremenil, saj vstopamo v novo industrijsko prihodnost - I4.0, v kateri se z uvajanjem novih tehnologij prepletata resnični in virtualni svet. Na prvi pogled se zdi, da se v tem digitalnem svetu izpostavlja inteligentne stroje in pozablja na človeka. Posledično se pojavljajo bojazni o izgubi delovnih mest. Ob tem ne moremo mimo vprašanj o tem, kakšen vpliv ima I4.0 na ergonomijo in dobro počutje zaposlenih, o tem ali so ergonomska načela pomembna tudi v digitalni prihodnosti in o tem, kako bo videti delovno mesto čez deset let.

Po mnenju strokovnjakov razlogov za strah, da bodo roboti v proizvodnji v celoti nadomestili delavce, ni. Število rutinskih delovnih mest se bo zmanjšalo, število delovnih mest z višjo dodano vrednostjo pa se bo povečalo. Bistvo I4.0 namreč ni v zamenjavi ljudi z inteligentnimi stroji, temveč usposobiti jih za sodelovanje z njimi. To pomeni, da se bo posamezni delavec nedvomno moral soočiti z novimi tehnologijami, procese pa bo moral znati z uporabo različnih pametnih naprav spremljati ali pa s spreminjanjem posameznih parametrov vanje aktivno posegati. Od delavcev se v tovarnah prihodnosti zato pričakuje interdisciplinaren pristop, hitro sprejemanje lastnih odločitev in hitro prilagajanje zapletenim procesom. Zato lahko rečemo, da gre v pametnih tovarnah za mreženje - med delavcem in strojem ter med različnimi stroji.

Z razvojem I4.0 se vzporedno razvija tudi ergonomija, ki s pridom izkorišča nove tehnologije. V konceptualni načrt ergonomije je vse pogosteje vključena virtualna ergonomija, s pomočjo katere je mogoče pridobiti dragoceno podporo pri načrtovanju npr. novih proizvodnih linij ali njihovih delov, zmanjšanju potreb po fizičnih prototipih in skrajšanju časa in predvsem zmanjšanju stroškov razvoja.

Virtualna ergonomija omogoča oceno vplivov vpeljave človeških dejavnikov v virtualna okolja ustvarjena za prototipe izdelkov in procesov, virtualne lutke, digitalne biomehanske modele, ki simulirajo človeka, tako s kinematičnega kot dinamičnega vidika. Uporaba digitalnih modelov omogoča matematični opis gibanja delavca med delovnimi operacijami, ki so vzporedne s tehnikami vizualizacije virtualnih okolij

Industrija 4.0 se sooča tudi z izzivi razvoja, usposabljanja in upravljanja zaposlenih za potrebe okolja I4.0. Konceptualni načrt vpetosti ergonomije v I4.0 mora zato odgovoriti na vprašanja, katere spretnosti, kompetence in znanja potrebujejo zaposleni za učinkovito in varno delo.

Zaključimo lahko, da tovarna prihodnosti vzpostavlja novo raven interakcije med človekom in strojem. Dejstvo je, da se vloga delavca spreminja, saj ga bo novo digitalno okolje usmerjalo k novim izkušnjam in od njega zahtevalo več strokovnega znanja za načrtovanje, uporabo in nadzor inteligentnih strojev, ki mu bodo pomagali pri lažjem in varnejšem izvajanju delovnih nalog.

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Spletni forum kot orodje za spremljanje pouka pri skupinskem načrtovanju podatkovne baze

Web forum as a tool for monitoring lessons in group database planning

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POVZETEK

V prispevku je predstavljen del praktičnega pouka, povezan z načrtovanje entitetno–relacijske podatkovne baze, ki ga izvajamo v srednjem tehniškem izobraževanja pri modulu Načrtovanje podatkovni baz. Predstavljeni del praktičnega pouka izvajamo kot skupinsko načrtovanje podatkovne baze, vse delo pa beležimo in objavimo v spletni forum. Dijake bi v tem delu praktičnega pouka radi predvsem naučili konceptualnega načrtovanja podatkovne baze. To je tisti korak razvoja, ki dijakom povzroča največ težav.

Ključne besede

Načrtovanje, podatkovne baze, spletni forum, konceptualni model, skupinsko delo, entitetno–relacijski model

ABSTRACT

The article presents a part of practical training related to planning entity-relational database design, which is implemented in secondary technical education in the module Database Design. The presented part of the practical training is implemented as a group database design, and all the work is recorded and published in an online forum. In this part of the practical lesson, pupils would like to learn, above all, how to make a proper conceptual design of the database. This is the development step that causes the most problems.

Keywords

Planning, databases, online forum, conceptual model, teamwork, entity-relational model

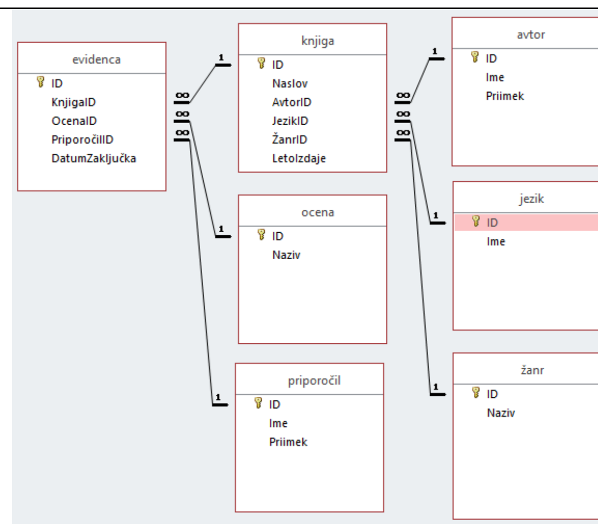
1. UVOD

Varnostne kopije so dandanes eden izmed najpomembnejših vidikov informatike. Verjetno se niti ne moremo predstavljati, kakšno škodo bi izguba podatkov povzročila tako posamezniku kot podjetju. [1] Zato moramo bodoče tehnike računalništva naučiti načrtovanja podatkovnih baz, saj bodo prav oni v naslednjih desetletjih skrbeli za naše dragocene podatke.

V srednješolskem strokovnem izobraževalnem programu računalniški tehnik imajo dijaki drugega letnika v predmetniku modul Načrtovanje in postavitev podatkovnih baz. Pri tem modulu se v prvi polovici leta učijo načrtovanja, v drugi polovici pa programiranja podatkovnih baz s programskim jezikom SQL. V prvi polovici leta dijaki rešujejo naloge, kjer dobijo kratek opis problema, za rešitev pa sestavijo entitetno–relacijski podatkovni model. Podobno kot prikazuje spodnji primer.

Tabela 1: Primer naloge

Opis naloge:
Načrtovali bomo podatkovno bazo Evidenca prebranih knjig. Zajeli bomo sledeče podatke: naslov knjige, avtorja knjige, žanr, jezik, v katerem je napisana, leto izdaje, datum zaključka branja, oceno knjige, ime in priimek - kdo nam je knjigo priporočil. Načrtuj podatkovno bazo tako, da bo možno isto knjigo prebrati večkrat. Nariši tabele in relacije med tabelami. V tabelah določi primarne ključe.
Rešitev naloge:



Slika 1: Rešitev naloge
[Vir: lastni]

Kot pravi Andreja Šet, izhodišče za izdelavo konceptualnega modela je opis problema. [2] To pa je za dijaka pravzaprav navodilo oz. naloga, ki opisuje problemsko stanje, za katerega dijak izdela načrt oz. entitetno–relacijski model podatkovne baze (Tabela 1). Naloge pa učitelji računalništva velikokrat priskrbimo sami, saj zbirke le-teh še ne obstajajo.

Pri takem načinu dela dijak dobi nalogo v obliki opisa problema, potem nalogo na računalniku rešuje samostojno. Po pretečenem času učitelj predstavi in razloži svojo rešitev. Tako lahko dijak primerja svojo rešitev z rešitvijo učitelja in tako sklepa, katere stvari je načrtoval pravilno in katere napačno in se posledično nauči, ali pa tudi ne, načrtovati PB.

Z opisano metodo dela se dijaki velikokrat srečujejo že na začetku z zmotnim prepričanjem o tem, kaj naloga od njih zahteva, ali nerazumevanjem predstavljene naloge in posledično z nepravilnim reševanjem le-te. Pokazatelj neznanja je, da dijaki dostikrat čakajo, da učitelj pokaže rešitev naloge, ali pa na sošolca, ki zna rešiti nalogo. S prepisovanjem rešitve se seveda ne naučijo konceptualnega načrtovanja. Da bi dinamiko praktičnega pouka spremenili in naredili bolj razumljivo, smo si zamislili skupinsko načrtovanje PB.

2. IZBIRA INOVATINEGA PEDAGOŠKEGA ORODJA

Na spletni strani Ministrstva za izobraževanje, znanost in šport so bili objavljeni strateški cilji, med drugim: razviti in preizkušati inovativne pedagoške pristope, modele in strategije poučevanja in učenja, ki osmišljajo uporabo IKT v vseh fazah učenja. [3] V okviru te strategije pa smo se sami odločili, da pri poučevanju modula NPB vpeljemo nove IKT pristope.

Predvideli smo, da bo delo po skupinah potekalo zelo neenakomerno. Med drugim smo iskali orodje, ki bi omogočalo nesočasno strukturirano komunikacijo vseh vpletenih v procesu učenja.

Nesočasna komunikacija ima kar nekaj prednosti: časovna in prostorska prilagodljivost, razprava in zbiranje idej poteka skozi daljše časovno obdobje, hranjenje "zgodovine" pogovora. [4] Iz vseh teh predpostavk smo dokončno ugotovili, da bo za naše potrebe najbolj primerna uporaba spletnega foruma.

3. IZVEDBA PRAKTIČNEGA POUKA

Pri praktičnemu pouku uporabljamo spletno učilnico za deljenje datotek med učitelji in dijaki. Spletna učilnica nam med drugim omogoča ustvariti spletni forum. To funkcionalnost smo uporabili za spremljanje dela dijakov po skupinah. Tako so dijaki že med procesom izkazovali svoje delo z objavami v forumu. Učitelj pa je te objave pregledoval in jih komentiral. Vse je bilo zapisano v forumu. Tudi to, kaj je posamezni dijak ali skupina dijakov v tistem trenutku uspela narediti. Napake, ki so jih dijaki naredili pri postopku načrtovanja, pa je učitelj neposredno komentiral in zapisal z objavo v forumu. Tako so dobili povratne informacije in jih kasneje lahko tudi večkrat prebrali in napake postopno odpravljali.

Razdelili smo jih v skupine glede na vrste v učilnici. Na spletu pa je forum izgledal, kot prikazuje slika 2.

V forumu smo ustvarili teme, kot je na primeri »2.Rb – četrta vrsta« v katerih so pripadajoči dijaki lahko razpravljali. V forumu pa jih je čakala tudi tema »*Splošna navodila*« v kateri so si učenci prebrali korake dela, ki so jih morali opraviti. Tako so učenci lahko pričeli z delom.

4. NALOGA UČITELJA

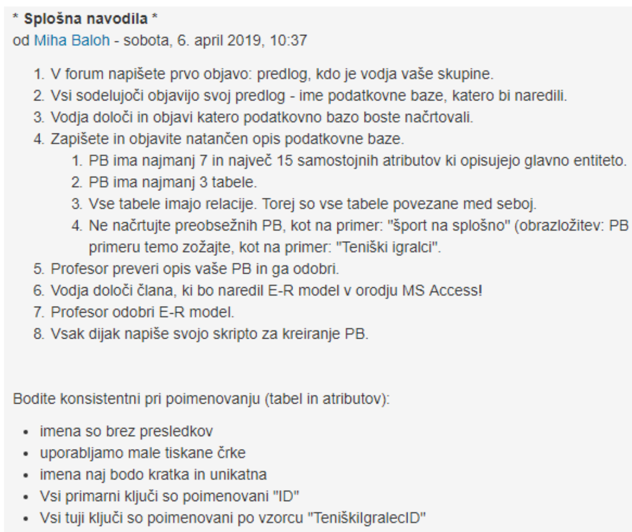
Naloga učitelja je bila predvsem, da spremlja delo dijakov na daljavo in dinamično pregleduje delo od ene do druge skupine. Popolnoma razumljivo je, da so nekatere skupine hitrejše od drugih. Tako učitelj lahko na daljavo usmerja dijake, ki so v poljubnem koraku procesa dela. Resne težave pa smo še vedno reševali v neposredni bližini.

Razprava	Začel(a)	Odgovori	Zadnja objava
2.Rb - četrta vrsta	Miha Baloh	65	Vojko Novak čet, 17. jan 2019, 19:09
2.Ra - prva vrsta	Miha Baloh	21	Tomaž Kerec sre, 9. jan 2019, 10:49
2.Ra - četrta vrsta	Miha Baloh	22	Petar Petrovic sre, 9. jan 2019, 10:02
* Splošna navodila *	Miha Baloh	0	Miha Baloh tor, 8. jan 2019, 16:25
2.Rb - tretja vrsta	Miha Baloh	74	Nejc Mihelič tor, 8. jan 2019, 09:38
2.Rb - druga vrsta	Miha Baloh	15	Luka Colarič tor, 8. jan 2019, 09:36
2.Rb - prva vrsta	Miha Baloh	31	Luka Colarič tor, 8. jan 2019, 09:32
2.Rb - peta vrsta	Miha Baloh	7	Luka Colarič tor, 8. jan 2019, 09:24
2.Ra - druga vrsta	Miha Baloh	73	Miha Baloh čet, 3. jan 2019, 11:57
2.Ra - tretja vrsta	Miha Baloh	19	Miha Baloh čet, 3. jan 2019, 11:55
2.Ra - peta vrsta	Miha Baloh	9	Miha Baloh čet, 3. jan 2019, 11:53
* Navodila za dokumentacijo *	Miha Baloh	0	Miha Baloh sre, 12. dec 2018, 10:11

Slika 2: Forum za delo po skupinah [Vir: lastni]

5. PROCES DELA

Proces dela so narekovala splošna navodila, ki so bila predhodno objavljena v forumu. Vidna so na sliki 3. Delo je potekalo natančno po predvidenih korakih, ki jih ni bilo možno preskakovati. Na posameznih korakih so bili predvideni mejniki, ki so predstavljali objavo v forumu. Vanje je bil obvezno vključen učitelj, ki je po presoji proces dela zaustavil, komentiral, spustil naprej ali vrnil v prejšnji korak. Koraki dela so podrobneje obrazloženi v nadaljevanju referata.



*** Splošna navodila ***
od Miha Baloh - sobota, 6. april 2019, 10:37

1. V forum napišete prvo objavo: predlog, kdo je vodja vaše skupine.
2. Vsi sodelujoči objavijo svoj predlog - ime podatkovne baze, katero bi naredili.
3. Vodja določi in objavi katero podatkovno bazo boste načrtovali.
4. Zapišete in objavite natančen opis podatkovne baze.
   1. PB ima najmanj 7 in največ 15 samostojnih atributov ki opisujejo glavno entiteto.
   2. PB ima najmanj 3 tabele.
   3. Vse tabele imajo relacije. Torej so vse tabele povezane med seboj.
   4. Ne načrtujte preobsežnih PB, kot na primer: "šport na splošno" (obrazložitev: PB primeru temo zožajte, kot na primer: "Teniški igralci".
5. Profesor preveri opis vaše PB in ga odobri.
6. Vodja določi člana, ki bo naredil E-R model v orodju MS Access!
7. Profesor odobri E-R model.
8. Vsak dijak napiše svojo skripto za kreiranje PB.

Bodite konsistentni pri poimenovanju (tabel in atributov):

- imena so brez presledkov
- uporabljamo male tiskane črke
- imena naj bodo kratka in unikatna
- Vsi primarni ključi so poimenovani "ID"
- Vsi tuji ključi so poimenovani po vzorcu "TeniškilgralecID"

Slika 3: Splošna navodila, objavljena v forumu [Vir: lastni]

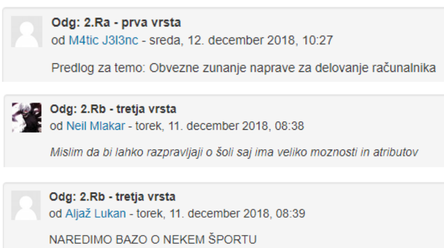
5.1 Korak 1: Izbor vodja skupine

V prvem koraku so dijaki dobili navodilo: »V forum napišete prvo objavo: predlog, kdo je vodja vaše skupine.« Primeri objav so prikazani na sliki 4. Dijaki so z objavo v forumu opravili prvi korak. Na demokratičen način, z največ glasovi je bil izvoljen vodja ekipe. Dijaki se sicer niso zavedali, da ima vodja v nadaljnjih korakih znotraj skupine posebne pravice.

Slika 4: Odzivi dijakov

5.2 Korak 2: Predlogi podatkovne baze

V drugem koraku so dobili navodilo: »Vsi sodelujoči objavijo svoj predlog - ime podatkovne baze, ki bi jo naredili.« Primeri objav so prikazani na sliki 5.



Slika 5: Primeri objav
[Vir: lastni]

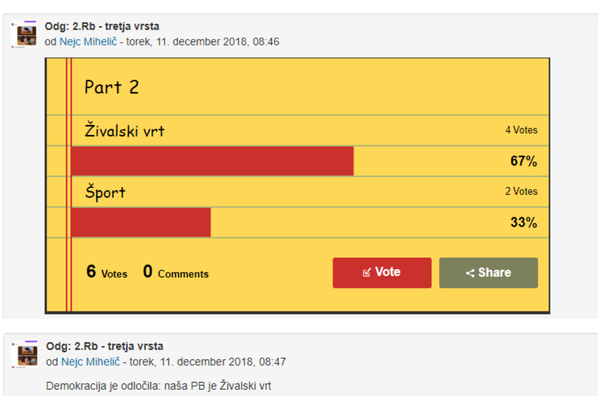
Tukaj so dijaki pokazali svoje ideje in domišljijo. Malokdo je razmišljal, kaj bo to pomenilo v nadaljevanju. Kajti na koncu bo potrebno PB narediti in jo napolniti s podatki. Predlogi so bili resnično zelo različni in zanimivi.

Ker so se dijaki večinoma prepuščali domišljiji, premalo pa načrtovanju, jih je učitelj opozarjal na korak številka 4, ko bo potrebno narisati načrt z določenimi omejitvami.

Primer objave učitelja iz foruma: »Ne načrtujte preobsežnih PB kot primer *šport na splošno*. PB bi bila velika nekaj TiB. V tem primeru temo zožite kot na primer na *teniški igralci*«.

5.3 Korak 3: Izbor podatkovne baze

V tretjem koraku so dobili navodila: »Vodja določi in objavi, katera PB se bo načrtovala.« Ena izmed najbolj zanimiv objav je prikazana na sliki 6.



Slika 6: Glasovanje za izbor teme

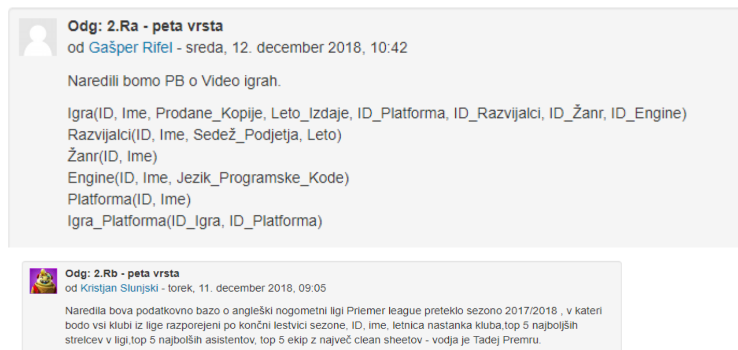
Vodja skupine je izbiro teme izvedel na zelo demokratičen način, čeprav se je zavedal, da ima absolutno pravico lastne izbire. Tema je bil izglasovana s pomočjo kratke ankete, kot je razvidno na sliki 6.

5.4 Korak 4: Natančen opis podatkovne baze

V četrtem koraku so prejeli navodila: »Zapišite in objavite natančen opis podatkovne baze.« Pomembne pa so bile tudi smernice in omejitve, ki so jih morali upoštevati:

- PB ima najmanj 7 in največ 15 samostojnih atributov, ki opisujejo glavno entiteto.
- PB ima najmanj 3 tabele.
- Vse tabele imajo relacije, torej so med seboj povezane.
- Ne načrtujte preobsežnih PB kot primer *šport na splošno*. PB bi bila velika nekaj TiB. V tem primeru temo zožite kot na primer na *teniški igralci*.

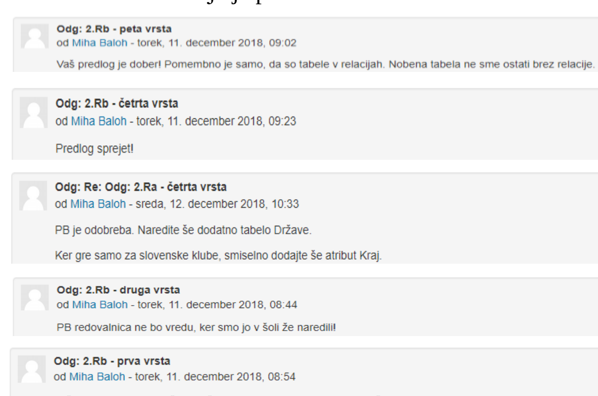
Primeri objav so vidni na sliki 7.



Slika 7: Primeri objav
[Vir: lastni]

5.5 Korak 5: Odobritev podatkovne baze

V petem koraku je v obvezno interakcijo prišel na vrsto učitelj, pri čemer je preveril opis posamezne PB, in ga odobril. Nekaj primerov odziva učitelja je prikazanih na sliki 8.

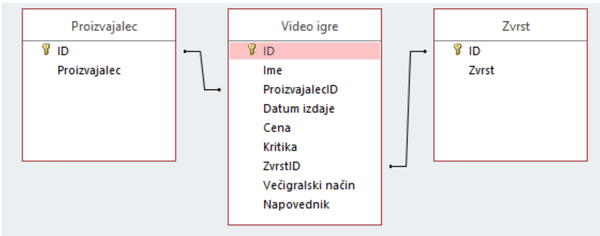


Slika 8: Objave učitelja
[Vir: lastni]

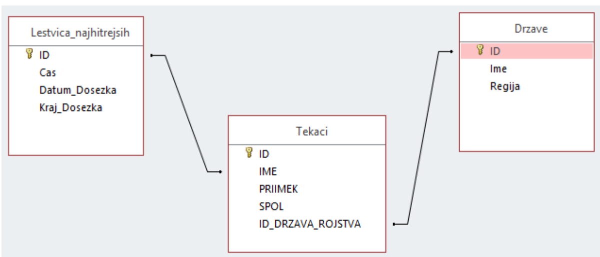
5.6 Korak 6: Objava slike E-R modela

V šestem koraku so dobili navodila: »Vodja določi člana, ki bo naredil E-R model v orodju MS Access.« V tem koraku je učitelj čakal, da izbrani član skupine objavi sliko E-R modela. Dijaki so v prvih poizkusih objavili PB video iger in PB lestvico tekačev.

Iz slik 9 in 10 je razvidno, da so v prvem poizkusu objavili rešitev, ki je imela veliko vsebinskih, logičnih in sintaktičnih napak. **Vsebinske napake** so bile: pri tekačih nas zanimajo države, iz katerih prihajajo. Celina ali regija pa nas ne zanimata, zato je ta podatek odvečen. **Logične napake** so bile: v relacijski povezavi, med tabelo lestvica najhitrejših in tabelo tekači manjka tuji ključ. **Sintaktične napake** so bile: imena tabel (npr: Video igre) in imena atributov (npr: Datum izdaje) se v PB pišejo brez presledkov.



Slika 9: PB video iger



Slika 10: PB lestvica tekačev

Sicer so dijaki dobili navodila, ki opozarjajo, naj bodo konsistentni pri poimenovanju tabel in atributov:

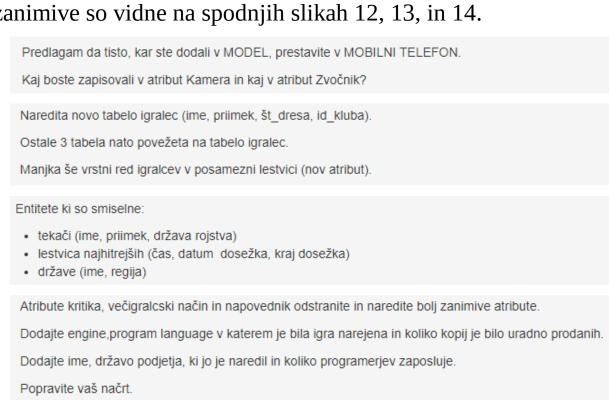
- Imena so brez presledkov.
- Uporabljamo samo male tiskane črke.
- Imena naj bodo kratka in unikatna.
- Vsi primarni ključi so poimenovani "ID".
- Vsi tuji ključi so poimenovani po vzorcu "TeniškiIgralecID".

V skupinah so se kljub jasnim navodilom še vedno pojavljale napake.

5.7 Korak 7: Učitelj odobri E-R model

Po objavi E-R modela so dijaki morali pred nadaljevanjem postopka počakati, da je učitelj pregledal trenutne rešitve in zapisal napake, ki jih je bilo potrebno popraviti.

Po popravkih so nastale odlične podatkovne baze. Najbolj zanimive so vidne na spodnjih slikah 12, 13, in 14.


Predlagam da tisto, kar ste dodali v MODEL, prestavite v MOBILNI TELEFON.

Kaj boste zapisovali v atribut Kamera in kaj v atribut Zvočnik?

Naredita novo tabelo igralec (ime, priimek, št_dresa, id_kluba).

Ostale 3 tabela nato povežeta na tabelo igralec.

Manjka še vrstni red igralcev v posamezni lestvici (nov atribut).

Entitete ki so smiselne:

- tekači (ime, priimek, država rojstva)
- lestvica najhitrejših (čas, datum dosežka, kraj dosežka)
- države (ime, regija)

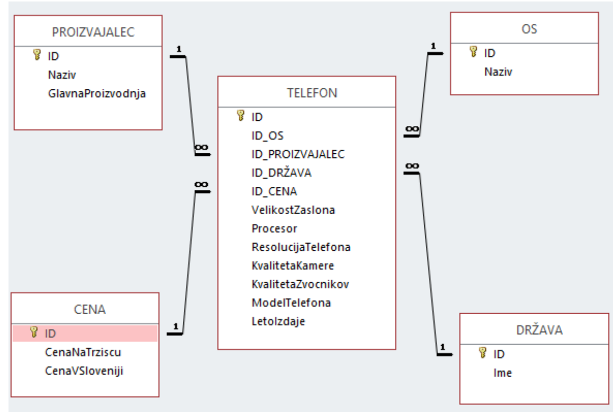
Atribute kritika, večigralcski način in napovednik odstranite in naredite bolj zanimive atribute.

Dodajte engine,program language v katerem je bila igra narejena in koliko kopij je bilo uradno prodanih.

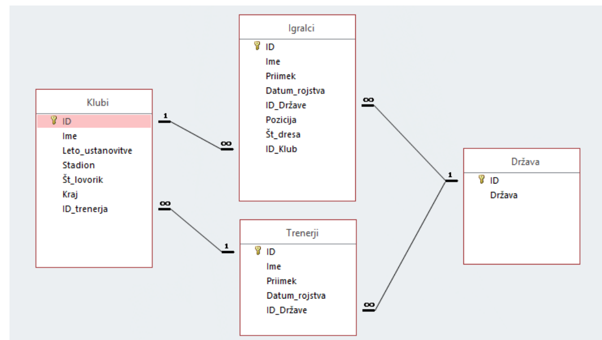
Dodajte ime, državo podjetja, ki jo je naredil in koliko programerjev zaposluje.

Popravite vaš načrt.

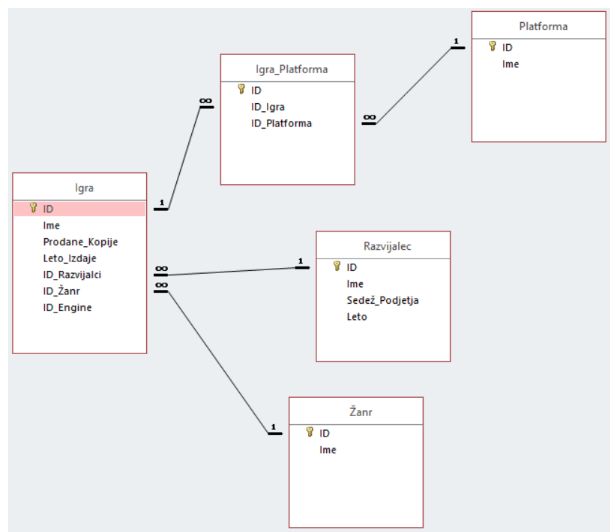
Slika 11: Primeri napak, ki jih je povzel učitelj



Slika 12: PB telefonov
[Vir: lastni]



Slika 13: PB klubi 1. slovenske lige
[Vir: lastni]



Slika 14: PB video iger
[Vir: lastni]

6. ZAKLJUČEK

Dr. Iztok Savnik navaja, da hiter in učinkovit razvoj kvalitetne programske opreme zahteva: prave ljudi, prava orodja in pravo usmeritev. [5] Po teh načelih si prizadevamo, da bi naši dijaki uporabljali prava orodja, da bi jim učitelji nakazovali prave usmeritve in predvsem, da bi postali uspešni strokovnjaki.

Množico objav dokazuje, da je opisani način dela dijake zelo pritegnil. Rezultati so vidni znotraj foruma, kjer so dijaki pustili sledi svojega dela. V obliki skupinskega načrtovanja so ponovno našli motivacijo za delo in učenje. Preko foruma so dobili ogromno povratnih informacij in se posledično hitreje in več naučili. Takšen način dela nam je vzel veliko več časa kot običajno. Za izdelavo ene podatkovne baze smo porabili od 4 do 6 pedagoških ur. Samostojno pa dijaki izdelajo PB enakega obsega v 2 šolskih urah. Podatek je sicer irelavanten, saj je naš cilj, da se načrtovanja podatkovne baze naučijo vsi dijaki.

7. VIRI

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[2] A. Šet, "Načrtovanje in postavitev podatkovnih baz: [učbenik za srednje strokovno izobraževanje, Tehnik računalništva]". Ljubljana, i2, 2017.

[3] Ministrstvo za izobraževanje, znanost in šport: Urad za razvoj in kakovost izobraževanja, "IKT v izobraževanju". Pridobljeno (25. 8. 2019) s http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/StrateskeUsmeritveNadaljnjegaUvajanjaIKT1_2016.pdf.

[4] CDI Univerzum, "Elektronske komunikacije". Pridobljeno (25. 8. 2019), s http://www.portalosv.si/komunikacija/elektronske-komunikacije/.

[5] I. Savnik, "Skripta za predmet Programiranje II: koncept programskih jezikov [Elektronski vir] : študijski program Računalništvo in informatika". Koper, Fakulteta za matematiko, naravoslovje in informacijske tehnologije, 2012.

Preverjanje znanja z interaktivnimi nalogami po delu na terenu-ogled domačega kraja

Knowledge assessment with interactive assignments after fieldwork - tour of a hometown

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POVZETEK
Informacijsko-komunikacijska tehnologija (IKT) je v današnjem času pri pouku nepogrešljiv učni pripomoček. Čeprav jo največkrat uporabljamo za utrjevanje matematičnih problemov, slovnice in naravoslovnih vsebin, sem se v lanskem šolskem letu odločila, da jo uporabim pri predmetu družba, ko sem obravnavala znamenitosti domačega kraja. Z učenci si le-te gremo pogledat in se o njih pogovorimo na terenu, a iz leta v leto opažam, da v naravi in opazovanju niso skoncentrirani. Za učenje z računalnikom in za delo z interaktivno tablo so veliko bolj motivirani. Da bi spoznali znamenitosti in si jih tudi zapomnili, smo tokrat pri uri k spoznavanju le-teh pristopili na igriv način, z reševanjem dinamičnih nalog (iger) na interaktivni tabli, s programom SMART Notebook.

Ključne besede
Interaktivna tabla, i-gradiva, SMART Notebook, družba, znamenitosti domačega kraja, pomembni možje Komende

ABSTRACT
Information and communication technology (ICT) is nowadays an indispensable teaching aid. Although it is most commonly used to consolidate mathematical problems, grammar, and science content, I decided last year to use it at the school subject society, when we were discussing the sights of our hometown. We usually go out and look at them with pupils and talk about them in the field, but year after year I notice that they are not concentrated in nature and observation. They are much more motivated to study the sights with the help of a computer and work with an interactive whiteboard. In order to get to know the sights and remember them, we learned about the sights in a playful way, solving dynamic tasks (games) on the interactive whiteboard by using the SMART Notebook program.

Key words
Interactive whiteboard, i-materials, SMART Notebook, society, hometown landmarks, notable people of Komenda

1. UVOD
Kot učitelji si želimo, da naši učenci poznajo kraj, v katerem odraščajo, njegove znamenitosti in pomembne osebnosti, ki so se tukaj rodile, ustvarjale…kraju pustile pečat. In ker pri predmetu družba v 5. razredu spoznavamo Slovenijo in njene značilnosti, je prav, da spoznajo tudi značilnosti domačega kraja.

Vsako šolsko leto si z učenci znamenitosti pogledamo tam, kjer stojijo. Gremo torej peš po kraju, se pri določeni ustavimo in o njej nekaj povem. Že to, da gremo peš, učencem ni najbolj všeč, kaj šele, da bi se skoncentrirali in poslušali, ko jim o določeni znamenitosti želim kaj več povedati. Zmoti jih vsak zvok, pripomba sošolca.

Večino svojega časa učenci namreč preživijo v virtualnem svetu elektronskih naprav. Tudi pri pouku opažam, da jih k delu vedno bolj pritegne vse, kar proiciram na interaktivni tabli. Narava dela nas kot učitelje usmerja v tako delo in čeprav se sama na tem področju še veliko učim, s pomočjo mlajših sodelavk, sem toliko bolj vesela, ko mi uspe kaj novega narediti oz. pripraviti.

2. INTERAKTIVNO GRADIVO
S pomočjo slikovnega materiala in različnih multimedijskih vsebin sem pripravila I-gradiva v programu Smart Notebook, z namenom, da učenci utrdijo in si zapomnijo, znamenitosti in znane osebnosti domačega kraja, bolje kot so si jih njihovi vrstniki v preteklih šolskih letih.

Dosegli in presegli so zastavljene cilje [2]:

- prepoznajo določene znamenitosti domačega kraja,
- prepoznajo pomembne može domačega kraja,
- o vsaki znamenitosti vedo tudi kaj povedati,
- komunicirajo in odgovarjajo na vprašanja,
- rešujejo različne tipe nalog,
- se navajajo na medsebojno pomoč,
- spretnosti obvladovanja čustev, sodelovanja, učenja v skupini, vrednotenja, izražanja stališč in mnenj,
- na enostaven način uporabijo izdelano gradivo,
- znajo logično razmišljati.

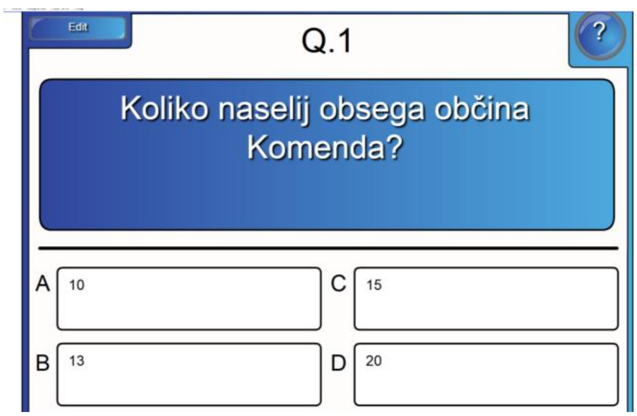
2.1 Gradivo: Spomin
(Miselna) didaktična igra je sestavljena iz 9 parov. Opis je na eni, slika znamenitosti na drugi ploščici spomina (slika 1).

Slika 1. Ploščice spomina (VIR: lasten, zajem zaslonske slike)

Ko odkrijejo pravi par, ploščici izgineta. Tako učenec dobi takojšnjo informacijo o pravilnosti odkritega.
Učenci se to igro zelo radi igrajo, saj jih igra spomin spremlja že od mlajših let.
Pri igri ob tem, da preizkušajo sposobnost pomnjenja in urijo možgane, razvijajo še vizualni spomin, orientacijo na ploskvi, usmerjajo pozornosti na detajle in predvsem usvajajo znamenitosti.

2.2 Gradivo: Kviz

Sestavila sem 10 vprašanj o domačem kraju [1]. Pri vsakem vprašanju imajo na voljo 4 odgovore, a le eden je pravilen (slika 2).



Slika 2. Kviz-domači kraj (VIR: lasten, zajem zaslonske slike)

Učenci dobijo takoj informacijo, če so pravilno odgovorili na vprašanje (sliki 3 in 4). V kolikor so se zmotili, morajo odgovarjati še enkrat, sicer ne morejo nadaljevati z naslednjim vprašanjem.

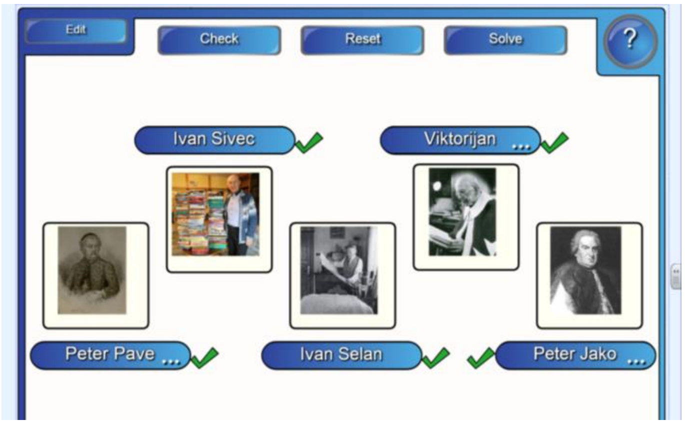
Slika 3 in 4. Povratna informacija o pravilnosti odgovora (VIR: lasten, zajem zaslonske slike)

Učenci s kvizom preverijo svoje znanje, ki so ga usvojili na terenu.

2.3 Gradivo: Znani možje Komende

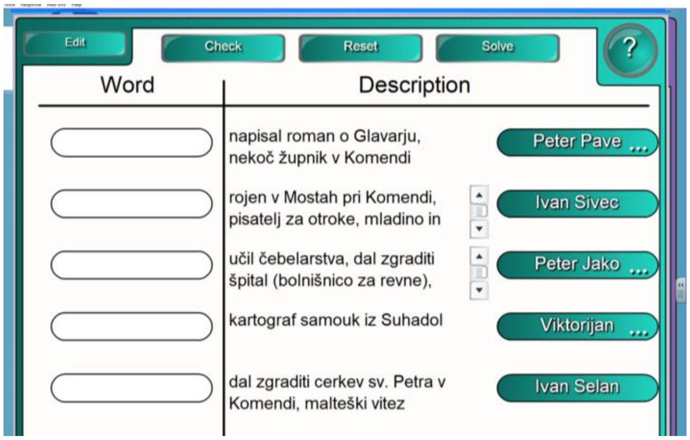
Glede na to, da učenci lažje sprejemajo informacije, če jih dobijo na različne načine, sem naredila dve interaktivni nalogi. Pri prvi učenci preko fotografij spoznavajo pomembne Komendčane (sliki 5 in 6). Ta naloga jim je všeč, ker ni potrebno veliko brati. V primeru, da povežejo napačno, se jim ob imenu pojavi rdeč križec.

Slika 5. Poveži sliko s pravim imenom (VIR: lasten, zajem zaslonske slike)

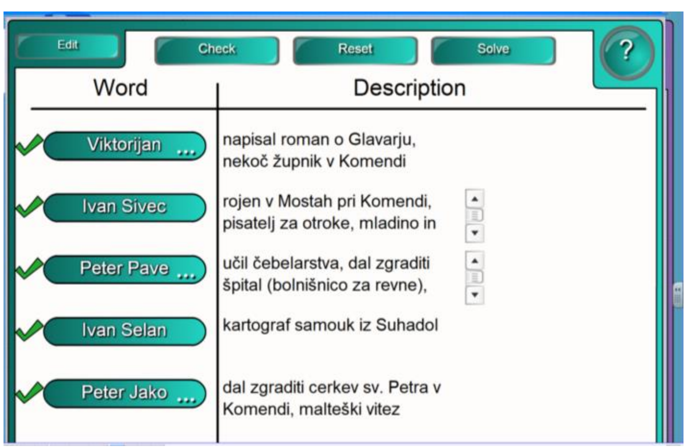


Slika 6. Povratna informacija o povezovanju (VIR: lasten, zajem zaslonske slike)

Druga naloga zahteva natančno branje in poznavanje dosežkov pomembnih Komendčanov. Pred opis morajo prenesti ustrezno ime osebnosti (sliki 7 in 8.



Slika 7. Poveži, kar spada skupaj (VIR: lasten, zajem zaslonske slike)

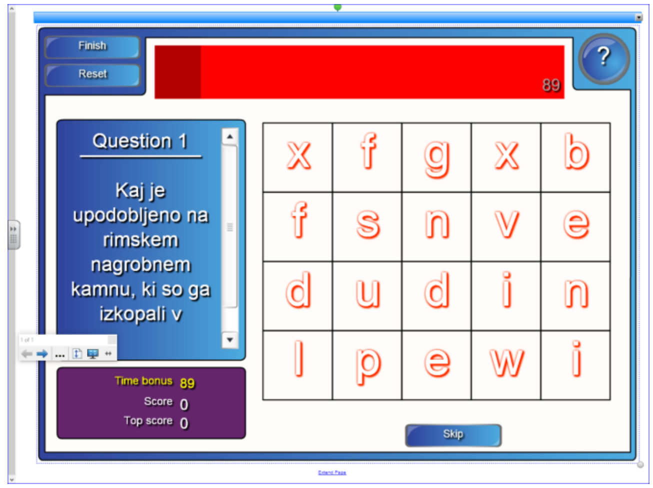


Slika 8. Takojšnja povratna informacija (VIR: lasten, zajem zaslonske slike)

Pri tej nalogi se je videlo, kako so učenci na terenu poslušali. Bilo je veliko nepravilnih odgovorov, zato so rešitve morali učenci zapisati v zvezke.

2.4 Gradivo: Katera beseda je prava?

Naloga od učencev zahteva, da preberejo vprašanje na levi strani in s klikanjem na ponujene črke uganejo pravo besedo (odgovor). Čas za reševanje je omejen, kar še poveča zanimanje za reševanje (sliki 9 in 10).



Slika 9. Izberi prave črke (VIR: lasten, zajem zaslonske slike)

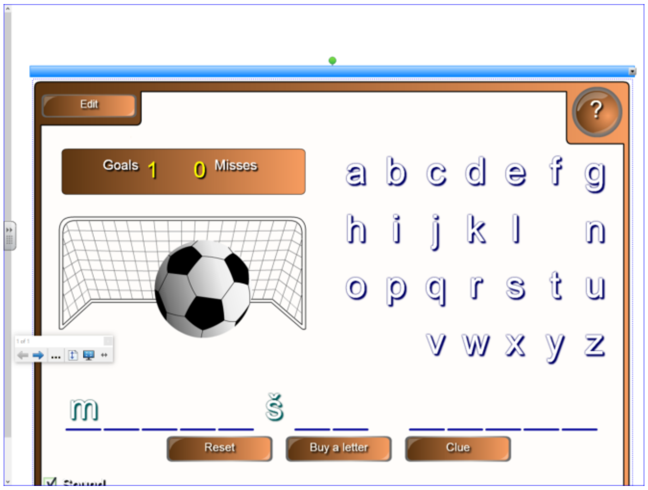
V rdečem okvirju zgoraj, se sproti izpisuje pravilna beseda. V kolikor učenec izbere napačno črko, se celotna beseda izbriše in učenec mora začeti znova.

Slika 10. Izpisovanje prave besede (VIR: lasten, zajem zaslonske slike)

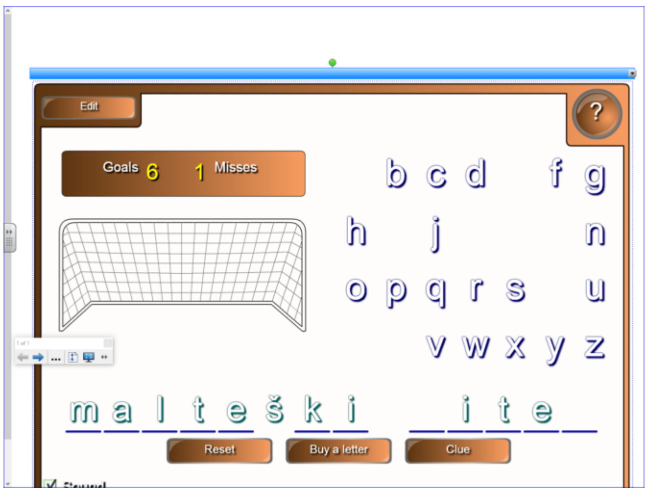
Učenci so morali prepisati vprašanje in odgovor v zvezek.

2.5 Gradivo: Zadeni gol

Naloga spominja na igro vislice, saj morajo učenci ugotoviti, za katero besedo gre. V pomoč sta jim gumba Clue (namig), kjer se jim prikaže za pomoč beseda, ki ga pripelje do rešitve in Buy a letter, kjer kupi črko. Če klikne na parvo črko, zadene gol, sicer žoga leti mimo (sliki 11 in 12).



Slika 11. Gol (VIR: lasten, zajem zaslonske slike)



Slika 12. Besedna zveza je že skoraj odkrita (VIR: lasten, zajem zaslonske slike)

Ko so odkrili besedo, so jo morali zapisati v zvezek in ob njej zapisati vsaj eno poved, ki se na besedo navezuje in so si jo zapomnili ob sprehodu po domačem kraju.

3. ZAKLJUČEK

Čeprav se sama na področju sestavljanja materiala za interaktivno gradivo še veliko učim, vidim, da so učenci bolj motivirani, ko ga v pouk vključim. Tudi v primeru spoznavanja znamenitosti domačega kraja, sem to opazila in ugotovila, da so bili za delo bolj skoncentrirani (kot takrat, ko smo znamenitosti opazovali v naravi). Tako pri ustnem preverjanju znanja in pisnem preizkusu je v lanskem šolskem letu bilo njihovo znanje boljše.

Veliko znanja so si preko sestavljenega interaktivnega gradiva pridobili tudi učenci, ki so na samem ogledu manjkali in si znamenitosti niso ogledali.

Taka priprava ure zahteva od učitelja, še posebej od takega kot sem sama, veliko dela, časa in potrpljenja, vendar pa si potem, ko vidiš, da so učenci preko i-gradiva dosegli večje pomnjenje kot na terenu, zelo vesel.

Vsekakor pa se zavedam in ostajam na tem, da računalnik narave in izkustvenega učenja ne more nadomestiti.

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Nevladne organizacije in neformalno izobraževanje za informacijsko družbo

Non-governmental organisations and the non-formal education for the Information society

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POVZETEK

Digitalna preobreozba družbe prinaša nove možnosti in izzive na področju izobraževanja. Izobraževanje za informacijsko družbo ni več domena enega samega sektorja. Nasprotno, postaja vse bolj več deležniško in raznoliko. Članek postavlja v ospredje vlogo nevladnih organizacij (NVO) v neformalnem izobraževanju za informacijsko družbo. Uvodoma izpostavlja problematiko obostoječega izobraževanja skozi naložbe kohezijske politike v Sloveniji in neizkoriščen potencial neformalnega izobraževanja. V nadaljevanju predstavlja koristi neformalnega izobraževanja in primere nevladnih organizacij, ki uvajajo inovativne pristope pri krepitvi e-veščin in digitalnih kompetenc prebivalstva. V sklepnem delu so oblikovani predlogi za sistemsko ureditev neformalnega izobraževanja in krepitev medsektorskega sodelovanja. Slednje bo nevladnim organizacijam omogočilo, da prevzamejo odgovornejšo in aktivnejšo vlogo v digitalni preobrazbi in prispevajo k izboljšanju položaja Slovenije na indeksu digitalnega gospodarstva in družbe.

Ključne besede

Informacijska družba, Digitalna Slovenija, neformalno izobraževanje, nevladne organizacije, DESI indeks, človeški kapital, kohezijska politika EU, naložbe

ABSTRACT

The digital transformation of society brings new opportunities and challenges in the field of education. Education for the information society is not anymore attached to a single sector. On the contrary, it is becoming increasingly multi-stakeholder in nature and therefore diverse. The article focus is on the role of non-governmental organisations (NGOs) in non-formal education for the information society. The issue of the EU Cohesion policy investments into the Slovene formal education system and the unexploited potential of non-formal education for the purpose of digital transformation are discussed as a starting point. Cases of NGOs developing innovative approaches in enhancing e-skills in the digital competences of the population are presented. The final part elaborates policy proposals for supporting of non-formal education and strengthening cross-sector collaboration. Both are necessary conditions for NGOs to undertake stronger and more accountable role in digital transformation as well improving Slovenia position on Digital economy and society index.

Keywords

information society, Digital Slovenia, non-formal education, non-governmental organisations, DESI index, human capital, EU cohesion policy, investments

1. PROBLEMATIKA IZOBRAŽEVANJA ZA INFORMACIJSKO DRUŽBO

Nahajamo se v obdobju hitrega razvoja tehnologij. Digitalizacija, industrija 4.0, verižni bloki, kriptovalute, pametne pogodbe, umetna inteligenca, globoko učenje, internet stvari in družbena omrežja so krilatice, o katerih udeleženci formalnega izobraževanja ne slišijo. Pravzaprav je stanje v formalnem izobraževanju še bolj kritično, ker IKT vsebin ni v obveznem programu osnovnih šol. Obstajajo izbirne vsebine, vendar se le-te izvajajo samo v nekaterih šolah. Ustanove, ki izvajajo vseživljenjsko izobraževanje (npr. ljudske univerze) ponujajo osnove uporabe računalnika (urejanje besedil, oblikovanje preglednic, pripravo predstavitev, uporabo interneta, elektronske pošte, multimedije in omrežij). Težko pričakujemo, da bodo te ustanove v kratkem času pripravile in ponudile sodobne vsebine digitalizacije, ki bodo pokrile vsestransko široko in uporabno znanje digitalnih spretnosti za aktivno vključevanje v sodobno družbo [1],[2]. Dodaten problem predstavlja usposobljenost izobraževalcev v formalnem izobraževalnem sistemu, katerim primanjkujejo potrebna znanja in veščine za izvajanje sodobnih vsebin digitalizacije. Problematiko izobraževanja za informacijsko družbo država Slovenija naslavlja v okviru prednostne naložbe 10a - Vlaganje v izobraževanje, usposabljanje in poklicno usposabljanje za spretnosti in vseživljenjsko učenje z razvojem infrastrukture za izobraževanje in usposabljanje v okviru Operativnega programa za izvajanje Evropske kohezijske politike v obdobju 2014-2020. Financirani projekti v okviru te prednostne osi so (bili) med drugimi naslednji: Nadaljnja vzpostavitev IKT infrastrukture v vzgoji in izobraževanju (20 milijonov evrov), Razvoj in udejanjanje inovativnih učnih okolij in prožnih oblik učenja za dvig splošnih kompetenc (10 milijonov evrov), Razvoj in implementacija preverjanja pedagoških digitalnih kompetenc izobraževalcev (1,98 milijona evrov), Odprt, odziven in kakovosten sistem visokega šolstva - Vključevanje uporabe IKT v visokošolskem pedagoškem procesu (1,5 milijona evrov), Spodbujanje prožnih in inovativnih oblik učenja z razvojem jezikovnih virov in tehnologij (1,5 milijona evrov), Inovativne in prožne oblike poučevanja in učenja v pedagoških študijskih programih (prispevek EU 1 milijon evrov) ter Razvoj in implementacija dviga digitalnih kompetenc ter temeljnih znanj računalništva in informatike otrok, učencev in dijakov (800.000 evrov. V okviru te prednostne osi potekata tudi projekta Pridobivanje temeljnih in poklicnih kompetenc od 2018 do 2022, ki vključuje računalniško pismenost za odrasle (22,1 milijona evrov; načrtovana poraba za programe digitalnega opismenjevanja v Operativnem programu znaša 8,9 milijona evrov) in Strokovna podpora področju pridobivanja temeljnih kompetenc (666.700 evrov) [3]. Navkljub več deset milijonskim naložbam Evropske kohezijske politike 2014-2020 v digitalne veščine mladih ter uporabo IKT pri poučevanju in učenju ter računalniško pismenost za odrasle, Slovenija v zadnjih letih ni dosegla napredka na tem področju. Slovenija se na tematskem sklopu indeksa digitalnega gospodarstva in družbe (DESI), ki meri človeški kapital oz. veščine za uporabo interneta, osnovna in napredna digitalna znanja ter spretnosti prebivalstva, nahaja pod povprečjem EU na 15. mestu [4].

Tabela 1. Uvrstitev države Slovenije na indeksu DESI (sklop človeški kapital)

	2014	2015	2016	2017	2018	2019
SLO	15	16	16	13	14	15

Pri razlagi uspešnosti naložb kohezijske politike Slovenije na področju vlaganja v izobraževanje predstavljajo pomemben dejavnik naložbeni cikli, katerih neposredni učinki in rezultati so lahko vidni v srednji ali dolgoročni perspektivi. Zato je pri oceni uspešnosti zaključenih projektov, ki nimajo izrazite infrastrukturne narave (npr. naložbe v človeški kapital) potrebno upoštevati časovno distanco, ki lahko traja tudi nekaj let [5].

2. NEIZKORIŠČEN POTENCIAL NEFORMALNEGA IZOBRAŽEVANJA

Tudi, če bi v tem trenutku prišlo do bistvenih sprememb v formalnem izobraževanju za informacijsko družbo, imamo veliko prebivalcev v populaciji starejših od 18 let, ki v času formalnega izobraževanja ni pridobila ustreznih znanj, veščin in ni pripravljena za sprejemanje sprememb. To pomeni, da bodo imeli težave pri delu in življenju v družbi, ki hitro uvaja nove tehnologije. Vrzel, ki je nastala zaradi hitrega razvoja in implementacije tehnologije, lahko učinkovito izpolnijo nevladne organizacije. Nevladne organizacije so fleksibilne in se za razliko od javnih izobraževalnih organizacij lahko hitro odločajo in ponudijo vsebine, ki so aktualne in nujno potrebne, da bo Slovenija ostala v stiku s sodobnimi trendi.

Načelu prožnosti in odprtosti v izobraževanju sledi Strategija Digitalna Slovenija 2020 – Strategija razvoja informacijske družbe do leta 2020, ki prepoznava vlogo neformalnega izobraževanja za informacijsko družbo. Formalni in neformalni šolski prostor je treba odpreti novim idejam in prilagoditi novim generacijam, potrebam izobraževanja za nova digitalna delovna mesta in enakopravnemu vključevanju vseh generacij v evropsko digitalno družbo (str. 6). Strategija med razvojna načela digitalizacije umešča tudi neformalno izobraževanje za mlajšo in starejšo generacijo (str. 9) [6].

Neformalno izobraževanje za informacijsko družbo prinaša veliko variabilnost, saj se prilagaja tako potrebam in zmožnostim posameznikov kot družbe in je lahko tudi zelo raznoliko. Odziva se na potrebe dane situacije in odgovarja na potrebe ljudi, izhaja pa iz človekovih vsakdanjih dejavnosti in ima nanje tudi povraten vpliv, saj se posamezniki v neformalnem izobraževanju izobražujejo in razvijajo za raznolike veščine in spretnosti, ki so izhajale iz njihovih potreb in želja. Neformalni programi se oblikujejo glede na potrebe, želje in zmožnosti posameznikov ali skupin. V okviru neformalnih izobraževanj nevladne organizacije dopolnjujejo in razširjajo storitve, ki jih sicer nudi javni sektor, in tako krepijo razpoložljive vire ter omogočajo hitrejše in boljše izobraževalne učinke.

Načelo variabilnost izobraževanja zasleduje dokument Strateške usmeritve nadaljnjega uvajanja IKT v slovenske visokošolske zavode do leta 2020, ki postavlja v izhodišče zagotavljanje pogojev za delovanje odprtih učnih okolij. Ta so konceptualizirana kot okolja, ki omogočajo, da se z inovativni pedagoškimi strategijami v polni meri izkoristijo možnosti uporabe IKT tako v procesu učenja kot v procesu poučevanja [7].

2.1 Pomanjkanje medsektorskega sodelovanja

Ključen pogoj koristnosti in učinkovitosti neformalnega izobraževanja predstavlja medsektorsko sodelovanje med različnimi akterji izobraževanja za informacijsko družbo. Strategija Digitalna Slovenija 2020 izpostavlja kot eno izmed pomembnih razvojnih načel digitalizacije tudi iskanje sinergij in vzpostavitev sodelovanja med deležniki na medresorski in medsektorski ravni, v katerega morajo biti vključena podjetja, ministrstva, javni sektor, ponudniki storitev in vsebin, uporabniki, izobraževalne in raziskovalne institucije ter nevladne organizacije. Iskati je potrebno sinergijske učinke, ki bodo izboljševali digitalne veščine prebivalstva, mlade usmerjali v poklice na področju IKT ter jih povezovali s potrebami in usposabljanji zasebnega sektorja za nova digitalna mesta. Strategija navaja tudi oblikovanje skupnih projektov industrije in nevladnih organizacij (str. 17).

Osrednji usklajevalni, koordinativni in posvetovalni odprt forum enakopravnih deležnikov na področju digitalizacije bi morala predstavljati Slovenska digitalna koalicija [8]. Koalicija se sooča s težavami pri vzpostavljanju redne in dolgoročno usmerjene medsektorske komunikacije deležnikov digitalne preobrazbe Slovenije. Odsotnost medsektorske komunikacije se kaže v daljšem obdobju neoperativnosti upravnega odbora in neizvajanju letnih forumov koalicije. Namesto principa več deležniškega usklajevanja, se je v koaliciji vzpostavil princip skupin pritiska, s katerim nosilci posameznih interesov določajo vsebinski okvir delovanja koalicije (BlockChain think thank, industrija 4.0, digitalno znanje pod okriljem formalnega izobraževanja itd.). Gre sicer za aktualna področja digitalizacije, ki pa so omejena na interes enega ali dveh sektorjev (praviloma gospodarstva). Usklajevanje na teh področjih samo po sebi ne vključuje širšega kroga ostalih zainteresiranih deležnikov, med katere sodijo tudi nevladne organizacije.

3. IZOBRAŽEVALNA FUNKCIJA NEVLADNIH ORGANIZACIJ

V nadaljevanju predstavljamo primere neformalnega izobraževanja za informacijsko družbo, katere izvajajo slovenske nevladne organizacije.

3.1 Inštitut IPAK

IPAK inštitut je v sodelovanju z West Valley Collegeom iz Silicijeve doline v letih 2001- 2004 kot prvi v Sloveniji izobraževal razvijalce za spletne aplikacije. Izobraževanje je potekalo v obliki »blended learning« kombinacija spletnega in klasičnega učenja. Udeleženci so pridobili sodobna in uporabna znanja, vendar je zaradi pomanjkanja finančnih sredstev IPAK prenehal s to obliko izobraževanja. Leta 2011 in 2012 je IPAK v sodelovanju z ustanovo Modra reka izvajal projekt »Izven štiridesetih« [9], v katerem so študenti iz Tuzle in Šapca obiskali Velenje in skupaj s sodelavci inštituta razvijali programsko opremo za logopede. V tednu dni intenzivnega dela so razvili prototip. Na žalost tudi ta projekt zaradi pomanjkanja finančnih sredstev ni prerasel v trajnostno obliko, čeprav so bili rezultati obetavni.

3.2 Zavod Simbioza

Projekt »Simbioza e-pismena Slovenija – vse življenje se učimo« je z akcijo e-opismenjevanja starejših povezal več kot trideset tisoč mladih in starejših v edinstven modul uporabnega podajanja znanja preko medgeneracijskega sodelovanja. Gre za nacionalno pobudo za dvig e-pismenosti med starejšimi s pomočjo mladih prostovoljcev, ki spodbuja socialno vključenost ranljivih skupin, aktivno participacijo in vključujočo digitalno družbo. Simbioza je s pomočjo deležnikov tekom let razvila več pobud in projektov na temo digitalne družbe (kot so Simbioza Šola, Simbioza BTC City Lab, e-Simbioza, etc…). Eden od glavnih ciljev Simbioze je dvig računalniške pismenosti in zanimanje za učenje e-veščin med starejšimi; pomagati jim pri (prvem) stiku z računalnikom, internetom in zadnja leta tudi pri uporabi pametnih telefonov. Po drugi strani pa med mladimi promovira vrednote prostovoljstva, odgovornosti in krepi proaktiven odnos do družbe in lastne prihodnosti. Tovrsten model medgeneracijskega sodelovanja je bil večkrat nagrajen – tako s slovenskimi kot s tujimi priznanji in nagradami.

3.3 Mreža NVO za vključujočo informacijsko družbo

Vsebinska mreža NVO za vključujočo informacijsko družbo (NVO-VID) si prizadeva za celosten pristop k digitalizaciji nevladnih organizacij [10]. Pri tem se osredotoča na naslednja tri področja: 1) uvajanje informacijsko-komunikacijske tehnologije v podporo dejavnostim nevladnih organizacij, 2) pridobivanje digitalnih veščin v nevladnih organizacijah za razumevanje uporabe informacijsko-komunikacijske tehnologije in 3) postopna preobrazba delovanja in organiziranosti v digitalne nevladne organizacije, kadar je to smiselno. Za enostavnejše uvajanje IKT v delo nevladnih organizacij je mreža pripravila pregled virov in ponudnikov dostopne programske in strojne opreme ter spletnih storitev v nevladnem sektorju. Za pridobivanje digitalnih veščin in postopno digitalno preobrazbo v nevladnih organizacijah je urejena ponudba dostopnih izobraževanj za uporabo programske opreme, spletnih in oblačnih storitev, družbenih omrežij, spletne dostopnosti, varnosti, upravljanja z bazami podatkov, projektnega vodenja, izboljšanja produktivnosti dela, komunikacije z uporabniki itd. Prizadevanja mreže NVO-VID na področju digitalizacije temeljijo na prepričanju, da družbeno ustrezna informacijsko-komunikacijska tehnologija in njeno smiselno vključevanje v delovanje nevladnih organizacij pomagata uresničevati njihovo poslanstvo na učinkovit in ustvarjalen način.

3.4 Primerjalne prednosti nevladnih organizacij

Nevladne organizacije imajo pomembno vlogo pri nagovarjanju socialnih in človeških vidikov digitalizacije ter posledično pri uravnoteženi in vzdržni digitalni sliki Slovenije. Primerjalne prednosti NVO na področju digitalizacije so naslednje: netehnološke oz. družbene inovacije in razvoj, umeščenost v družbeno okolje, neposreden stik z ljudmi, praktične izkušnje s terena ter socialne in strokovne kompetence. NVO delujejo na različnih ravneh digitalizacije: raven uporabnika (prepoznavanje potreb in dostop do ciljnih skupin, izobraževanje za uporabo, preverjanje zadovoljstva, vzpostavljanje zaupanja, približevanje uporabnikom), raven skupnosti (zagovarjanje digitalne preobrazbe, promocija inovacij, naslavljanje odločevalcev, pilotiranje in preizkušanje pred vstopom na trg oz. družbena sprejemljivost digitalnih rešitev) in raven vsebin (vrednotenje vsebin digitalizacije z vidika socialne pravičnosti in okoljske prijaznosti, družbeno odgovorno inoviranje in razvoj). Koristi vključevanja NVO v digitalizacijo so naslednje: dostopne, uporabne, učinkovite in prijazne digitalne rešitve, zadovoljstvo končnih uporabnikov, zaupanje v tehnologije, človeške kompetence za digitalno preobrazbo, družbena sprejemljivost inovacij in trajnost digitalnih produktov / projektov.

Nevladne organizacije lahko bistveno hitreje ponudijo izobraževanje novih vsebin kot ostali ponudniki izobraževanj. Vendar se tudi nevladni sektor pri realizaciji ciljev digitalizacije sooča z različnimi težavami. Najpogostejše so naslednje:

- relativno malo nevladnih organizacij lahko ponudi kakovostno izobraževanje s področja digitalizacije,
- večina teh organizacij se nahaja v osrednje slovenski regiji oziroma v Ljubljani,
- za izvajanje vsebin digitalizacije nevladne organizacije nimajo potrebnih sredstev in posledično tudi usposobljenega kadra.

4. PREDLOGI ZA KREPITEV NEFORMALNEGA IZOBRAŽEVANJA ZA INFORMACIJSKO DRUŽBO

Na osnovi izkušenj nevladnih organizacij, ki izvajajo neformalno izobraževanje za informacijsko družbo predlagamo, da se to področje uredi sistemsko prek javnih razpisov in s spodbujanjem medsektorskega sodelovanja. V prvi vrsti se večina nevladnih organizacij na področju neformalnega izobraževanja sooča s pomanjkanjem finančnih sredstev za svoje kadre, delovanje in izvedbo programov. Zato je eden izmed prvih predlogov, da se sistemsko uredi financiranje NVO, ki delujejo na področju neformalnega izobraževanja za informacijsko družbo in izpolnjujejo kriterije za pridobitev finančnih sredstev (npr. status nevladne organizacije v javnem interesu). Poleg tega bi bilo smotrno zagotoviti sredstva za izvedbo izobraževalnih vsebin, ki so bila pripravljena v sklopu EU projektov, vendar so realizirana samo v pilotnih fazah projektov. Po zaključku projekta pa zanje ni več na voljo sredstev. To še posebej velja za izvajanje izobraževanj na področjih digitalizacije, ki so pomembna za nadaljnji razvoj Slovenije in ki niso pokrita od strani drugih izobraževalnih organizacij. Prav tako je potrebno več razmisleka nameniti skupnim rešitvam in združevanjem storitev in izdelkov, ki se razvijajo na osnovi večdeležniške strukture zasebnega sektorja, javnega sektorja in civilne družbe. V povezavi s tem je potrebno tudi okrepiti sodelovanje nevladnih organizacij z gospodarstvom, javnim sektorjem in razvojno raziskovalnimi institucijami.

4.1 Načrtovanje kohezijske politike Slovenije 2021-2027

Na podlagi predstavljene problematike neformalnega izobraževanja za informacijsko družbo predlagamo, da država Slovenija v naložbenih smernicah za financiranje v okviru naslednje kohezijske politike v obdobju 2021–2027 nameni več pozornosti socialnim in človeškim vidikom digitalizacije. Te vidike kot cilje navaja Strategija Digitalna Slovenija 2020: (1) dvig splošnega zavedanja o pomenu IKT in interneta za razvoj družbe, (2) intenzivna in inovativna uporaba IKT in interneta v vseh segmentih družbe, (3) vključujoča digitalna družba in (4) zaupanje v kibernetski prostor in varovanje človekovih pravic (str. 12). Hkrati opozarjamo, da je država Slovenija postavila strateški razvojni cilj v Strategiji razvoja Slovenije 2030, po katerem bo uvrščena na 9. mesto po vseh tematskih razsežnostih indeksa DESI do leta 2030 [11]. Zato predlagamo povečanje naložb v socialne in človeške vidike digitalizacije v okviru cilja kohezijske politike 4: Bolj socialna Evropa – Izvajanje evropskega stebra socialnih pravic. V okviru tega cilja predlagamo naslednjo naložbeno smernico:

Zaupanje v kibernetski prostor in varovanje človekovih pravic (krepitev neformalnega izobraževanja mladih in odraslih ter usposabljanja prebivalstva za pridobivanje ključnih digitalnih kompetenc, znanj in spretnosti kot so digitalna pismenost in kultura, pametna in varna uporaba IKT, zaščita digitalne zasebnosti, preprečevanje digitalne odvisnosti, ozaveščanje o izzivih digitalizacije kot so umetna inteligenca, internet stvari, robotizacija itd. kot dopolnitev formalnim oblikam izobraževanja).

Prepričani smo, da bo takšna naložbena smernica izboljšala položaj Slovenije na tematskem sklop indeksa DESI, ki meri človeški kapital. Zato pričakujemo od Službe Vlade Republike Slovenije za razvoj in evropsko kohezijsko politiko (SVRK), da bo smernica vključena v načrtovanje kohezijske politike Slovenije za obdobje 2021-2027.

4.2 Programiranje proračuna države Slovenije 2020-2021

Zakon o nevladnih organizacijah (ZNOrg) v 2. odstavku 23. člena določa, da ministrstva na področjih, za katera so pristojna, preko javnih razpisov financirajo projekte in programe nevladnih organizacij in drugih oseb, namenjenih izvajanju ukrepov za razvoj posameznih področij, ter spodbujanju razvoja nevladnih organizacij in razvoju podpornega okolja za nevladne organizacije. Prav preko javnih razpisov financirajo projekte in programe vsebinskih mrež kot subjektov podpornega okolja, namenjenih spodbujanju razvoja nevladnih organizacij.

Predlagamo, da se določila ZNOrg uporabijo pri programiranju proračuna države Slovenije s ciljem okrepiti neformalno izobraževanje za informacijsko družbo na način spodbujanja medsektorskega sodelovanja med izvajalci izobraževanj. V skladu s tem pozivamo Ministrstvo za izobraževanje, znanost in šport (MIZŠ), da premisli in ustrezno prilagodijo obstoječe pogoje javnih razpisov in med upravičene izvajalce izobraževanj za digitalno pismenost prebivalstva vključi tudi nevladne organizacije in neformalne oblike izobraževanj.

5. ZAKLJUČEK

Nevladnim organizacijam je potrebno omogočiti, da prevzamejo odgovornejšo in aktivnejšo vlogo v digitalni preobrazbi Slovenije. Potencial nevladnih organizacij je potrebno izkoristiti pri naslavljanju trenutno najbolj kritičnih področij države Slovenije na indeksu DESI kot sta človeški kapital (osnovna in napredna digitalna znanja in spretnosti) in uporaba interneta (uporaba vsebin, komunikacij in spletnih transakcij med državljani). Obe področji digitalizacije je potrebno izdatneje podpreti z naložbami v neformalno izobraževanje za praktično digitalno pismenost in kompetence (zaupanje v kibernetski prostor in varovanje človekovih pravic), programe spodbujanja uporabe interneta (storitev e-uprave, e-zdravja, e-vsebin, dvig splošnega zavedanja o pomenu IKT in interneta za razvoj družbe) in projekte za vključujočo digitalno družbo (e-vključenost ranljivih družbenih skupin in starejših ljudi - še posebej na podeželju). S krepitvijo vloge nevladnih organizacij v digitalni preobrazbi Slovenije in krepitvijo medsektorskega sodelovanja na področju neformalnega izobraževanja za informacijsko družbo, se bodo posredno izpolnili tudi cilji Slovenske digitalne koalicije.

6. ZAHVALA

Prispevek je podprt s strani projekta »Profesionalizacija vsebinske mreže nevladnih organizacij za vključujočo informacijsko družbo (PRO-NVO-VID)«, katerega sofinancira Ministrstvo za javno upravo v okviru javnega razpisa za sofinanciranje projektov razvoja in profesionalizacije NVO in prostovoljstva. Spletna stran projekta https://www.informacijska-druzba.org/.

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Razvijanje računalniškega mišljenja z Micro:bitom

Developing computer thinking with Micro:bit

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POVZETEK

Računalniško mišljenje pri učencih razvija strategije razumevanja in reševanja problemov na način, da lahko rešitev izvede računalnik. Te strategije se prenašajo tudi na druga strokovna področja in pripomorejo k boljšemu reševanju problemov nasploh. Gre za veščine, ki niso vezane izključno na področje računalništva in jih je pomembno razvijati pri vsakemu posamezniku. V prispevku bomo podali primer inovativnega orodija in aktivnosti, ki spodbujajo razvoj računalniškega mišljenja pri otrocih v drugih dveh vzgojno-izobraževalnih obdobjih. Z uporabo Micro:bita smo dosegli namen, saj so učenci uspešno reševali tudi zahtevnejše odprte probleme. Micro:bit smo najprej preizkusili v okviru interesne dejavnosti in v okviru programa dela z nadarjenimi učenci ter v sklopu izbirnega predmeta računalništvo. Rezultati dela so nas prepričali in bomo reševanje problemov z Micro:bitom v prihodnje vključili v redni pouk v obliki dneva dejavnosti za šesti razred.

Ključne besede

Digitalne kompetence, računalniško mišljenje, programiranje, Micro:bit, osnovna šola

ABSTRACT

Computational thinking develops student's strategies for understanding and problem solving in a way that the solution can be performed by a computer. These strategies are transmitted to other areas and help to develop problem solving in general. These skills are not strictly related to the field of computer science and are important to develop with each individual. In the article we will present an example of innovative tools and activities that develop student's computational thinking in the second two educational periods. Using Micro: bit, the goal was achieved as students successfully solved more difficult open problems. We used Micro:bit during interest activities, in program for gifted students and in optional classes of computing. The results of the work have convinced us, so we are going to includ problem solving with Micro:bit in the way of the whol day activity for all sixth graders.

Keywords

Digital competencies, Computational thinking, Programming, Micro:bit, primary school

1. UVOD

Če želimo mlade usposobiti za bodoča delovna mesta in za učinkovito sodelovanje v digitalni družbi, jih moramo opolnomočiti tudi s kompetencami, ki omogočajo uporabo digitalne tehnologije, kontrolo nad uporabo tehnologije in ustvarjanje lastne tehnologije [2]. Te kompetence je Evropska unija opredelila v Okviru digitalnih kompetenc za državljane (DigComp, DigComp 2.0 in DigComp 2.1), v katerem je opredeljenih pet kompetenčnih področij: informacijska pismenost, komunikacije in sodelovanje, izdelovanje digitalnih vsebin (sem sodi tudi programiranje), varnost in reševanje problemov [1]. Kot kažejo novejša spoznanja strokovne javnosti, bodo morali učenci razvijati digitalne kompetence in hkrati spoznavati računalniške vsebine, da bi se uspešno vključevali v informacijsko družbo [7]. V osnovni šoli so računalniške vsebine učencem 4., 5. in 6. razredov ponujene v okviru neobveznega izbirnega predmeta računalništvo v obsegu 35 ur letno. Če predmet učenci izberejo, ga lahko obiskujejo ali eno ali dve ali tri leta. So šole, ki izbirnega predmeta računalništvo sploh ne ponujajo, nekatere šole pa ga zaradi omejenega števila skupin ne izvajajo. V šolskem letu 2016/2017 je neobvezni izbirni predmet računalništvo izbralo 17,1 % učencev [6]. Učenci 7., 8. In 9. razreda lahko obiskujejo izbirni predmet računalništvo (urejanje besedil, multimedija in računalniška omrežja). Po poročilu RINOS je v šolskem letu 2016/2017 ta predmet izbralo 18,3 % učencev.

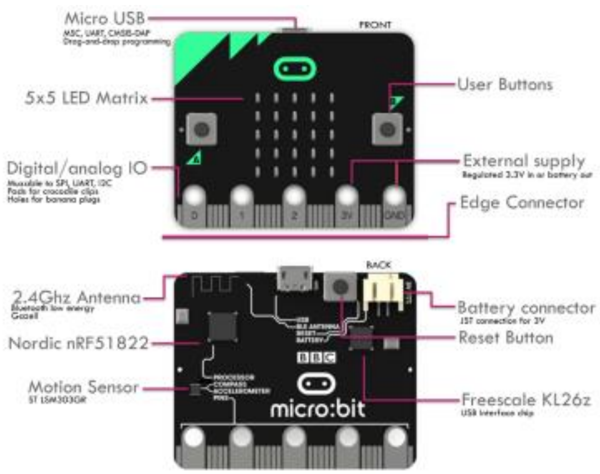
Namen prispevka je osvetliti pomen razvijanja računalniškega mišljenja (ang. computational thinking) pri učencih in podati primere aktivnosti, ki spodbujajo razvoj računalniškega mišljenja v 2. In 3. vzgojno-izobraževalnem obdobju (VIO) osnovne šole. Predstavljene bodo aktivnosti in orodje za poučevanje učencev od 4. do 9. razreda, ki jih izvajamo na naši šoli v okviru ur interesnih dejavnosti, v okviru ponujenih dejavnosti za nadarjene učence in v okviru pouka neobveznih izbirnih predmetov računalništva.

2. RAČUNALNIŠKO MIŠLJENJE

Obrazložitev pojma računalniško mišljenje lahko najdemo v Poročilu strokovne delovne skupine za analizo prisotnosti vsebin računalništva in informatike v programih osnovnih in srednjih šol ter za pripravo študije o možnih spremembah (RINOS) [6]: »Računalniško mišljenje se nanaša na miselne procese, ki sodelujejo pri opredeljevanju problema in izražanju njegove rešitve na način, da lahko rešitev učinkovito izvede računalnik. Pri tem iščemo rešitev za odprte probleme tako, da sledimo nizu dobro opredeljenih korakov, ki vključujejo koncepte, ključne za področje računalništva (npr. iteracija, abstrakcija, avtomatizacija). Računalniško mišljenje je prenosljivo na druga strokovna in znanstvena področja, prispeva k razvoju metakognitivnih sposobnosti in boljšemu reševanju problemov nasploh.« Računalniško razmišljanje torej ni veščina, ki je povezana izključno z računalništvom. Raziskave namreč kažejo, da je programiranje zelo dober mehanizem za razvijanje reševanja problemov, tudi v vsakdanjem življenju [4]. To pa vpliva na razvoj metakognitivnih strategij učencev [6]. Računalniško mišljenje je uvrščeno med sedem ISTE standardov za učence [3]: podpiranje učenca, konstrukcija znanja, inovativni dizajn, računalniško razmišljanje, kreativno komuniciranje, računalniško sodelovanje. ISTE opredeljuje računalniško mišljenje kot razvijanje strategij za razumevanje in reševanje problemov na način, ki omogoča uporabo tehnoloških metod za razvoj in testiranje rešitev [3]. Kot navaja poročilo RINOS, lahko v prvih letih šolanja računalniško mišljenje urimo tudi brez uporabe računalnika, čeprav je uporaba orodij, ki otrokom omogočajo programiranje, zelo smiselna. Pomembno je tudi, da ta orodja omogočajo velik razpon težavnosti. Še vedno pa velja, da je razvijanje računalniškega mišljenja najučinkovitejše pri pouku računalništva in informatike, kjer učenci rešujejo probleme z uporabo računalnika [6].

2.1 Razvijanje računalniškega mišljenja z Micro:bitom

Micro:bit je majhen računalnik, ki ga lahko programiramo (Slika 1). Na njem je USB priključek, priključek za baterijsko napajanje, matrika 5 x 5 LED lučk, dva kontrolna gumba, radijska antena, senzor svetlobe, senzor premikanja, senzor temperature in kompas. Micro:bit lahko preko vhodov ali izhodov povežemo tudi na druge naprave ali senzorje. Razvit je bil s pomočjo Micro:bit fundacije za izobraževnje (micro:bit Educational Foundation) britanskega BBC.



Slika 1: Micro:bit [5]

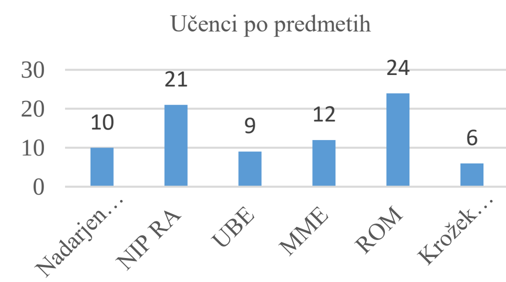
Programiramo ga lahko s pomočjo enostavnega programiranja blokov, ki ga omogoča njihov t.i. ustvarjalnik kode (ang. Make Code Editor) ali pa s pomočjo programskega jezika Python. Na naši šoli smo se odločili, da z učenci programiramo z bloki. Ta način je enostavnejši in ga tudi učenci brez predznanja hitro usvojijo. Učenci so se z Micro:bitom srečali pri neobveznih predmetih računalništva, pri interesni dejavnosti programiranje in v sklopu programa za nadarjene učence. Odločili smo se za 10 urne sklope. Učitelji, ki dela z učenci ima nekaj predznanja iz programiranja, udeležil se je tudi seminarja Fizično računalništvo z Micro:bitom in FischerTechnik, ki ga je organiziral ZRSŠ.

Učence najprej seznanimo z napravo in programskim okoljem. Nato sledi ustvarjanje preprostih programov in algoritmov, sledi uporaba spremenljivk, pogojev, zank… Pri pouku vedno vključujemo metodo problemskega pouka, ki vključuje tudi odprte probleme. Učna ura poteka v obliki krajših projektov, pri katerih učenci pridobivajo nova znanja (spoznavajo računalniške ukaze, računalniške strukture), raziskujejo, rešujejo zastavljen problem, ustvarijo algoritm reševanja in končno sestavijo program, ki reši problem. Posledično v celotnem učnem procesu razvijajo računalniško mišljenje. V projekte vključujemo uporabo naprav, ki so na Micro:bitu že integrirane in jih tudi nadgradimo s priklapljanjem zunanjih naprav, kot so zvočniki, LED diode, stikala in motorčki. Modele za projekte si izdelamo tudi sami. Pri tem uporabimo material, ki nam je na voljo in je poceni, npr. papir, karton, stiropor, vezne plošče… Preprosti primer projekta je izdelava semaforja za pešce, kjer uporabimo LED diode in modele iz kartona. Projekt smo nadgradili z izdelavo semaforja za avtomobile in kompleksnejše križišče. Veliko idej za projekte smo dobili na spletni strani www.microbit.org. Projekte so učenci pripravljali ali sami ali v dvojicah.

S pomočjo plošče za krmiljenje motorjev (ang. Motor driver board) lahko Micro:bit povežemo z modeli FischerTechnik. Za FisherTechnik smo se odločili zato, ker smo nekaj kompletov na šoli že imeli (šole smo jih dobile v okviru drugega projekta izpred nekaj let). Zaenkrat so učenci uporabljali že sestavljene modele (sestavili smo jih ali učitelji ali učenci pri drugih dejavnostih). Tako smo prihranili čas in obdržali fokus na programiranju. S temi modeli lahko učenci spoznajo programsko krmiljenje zunanjih naprav, stikal, motorjev in različnih senzorjev.

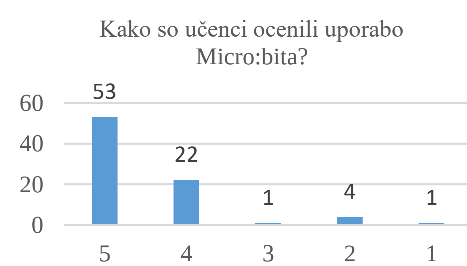
2.2 Vključevanje Micro:bita v pouk

Kot že omenjeno, smo na naši šoli za razvijanje računalniškega mišljenja uporabljali napravo Micro:bit. Vključeni so bili učenci od 4. do 9. razreda. Učenci od 4. do 6. razreda so bili vključeni v okviru neobveznega izbirnega predmeta računalništvo (NIP RA), programa za nadarjene učence in interene dejavnosti Programiranje. Učenci od 7. do 9. razreda so sodelovali pri izbirnem predmetu računalništvo: Urejanje besedil (UBE), Multimedija (MME) in Računalniška omrežja (ROM). Skupaj je bilo vključenih 82 učencev. Razpored in število učencev prikazuje Slika 2.



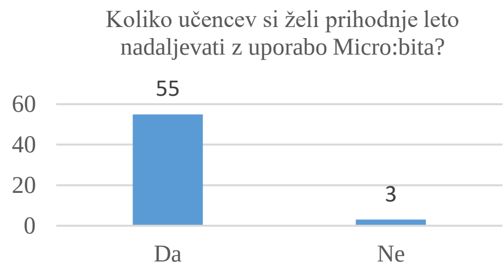
Slika 2: Učenci po predmetih

Učenci so praviloma Micro:bit uporabljili 10 učnih ur. Po končanem sklopu pa smo jim preko spletne ankete zastavili nekaj vprašanj, s katerimi smo evalvirali njihov odziv na uporabo Micro:bita. Učenci so z oceno od 1 (ni mi bilo všeč) do 5 (zelo mi je bilo všeč) ocenili, kako jim je bila všeč uporaba Micro:bita (Slika 3). Povprečna ocena je bila 4,5.



Slika 3: Ocenjevanje uporabe Micro:bita

Učence smo povprašali o tem, če si želijo Micro:bit uporabljati tudi v prihodnje? Velika večina je odgovorila, da si tega želijo (Slika 4) Iz analize smo izvzeli odgovore devetošolcev.



Slika 4: Uporaba Micro:bita prihodnje leto

Učenci na vprašanje, zakaj jim je delo z Micro:bitom všeč, so pogosto odgovorili, da zato, ker lahko s programiranjem upravljajo stvari in ker radi programirajo. Čeprav smo na naši šoli šele pričeli z uporabo Micro:bitov, lahko poročamo o izrednem navdušenju in zanimanju učencev. Razvoj računalniškega mišljenja smo pri teh učencih z veliko gotovostjo dosegli, kar so dokazali z izdelavo lastnih projektov in idejami za prihodnje projekte.

3. ZAKLJUČEK

Pri uporabi Micro:bita so učenci uspešno opredeljevali in reševali probleme s pomočjo računalnika in programiranja. Računalniško mišljenje so razvijali tudi pri razvijanju in reševanju manjših projektov, ki so bili delno ali v celoti zastavljeni kot odprti problemi. Dopuščena jim je bila velika mera kreativnosti. Pouk z Micro:bitom smo izvajali s šestimi različnimi skupinami učencev. Opazili smo, da je bilo najbolj učinkovito delo v skupini do 12 učencev in ni bilo pogojeno s predznanjem učencev. Zelo pomembna je bila vloga učitelja kot mentorja. Pri urah izbirnega predmeta računalništvo, ki poteka v skupini 26 otrok iz 4., 5. in 6. razreda je bilo delo sicer zabavno, vendar je učitelj porabil veliko energije za organizacijo dela. V tej skupini smo v enakem času rešili tretjino manj primerov, modelov FisherTechnik pa sploh nismo uporabili. Učitelj je v tej skupini težje ocenjeval napredek posameznika.

Odločili smo se, da bomo prihodnje šolsko leto Micro:bit vključili v redni pouk v obliki dneva dejavnosti v 6. razredu. Na tak način bomo dosegli vse učence v generaciji. Preizkusili bomo še možnost povezave Micro:bita s Scratchem, ki je v novi različici Scratcha možna prek bluetooth povezave. V višjih razredih, bomo v prihodnje Micro:bit uporabili tudi za učenje programiranja v programskem jeziku Python.

Kot učiteljica lahko poročam o zelo dobri pedagoški izkušnji. Sploh v manjših skupinah so bili rezultati izjemni. Z rezultati mislim tako na glavni zastavljeni cilj, ki je bil razvijanje računalniškega mišljenja pri učencih, kot na odziv učencev, potek dela, vzdušje v razredu in željo otrok po nadaljnem delu.

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Mednarodni projekti eTwinning kot del pouka angleščine

eTwinning international projects as part of English lessons

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POVZETEK

Namen prispevka je predstaviti spletni portal eTwinning ter nekaj konkretnih primerov sodelovanja učencev v mednarodnih projektih eTwinning, in sicer v okviru pouka angleščine. Mednarodni projekti učencem omogočajo uporabo pridobljenega znanja v praktičnih situacijah, medpredmetno povezovanje znanja, poleg tega pa učence motivirajo za delo in popestrijo sam pouk. Delo večinoma poteka preko računalnika in že sama uporaba tehnologije učence motivira k večji aktivnosti.

Ključne besede

eTwinning, mednarodni projekt, IKT, motivacija, angleščina

ABSTRACT

The aim of the article is to present the eTwinning platform as well as a few examples of students taking part in international projects eTwinning – as part of English lessons. International projects not only give students an opportunity for cross-curricular integration and a chance to actually use their knowledge in real situations but they also motivate them for work and make English lessons more interesting. Most of the work is done by using computers and the use of technology motivates the students to be more active.

Keywords

eTwinning, international project, ICT, motivation, English

1. UVOD

Učitelji se pogosto sprašujemo, kako učence motivirati za delo oz. kako vzdrževati pozornost učencev v razredu. Velikokrat se zgodi, da so učenci fizično prisotni v razredu, vendar pa so z mislimi nekje drugje. Razlog je v premajhni aktivnosti otrok in premajhni motivaciji za pridobivanje novega znanja. Zaradi tega se učitelji na različne načine trudimo, da učencem približamo učno snov, jim jo ustrezno predstavimo ter jim nudimo priložnosti, da nova znanja tudi uporabijo. Pri tem si lahko precej pomagamo z vključevanjem informacijsko-komunikacijske tehnologije (IKT) v pouk. Pri poučevanju angleškega jezika je možnosti za uporabo IKT kar precej, saj se IKT in angleščina v vsakdanjem življenju močno prepletata.

Eden izmed spletnih portalov, ki ga pri tem lahko uporabimo, je eTwinning. Preko tega portala se učitelji lahko povežemo s šolami iz celotne Evrope ter s tem učencem omogočimo tisto, kar je glavni cilj učenja jezika – sporazumevanje v angleščini.

2. PORTAL ETWINNING

Portal eTwinning je skupnost evropskih šol, ki učiteljem ter ostalim pedagoškim delavcem po vsej Evropi omogoča povezovanje, sodelovanje ter razvijanje projektov na katerem koli predmetnem področju. Učitelji lahko na tem portalu najdemo orodja (eTwinning Live, Twinspace), s pomočjo katerih lažje pripravimo in izpeljemo svoje projekte. Na voljo je tudi galerija primerov dobrih praks, ki služi kot vir navdiha za oblikovanje in izvajanje novih projektov eTwinning. [1]

2.1 eTwinning Live

Učitelji, ki smo registrirani na portalu eTwinning, imamo dostop do eTwinning Live. Tu lahko poiščemo druge registrirane eTwinnerje in šole, se povežemo z njimi in sledimo njihovim aktivnostim. Ogledamo si lahko partnerske forume, kjer najdemo ideje drugih učiteljev in se lahko odzovemo na njihove pobude. Učitelji imamo s pomočjo eTwinning Live tudi možnost pripraviti svoje projekte oz. ustvariti skupine, v okviru katerih nato sodelujemo z drugimi učitelji in učenci.

2.2 Twinspace

Ko učitelj ustanovi projekt oz. se mu priključi, do projekta dostopa preko varnega portal Twinspace. Ta je namenjen izključno učiteljem, ki sodelujejo v določenem projektu. Učitelj lahko nato v projekt doda tudi svoje učence in jim na ta način omogoči neposredno sodelovanje z vrstniki iz partnerskih šol.

3. PROJEKTI ETWINNING

Projekti eTwinning so lahko vezani na katerokoli predmetno področje in lahko potekajo v različnih jezikih. Časovno niso strogo omejeni. Trajajo lahko 1 teden ali več šolskih let. Projekt začneta vedno 2 šoli partnerici iz različnih držav, nato se jima pridruži poljubno število šol. Projekti so lahko vključeni v redne ure pouka, lahko pa potekajo v okviru dodatnega pouka ali interesne dejavnosti.

V nadaljevanju bom predstavila nekaj konkretnih projektov, v katerih smo z učenci sodelovali v preteklih letih. Vsi projekti so potekali med rednimi urami angleščine.

3.1 Postcards for European Day of Languages

Učenci 6. razreda na začetku šolskega leta ponavljajo, kako povedati nekaj osnovnih podatkov o sebi ter se seznanijo s pisanjem razglednice oz. z obliko pisma. Ob evropskem dnevu jezikov, ki ga obeležujemo 26. septembra, šestošolce zato skoraj vsako leto vključim v kratek (enomesečni) projekt, v sklopu katerega lahko uporabijo to znanje. Sodelujoče države namreč druga drugi pošljejo razglednice z voščilom za dan jezikov ter kratko predstavitvijo učencev.

V okviru tega projekta so učenci najprej s pomočjo računalnika izdelali razglednice z motivi Slovenije, domačega kraja in šole. Na hrbtni strani so se na kratko predstavili ter napisali slovensko in angleško voščilo ob evropskem dnevu jezikov. Po klasični pošti smo razglednice nato poslali sodelujočim šolam.

Na oglasni deski v učilnici smo pripravili zemljevid Evrope, kjer so bile označene vse države, ki so v tem projektu sodelovale. Prejete razglednice iz partnerskih šol smo si ogledali ter jih razstavili na oglasni deski (slika 1).

V spletni učilnici Twinspace smo v sliki in besedi objavili kratko predstavitev našega kraja in šole, objavili fotografijo vseh prejetih razglednic ter napisali zahvalo sodelujočim državam.

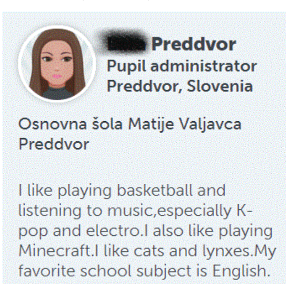
V okviru projekta so učenci spoznali nekaj novih spletnih orodij (padlet, Twinspace), znanje angleščine so uporabili v konkretni situaciji, poleg tega so utrdili in poglobili znanje geografije. [5]

Slika 1. Razstava razglednic ob evropskem dnevu jezikov

3.2 Making Slovenian-Catalan friends

V tem projektu so ravno tako sodelovali učenci 6. razreda, ki so se povezali z vrstniki iz Španije. Projekt se je odvijal ob koncu šolskega leta - maja in junija, njegov glavni namen pa je bil učencem pokazati, zakaj se sploh učijo angleščino ter jim omogočiti, da svoje znanje v čim večji meri uporabijo v konkretnih situacijah. Projekt je bil zasnovan tako, da so bile aktivnosti v bistvu le nekoliko drugačna oblika ponavljanja celoletne snovi.

Učiteljici sva najprej vse učence dodali v spletno učilnico Twinspace. Za uvod so si učenci uredili profil, vendar brez slike. Potem je vsak učenec dobil enega partnerja iz druge šole ter se mu čim bolj natančno predstavil in opisal. Na podlagi prejetega opisa so učenci nato izdelali avatar za svojega partnerja. Pri tem so uporabili orodje Avatar Maker. Ko so prejeli svoj avatar, so si ga nastavili za profilno sliko (slika 2).



Slika 2. Primer profila učenke

V naslednji fazi projekta so učenci v forumu pod temo Hobbies pisali o svojih interesih – o nogometu, glasbi, filmih oz. računalniških igrah.

Preko elektronske pošte, ki jo omogoča spletna učilnica Twinspace, so nato navezali stik še z vsaj dvema učencema iz partnerske šole.

Naslednja aktivnost je bila vezana na šolske predmete. Vsaka šola je v spletno učilnico dodala svoj urnik, sledila pa je primerjava šolskih predmetov ter glasovanje o najljubšem predmetu.

V spletno učilnico smo nato naložili skupinsko fotografijo ter fotografije šole in domačega kraja s kratkimi opisi.

Ker je ob koncu šolskega leta zelo pestro, smo bili nekoliko na tesnem s časom, vendar nam je uspelo v večji meri aktivnosti dokončati. Učenci so bili nad projektom navdušeni in so izrazili željo, da bi v naslednjem letu s tem nadaljevali. Kar nekaj naših učencev pa je vzpostavilo stik s katalonskimi učenci tudi izven spletne učilnice. [3]

3.3 Greetings from Europe

V tem projektu so sodelovali učenci 7. razreda. Najprej so se partnerskim šolam predstavili ter pripravili projekcije oz. fotozgodbe, s katerimi so na kratko predstavili svojo državo in domači kraj.

Glavni del projekta je bilo snemanje kratkega filma o šoli. Z učenci smo se skupaj dogovorili, kako bi predstavili šolo ter katere dele šole bi izpostavili. Razdelili so se v pare oz. v skupine po tri. Vsak par oz. vsaka skupina si je izbrala en del šole in sestavila kratek opis. Ko smo imeli pripravljene vse opise, je na vrsto prišlo snemanje. Večinoma so bili učenci dovolj pogumni, da so izbrani del šole v angleščini predstavili pred kamero, tisti bolj sramežljivi pa so se prelevili v vlogo snemalcev. Trije učenci, ki so precej spretni z računalnikom, so nato posamezne posnetke združili v celoto. Fotozgodbe in film o šoli smo objavili v spletni učilnici Twinspace ter si ogledali tudi predstavitve ostalih šol. Učenci so bili navdušeni nad končnim izdelkom, hkrati pa zelo ponosni nase, ker jim je film dejansko uspelo pripraviti.

V okviru projekta so spoznali nekaj novih orodij (MovieMaker, PhotoStory) ter se preizkusili kot snemalci. Pri projektu nam je na pomoč priskočila tudi učiteljica računalništva. [2]

3.4 Mystery students

V projektu so sodelovali učenci 8. razreda. Projekt je bil zasnovan kot igra, ki sta jo naenkrat igrala dva razreda preko Skypa. Učitelji smo se vnaprej dogovorili za termine, kdaj bi bilo možno izpeljati video konference. Učenci so bili o tem obveščeni, niso pa vedeli, s kom bodo te video konference potekale. Cilj igre je bil uganiti, od kod druga šola prihaja (lahko samo državo). Eden izmed učencev je drugi šoli postavil vprašanje, na katerega so lahko odgovorili le z da ali ne, nato pa so oni postavili vprašanje. Igra je potekala toliko časa, da je ena šola pravilno ugotovila lokacijo druge. V drugem delu video konference so se učenci lahko pogovarjali o poljubnih temah (hrani, šoli, počitnicah, nogometu …). Pogoj je bil le ta, da je celotna video konferenca potekala v angleščini, brez zatekanja k materinščini (slika 3).

Šola, ki je v igri izgubila, je morala pripraviti Powerpoint predstavitev o državi druge šole ter jo naložiti v Twinspace.

Učenci so v tej igri izjemno uživali in se na koncu, čeprav jim je bilo sprva nekoliko nerodno govoriti v angleščini, zelo zavzeto pogovarjali z vrstniki. [4]

Slika 3. Video konferenca med šolo iz Italije in našo šolo

3.5 Water for life, not for death!

Pri pouku angleščine se učenci v zadnjem triletju osnovne šole srečajo s temami, vezanimi na okolje, med drugim tudi z vlogo vode v človekovem življenju. Pred tremi leti smo se zato z učenci 9. razreda vključili v e-Twinning projekt z naslovom »Water for life, not for death«. V projektu so sodelovale šole iz različnih držav, ki ležijo ob Sredozemskem morju. Glavni cilj projekta je bil ozavestiti učence o problematiki vode, tudi v Sredozemskem okolju.

Učence 9. razreda smo najprej vključili v spletno učilnico Twinspace, kjer so se predstavili ter glasovali za logo projekta (slika 4). V padlet smo vnesli slovenske pozdrave ter zemljevid Slovenije kot ene izmed mediteranskih držav. Z učenci smo izbrali nekaj fotografij domačega kraja ter šole in jih objavili v spletni učilnici. Nato smo si ogledali prispevke drugih držav. Med rednim poukom angleščine smo se veliko pogovarjali o pomembnosti vode, o posledicah pomanjkanja le-te, o onesnaževanju ter tudi o problematiki beguncev, ki preko Sredozemskega morja iščejo poti v Evropo. Učenci so na internetu iskali posnetke ter fotografije, ki govorijo o tej problematiki ter jih predstavili sošolcem. V okviru projekta je nastala tudi Powerpoint predstavitev o pomembnosti vode, ki smo jo preko Skype konference predstavili učencem iz nekaterih sodelujočih držav. Ob zaključku projekta so učenci v forumu v spletni učilnici Twinspace objavili kratke komentarje o pomembnosti vode ter o pretirani uporabi vode.

V času trajanja projekta so učenci spoznali nekaj novih internetnih orodij (padlet, Twinspace), bolj podrobno so se seznanili s problematiko pomanjkanja pitne vode ter iskali konkretne možnosti za varčevanje z vodo. Z vključitvijo IKT je delo postalo zabavnejše in je dodatno motiviralo učence za delo. [6]

Slika 4. Zmagovalni logo projekta

4. ZAKLJUČEK

Sodelovanje v eTwinning projektih se je meni osebno izkazalo za zelo dragoceno, saj s tem lahko poglobimo, razširimo in diferenciramo vsebine, vključene v učni načrt. Učenci lahko znanje, ki ga pridobivajo med poukom, uporabijo v konkretnih situacijah in na ta način spoznajo, da je to znanje uporabno in da so sposobni določene aktivnosti izvesti v angleškem jeziku.

Učenci so bili nad tovrstnimi aktivnostmi ravno tako navdušeni, saj je delo potekalo na drugačen način, pogosto so pri tem uporabljali računalnike oz. mobilne telefone. Delali so na način, ki jim je blizu, ob tem pa bili ves čas zelo dejavni.

Znotraj projektnih aktivnosti se ponuja tudi ogromno možnosti za diferenciacijo dela. Nadarjeni učenci lahko prevzamejo zahtevnejše naloge in s tem dobijo potreben izziv, hkrati pa pri delu pomagajo učno šibkejšim učencem. Tudi učno šibkejši učenci so bili aktivni, saj so se lahko dokazali na drugih področjih (snemanje, montaža filmov, oblikovanje razglednic …), če že ne v znanju angleščine.

Pri določenih aktivnostih so učenci delali samostojno, pri drugih pa so se morali uskladiti s partnerjem oz. skupino, najti neko skupno idejo in iskati kompromise. Med seboj so dobro sodelovali, si pomagali in urili socialne in komunikacijske spretnosti. Ves čas je bilo čutiti pozitivno in ustvarjalno vzdušje.

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Obogatena resničnost pri pouku biologije

Augmented reality in biology classes

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POVZETEK

Obogatena resničnost (angl. augmented reality ali AR) je tehnologija, ki uporabniku omogoča, da s pomočjo kamere na mobilni napravi ali tablici v resničnem okolju vidi virtualne oziroma navidezne elemente. Od virtualne se obogatena resničnost razlikuje po okolju, v katerega smo postavljeni. V virtualni resničnosti se premikamo po prostoru, ki ga je v celoti generiral računalnik, medtem ko se nam pri obogateni resničnosti prikazuje svet, ki ga vidimo vsak dan, z le nekaj dodatki. V prispevku je opisan potek učne ure z uporabo obogatene resničnosti. Učna ura je bila zasnovana na medsebojnem povezovanju aplikacije Mirage AR9, delovnega lista z nalogami in učbenika. Učenčevo znanje o izbrani temi smo preverjali pred in po izvedeni učni uri ter s poznim preizkusom znanja in s tem ugotavljali učinke uporabe razvitih učnih gradiv na gradnjo znanja učencev. Rezultati so pokazali pomembne izboljšave pri razumevanju osnov anatomije in fiziologije človeškega srca in krvnega obtoka ter učinkih adrenalina na človeški krvni sistem. Študija kaže koristen učinek uporabe 3D animacije, videa in AR tehnologije za razumevanje dinamičnih in kompleksnih bioloških pojavov, vendar morajo učitelji biti sposobni oceniti, kdaj je uporaba te tehnologije smiselna in kdaj ne.

Ključne besede

Obgatena resničnost, animacija, mobilna naprava, poučevanje, krvožilje

ABSTRACT

Augmented reality or AR is a technology that allows the user to see virtual or virtual elements using a camera on a mobile device or a tablet in the real environment. From a virtual, enriched reality, it differs in the environment in which we are placed. In virtual reality, we move around a space that is entirely generated by a computer, while the augmented reality shows us the world we see every day with just a few additions. The article describes the course of the lesson using the augmented reality. The lesson was based on the interconnection of the Mirage AR9 application, a worksheet with tasks and a textbook. We checked the pupil's knowledge of the chosen topic before and after the carried out lesson as well as by using a later test. By doing so we determined the effects of the use of the developed teaching materials on the building of pupils' knowledge. The results showed significant improvements in students' understanding of the basic anatomy and physiology of the human heart and circulatory system, and the effects of adrenaline on the human circulatory system. The study indicates a beneficial effect of applying 3D animation, videos, and AR technology to understand dynamic and complex biological phenomena, but teachers should be able to criticaly evaluate when the use of this technology is meaningful and when not.

Keywords

Augemented reality, animation, mobile device, teaching, blood circulatory system

1. UVOD

Razlika v virtualni in obogateni resničnosti je v dojemanju sveta okoli sebe. Pri virtualni resničnosti so okolje in predmeti okoli uporabnika popolnoma spremenjeni in s tem uporabnika oddalji od resničnosti. Obogatena resničnost pa realen svet nadgradi in izboljša z dodatnimi informacijami, uporabniku pa daje občutek da je sam del tega okolja [5].

Tehnologija se je razvijala predvsem za potrebe vojske. V sredini osemdesetih let je doživela prvi večji razmah, ko je tehnologija postala bolj dostopna in so začeli uvajati prve namizne računalnike. Začeli so izdelovati prve arkadne računalniške igre. Zanimanje potrošnikov je kmalu upadlo, saj jih igralci, zaradi pomanjkanja realističnosti niso dobro doživljali. Splošna uporaba tehnologije je v devetdesetih letih še bolj upadla zaradi razmaha interneta in 3D iger, ki so bile že same po sebi za uporabnika dovolj zanimive [16]. Tehnologija se je kljub temu razvijala vendar le za potrebe letalske industrije in izobraževanja (najpogosteje pri zdravstvenih posegih) [4].

Velik premik v tehnologiji se je zgodil leta 2007, ko je podjetje Google predstavil ulični pogled, panoramski pogled na ceste, zgradbe in javna območja [18].

1.1 Lastnosti obogatene resničnosti

Ključne lastnosti obogatene resničnosti so:

- fizični svet je obogaten z digitalnimi informacijami, ki nastopajo sinhrono,
- informacije so prikazane glede na lokacijo realnega sveta in fizično perspektivo človeka v fizičnem svetu, resnični in navidezni predmeti morajo delovati usklajeno,
- izkušnja obogatene resničnosti je interaktivna, kar pomeni, da lahko človek čuti informacije in jih lahko tudi spreminja [4, 15].

2. UPORABA AR TEHNOLOGIJE V IZOBRAŽEVANJU

Informacijsko komunikacijske tehnologije so prisotne na vseh področjih našega življenja. Obsegajo področje računalništva in telekomunikacij, ki se zaradi izjemno hitrega napredka vedno bolj prepletata.

V izobraževanju se informacijsko komunikacijska tehnologija uporablja vedno bolj pogosto. Njena prisotnost ustvarja široko polje učnih priložnosti, ki se jih lahko poslužujejo učitelji. O'Brien in Toms v [14] navajata, da je uporaba virtualne resničnosti, kot naprednejše tehnologije prinesla izboljšan učni proces.

Kerawall in drugi v [11] trdijo, da je AR tehnologija dober nadomestek virtualnega učnega okolja. Raziskave kažejo, da uporabnik z VR vstopa v povsem navidezni medij, medtem ko se pri AR virtualno okolje in realnost medsebojno prepletata in dopolnjujeta.

Hsiao s sodelavci v [9] poročajo, da so pri uporabi AR študenti fizično aktivnejši med poučevanjem.

Anatomija človeka je po svoji naravi tridimenzionalna, zato se spodbuja uporaba 3D predstavitev za učenje in poučevanje anatomije [19].

2.1 Prednosti in slabosti uporabe AR tehnologije pri poučevanju

Prednosti uporabe AR tehnologije pri poučevanju:

- Informacije so dosegljive učencem takrat in tam ko jih potrebujejo [2].
- Aplikacije, namenjene izobraževanju so v razponu (prav tam).
- Učencem, ki so vizualni učni tipi, tehnologija AR zagotavlja, da bolje razumejo učno snov kot bi jo preko učiteljeve razlage ali preko razlage v tradicionalnih učbenikih (prav tam).
- AR je učno orodje, ki dovoljuje učencem, da pridobijo znanje individualno, na različne načine (prav tam).
- Za razrede, ki že uporabljajo tablice pri pouku je uporaba AR tehnologije ugodna, saj je učencem omogočeno, da interaktivno učenje lahko poteka tako v razredu, kot tudi doma (prav tam), učenci, ki so odsotni od pouka zamujeno lahko nadoknadijo doma.
- Z aplikacijami AR si učenec lahko prilagodi hitrost dela glede na svoje sposobnosti in želje v [8] in po potrebi si lahko večkrat ogleda isto animacijo.
- AR pretvori objekte, ki ne obstajajo v realnem svetu v 3D objekte [20].

Velika ovira pri uporabi tehnologije AR pri poučevanju je tehnična plat, saj je potrebno razviti in pripraviti 3D modele in jih umestiti v aplikacijo [20]. Pri uporabi tehnologije v učnem procesu moramo računati na to, da nam tehnologija lahko zataji in imeti dodaten rezervni načrt za izvedbo učne ure.

3. EMPIRIČNI DEL

3.1 Cilji empiričnega dela:

(1) Oblikovati učna gradiva, ki temeljijo na tehnologiji, ki vključuje obogateno resničnost na temo zgradbe srca in njegovega delovanja.

(2) Oblikovavati učna gradiva za primerjavo znanja učencev pred in po osvajanju nove učne snovi.

(3) Ugotoviti, kako se znanje pred in po osvajanju nove učne snovi z uporabo oblikovanih učnih gradiv razlikuje med učenci 7. in 8. razreda osnovne šole.

(4) Ugotoviti, kakšen je interes učencev za učenje z oblikovanimi učnimi gradivi.

3.2 Opis učil in učnih pripomočkov

Učna ura je bila zasnovana na medsebojnem povezovanju aplikacije Mirage AR9 (slika 1), delovnega lista z nalogam in učbenika (slika 2). Učenci so lahko samostojno pridobivanje informacij, ob stalnem vodenju učitelja. Naloge se medsebojno povezujejo.

Slika 1. Tarča na majici (desno) in navidezna resničnost notranjih organov, ki se je prikazala po skeniranju tarče na majici (levo).

3.3 Metoda in raziskovalni pristop

V raziskavi smo se poslužili kavzalno-neeksperimentalne metode. Na raziskovalna vprašanja smo odgovorili na podlagi podatkov, ki smo jih pridobili s pomočjo kvantitativnega raziskovanja. Na podlagi kvantitativnega pristopa smo pridobili podatke s pomočjo preizkusa znanja.

3.4 Vzorec

V raziskavi so bili vključeni učenci sedmega in osmega razreda, iz Osnovne šole Šmartno pod Šmarno goro. Starost učencev je bila od 12 do 14 let. Učenci učne snovi še niso obravnavali pri pouku. Intervencijo pri učenci sedmih razredov smo vključili pod temo transportnimi sistemi pri živalih, z učencih osmih razredov pa pri obravnavanju teme obtočil.

3.5 Opis zbiranja podatkov

Raziskavo smo izvedli v juniju. Teden dni pred izvedbo izobraževalne dejavnosti je bil uporabljen predtest za zbiranje informacij o predhodnem znanju učencev, na temo zgradbe srca in njegovega delovanja. Za reševanje predtesta so učenci porabili deset do petnajst minut. V drugem delu raziskave je potekalo poučevanje v razredu.

Učni cilji poučevanja:

Učenci

- spoznajo položaj in velikost človeškega srca,
- spoznajo osnovno anatomijo človeškega srca,
- spoznajo osnovno fiziologijo človeškega srca,
- spoznajo anatomijo in delovanje cirkularnega sistema,
- spoznajo delovanje adrenalina na človeški organizem.
-

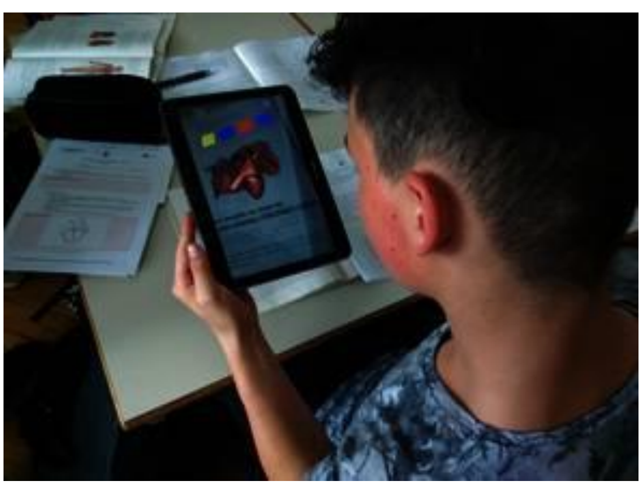
Učenci so delali po skupinah. V vsaki skupini so bili štirje učenci.

Vsak učenec je imel:

- delovni list (slika 2), ki je vseboval vaje zasnovane na podlagi zgoraj navedenih učnih ciljev. Delovni list je učence vodil po korakih skozi učno uro.
- učbenik za biologijo, Spoznavam svoje telo, založbe DZS.
- tablični računalnik ali pametni telefon z nameščeno aplikacijo Mirage AR9 (slika 3 in 4).

Po izvedeni učni uri so učenci rešili po teste – preizkuse znanja, s katerimi smo zbrali podatke o njihovem znanju na obravnavano temo.

Slika 2. Delovni list je vodil učence, da so uporabljali tako učbenik, kot animacije na aplikaciji Mirage AR9.



Slika 3. Reševanje delovnega lista z uporabo tablice.

Slika 4. Reševanje delovnega lista z uporabo pametnega telefona.

4. ZAKLJUČEK

V povprečju so učenci dosegli boljše rezultate na testu po koncu izvedene učne ure v katero smo vključevali AR gradiva, kot teden dni pred začetkom ure. Tudi druge raziskave ugotavljajo, da so dosegali boljše učne rezultate ob uporabi AR tehnologije [1, 6, 10, 11, 12, 13, 17, 21].

Poučna dejavnost v raziskavi je bistveno izboljšala znanje učencev o osnovi anatomije in fiziologije človeškega srca, cirkularnega sistema in učinkih, ki jih ima adrenalin na človeški krvni sistem.

Ferrer-Torregrosa idr. v [7] trdijo, da z uporabo AR učenci razvijejo boljšo prostorsko zaznavo človeške anatomije. Raziskava, ki je predstavljena v tem članku, ni identificirala bistvenih sprememb v poznavanju položaja in velikosti srca, kar je vsaj deloma mogoče pripisati metodološki napaki pri zbiranju podatkov, saj je naloga od učenca zahtevala, da v silhueto človeškega telesa, ki je bila v velikosti 5 × 3,5 cm pravilno označio lokacijo in velikost srca.

Raziskava kaže, da se je veliko učencev naučilo boljših povezav med dvema sorodnima organskima sistemoma (sistemom obtočil in hormonov). V okviru nalog, ki so zajemale vpliv stresne situacije na delovanje srca in pomen adrenalina, so AR in video uporabili za združevanje vsebin na dveh različnih organskih sistemih, ki jih učbenik za biologijo razlaga v dveh ločenih poglavjih. Cilj je bil poudariti pomemben prispevek AR pri ustvarjanju povezav med organskimi sistemi in sintetiziranjem znanja. Na ta način učenci razvijejo svoje sposobnosti sistemskega razmišljanja, da bi celostno analizirali človeško fiziologijo. Sistemsko razmišljanje je pomembno in bistveno za razvoj sistemske koncepcije življenja [3], tehnologija AR pa lahko to olajša. V prihodnjih raziskavah bi bilo koristno preizkusiti opisani izobraževalni pristop za povezavo s pljučnimi in cirkulacijskimi sistemi, ki se v učbenikih obravnavajo ločeno, čeprav so sistemi med seboj povezani z izmenjavo plinov.

Iz vprašalnika o povratnih informacijah učencev o uporabi AR v šoli smo ugotovili, da učenci vključevanje AR v učno snov razumejo kot zanimivo in zabavno, ter da izboljšuje njihov učni proces. Uporaba AR se jim ne zdi zahtevna za njih in jim ne vzame veliko časa. Podobne ugotovitve so bile že ugotovljene v prejšnjih študijah v [1, 11], kar je dodaten dokaz pomena, ki ga AR ima za poučevanje.

5. ZAHVALA

Zahvaljujem se celotni ekipi, ki je sodelovala pri projektu v okviru razpisa projektno delo z gospodarstvom in negospodarstvom v lokalnem in regionalnem okolju – Po kreativni poti do znanja 2017 – 2020. Projekt je vodil in koordiniral izr. prof. dr. Gregor Torkar.

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Tekmovanje Lego sumobot kot podpora učenju robotike

Lego sumobot competition as support of learning robotics

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POVZETEK

Robotska tekmovanja so pomemben del učenja robotike. Učence pripravijo na projektno delo, saj morajo do določenega roka načrtovati in izdelati čim učinkovitejšo napravo. Na tekmovanju svoj izdelek primerjajo z drugimi, izmenjavajo izkušnje in se učijo. Dober uspeh jim pove, da so na dobri poti, slabšim pa pokaže, da bo treba vložiti še nekaj truda. V Sloveniji je razmeroma malo tekmovanj za začetniški nivo, zato smo na OŠ n. h. Maksa Pečarja Ljubljana Črnuče začeli z odprtim prvenstvom Ljubljane v Lego sumobotu. Udeležba je s 7 ekip v prvem letu skočila na 19 ekip v drugem letu.

Ključne besede

Osnovnošolsko izobraževanje, robotika, sumobot

ABSTRACT

Robotics competitions are an important part of learning robotics. They prepare students for project work, as they have to design and build the most efficient device by the deadline. In a competition, students compare their product to others, sharing experiences and learn. Good success tells them that they are on the right track, the worse shows them that they will have to put in some more effort. There are relatively few beginner level competitions in Slovenia, so we at Elementary school Maks Pečar Ljubljana Črnuče started with the Lego Sumobot Ljubljana Open. Participation jumped from 7 teams in the first year to 19 teams in the second.

Keywords

Primary school education, robotics, sumobot

1. UVOD

Na slovenskih osnovnih šolah pouk robotike običajno poteka v obliki izbirnega predmeta v osmem in devetem razredu ter v obliki interesne dejavnosti (običajno od 5. razreda dalje, lahko tudi prej). Poleg teh dveh oblik so na voljo številne plačljive 2-3 dnevne delavnice tako med šolskim letom, še raje pa med počitnicami.

2. Oblike pouka robotike

Izbirnemu predmetu in interesnim dejavnostim je namenjeno 30-35 ur pouka. Zaradi lažjega dela na naši šoli pouk izvajamo v dveurnih blokih. V prvem polletju izbirni predmet in v drugem polletju interesno dejavnost. Na ta način je izkoriščenost delovnih kompletov dvojna.

2.1 Izbirni predmet robotika v tehniki

Učni načrt robotike v tehniki [1] v osmem in devetem razredu OŠ 32-35 ur na leto. V okviru ur:

• spoznajo različne oblike uporabe računalniške tehnologije,

• spoznavajo osnovne pojme robotike in računalniško vodene proizvodnje,

• berejo, rišejo in sestavljajo sheme električnih krmilj in razumejo njihovo delovanje,

• načrtujejo in s sestavljankami izdelajo različne računalniško krmiljene modele,

• uporabljajo računalnik in spoznavajo njegovo vlogo pri krmiljenju zgrajenih modelov,

• razvijajo sposobnost prostorske predstavljivosti,

• poznajo vlogo računalniškega vmesnika pri krmiljenju strojev in naprav,

• naštejejo in opišejo področja z računalniško vodeno tehnologijo in kritično presojajo vpliv tega področja na tehnologijo in okolje,

• pridobivajo in uporabijo informacije in znanje s področja robotike iz monografij, periodičnega tiska in interneta,

• z uporabo projektnega in eksperimentalnega dela ter konstruiranja usvojijo temeljne metode in oblike dela, značilne za tehnično-tehnološko področje,

• razvijajo sposobnost za delo v skupini,

• razvijajo psihomotorične sposobnosti,

• pridobivajo sposobnost samostojnega reševanja problemov,

• spoznavajo poklice s področja elektronike, elektrotehnike, računalništva ... in sposobnosti, ki jih potrebujejo zanje.

Vse zgoraj našteto se lahko uresničuje na različne načine z različnimi orodji. Največkrat to poteka s kompleti Lego Mindstorms in Fischertechnik RoboPro. Vse več se uporablja tudi krmilnika micro:bit in Arduino.

2.2 Izbirni predmet elektronika z robotiko

Učni načrt elektronike z robotiko [2] obsega 32 ur v devetem razredu.

- Učenci spoznajo karakteristike in vlogo posameznih komponent in podsistemov in jih lahko zlagajo v sisteme z vnaprej izbrano funkcijo.
- Tako usvojijo sistemski pristop, ki je značilen za sodobno delo na področju elektronike in robotike.
- Urijo se v reševanju problemov in si pridobivajo veščino opazovanja in sklepanja.
- Pridobijo si kritičnost pri vrednotenju rezultatov in se vadijo predstavljati lastne zamisli in s sogovorniki iskati najboljše rešitve.

Učenci se spoznajo z osnovnimi elektronskimi komponentami, senzorji, krmilniki (Arduino, micro:bit, Raspberry Pi, ...) in nato izdelajo projekt. Običajno so to razne obdelave senzorjev z izpisovanjem na LCD zaslon pa vse do mobilnih robotkov.

2.3 Interesna dejavnost robotika

Program izbirnega predmeta robotika v tehniki se v glavnem uporablja tudi pri interesni dejavnosti. Prilagojen je stopnji znanja učencev. Učenci se najprej spoznajo s sestavljankami, nato pa uresničujejo svoje zamisli in ideje ali se usmerijo v kakšno od tekmovanj.

3. Robotska tekmovanja

V Sloveniji osnovnošolci lahko sodelujejo na nekaj oblikah robotskih tekmovanj:

- FLL - FIRST Lego League [3]: popularno tekmovanje 3 do 10 članskih ekip starosti 9-16 let,
- jrFLL - junior FIRST Lego League: tekmovanje 2 do 6 članskih ekip starosti 6-10 let,
- Robobum [4]: državno tekmovanje z mobilnimi robotki v okviru katerega so tekmovanja v sledenj črti (za začetnike) in robot reševalec (za naprednejše).

Vsa tri tekmovanja so na regijskem in državnem nivoju. FLL tekmovanja so povezana s kar zajetnim vstopnim vložkom. Naša šola je sodelovala v šestih sezonah in dodatni stroški niso bili nikoli nižji od 100 EUR na osebo.

3.1 Potreba po dodatnih tekmovanjih

Iz zgoraj naštetih tekmovanj lahko hitro vidimo, da jih ni veliko. Še posebej ne na začetni stopnji. To je bil razlog, da smo se na šoli odločili organizirati dodatno tekmovanje, kjer bi se začetniki lahko pomerili s svojimi projekti in pokazali znanje. V letu 2018 smo tako pripravili prvo tekmovanje z Lego sumoboti. Sodelovalo je 7 ekip. Dober glas in dobra organizacija tekmovanja sta naslednje leto privabila že 19 ekip.

4. Lego sumobot - Odprto prvenstvo Ljubljane

Tekmovanje potrebuje svoja pravila in ta smo vzeli kar iz enotnih svetovnih pravil [5] (slovenski prevod [6]). Omejili smo se na Lego komplete, ki so na slovenskih šolah najpogostejši. Na kratko povzeto:

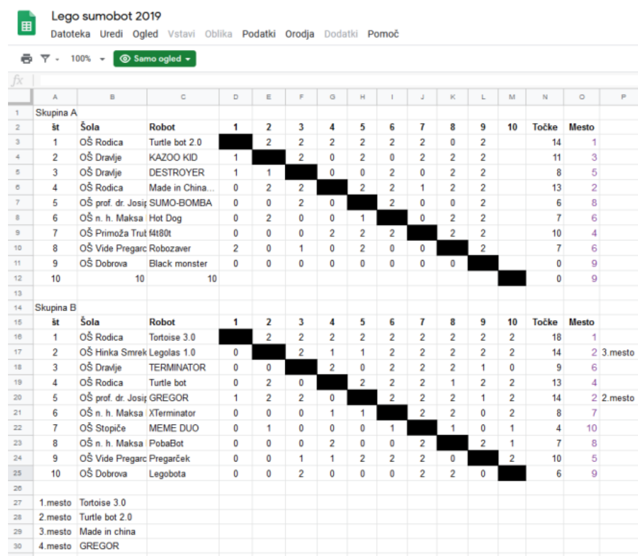
- Lego komplet,
- dimenzije ob startu: širina do 25 cm, dolžina do 25 cm, višina neomejeno,
- teža do 1000 g,
- robot ne sme poškodovati nasprotnika, lahko ga le izrine s tekmovalnega polja.

Tekmovanje poteka v skupinah do 10 robotkov, dvoboji (slika 1) vsak z vsakim do dveh zmag. Po prva dva iz skupine se uvrstita v nadaljnje tekmovanje, kjer se tekmuje na izpadanje.

Vsak dvoboj sodita po dva sodnika.

Slika 1. Dvoboj sumo robotkov

Ker je za tekmovalce pomembno spremljanje aktualnih rezultatov, se ti vnašajo v deljeno preglednico (slika 2), ki je sprogramirana tako, da se po vsakem vnosu sproti ažurira stanje ekip (spletni rezultati 2019 [7]).



Lego sumobot 2019

Datoteka Uredi Ogled Vstavi Oblika Podatki Orodja Dodatki Pomoč

100% Samo ogled

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Skupina A															
2	št	Šola	Robot	1	2	3	4	5	6	7	8	9	10	Točke	Mesto	
3	1	OŠ Rodica	Turtle bot 2.0		2	2	2	2	2	2	0	2		14	1	
4	2	OŠ Dravlje	KAZOO KID	1		2	0	2	0	2	2	2		11	3	
5	3	OŠ Dravlje	DESTROYER	1	1		0	0	2	0	2	2		8	5	
6	4	OŠ Rodica	Made in China...	0	2	2		2	2	1	2	2		13	2	
7	5	OŠ prof. dr. Josip	SUMO-BOMBA	0	0	2	0		2	0	0	2		6	8	
8	6	OŠ n. h. Maksa	Hot Dog	0	2	0	0	1		0	2	2		7	6	
9	7	OŠ Primoža Trub	f4t80t	0	0	0	2	2	2		2	2		10	4	
10	8	OŠ Vide Pregarc	Robozaver	2	0	1	0	2	0	0		2		7	6	
11	9	OŠ Dobrova	Black monster	0	0	0	0	0	0	0	0			0	9	
12	10	10	10											0	9	
13																
14	Skupina B															
15	št	Šola	Robot	1	2	3	4	5	6	7	8	9	10	Točke	Mesto	
16	1	OŠ Rodica	Tortoise 3.0		2	2	2	2	2	2	2	2	2	18	1	
17	2	OŠ Hinka Smrek	Legolas 1.0	0		2	1	1	2	2	2	2	2	14	2	3.mesto
18	3	OŠ Dravlje	TERMINATOR	0	0		2	0	2	2	2	1	0	9	6	
19	4	OŠ Rodica	Turtle bot	0	2	0		2	2	2	1	2	2	13	4	
20	5	OŠ prof. dr. Josip	GREGOR	1	2	2	0		2	2	2	1	2	14	2	2.mesto
21	6	OŠ n. h. Maksa	XTerminator	0	0	0	1	1		2	2	0	2	8	7	
22	7	OŠ Stopiče	MEME DUO	0	1	0	0	0	1		1	0	1	4	10	
23	8	OŠ n. h. Maksa	PobaBot	0	0	0	2	0	0	2		2	1	7	8	
24	9	OŠ Vide Pregarc	Pregarček	0	0	1	1	2	2	2	0		2	10	5	
25	10	OŠ Dobrova	Legobota	0	0	2	0	0	0	2	2	0		6	9	
26																
27	1.mesto	Tortoise 3.0														
28	2.mesto	Turtle bot 2.0														
29	3.mesto	Made in china														
30	4.mesto	GREGOR														
31																

Slika 2. Sprotni rezultati v deljeni tabeli

Dvoboji se snemajo in so po tekmovanju objavljeni na spletu ter na voljo za analizo (video posnetek borb 2019 [8]).

Vse ekipe prejmejo priznanja, najboljši še praktične nagrade in pokale.

Učenci na tekmovanju pokažejo znanje konstruiranja, krmiljenja motorjev, uporabe senzorjev (ultrazvočni, svetlobni oz. barvni, za dotik, ...) in taktike bojevanja.

5. ZAKLJUČEK

Ugotavljamo, da smo z uvedbo novega tekmovanja uspešno zapolnili eno od niš. Učenci lahko predstavijo svoje izdelke in dobijo povratno informacijo o njihovi kvaliteti. Na tekmovanjih so soočeni z adrenalinom in nenapovedanimi težavami, ki jih morajo sproti inovativno odpravljati. Vidijo, da je pomembno zagotoviti zanesljivost delovanja. Obenem se družijo, učijo, spodbujamo pa jih tudi k pomoči sotekmovalcem tako pri posojanju kock kot pri skupnem reševanju problemov. Pravila od udeležencev zahtevajo tudi lepo vedenje in fair-play.

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Tehniški dan z urejanjem besedil v 6. razredu

Technical day with word processing in 6th grade

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POVZETEK

V Sloveniji že od pojava osebnih računalnikov dalje poteka boj dveh idej računalniškega opismenjevanja. Za nove predmete ni prostora (razen za tuje jezike) in tako opcija, ki podpira samostojni redni predmet s področja računalništva izgublja proti opciji, ki zagovarja vsebovano računalniško opismenjevanje. To pomeni, da vsak učitelj v okviru svojega predmeta poskrbi za računalniško pismenost učencev. To bi šlo, če bi učitelji dejansko izvajali program, vendar se večinoma ne čutijo dovolj usposobljene in tako ta del učnega načrta ostaja okrnjen, oziroma ga šole poskušajo izvajati z raznimi »gasilskimi« akcijami računalničarjev. Na OŠ n. h. Maksa Pečarja Ljubljana Črnuče smo del bremena urejanja besedil rešili s tehniškim dnevom v šestih razredih.

Ključne besede

Osnovnošolsko izobraževanje, računalniško opismenjevanje, urejanje besedil

ABSTRACT

In Slovenia, since the advent of personal computers, there has been a struggle between two ideas of computer literacy. There is no room for new subjects (except for foreign languages) and thus the option of supporting a stand-alone computer science course loses against the option that advocates implicit computer literacy. This means that each teacher provides computer literacy for the students within their subject. This would be the case if the teachers were actually implementing the program, but for the most part they do not feel sufficiently qualified, and thus this part of the curriculum remains truncated, or schools try to implement it through various "firefighting" actions by IT employees. At the Primary school Maks Pečar Ljubljana Črnuče we have solved part of the burden of text editing with a technical day in 6th grade.

Keywords

Primary school education, computer literacy, word processing

1. UVOD

V slovenskih osnovnih šolah se učenci lahko naučijo urejanja besedil pri izbirnem predmetu urejanje besedil v sedmem razredu. Žal se učenci že zaradi čudnega imena predmeta zelo redko odločajo zanj. Marsikdo sploh ne ve, da gre za računalništvo. Drugih oblik opismenjevanja urejanja besedil so učenci deležni pri pouku slovenščine, kjer se srečajo predvsem s formalnimi oblikami dopisovanja v zadnjem triletju. Redki posamezniki se lotijo raziskovalnih nalog, kjer naletijo na predpisano obliko oddaje naloge. Po drugi strani gre tudi za problem, da učenci v osnovni šoli na splošno nimajo veliko opravka z besedili. Če že, potem te stvari rešujejo s predstavitvenimi programi.

2. Oblike pouka urejanja besedil

2.1 Izbirni predmet urejanje besedil

Učni načrt urejanja besedil [1] v sedmem razredu OŠ obsega 35 ur na leto. Po končanem izobraževanju znajo učenci (operativni cilji za urejanje besedil):

- z urejevalnikom besedil dopolniti besedilo in ga urediti,
- z risarskim programom izdelati nezahtevno predmetno računalniško sliko in jo vriniti v besedilo,
- uporabiti ustrezen risarski program za dopolnitev že izdelane računalniške slike,
- vnesti in oblikovati podatke v preglednico,
- narisati ustrezen grafikon in ga vriniti v besedilo,
- poiskati in uporabiti podatke iz omrežja internet,
- opisati področja, na katerih so uporabljali računalnik.

2.2 Opismenjevanje pri pouku slovenščine

Digitalne kompetence v predmetnih učnih načrtih [2] je zbral mag. Radovan Krajnc, svetovalec na Zavodu RS za šolstvo.

V učnih načrtih pri slovenščini v vseh razredih veljajo didaktična priporočila:

- Razvijanje digitalne zmožnosti se povezuje z razvijanjem sporazumevalne zmožnosti v slovenskem jeziku, to je zmožnost sprejemanja (poslušanja, gledanja in branja) in tvorjenja (govorjenja in pisanja) raznih besedil. Digitalna zmožnost vključuje zavestno in kritično rabo informacijskih spretnosti v okviru IT, to je z rabo računalnika, da bi pridobili, ovrednotili, shranili, tvorili, oblikovali, predstavljali in izmenjevali informacije ter komunicirali in sodelovali na medmrežju (Priporočila Evropskega parlamenta in Sveta o ključnih zmožnostih za vseživljenjsko učenje in izobraževanje, 2006).
- Raba informacijskih tehnologij lahko pomembno pripomore h kakovostnejšemu pouku, a mora biti tesno povezana z novimi načini in oblikami dela, predvsem pa s cilji in vsebinami pouka slovenščine, to je z razvijanjem sporazumevalne zmožnosti.

- Pouk slovenščine naj občasno kot nadgradnja klasičnega pouka v učilnici poteka v spletni učilnici, ki je opremljena z e-didaktičnimi gradivi in pripomočki ter orodji, ki omogočajo iskanje podatkov in informacij, dostop do brezplačnih učnih gradiv, avtorskih programov, spletnih slovarjev, komuniciranje z uporabo internetnih storitev, sodelovanje v mrežnih projektih, forumih in različnih spletiščih za učenje slovenskega jezika kot materinščine. V spletni učilnici naj bo priročna e-knjižnica z literaturo za učitelje, s priročniki in učbeniki za učence, vsebuje pa naj tudi zadostno število leposlovnih del, ki jih učitelj izbere za šolsko in domače branje. Na voljo naj bodo tudi slovarji, leksikoni in drugi priročniki v elektronski obliki za pouk jezika in književnosti.

Pri slovenščini v drugem in tretjem triletju so cilji:

- Razvijanje jezikovne in slogovne zmožnosti ter zmožnosti sporazumevanja. Učenci razvijajo poimenovalno zmožnost tako, da:

  uporabljajo slovarske priročnike v knjižni in elektronski obliki (na primer SSKJ, Veliki slovar tujk).

- Učenci razvijajo pravopisno zmožnost tako, da:

  uporabljajo pravopisne priročnike (v knjižni in elektronski obliki), pri oblikovanju besedil z računalnikom pa tudi urejevalnike besedil.

Minimalni standardi

- Učenec ima skladno s cilji iz tega učnega načrta razvito zmožnost dopisovanja. Pokaže jo tako, da:

  v vlogi pobudnega in odzivnega dopisovalca piše dopise, določene s tem učnim načrtom.

2.3 Druge oblike izobraževanj

Sem spadajo predvsem interesne dejavnosti in samostojno izobraževanje na plačljivih tečajih.

Problem večine zgoraj navedenih izobraževanj je, da se s tem ne srečajo vsi.

Na OŠ n. h. Maksa Pečarja smo predvsem zaradi seznanitve učencev z urejanjem besedil, to temo vsem učencem ponudili v okviru tehniškega dneva v šestem razredu.

3. Tehniški dan urejanje besedil

Tehniški dan izvajamo že od leta 2010. V tem času smo se srečevali s številnimi problemi, ki so bili vezani predvsem na število računalnikov. V računalnico (slika 1) smo lahko sprejeli en razred (od štirih). Pouk smo zato izvajali tudi v popoldanskem času. Poleg tega smo tehnični dan kombinirali z naravoslovnim dnevom. V zadnjih letih smo se okrepili s prenosnimi računalniki za prvo triletje in jih uporabili tudi za izvedbo tehniškega dneva. Na ta način sta dva razreda en dan izvajala tehniški dan urejanja besedil, druga dva pa naravoslovni dan. Naslednji dan so se učenci zamenjali. Pouk izvedeta po en predavatelj in en asistent na razred.

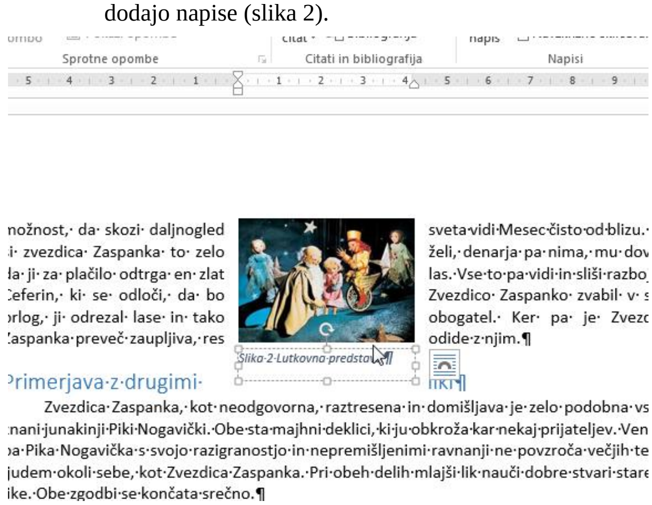
Slika 1. Pouk v računalnici

3.1 Vsebina tehniškega dne

Učenci se najprej vpišejo v spletno učilnico [3], kjer se seznanijo z načrtom dela, kaj se bodo naučili in kaj bodo morali narediti za oceno. V spletni učilnici so na voljo vsi potrebni dokumenti: neurejeno besedilo, izgled urejenega besedila v PDF, slike, navodilo za delo, dva video vodiča in kriteriji za ocenjevanje.

3.2 Potek tehniškega dne

- V urejevalniku besedil Word učenci odprejo neurejeno besedilo in ga takoj shranijo pod novim imenom. Gre za članek o Zvezdici Zaspanki na 3 do 4 straneh.
- Spoznajo se z naslovnimi slogi in njihovo uporabo pri kazalih.
- Oblikujejo lasten slog in ga uporabijo na običajnem besedilu. Sprva bi učenci za vsak odstavek nastavljali lastnosti. Ko se jih vpraša, kako bi to naredili na 100-stranski knjigi, vidijo da njihov način ni najboljši in da so slogi zelo uporabni.
- Vstavijo polje z vsebino in dodajo vsebino. Oblikujejo polje in ga premaknejo na ustrezno mesto.
- Na različne načine (poravnava) vstavijo štiri slike in dodajo napise (slika 2).



Slika 2. Vstavljanje slike in napisa

- Na delu besedila uporabijo 2 stolpca in s Ctrl+Enter vstavijo novo stran.
- Na dva načina uredijo dve tabeli. Prvo pretvorijo v tabelo in jo oblikujejo, v drugi nastavijo tabulatorje in poravnave.
- Dodajo številčenje strani.
- Na samostojno zadnjo stran vstavijo kazalo vsebine in kazalo slik.

3.3 Ponovitev

Prva leta nismo zahtevali samostojne ponovitve urejanja dokumenta. Znanje je hitro šlo v pozabo. Zato smo uvedli še samostojno ponovitev postopka in oddajo izdelka v spletni učilnici. Zaradi večje resnosti se izdelek oceni pri predmetu tehnika in tehnologija. Izdelek morajo oddati v enem tednu po izvedbi tehniškega dneva. Zapomnitev je sedaj bistveno boljša.

4. ZAKLJUČEK

Glede na dolgoletno izvajanje, se je tehniški dan "prijel". Z njim so zadovoljni tako učitelji kot učenci. Urejanje besedil učencem na ta način ni več tuje. Za še boljše znanje bi bila potrebna še kakšna praktična izkušnja oz. vaja v obliki spisa ali projektne naloge pri katerem od predmetov. Na žalost v vseh teh letih do tega ni prišlo. "Ni časa. Učni načrti so prenatrpani", so običajni izgovori.

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Web-based platform for noise monitoring in support of DIY sensing tools

Spletna platforma za nadzor hrupa s pomočjo 'naredi sam' merilnih orodij

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ABSTRACT

This paper gives insight into how 3 years of project work incorporated into the regular high school curriculum can result in a final, more extensive research project. It shows the development of a web-based environmental noise assessment platform. It was developed as a Citizen's Observatory tool for environmental noise governance, because no such tools were available before. It consists of an Arduino based DIY (Do-It-Yourself) noise-level sensing device and a supporting web application developed in JavaScript (Node.js). The web app collects and visualizes the data. The device measuring capability was tested thoroughly. Instructions on how to assemble such a device and connect it to the web application have been published on our website. With this platform anybody can conduct measurements, share them and unite a noise measuring community. This engages the non-scientific community, allowing them to learn about technologies used in our device's design, environmental issues and enthuses (young) people for science and technology.

Keywords

Project work, learning by doing, science and technology, noise platform, DIY

POVZETEK

Ta članek na praktičnem primeru prikazuje, kako izgleda končni, obsežnejši raziskovalni projekt kot posledica triletnega projektnega dela pri pouku. Opisuje nastenek spletne platforme za merjenje okoljskega hrupa. Sestavljajo jo »naredi sam« senzor za merjenje okoljskega hrupa na podlagi Arduino platforme in spletna aplikacija, ki zbira in prikazuje podatke, razvita v JavaScriptu (Node.js). Opravljen je bil test merilne zmogljivosti merilnika, ki se je izkazal primeren za ta način uporabe. Končni produkt tega projekta je spletna aplikacija za povezovanje s senzorjem, prek katere se tudi dostopa do navodil za sestavljanje senzorja. S to platformo lahko izvaja meritve okoljskega hrupa kdorkoli, jih deli naprej in oblikuje civilno iniciativo. Takšna platforma tudi omogoča seznanjanje javnosti z uporabljenimi tehnologijami, okoljskimi problemi in navdušuje (mlade) ljudi za znanost in tehnologijo.

Ključne besede

Projektno delo, participativni pristop, znanost in tehnologija, platforma za merjenje hrupa, DIY

1 INTRODUCTION

At Gimnazija Vič in 2006, based on students' interests and in cooperation with different research institutions, a special science project was introduced; the most motivated students in the field of science and technology were invited to enroll in the so called "science class". Science courses (physics, chemistry, biology, computer science) are anchored by short students' experimental tasks and also more demanding project work in teams (learning by doing principle); these projects are carried out under the mentorship of their teachers and/or researchers from different research institutes and science and technology faculties. The project is fully incorporated into the regular high school curriculum.

Furthermore, matura exam results in the field of science clearly indicate that inquiry-based science learning and possibilities to work and learn under the mentorship of researchers significantly influence the better quality of students' knowledge and have an important impact on choosing their studies in the field of science and technology. [1]

We for one found our joy in programming this way and with every school project (the project described in this paper being the third and most extensive) we became more eager to further explore the field of computer science. With the help and guidance from our supervisors, we have also achieved great results at Genius Olympiad in the USA, where we received a gold medal for our project.

2 MOTIVATION

Many people live in areas that are loud. However, by our experience, street noise is perceived only as an annoyance that you get used to and not as a serious health risk that it is. People claim they don't even notice it and don't see the point in writing noise complaints. One of the authors of this paper decided to measure the environmental noise around his home and prove his neighbors quantitatively, that noise levels were exceeding a healthy threshold. He discussed with his friend, the co-author of this research, on how to conduct such measurements. After looking at our options, it became clear that there was hardly any suitable tool available for such an environmental noise governance task. We were looking for an affordable noise level meter that could create noise profiles of a location with a nice graphical representation of the measured data.

Struggling with the problem of the aforementioned noise pollution in our home environments, we made the decision to work together on a project that deals with this matter. As we attend the public high school Gimnazija Vič, which greatly encourages students to work on projects, our first thought was to approach Ms. Mozer. While being our chemistry teacher, she strongly encourages all kinds of project and research work. She co-supervised some of our projects during our previous years at Gimnazija Vič, such as the development of an electronic locker system for school lockers. She was sympathetic to our problem and gratefully offered her help on this more complex project. She suggested us an external supervisor in the area of our interest. Mr. David Kocman, Ph. D, of the Jozef Stefan Institute. Following a discussion about the problem of noise pollution, we agreed to the research goals, methodology, and first steps towards creating an extensive piece of research, with the objective of participating at Genius Olympiad in the USA.

Beginning with the assembly of a simple DIY (Do-It-Yourself) noise measuring tool, we gained the interest of our classmates at school. Some of them, just like us, live in the immediate proximity of a railway track. That made us think again and shift the paradigm: rather than creating something just for ourselves, we began to create a functional and easy-to-use web platform which allows anyone with a custom-made noise measuring tool to measure the noise in their surroundings and elsewhere, or even contribute the data to a wider community of those with similar concerns.

3 METHODOLOGY AND GOALS

For practical reasons we divided the project into two parts: a sample DIY sensing tool for noise measuring and a supporting online platform. Because of the diversity of the two parts, each one has a separate methodology and goal.

3.1 Online platform

For the platform the following content and technical goals were determined:

- **Provide information** about noise and its health effects. **Provide instructions** on how to assemble the DIY sensor and use of the platform. All of this with no prior knowledge required.
- A **simple** and modern **interface**, making the user experience as comfortable and comprehensive as possible. This includes easy to understand chart views and device management console.
- **High availability** of the platform and **optimized data**, that benefits the user as well as optimizes the cost of our service. 24/7 availability and short API response times are key for a measuring service we would provide.
- Enable **user interaction and measurement sharing** to help unite or form a noise measuring community; a community can achieve better results and raise common awareness more so than an individual citizen.

We started with determining the most optimal runtime environment, frameworks and libraries. The choice of protocol (HTTP/WebSocket) has also been scientifically tested, as shown in Figure 1. We have used them according to the official documentation, with the help of various Q&A developer websites (e.g. Stack Overflow, Stack Exchange etc.) and our high school Computer Science professor, Mr. Bajec.

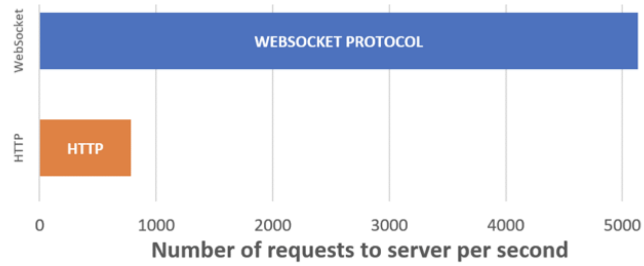


Figure 1: WebSocket and HTTP protocol comparison

The platform has also been divided into smaller parts or components. Each component was developed from top to bottom and tested. After it was successfully tested, we moved onto the next component. In the development process of the platform we were using various tools that increased productivity and simplified the development workflow:

- Visual Studio Code, which is one of the most used JavaScript code editors on the market.
- Git as our version control system for tracking changes in source code throughout our developing stage.
- Bitbucket as our version control repository hosting service.
- npm as the JavaScript package manager and dependency installer.

3.2 DIY sensing tool

For the DIY noise-sensing tool the following design goals were determined:

- Must be a standalone device (can be deployed at a location for long-term data collection, improving upon mobile apps).
- Produces high-quality measurements (including peak level measurements that are often overlooked in consumer-grade devices).
- Is affordable (low-cost), easy to assemble, open-source and simply (re)programmable.
- Can stream data to our online platform in real time.

Upon researching our options, we decided to base our device on the Arduino open-source electronics platform. The device would consist of a microcontroller board, a sound-level meter, battery and an enclosure.

For the board we decided to use the Arduino compatible WeMos D1 R2 (powered by an ESP8266 microcontroller). The main deciding factor was built-in WiFi capability.

The right sound-level sensor/meter was harder to choose. “Sound-level meter is a device for measuring the intensity of noise, music, and other sounds. A typical meter consists of a microphone for picking up the sound and converting it into an electrical signal, followed by electronic circuitry to process the signal. The indicating device is usually a meter calibrated to read the sound level in decibels.” [3]

We paid close attention to device specifications and settled on the DFRobot Gravity: Analog Sound Level Meter. We paid close attention to the sensor's specifications provided by the manufacturer (https://dfrobot.com/product-1663.html).

- Measuring Range: 30dBA ~ 130dBA
- Measurement Error: ±1.5dB
- Frequency Weighted: A Weighted
- Frequency Response: 31.5Hz ~ 8.5KHz
- Time Characteristics: 125ms

Expected environmental noise measurements fall within the sensor's measuring range. Frequency response was also deemed sufficient for our purpose, because A-weighting is being used here, which heavily decreases the importance of frequencies out of the sensor's scope. The sensor can make a measurement every 125ms, which allows measurements of quick but loud noises, that would otherwise be missed.

To 3D design the enclosure we used a computer program Fusion 360 by Autodesk, which was then printed using a 3D printer. Everything is powered by a commercial power bank Anker Astro E1.

We tested the sound measuring ability of our device in a controller sound-proof environment at The Faculty of Electrical Engineering, University of Ljubljana. First, we measured the sound pressure level (in dB(A)) at different frequencies. The amplitude of the electrical signal going to the speaker was constant at 100mV. The test ran once with a high-quality reference meter (BK2230 phonometer, BK4155 microphone, BK4231 calibrator) and then with our sensor. Our sensor produces very similar values to the reference one at lower frequencies (up to 1kHz), at high frequencies (over 1kHz) the values produced are less comparable.

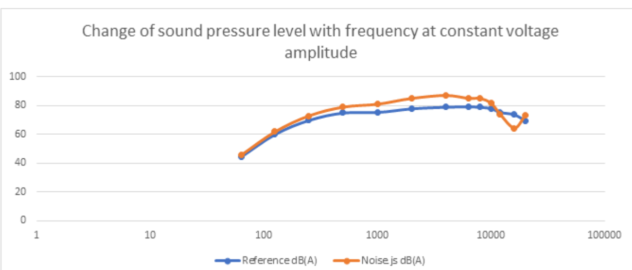


Figure 2: Change of sound pressure level with frequency at constant voltage amplitude

We compared the sensors in a real-world situation, measuring noise levels near a busy intersection and in a busy university hall. The reference meter was set to L_{eq} mode, which averages all the measurements. The same thing was done for our sensor manually. At the intersection our sensor measured L_{eq} 76.4 dB(A) while the reference device measured 75.0 dB(A). In the university hall our sensor measured 77.4 dB(A) and the reference device 78.3 dB(A). The values match surprisingly well (±1.3dB). The bigger measuring mistake that is present at high frequencies (over 1kHz) gets alleviated when the result is averaged.

Considering the above result, we thought that high frequencies do not contribute a lot to the overall decibel value, because lower frequencies (motor engines, voices, construction) dominate when it comes to environmental noise. A simple sound frequency spectrum analysis using a phone and an app called Spectroid (http://bit.ly/2mjRssH) was made at the same locations. We were able to confirm that in the environment lower frequencies (under 1kHz) indeed dominate. With this information we were able to declare the selected sound level sensor as good enough for our application. No other, more expensive, sensors are needed.

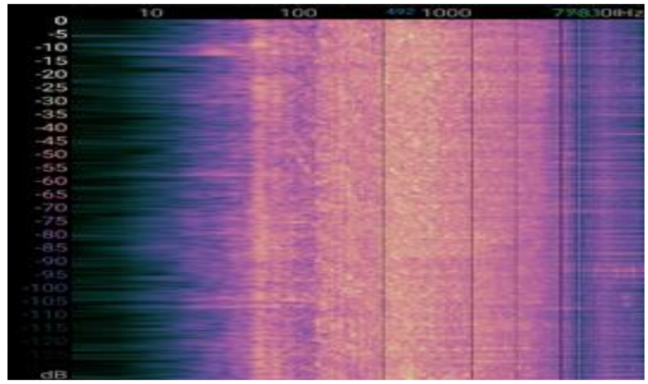


Figure 3: Spectrogram (horizontal logarithmic axis: 0 – 20000 Hz) of a high-speed train passing by

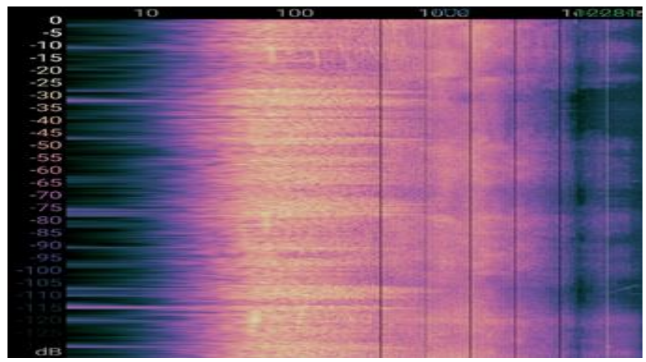


Figure 4: Spectrogram (horizontal logarithmic axis: 0 – 20000 Hz) of a busy intersection

4 RESULTS

All parts of this research managed to develop a fully functional noise monitoring online platform that consists of a standalone DIY sensing device and a web application, available on **noisejs.erazred.si**. The website includes DIY sensing device assembly and usage instructions, device management console, general information about noise pollution and the ability to share measurements and unite a noise measuring community.

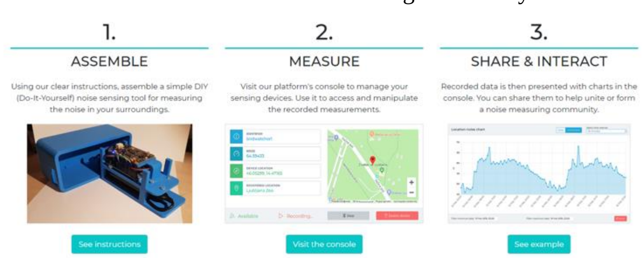


Figure 5: Platform usage description, taken from our website

4.1 Online platform

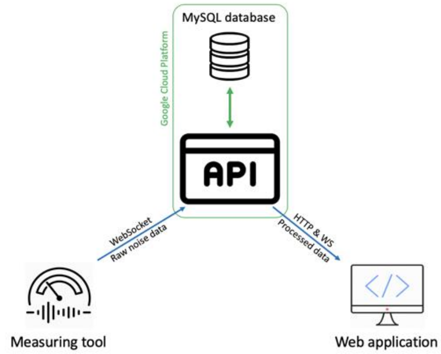


Figure 6: The project's component division scheme

In Figure 6 the parts in the green box, including the Web application represent the online platform.

Once a measuring tool is assembled, our platform offers various actions for the user to contribute or just monitor their noisy surroundings.

To work with the platform, a user account is required. An account can be created using the authorization page of the web application. The application provides us a unique device identifier, which will be used for device registration in further steps.

To initiate a new connection to the API we use a WebSocket handshake over the HTTP protocol, secured with SSL.

After the first device's event emit over the WebSocket protocol, named 'dvcDeviceData', the Device Card in the app expands, showing all the information sent from the device (as shown in Figure 7).

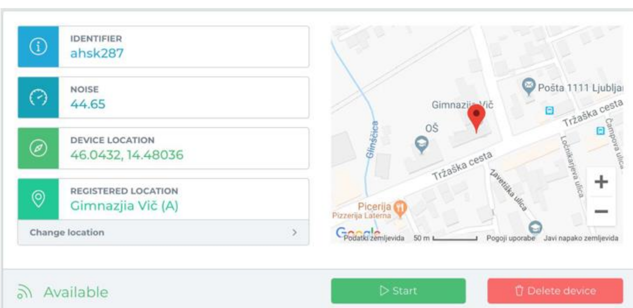


Figure 7: An active device's card (screenshot from the user console)

Using the buttons of the Device Card, further operations are available. Before initiating a noise recording, registering the device to a location is required. We can either select a registered location or register a new one using the location modal. Once the location of the device is set, it is sent to the device via the API and the device is ready to record data. The button 'Start' becomes enabled and thus allows us to initiate a new measuring. When a measuring is in process, changing of the location is disabled. The location can be changed after stopping the measuring in progress. Using the button 'Stop', measurements are no longer sent or recorded to the database. To check out the recorded data, we use the app's My Locations page. By choosing our desired location, its noise profile is displayed (shown in Figure 8).

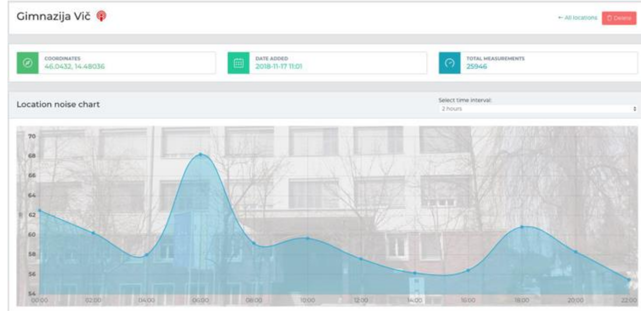
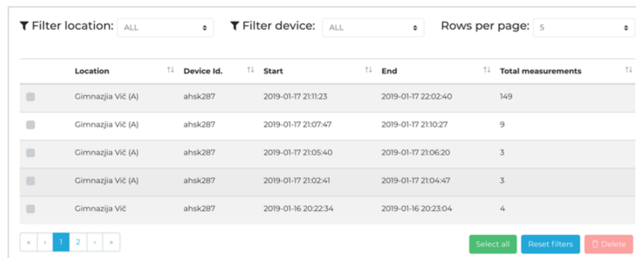


Figure 8: A locations noise profile (screenshot from the user console)

The icon next to the location's name indicates whether the location is private or public. Using the chart below, it is possible to view all noise data recorded on the location through a **continuous** or **daily chart**.

If not all data of a location needs to be deleted, that can be done using the measurings table of the My Measurings page. An example of it is nicely represented in Figure 9. Noise data can be deleted separately only in measuring units. For locating the right measuring we can use the filters on the top.



Filter location: ALL Filter device: ALL Rows per page: 5

Location	Device Id.	Start	End	Total measurements
Gimnazjia Vič (A)	ahsk287	2019-01-17 21:11:23	2019-01-17 22:02:40	149
Gimnazjia Vič (A)	ahsk287	2019-01-17 21:07:47	2019-01-17 21:10:27	9
Gimnazjia Vič (A)	ahsk287	2019-01-17 21:05:40	2019-01-17 21:06:20	3
Gimnazjia Vič (A)	ahsk287	2019-01-17 21:02:41	2019-01-17 21:04:47	3
Gimnazija Vič	ahsk287	2019-01-16 20:22:34	2019-01-16 20:23:04	4

1 2 Select all Reset filters Delete

Figure 9: Table of measurings in the web application

4.2 DIY sensing tool

As a result of the device development, assembly instructions have been uploaded and made available on our website located at https://noisejs.erazred.si/#/device-assembly. The instructions are covering the following segments:

- Required components
- Very simple physical assembly
- Registering the device on our platform
- Setting up and uploading code (provided by us) with the Arduino IDE
- Connecting the device to WiFi
- Viewing the streamed data
- Tips on how to measure noise

Our project integrates closely with the idea of participative approach to raising awareness of environmental issues. It falls in the category of Citizen's Observatories, that are community-based environmental monitoring and information systems. We provide the noise assessment tools that active citizens need to be effective in reducing noise pollution through the sharing of information, and in this way facilitating the engagement of the general public.

The idea of participative approach and our project can both be used in an educational context (e.g. in schools). Students can participate in assembling the device, learning about the basics of electronics and programming, while also learning about the environmental issues present in their local environment. Many different noise-level data collection tasks can be given. We propose that one of the experiments is the measurement of noise levels in the school dining halls. After measurements are collected, the students are challenged to modify the sensing device so that a light signal is triggered when noise levels are too high. This is an attempt to reduce noise in the dining halls by warning students about high noise levels that they are not aware of. An effect proven by vehicle activated signs, that achieve reduction of speed by informing the drivers that are driving too fast. [4]

5 DISCUSSION

Because measurements on our platform are user-contributed there is a chance of them being inaccurate or even falsified. We recognize 2 main sources of user errors that could lead to inaccurate data. First could be a wrong assembly of the sensing device (such as sound-level sensor not being exposed to the outside) with the second being an incorrect measuring methodology (such as measuring with obstacles between sensing device and the noise source). There is also a chance that the contributed data would be falsified. However, we fail to see the motive of doing something like this intentionally. We predict most of falsified data will be contributed by users, that are testing how our platform works, and won't be shared with other users.

We realize that our platform is not a tool upon which regulatory action can be based. In this case, professional methodology and equipment is required. Our platform should be seen more as a tool that improves on accuracy and functionality of other consumer-oriented products. An article from Nature titled "Validate personal air-pollution sensors" [2] suggests personal sensing devices to be validated and their fitness-for-purpose estimated. We estimate our device could very well be used as a trend assessment and early detection tool to indicate where further action by regulatory officials is needed.

6 CONCLUSION

We succeeded in creating a dedicated DIY (Do-It-Yourself) sensing device that can be deployed for longer periods of time. We kept the idea of a budget in mind and the device works out at 64€, which is much cheaper than similar alternatives. In addition, by following out clear instructions, it is relatively easy to assemble. The DIY sensing device connects to our online platform and is open source. The code is freely available for anybody who wishes to improve on it and use it in other projects. In terms of measuring accuracy, we improved upon the frequency response of mobile apps, sensor sensitivity and improved on the number of measurements made each second, producing much better averages. Our sensor can produce 8 measurements each second. We combined the best features of a commercial Netatmo product – its online platform – and the performance of more expensive sound level meters, creating an affordable but high-quality environmental noise sensing platform.

We classified our device as a trend assessment and early noise-pollution detection tool with an acceptable degree of accuracy. It is able to indicate where further regulatory inspection is needed. The implementation of offline data-logging is also in the works, so an internet connection will only be required during occasional data uploads.

With the creation of the online platform, we also fulfilled our research's goals, as the publicly available outcome provides information about our research and instructions for the aforementioned device's assembly. It has a very simple interface with a logical structure and suggestive interaction components. It's high availability and data optimization also reflects in the measuring results of our colleagues, showing all measurements have been recorded in a rhythmic pattern without any data loss. Basic user interaction and data sharing is already implemented, but we plan to massively expand this functionality with additional sharing and communicational features (location noise profiles), thus gaining the benefits of a wider community.

The platform was already successfully used in practice, validating the concept under real-life conditions. A group of colleagues created a smart bird feeder that also integrated our noise monitoring system. Using the recorded data and our data representation tools, they concluded there were more birds visiting the feeder when noise levels were low. After more extensive sharing features are implemented on our platform, they will be able to share their findings and inform the public about the effects of noise pollution on birds.

7 ACKNOWLEDGMENTS

We would like to thank our supervisor Ms. Mozer, our external supervisor Mr. Kocman, Gimnazija Vič High School and the Jožef Stefan Institute.

Our gratitude goes to our chemistry teacher, Ms. Mozer, which made this research possible and willingly coordinated it. She helped us pursue our goal of helping others and ourselves in the way of quantifying the noise in our surroundings and thus trying to live a healthier and better lifestyle.

We would also like to thank Mr. Kocman from the Institute for giving us firsthand advice in the expertise of environment observation and measuring of environmental parameters. His readiness and responsiveness to our questions and requests also majorly contributed to the result of this research.

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We would also like to express our gratitude to Mr. Samo Beguš, Ph. D. from The Faculty of Electrical Engineering for giving us the chance of professionally testing our sound meter in their soundproof room and lending us the professional equipment required for testing on the field.

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Računalniški program AritmetikaPDF za pomoč pri učenju osnovnih računskih spretnosti

The computer program AritmetikaPDF to help learn the basic calculation skills

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POVZETEK

Pri matematiki se učenci z osnovnimi računskimi operacijami srečajo že v 1. razredu osnovne šole. V 6. razredu se poleg naravnih števil obravnava tudi računanje z decimalnimi števili. Učencem, ki z naravnimi števili ne znajo dobro računati, se težave pri računanju še poglobijo. Težave se pokažejo tudi pri delu z ulomki in pri merskih pretvorbah. Zato je tako pomembno, da znajo učenci dobro računati. Najlaže se postopkov naučijo z veliko vaje. Pri tem jim lahko pomaga računalniškim programom AritmetikaPDF, ki generira naloge z naravnimi števili za računske operacije seštevanje, odštevanje, množenje in deljenje. Učenci vnesejo rezultate, program pa preveri njihovo pravilnost ter izpiše pravilne postopke računanja. Zaradi takojšnje povratne operacije lahko učenci v znanju napredujejo hitreje.

Ključne besede

Osnovna šola, matematika, računske operacije, računalniški program AritmetikaPDF

ABSTRACT

At Maths classes students get basic calculation skills already in the 1st grade. In the 6th grade among natural numbers students also get skills for calculating with decimal numbers. Students that have problems calculating with natural numbers, have even more troubles. Problems occur at fractions and at unit measurements also. So it is very important for students to have good calculation skills. The easiest way of getting them is to practice a lot. Here comes in handy the computer program AritmetikaPDF. It generates different exercises for addition, subtraction, multiplication and division of natural numbers. Students type results into the computer program, which check them and shows the correct methods for the calculations.

Keywords

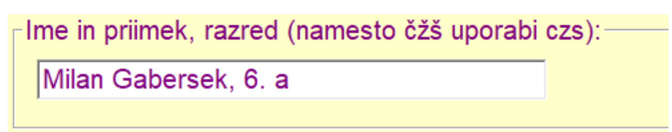
Primary school education, math, calculation skills, computer program AritmetikaPDF

1. UVOD

Obravnava decimalnih števil je pri pouku matematike v šestem razredu ena od pomembnejših tem, kar lahko razberemo tudi iz učnega načrta [1]. Obravnavajo se tudi ulomki in merske pretvorbe. Pri navedenih temah je dobro znanje računanja z naravnimi števili predpogoj za uspešno delo. Učenci, ki imajo pri tem težave, svoje neznanje še poglobijo. Prepad med njimi in matematično spretnejšimi učenci se tako še poglobi. Da se to ne zgodi, je priporočljivo nekaj uvodnih ur nameniti ponovitvi računanja z naravnimi števili. Delovni zvezek sicer ponuja kar nekaj vaj [2], vendar jih je za uspešno premostitev neznanja žal premalo. Problematično je tudi pregledovanje in preverjanje rezultatov pri površnih učencih, še posebej v številčnejših razredih. To kar kliče po uporabi računalniškega programa, v našem primeru AritmetikaPDF. Program generira računske naloge za seštevanje, odštevanje, množenje in deljenje z naravnimi števili. Učenci naloge praviloma rešujejo na listu, rezultate pa pretipkajo v program. S tem se urijo tudi v natančnosti pri prepisovanju, kar je pri matematiki in nasploh v naravoslovju zelo pomembno. Računalniški program vnesene rezultate ovrednoti in jih vpiše v dokument, hkrati pa izpiše tudi pravilne postopke računanja. S pomočjo točkovanja generira tudi oceno, ki je učencu lahko dobra povratna informacija in hkrati tudi motivacija za nadaljnje delo. Izpiše se tudi čas reševanja, ki je pri dobrih učencih pogosto krajši od dvajset minut, pri slabših pa tudi cela šolska ura ni dovolj. Ker je program dostopen preko spleta, ga lahko učenci naložijo in uporabljajo tudi doma.

2. UPORABA PROGRAMA

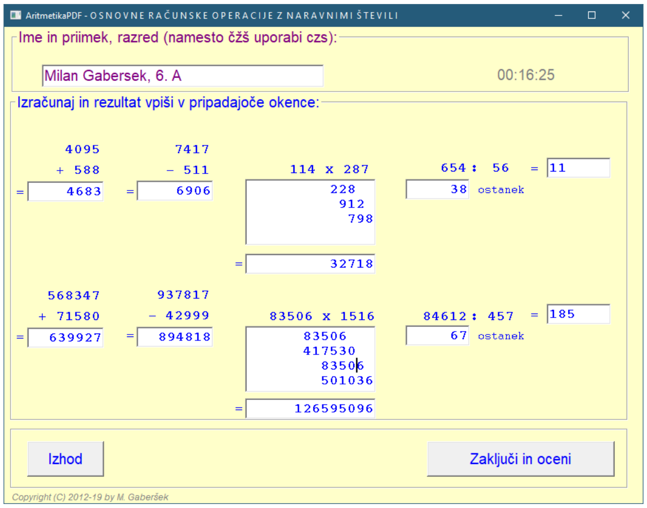
Iz spletne strani na svoj računalnik najprej prenesemo Program AritmetikaPDF [3]. Ko program prvič zaženemo, bo računalnik najverjetneje opozoril na morebitno škodljivo programsko opremo, kot to običajno stori pri prenosu iz spleta. Po prvi potrditvi, da je program neškodljiv, nas o tem ne sprašuje več.



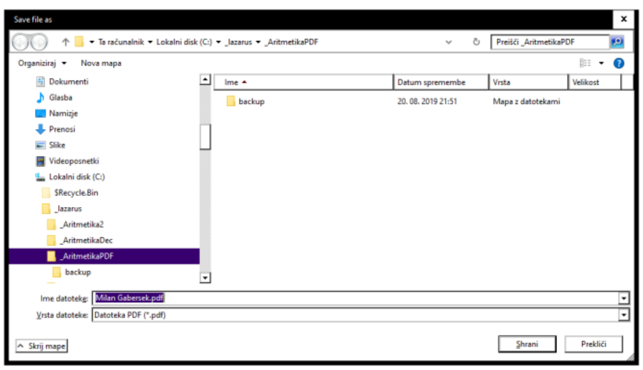
Slika 1: Pri vnosu imena in priimka znakov čžš ni priporočljivo uporabljati.

Po zagonu programa najprej vnesemo ime in priimek ter razred (slika 1), pri čemer znake čžš ni priporočljivo uporabljati. V tem primeru bo program sicer deloval, vendar bo na koncu namesto znakov čžš izpisal čudne znake. Praksa je pokazala, da se v razredu kljub opozorilu vedno najde kak učence, ki na to pozabi.

Po vnosu imena kliknemo na gumb *Začni.* Program nam pripravi po dve nalogi za vsako računsko operacijo. Prva naloga je lažja, saj ima manj števk od pri drugi nalogi. Najbolje je, da učenci naloge prepišejo na list in šele na koncu pazljivo pretipkajo rešitve v ustrezna okenca (slika 2). S tem se urijo tudi v natančnosti, ki je, kot smo že omenili, pri matematiki zelo pomembna.



Slika 2: Program zastavi po dve nalogi za vsako računsko operacijo.

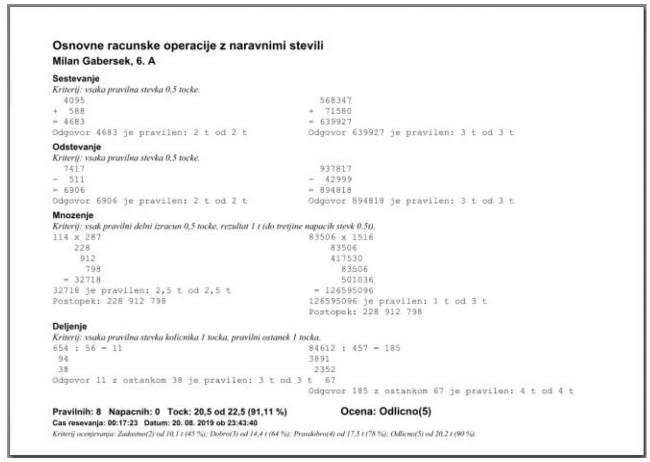


Slika 3: Program rezultate shrani v datoteko formata *.pdf*.

Ko učenci končajo z vnosom, lahko v naši prisotnosti ali sami kliknejo na gumb *Zaključi in oceni*. Dobro je, da se predhodno dogovorimo o tem, kam bodo posneli datoteko s končnico *.pdf*, ki jo generira program (slika 3). Na šolskih računalnikih moramo zaradi uredbe o varovanju osebnih podatkov GDPR [4] kasneje poskrbeti, da učenci svoje datoteke izbrišejo. Ena od možnosti je, da učenci datoteke shranijo v skupno mapo na mrežnem disku, katere vsebino kasneje prenesemo na ustrezno varnejše mesto oziroma jo pobrišemo.

Datoteko .pdf odpremo na klasičen način z dvoklikom. Če privzetega programa ni, ga moramo namestiti. Možnosti je več, sam uporabljam program PDF Exchange Viewer [5], ki tudi v neprofesionalni brezplačni različici omogoča tiskanje več strani na eno stran, prepoznavanje besedila OCR, dodajanje komentarjev, risanje črt, shranjevanje, česar nam ostali programi večinoma ne omogočajo. Prednost formata *.pdf* je predvsem v prenosljivosti, saj so datoteke na vseh računalnikih prikazane na enak način, vključno s posebnimi znaki in prelomi strani.

Po odprtju dokumenta se prikažejo vse rešitve nalog (slika 4), hkrati pa se preveri in točkuje tudi odgovore učenca. Na koncu se izpiše, koliko računov je bilo rešenih pravilno, koliko napačno, koliko točk je bilo zbranih, čas reševanja, datum, kriterij ocenjevanja in pridobljena ocena. Slednja je učencu dober pokazatelj, kako uspešen je bil in je hkrati lahko dodatna motivacija za dodatno delo. Spretnejši učenci naloge rešijo v manj kot dvajsetih minutah. Pri šibkejših učencih se lahko reševanje zavleče v celotno šolsko uro.



Osnovne racunske operacije z naravnimi stevili
Milan Gabersek, 6. A

Sestevanje
Kriterij: vsaka pravilna stevka 0,5 tocke.

4095
+ 588
= 4683
Odgovor 4683 je pravilen: 2 t od 2 t

568347
+ 71580
= 639927
Odgovor 639927 je pravilen: 3 t od 3 t

Odstevanje
Kriterij: vsaka pravilna stevka 0,5 tocke.

7417
- 511
= 6906
Odgovor 6906 je pravilen: 2 t od 2 t

937817
- 42999
= 894818
Odgovor 894818 je pravilen: 3 t od 3 t

Mnozenje
Kriterij: vsak pravilni delni izracun 0,5 tocke, rezultat 1 t (do tretjine napacih stevk 0.5t).

114 x 287
228
912
798
= 32718
32718 je pravilen: 2,5 t od 2,5 t
Postopek: 228 912 798

83506 x 1516
83506
417530
83506
501036
= 126595096
126595096 je pravilen: 1 t od 3 t
Postopek: 228 912 798

Deljenje
Kriterij: vsaka pravilna stevka kolicnika 1 tocka, pravilni ostanek 1 tocka.

654 : 56 = 11
94
38
Odgovor 11 z ostankom 38 je pravilen: 3 t od 3 t

84612 : 457 = 185
3891
2352
67
Odgovor 185 z ostankom 67 je pravilen: 4 t od 4 t

Pravilnih: 8 Napacnih: 0 Tock: 20,5 od 22,5 (91,11 %) **Ocena: Odlicno(5)**
Cas resevanja: 00:17:23 Datum: 20. 08. 2019 ob 23:43:40
Kriterij ocenjevanja: Zadostno(2) od 10,1 t (45 %); Dobro(3) od 14,4 t (64 %); Pravdobro(4) od 17,5 t (78 %); Odlicno(5) od 20,2 t (90 %).

Slika 4: Povratna informacija, ki jo po vnosu generira program AritmetikaPDF.

3. ZAKLJUČEK

Običajno so učenci navdušeni, da gredo lahko v računalnico, in tudi pri matematiki je tako. Mnogo jih je program AritmetikaPDF namestilo tudi doma. Žal program deluje le v okolju Windows, zato imajo učenci po pouku možnost delati v šolski računalnici, tako da niso prikrajšani. Delo s programom so učenci dobro sprejeli, in kot pravijo, je koristno in dosega svoj namen. Upamo lahko, da bodo težave z znaki čžš dolgoročno odpravljene, še boljša bi bila spletna rešitev.

Kar se tiče pouka, je bilo v okviru pisnih preizkusov znanja pri matematiki zaznano vidno izboljšanje pri ocenjevanju reševanja izrazov. Večjih težav z računskimi operacijami v izrazih učenci praktično niso imeli, težavo predstavljajo le še oklepaji in vrstni red računskih operacij. S tem je uporaba programa AritmetikaPDF upravičila svoj namen, zato ga bom uporabljal tudi v prihodnje.

4. CITIRANA DELA

[1] delovna skupina, Amalija Žakelj ..[et al.], MIZŠ - Učni načrt . Matematika: program osnovnošolskega izobraževanja. [Elektronski]. Available: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_matematika.pdf [Poskus dostopa 21. 8. 2019].

[2] Končan, T.,; Moderc, V.; Strojan, R., 2019. Skrivnosti števil in oblik 6. [Samostojni delovni zvezek za matematiko v 6. razredu osnovne šole]. Založba Rokus Klett, d.o.o., Ljubljana

[3] Program AritmetikaPDF.exe. Available: http://www2.arnes.si/~mgaber6/vivid2019/ [Poskus dostopa 21. 8. 2019].

[4] Splošna uredba EU o varstvu podatkov GDPR. Available: https://www.ip-rs.si/zakonodaja/reforma-evropskega-zakonodajnega-okvira-za-varstvo-osebnih-podatkov/najpogostejsa-vprasanja-in-odgovori/ [Poskus dostopa 21. 8. 2019].

[5] Program za delo z dokumenti s končnico *.pdf*. https://www.tracker-software.com/product/pdf-xchange-viewer [Poskus dostopa 21. 8. 2019].

Računalniški program PretvorbePDF za pomoč pri učenju merskih enot

The computer program PretvorbePDF to help learn the units of measurement

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POVZETEK

Snov merske enote pri matematiki v 6. razredu osnovne šole povzroča veliko učencem velike težave. Običajno je težava iskanje ustreznega množitelja, nato pa pretvorba konkretnega podatka. Učenci se pretvorb najlaže naučijo z veliko vaje. Tu nam na pomoč priskoči program PretvorbePDF. Program generira naloge z različnimi števili z različnimi merskimi enotami. Učenec te naloge reši, nakar program odgovore ovrednoti in poda pravilne rezultate. Učenci zaradi takojšnje povratne informacije napredujejo hitreje.

Ključne besede

Osnovna šola, matematika, merske enote, računalniški program PretvorbePDF

ABSTRACT

Subject of the units of measurement within the math in 6th grade of the primary school is difficult for many students. Usually they have problems in finding the correct multiples and after that conversion of the concrete data. Best way for the students to learn them is doing a lot of exercises. Here comes in handy the computer program PretvorbePDF. It generates exercises with the different numbers and with the different measurement units. The students solve them, and after entering the results, the program check them and return the feedback and the correct answers. Because of the immediate feedback the students are progressing faster.

Keywords

Primary school education, math, units of measurement, computer program PretvorbePDF

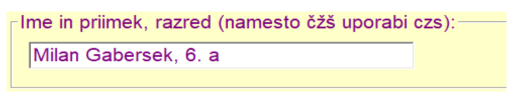
1. UVOD

V šestem razredu se pri pouku matematike glede na učni načrt [1] obravnavajo tudi merske enote, in sicer razdalja, masa, denar, prostorninske enote, površina in čas. Večinoma gre za ponovitev znanja iz nižjih razredov, le nekaj je novih. Nekaterim učencem predstavljajo pretvorbe veliko težavo, še posebej zaradi zapisa z decimalnimi števili. Najboljši način za učenje je narediti čim več vaj. Žal je teh v delovnih zvezkih v osnovni obliki relativno malo [2]. Težava je tudi v tem, da učenci, še posebej površni, rešitve težko preverjajo, učitelju pa to vzame zelo veliko časa. Tu nam lahko na pomoč pride računalnik, konkretneje z uporabo programa PretvorbePDF. Program genereria različna števila in različne predpone za vse omenjene merske enote. Učenec naloge najprej reši na list, nato pa rezultate vnese v program. Po končanem vnosu program poda pravilne rešitve ter ovrednoti odgovore, hkrati pa poda tudi številčno oceno znanja. Prav ocena je običajno dovolj dobra vzpodbuda, da učenec vztraja pri nadaljnjem urjenju. Program lahko učenci uporabljajo doma ali v šoli.

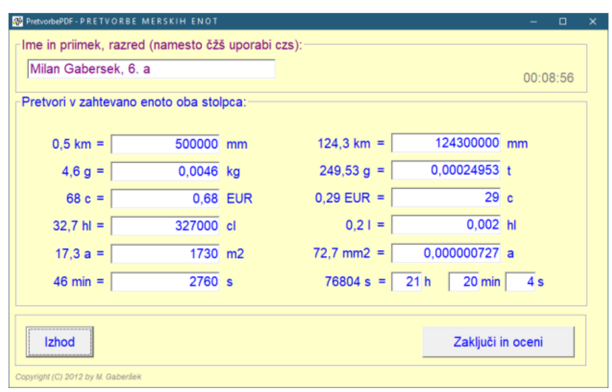
2. UPORABA PROGRAMA

Program PretvorbePDF najprej prenesemo iz spleta [3] v katerokoli mapo na računalniku. Po zagonu se bo pojavilo običajno opozorilo o škodljivi programski opremi. Po potrditvi se opozorilo ne bo več pojavljalo.

Učenci najprej vnesejo ime in priimek, glede na dogovor pa tudi razred in oddelek (slika 1). To je uporabno, če poučujemo v več razredih hkrati. Program v izpisu ne podpira znakov čžš, zato je najbolje, da jih nadomestimo z znaki czs (enako velja za velike črke). V praksi to ne predstavlja prevelike težave, saj se v primeru uporabe v izpisu sicer pojavijo čudni simboli, na sam program pa to k sreči ne vpliva. To je pomembno, saj se vedno najde kak učenec, ki presliši navodilo.



Slika 1: Pri imenu in priimku znakov čžš ni priporočljivo uporabljati.

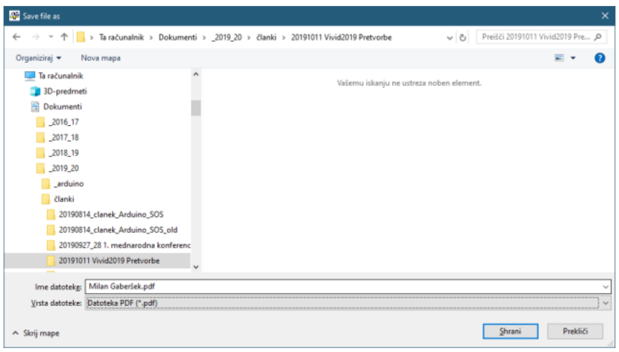


Slika 2: Dva stolpca nalog z različnimi merskimi enotami.

Po kliku na gumb *Začni* računalniški program pripravi dva stolpca različnih merskih enot (slika 2). Prvi stolpec z nalogami je enostaven, drugi pa za večino učencev zahtevnejši.

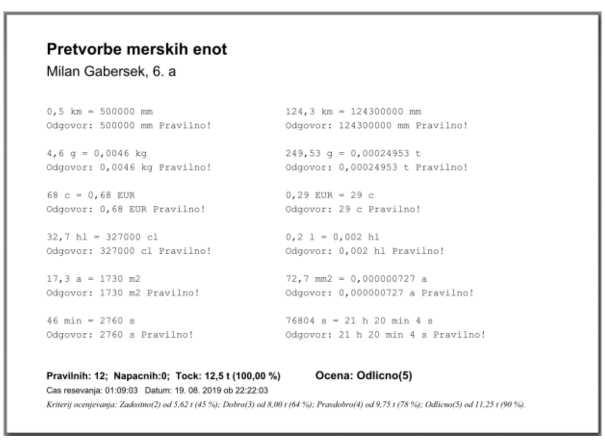
Najbolje je, da učenci naloge najprej rešijo na list, kasneje pa jih vnesejo v vnosna okenca programa. Pri tem zavestno (ali podzavestno) še enkrat preverijo smiselnost rezultatov, hkrati pa se vadijo tudi v natančnosti.

Ko je vnos rezultatov končan, kliknejo gumb *Zaključi in oceni*. V svojem razredu ta korak raje opravim sam, da ne bi prišlo do težav. Program po kliku vpraša, kam naj shrani datoteko z rezultati s končnico *.pdf* (slika 3). Format *.pdf* je dobra izbira, saj je z njim tiskanje enostavnejše in običajno brez zapletov. Hkrati tudi ne dopušča popravljanja vsebine (obstajajo sicer programi, ki to do neke mere omogočajo, vendar so v računalnici redko nameščeni). Po uspešni shranitvi se program zapre.



Slika 3: Program rezultate shrani v datoteko formata *.pdf*.

Datoteko .pdf, ki smo jo shranili na želeno mesto, moramo seveda odpreti. Večina računalnikov ima že nameščen pregledovalnik datotek .pdf. Če temu ni tako, ga lahko namestimo iz spleta. Sam uporabljam brezplačno različico programa PDF Exchange Viewer [4], ki ima nekaj dodatnih uporabnih možnosti za delo z dokumenti, na primer tiskanje več strani na eno, rotacijo strani, kopiranje delov besedila, OCR prepoznavo besedila ...



Pretvorbe merskih enot

Milan Gabersek, 6. a

0,5 km = 500000 mm Odgovor: 500000 mm Pravilno!	124,3 km = 124300000 mm Odgovor: 124300000 mm Pravilno!
4,6 g = 0,0046 kg Odgovor: 0,0046 kg Pravilno!	249,53 g = 0,00024953 t Odgovor: 0,00024953 t Pravilno!
68 c = 0,68 EUR Odgovor: 0,68 EUR Pravilno!	0,29 EUR = 29 c Odgovor: 29 c Pravilno!
32,7 hl = 327000 cl Odgovor: 327000 cl Pravilno!	0,2 l = 0,002 hl Odgovor: 0,002 hl Pravilno!
17,3 a = 1730 m2 Odgovor: 1730 m2 Pravilno!	72,7 mm2 = 0,000000727 a Odgovor: 0,000000727 a Pravilno!
46 min = 2760 s Odgovor: 2760 s Pravilno!	76804 s = 21 h 20 min 4 s Odgovor: 21 h 20 min 4 s Pravilno!

Pravilnih: 12; Napacnih:0; Tock: 12,5 t (100,00 %) **Ocena: Odlicno(5)**

Cas resevanja: 01:09:03 Datum: 19. 08. 2019 ob 22:22:03

Kriterij ocenjevanja: Zadostno(2) od 5,62 t (45 %); Dobro(3) od 8,00 t (64 %); Pravdobro(4) od 9,75 t (78 %); Odlicno(5) od 11,25 t (90 %).

Slika 4: Zaslonska slika povratne informacije.

Po odprtju dokumenta vidimo pravilne rešitve (slika 4), hkrati pa so zapisani tudi odgovori učenca ter informacija, ali je odgovor pravilen ali ne. Na dnu dokumenta je navedeno število pravilnih in napačnih odgovorov, dosežene točke (tudi v procentih) ter ocena glede na zapisani kriterij. Zanimiv je tudi podatek o času reševanja, saj lepo pokaže, ali je učenec dovolj hiter ali ne. Matematično spretnejši učenci rešijo naloge v manj kot dvajsetih minutah, manj spretnim pa je celo šolska ura premalo. Slednje lahko nato spodbudimo k dodatnim vajam.

Zaradi evropske uredbe o varovanju osebnih podatkov GDPR [5] morajo učenci na šolskih računalnikih ustvarjeno *.pdf* datoteko striktno pobrisati, na kar jih moramo še posebej opozoriti. Datoteke lahko tudi zberemo na mrežnem disku in shranimo na varnejše mesto za kasnejšo analizo.

3. ZAKLJUČEK

Učenci so delo s programom dobro sprejeli. Verjetno tudi zato, ker predstavlja zanimivo popestritev ur pri matematiki. Veliko učencev je program uporabljalo tudi doma. Nekateri so imeli težave, saj program deluje le v operacijskim okolju Windows. Ti in ostali so imeli v prostem času možnost vaditi na šolskih računalnikih, tako da niso bili prikrajšani. Dolgoročno obstaja ideja o spletni različici, ki bi najvrjetneje odpravila tudi težave z znaki čžš ter ne bi bila vezana na en operacijski sistem.

Učenci so ob uporabi programa vidno izboljšali znanje pretvajranja merskih enot, kar se je poznalo tako pri delu v razredu kot pri pisnih preizkusih znanja.

4. CITIRANA DELA

[1] delovna skupina, Amalija Žakelj ..[et al.], MIZŠ - Učni načrt . Matematika: program osnovnošolskega izobraževanja. [Elektronski]. Available: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_matematika.pdf [Poskus dostopa 20. 8. 2019].

[2] Končan, T.,; Moderc, V.; Strojan, R., 2019. Skrivnosti števil in oblik 6. [Samostojni delovni zvezek za matematiko v 6. razredu osnovne šole]. Založba Rokus Klett, d.o.o., Ljubljana

[3] Program PretvorbePDF.exe. Available: http://www2.arnes.si/~mgaber6/vivid2019/ [Poskus dostopa 20. 8. 2019].

[4] Program za delo z datotekami s končnico *.pdf*. https://www.tracker-software.com/product/pdf-xchange-viewer [Poskus dostopa 20. 8. 2019].

[5] Splošna uredba EU o varstvu podatkov GDPR. Available: https://www.ip-rs.si/zakonodaja/reforma-evropskega-zakonodajnega-okvira-za-varstvo-osebnih-podatkov/najpogostejsa-vprasanja-in-odgovori/ [Poskus dostopa 21. 8. 2019].

Naj se igra začne

Let the game begin

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POVZETEK

Najprej delo, nato zabava je načelo, ki je poznano in večkrat uporabljeno. Kaj pa če sta delo in zabava povezana, prepletena? Različni avtorji, ki utemeljujejo igrifikacijo, želijo poudariti, da lahko z njeno pomočjo nezanimive in monotone stvari spremenimo v dinamične in zanimive. Namen igrifikacije (ang. Game-Based Learning) ni spreminjanje pouka v igro, temveč izkoriščanje elementov igre za ohranjanje pozornosti, vztrajnosti in radoživosti. S tem načinom poučevanja dosežemo, da je učenec aktiven na več ravneh in da pridobiva vseživljenjsko znanje. V prispevku predstavljam primer dobre prakse, ki sem ga pripravila za učence 3. razreda, učilnico pobega.

Ključne besede

Igrifikacija, Flippity Scavenger Hunt, soba pobega, utrjevanje snovi, aktivnost učencev

ABSTRACT

Work first, play later, is a well-known and widely-used principle. But what if work and games were inter-connected? Various authors who justify game-based learning want to make it clear that this concept can turn boring and monotonous activities into dynamic and interesting ones. The purpose of game-based learning is not to turn lessons into a game, but to take advantage of the elements of games to maintain concentration, perseverance, and playfulness. In this manner, we can achieve that learners become more active on multiple levels and that they acquire knowledge with life-long learning. This article presents an example of good practice: an escape room, which was prepared for 3rd-grade learners.

Key words

Game-based learning, Flippity Scavenger Hunt, escape room, learning consolidation, learner activity

1. UVOD

Igra sama je od nekdaj nepogrešljiv način učenja, ki je skupen človeku in živalim. Prek igre otrok spoznava življenjske resnice in je zanj nujen element učenja, razvoja, napredka. Zelo pomembna je tudi v času šolanja, zlasti v času prve triade. Z uporabo igre učenci šole ne razumejo kot zahtevno obveznost in breme, temveč predvsem kot izziv in priložnost za potešitev radovednosti in želje po znanju. Da bi ohranili njihovo zanimanje, si učitelji prizadevajo, da bi v pouk vnesli vse več fizičnih in digitalnih iger.

1.2.Igrifikacija

Učitelji si želijo, da bi se učenci pri pouku čutili vključene, da bodo ustvarjalni in da se bodo znašli v novih okoliščinah. K temu pripomore igrifikacija: premiku učenca iz pasivne v aktivno vlogo. Z vpeljavo igre v proces izobraževanja lahko ustvarimo boljše učno okolje, v katerem bodo novi pojmi hitreje osvojeni, snov lažje razumljena, rutinske naloge se bodo spremenile v zabavno izkušnjo, ki bo učence motivirala in poskrbela za popolno vključenost. Igrifikacija uporablja elemente igre in tehnike igre v vsebinah, ki niso igra.

2. PRIMER IGRIFICIRANE UČNE URE

2.1. Cilj

Poglavitni cilj je bil, da bi učenci utrjevali in ponavljali, oziroma poglabljali in razširjali učno snov tretjega razreda. Običajno so učenci konec šolskega leta že utrujeni, brezvoljni in jim naloge ponavljanja, poglabljanja predstavljajo le še breme. Razmišljala sem, kako bi tako vsebino spremenila v novo bolj zanimivo, izzivajočo in zabavno. Razmišljala sem, da bi ustvarila izkušnjo sobe pobega. Učitelj mora najprej oceniti učni potencial posamezne igre, preden jo implementira v razred. Odgovoriti si mora na vprašanja, ali ta ustreza starostni stopnji učencev, kakšen je njen namen in kako se ujema z učnim načrtom, ali želi s pomočjo igre razviti spretnosti ali pokriti vsebine. Vprašati se mora, kako igra vključuje učence ter določiti časovni okvir, ki ga bo zavzela.

2.1 Učilnica pobega

Po Vikipediji, prosti spletni enciklopediji, je soba pobega (angleško escape room) vrsta detektivske in avanturistične igre, ki poteka v določenem prostoru, v katerem je zaklenjena skupina ljudi. Udeleženci naj bi s pomočjo predmetov, ki so jim na voljo rešili uganke, odklenili ključavnice, dešifrirali kode in poiskali sledi, ki bi jih vodile na prostost v določenem času. Te miselne igre so oživele v zadnjih nekaj letih po svetu in tudi pri nas.

Ker se je bližal konec šolskega leta, sem se odločila, da bo nastala učilnica pobega.

2.2. Določitev časovnega okvira

Sobe pobega so običajno časovno omejene. Predvidevala sem, da bo reševanje nalog zavzelo približno šolsko uro. Ker pa sem želela, da bi vsem uspelo priti do zaključne nagrade, sem čas podaljšala. Skupaj z navodili sem igri namenila dve šolski uri.

Omejevanje časa je opcija, ki jo lahko uporabimo ali ne. Nekaterim učencem omejevanje časa predstavlja le dodaten stres, nekaterim pa spodbudo za še boljši zagon. Navsezadnje so potrebne tudi take priložnosti, s katerimi pridobivamo veščine, ki nam pomagajo, da lažje obvladujemo situacije tudi, ko smo pod stresom. V primeru, da se ne odločimo za omejitev časa, pa morda lahko uporabimo »kazensko nalogo«

za nerešen izziv ali morda domačo nalogo, ki jo morajo rešiti v popoldanskem času.

2.3. Preverjanje ustreznosti orodij

Naslednji problem, s katerim sem se soočala je bil, kako s pomanjkljivo strojno opremo, ki jo imamo na voljo v učilnici, izvesti tako uro. V razredu dostopamo do enega osebnega računalnika, ki je običajno namenjen učitelju. To je vsekakor vplivalo na načrtovanje in izvedbo. Dobra stran vsega pa je bila ta, da je bilo potrebno le na enem samem računalniku namestiti potrebno opremo in da je bil potek igre pod nadzorom učitelja.

2.4. Skrb za varnost

Še en vidik, ki ga je bilo potrebno dobro premisliti, je bila varnost. Predvideno je bilo, da bodo učenci med reševanjem ugank v učilnici pod nadzorom. Zavedala pa sem se, da bodo nekatere skupine hitreje zaključile reševanje od drugih in njihova nagrada naj bi bila, da »pobegnejo« iz učilnice. Odločila sem, da uporabim dodatno prosto učilnico, ki jo imamo v neposredni bližini razreda. Učenci, ki so hitreje našli končno geslo, so imeli navodilo, kam se lahko umaknejo in kaj lahko počnejo. Ker je zaključek sovpadal s časom šolske malice, so učenci v sosednjem prostoru tudi pomalicali, nanje pa je popazil dežurni učitelj, ki je bil takrat na voljo na hodniku.

2.5. Cilj in motivacija

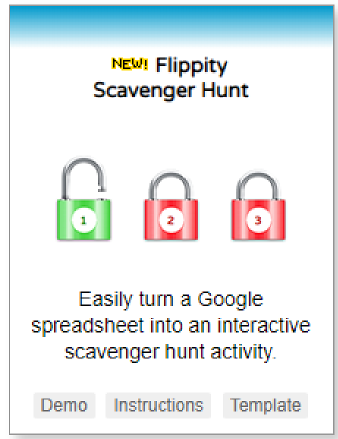
Utrjevanje, poglabljanje in razširjanje učne snovi tretjega razreda, je bil cilj učne ure povzet po učnem načrtu. Predvidevala sem, da bi klasična izpeljava ure z običajnim reševanjem učnih listov pri učencih izzvala nejevoljo, vzdihe in odpor. Odločila sem se, da bom uporabila elemente igre, ki bodo pripomogli k večji motiviranosti in zavzetosti otrok v doseganju zastavljenih učnih ciljev. Še zlasti je tak način dobrodošel za tiste, ki imajo učne težave, težave s pozornostjo. Igrifikacija jim omogoča, da izboljšajo pozornost. Učenci na koncu lahko zmagajo ali izgubijo, vendar je najpomembneje, da so vsi v učni situaciji in da se vsi nekaj naučijo.

2.6. Priprava nalog in predloge Flippity Scavenger Hunt

Ker se je časovno hitro bližal zaključek leta in veliko časa na voljo ni bilo, sem se omejila na uporabo nalog, ki sem jih že imela na voljo. Pri prebiranju informacij o značilnostih sob pobega, sem se naučila, da je treba igri dati rdečo nit, uganko, skrivnost, ki jo učenci skušajo rešiti. Lahko je to iskanje izgubljenega zaklada, ali iskanje mladiča neke skoraj že izumrle živalske vrste, morda je premagovanje sovražnika, ki želi prevzeti učilnico. Dodajanje zgodbe, je eden od privlačnih elementov igre za igralca, saj mu izzove določene čustvene odzive.

V običajnih sobah pobega imajo igralci na voljo veliko različnih škatel s ključavnicami, kjer so skrite naloge. Ker teh nisem imela, sem uporabila spletno orodje Flippity.net, do katerega lahko dostopamo s osebnim računalnikom ali mobilno napravo. To spletno orodje omogoča široko uporabo različnih predlog. Učitelj ustvari interaktivne izdelke s podatki, ki jih vnese v eno od predlog. Dostop do spletnega orodja Flippity.net je prost. Potrebujete le Googlov račun, nato pa je njegova raba enostavna, če poznate Googlove preglednice. Enostavno odprete spletno stran Flippity.net in izberete predlogo, ki jo želite.

Za svoj projekt sem uporabila Flippity Scavenger Hunt (slika 1). Spletno orodje nam daje možnost predstavitve, ki prikazuje izgled končne verzije ter njeno uporabo, vpogled imamo v navodila, kako uporabiti predlogo za izdelavo končnega izdelka in nazadnje seveda predlogo za kopiranje. Poiščemo lahko tudi video vodič za lažje rokovanje.



Slika 1. Flippity Scavenger Hunt.
https://www.flippity.net/

Gre za serijo postavljenih vprašanj, na katere mora učenec odgovoriti, da se mu posamezna digitalna ključavnica odpre.

Flippity Scavenger Hunt je v obliki Googlove preglednice, ki sem jo shranila v Google Drive in jo preimenovala.

V mojem primeru sem izbrala le tri ključavnice. Za odklepanje posamezne ključavnice je bilo treba napisati besedo. Vse tri besede so odklenile vse tri ključavnice in vrata iz učilnice so bila navidezno odklenjena.

Takšen način uporabe sem izbrala zato, ker imamo v učilnici le en sam računalnik, učenci na tej stopnji pa pogosto še nimajo svojih prenosnih telefonov, ki bi jih vsakodnevno nosili s seboj. Na tem računalniku je bila postavljena predloga, do katere so izmenično hodili učenci oziroma skupine in poskušali z odklepanjem.

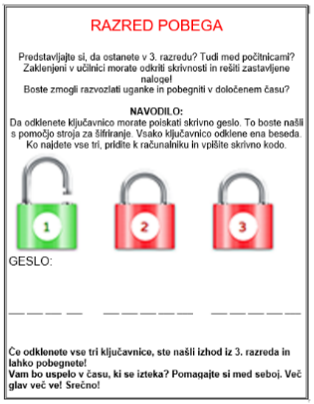
Možnost uporabe je seveda širša, če je več osebnih računalnikov ali mobilnih naprav za dostop. Napišeš lahko vprašanja, odgovore, namige, lahko uporabiš slike, video posnetke, povezave do spletnih strani, ki služijo kot namig k odprtju ključavnic.

2.6. Praktični del izvedbe

Zaradi številčnega oddelka je delo potekalo v šestih skupinah po štirje učenci. Z delom v manjših skupinah so lažje sodelovali. Pri delu so si pomagali, da so dosegli kar najboljše rezultate. Lahko so si porazdelili delo in je vsak reševal svojo nalogo, lahko pa so naloge prebrali skupaj in jih rešili. Največ skupin seje odločilo za slednji način reševanja, ker je bil praviloma eden iz skupine tisti, ki je vodil in naloge bral, to pa je bil običajno najhitrejši in najboljši bralec. Na tej stopnji je še veliko takih učencev, katerih branje ni avtomatizirano.

Preden sem učence poslala v igralni prostor, jih je bilo treba seznaniti s pravili igre (slika 2). Ko so učenci razumeli pravila, se je pričel meriti čas. Če se je kje zataknilo, sem ponudila namig. Učence sem izzvala z vprašanjem: »Ali jim bo uspelo razvozlati uganke in pobegniti iz tretjega razreda ali pa bodo ostali zaklenjeni v učilni še med počitnicami?« Z znanjem, ki so ga pridobili skozi šolsko leto, bodo zmogli rešili zastavljene naloge in pridobiti vstopnico za četrti razred.

Temu primerno sem izbrala končno geslo: GREŠ SKOZI IZHOD.


RAZRED POBEGA

Predstavljajte si, da ostanete v 3. razredu? Tudi med počitnicami? Zaklenjeni v učilnici morate odkriti skrivnosti in rešiti zastavljene naloge!
Boste zmogli razvozlati uganke in pobegniti v določenem času?

NAVODILO:
Da odklenete ključavnico morate poiskati skrivno geslo. To boste našli s pomočjo stroja za šifriranje. Vsako ključavnico odklene ena beseda. Ko najdete vse tri, pridite k računalniku in vpišite skrivno kodo.

1 2 3

GESLO:

_ _ _ _   _ _ _ _ _   _ _ _ _ _

Če odklenete vse tri ključavnice, ste našli izhod iz 3. razreda in lahko pobegnete!
Vam bo uspelo v času, ki se izteka? Pomagajte si med seboj. Več glav več ve! Srečno!

Slika 2. Navodila za učence. Foto: B. Gabrijelčič.

Za vsako od treh besed, so morali učenci poiskati posamezne črke. Črke so iskali s pomočjo nalog na učnih listih. Izbrala sem naloge različnih tipov iz različnih vsebinskih sklopov, s področja naravoslovja, matematike in slovenščine. Nekatere so bile krajšega tipa, druge daljše, nekatere zabavne in lažje, druge težje. Paziti je bilo treba, da nalog ni bilo preveč, saj bi lahko učencem interes za reševanje zamrl. Bile so dopolnilne naloge, naloge tipa kratkih ali enobesednih odgovorov, naloge alternativne izbire (odgovori npr. DA in NE), naloge urejanja – razvrščanja, naloge povezovanja, iskanj razlik ali podobnosti. Tako sem reševanje »starih« dolgočasnih nalog obrnila v zabavno in zavzeto reševanje.

Odgovor vsake naloge je vodil do ene številke.

Vsako številko so morali pretvoriti v črko s pomočjo »stroja za šifriranje« (slika 3). Predlogo zanj sem našla na spletni strani, s pomočjo programa Slikar pa sem angleško različico abecede spremenila v slovensko. Nalog je bilo toliko, kolikor je bilo črk v geslu. Ni bilo potrebno, da so rešili vse naloge. Če so sodelovali in logično razmišljali, so lahko besedo oziroma končno geslo uganili prej, kot so našli vse črke.

Tak postopek sem izbrala, da so imeli učenci lažje delo pri šifriranju. Glede na to, da nimajo veliko izkušenj s takšnim načinom reševanja, sem se odločila, da iskanje poenostavim. Predvidevala sem, da se bodo že tako dovolj zapletali pri iskanju pravilnih rešitev nalog in tako je tudi bilo (slika 4 do 7).

Slika 3. Šifrirni stroj. Foto: B. Gabrijelčič.

Slika 4: Navodila učencem. Foto: B. Gabrijelčič

Slika 5. Potek izvedbe. Foto: B. Gabrijelčič.

Slika 6. Vpisovanje gesla. Foto: B. Gabrijelčič.

Slika 7. Nagrada. Foto: B. Gabrijelčič.

3. ZAKLJUČEK

Celoten proces ustvarjanja mi je vzel nekaj časa in potrpljenja, da sem se naučila uporabe spletnega orodja in zbrala ter uredila primerne naloge, vendar me je delo obogatilo, za svoje delo pa sem bila nagrajena z navdušenim sodelovanjem učencev.

Cilj, ki sem si ga zadala je bil uspešno izpolnjen. Učenci so rešili večino nalog, pri tem pa so se izkazali v medsebojni komunikaciji. Skupine so delovale kot ekipa, imeli so občutek, kako so s skupnimi močmi rešili uganke in odprli vrata v naslednji razred. Po njihovih iskrivih očeh pa se je videlo, da jih ob tem preplavljali občutki veselja, zmagoslavja, navdušenja. Pridobili so dobro izkušnjo v učenju. Z medsebojno pomočjo so rešili večino zastavljenih nalog. Imeli so takojšnjo povratno informacijo o svojem vedenju in znanju. Če naloge niso pravilno rešili, so imeli težave pri sestavljanju gesla. Izziv je pritegnil in ohranjal pozornost učencev celo šolsko uro brez odmora, kar je na tej starostni stopnji učencev velik uspeh.

Po izvedeni dejavnosti bi lahko rekla, da bi bilo vsekakor boljše, če bi vsaka skupina lahko dostopala do naprave, na kateri bi bila nameščena Googlova predloga. Tako pa so se morale skupine čakati, da so lahko na skrivoma vpisovale gesla, sama pa sem za vsako skupino morala predlogo ponovno zakleniti. To mi je onemogočalo, da sem bila mobilna.

Vsi učenci tudi niso enako spretni pri rabi tehnologije, zato je potreben spoten nadzor in pomoč učitelja, da nadzoruje potek, usmerja, če se zatakne ter skrbi, da se učenci ne oddaljujejo od ciljev ure.

Vsekakor bom v naslednjih pripravah sob pobega za učence vnesla še druge vrste iskanja skritih predmetov: morda sestavljanko ali naloge, ki zahtevajo tudi drugačen način razmišljanja z dodanim praktičnim delom, da bodo resnično vključeni vsi učenčevi čuti.

Ob koncu smo bili vsi zadovoljni, tudi sama, ko sem lahko opazovala navdušenje učencev ob prejetju končne nagrade, še bolj pa ko jim je uspelo oditi skozi vrata in pomahati razredu ter učiteljici v slovo.

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Uporaba elektronskih gradiv učencev pri jezikovnem pouku

Using learner produced e-materials in language lessons

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POVZETEK

V prispevku so predstavljena različna elektronska gradiva, ki so jih ustvarili učenci in jih kot interaktivna gradiva uporabili pri jezikovnem pouku. Njihov način dela je v veliki meri temeljil na prepletanju literarne dejavnosti s filmsko umetnostjo. Izdelali so krajše filmske posnetke, vezane na učni načrt slovenščine, ustvarjali digitalne obnove prebranih del, filmske napovednike za umetnostna besedila ter elektronsko poustvarjali tudi neumetnostna besedila. Tak način dela so uporabili tudi po prebranih domačih branjih, ko so svoje razumevanje in doživljanje prikazali s kratkimi video posnetki. Njihovo delo smo nadgradili z interaktivnimi nalogami, ki so služile razvijanju medvrstniškega učenja in omogočale hitro medvrstniško povratno informacijo. Pri izdelavi elektronskih gradiv so uporabljali svoje telefone, orodje Edpuzzle in aplikacijo iMovie. Ustvarjanje elektronskih gradiv učence izjemno privlači in jim v sodobnem izobraževalnem procesu nudi učno okolje, v katerem lahko na kreativen način izkažejo svoje doživljanje sveta in neomejeno mladostno ustvarjalnost.

Ključne besede

Elektronska gradiva, film, Edpuzzle, iMovie, jezikovni pouk

ABSTRACT

The article presents various learner produced e-materials and the interactive use of such e-materials in language lessons. Learners' method of work was based on intertwining literature and film. They created short films, digital summaries of literary works, movie trailers and visual productions of non-literary texts. The similar process of work, which was based on the curriculum, was also used in the creative reproduction of home reading. Learners' knowledge, understanding and experience were boosted by the production of creating film art. We upgraded their e-materials by adding interactive tasks aimed at developing peer learning and peer assessment. Learners made their e-materials by using smartphones, Edpuzzle and an iMovie application. Encouraging learners to incorporate their innovative e-materials into the class brings many benefits to students and teachers. It actively involves students into the process of learning and teaching and provides innovative learning environment which becomes particularly powerful when it allows learners to express their inner thoughts, beliefs and experiences.

Keywords

E-materials, film, Edpuzzle, iMovie, Language lessons

1. UVOD

V sodobnem učnem procesu je aktivnost učenca eno izmed temeljnih didaktičnih načel. Skrb za kakovostno pridobljeno izobrazbo, razvijanje veščin, kompetenc ter uporaba IKT pri pouku so ključni dejavniki, ki ne le na novo definirajo vlogo učenca v učnem procesu, pač pa so v današnjem tekmovalnem in spreminjajočem se svetu ključnega pomena. Aktivnejši učni proces, večja učinkovitost učiteljevega dela in uporaba različnih sodobnih učnih metod in oblik pri pouku igrajo pomembno vlogo pri razvijanju motivacije in intenzivnejšem sodelovanju učencev pri pouku. Razvoj informacijsko-komunikacijske tehnologije je prinesel nove možnosti za učenje in poučevanje in s tem omogočil učinkovitejše načine pridobivanja novega znanja in kompetenc za zadovoljevanje potreb in izzivov sodobne družbe, še posebej na področju e-vključenosti.

2. ELEKTRONSKA GRADIVA

Elektronska učna gradiva so v slovenskem šolskem prostoru že nekaj časa v uporabi. Razvoj IKT je tudi na področju izobraževanja omogočil razvoj raznih spletnih orodij in aplikacij, ki kadar so tesno povezane s cilji in vsebinami pouka posameznega predmeta, pripomorejo h kakovostnejšemu pouku. Med elektronska gradiva uvrščamo gradiva, ki temeljijo na elektronskem besedilu, elektronski strani, spletnih igrah za učenje, spletnih kvizih ipd. So inovativni viri za učenje, saj pri današnjih mlajših generacijah otrok, ki so že od rojstva obdane s tehnologijo, izboljšajo, popestrijo in motivirajo učence za kvaliteten pouk in aktivnejšo vlogo pri učnem procesu [3].

2.1 Elektronska gradiva, ki jih ustvarjajo učenci

Elektronska gradiva, ki jih s premišljenim načrtovanjem in medsebojnim sodelovanjem ustvarijo učenci, so neprecenljivo orodje v sodobnem izobraževalnem procesu, v katerem IKT počasi, a vztrajno in učinkovito nadomešča klasične metode poučevanja. Izdelava takih gradiv od vseh udeležencev zahteva utrjeno znanje, temeljito pripravo, tesno medsebojno zaupanje in sodelovanje, razvijanje digitalnih kompetenc ter prevzemanje odgovornosti vseh članov za opravljeno nalogo. V ospredju je tako aktivna vloga učencev ter njihova samostojnost in suverenost. Čeprav je pobudnik takih pristopov učitelj, pa so učenci tisti, ki morajo izdelek, s pomočjo predznanja in novih znanj, ustvariti sami. Učitelj jih pri tem ustvarjalnem procesu usmerja, spremlja in jim svetuje [1].

2.2 Film

Med mladimi je film ena izmed najbolj razširjenih umetnosti, saj omogoča razmislek o življenjskih temah, posameznikovih in družbenih vrednotah ter spodbuja mlade, da si ustvarijo svoj pogled na svet. V današnjem času, ki je podvržen avdiovizualnemu dojemanju sveta, film predstavlja eno najbolj pomembnih in hkrati priročnih sredstev za soočanje mladih s temeljnimi dejavniki sodobne družbe in kulture. Vključevanje filma v pouk predstavlja pester, aktualen, sodoben in zanimiv vzgojno-izobraževalni proces, še večji izziv pa udeležencem predstavlja samostojno in odgovorno ustvarjanje [2].

Pri pouku slovenskega jezika so učenci osmih in devetih razredov po obravnavanem umetnostnem besedilu napisali scenarij in posneli film. Ob tem so razvijali cilje, vezane na učni načrt, poustvarjali in aktualizirali dano književno besedilo ter ga prenesli na filmski trak. Ustvarjalnost in timsko delo sta bila ključnega pomena za končni izdelek, poleg vsebinskih zahtev pa so učenci razvijali tudi medijsko pismenost in digitalne kompetence (sodelovanje z uporabo digitalnih tehnologij, ustvarjalna uporaba digitalnih tehnologij). Da filmski izdelek ne bi bil sam sebi namen, smo posamezne izseke filma predvajali vrstnikom ter z interaktivnimi nalogami nadgrajevali medvrstniško učenje. Njihov film, posnet po literarni predlogi, je tako služil za nadaljnje delo v razredu, ki je temeljilo na razgovoru, debatah ter iskanju vzporednic in razlik med literarnim besedilom in posnetim filmom. Hkrati so imeli učenci možnost pridobitve hitre medvrstniške povratne informacije, motivacija za delo v razredu pa je bila neprimerno višja (Slika 1).

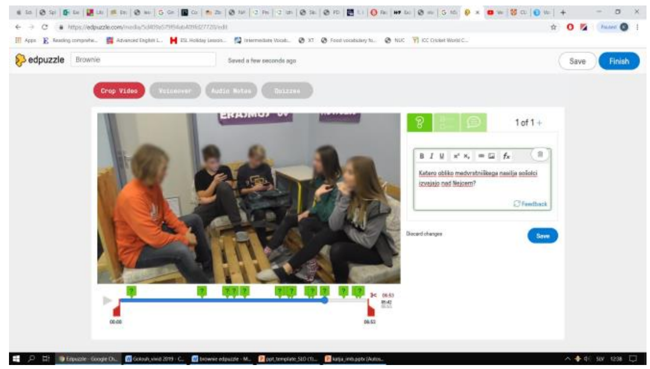
Slika 1: Prizor iz filma Vesolje v meni

2.3 Izdelava interaktivnega filma z orodjem Edpuzzle

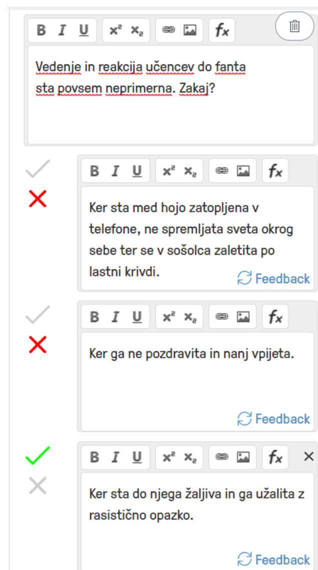
Edpuzzle je orodje, s katerim lahko video posnetek opremimo s komentarji in z vprašanji odprtega ali zaprtega tipa, na katera učenci odgovarjajo, in tako pripravimo interaktivni video (Slika 2, Slika 3). Odgovori učencev se beležijo in so učitelju v pomoč pri spremljanju napredka in razumevanja. S takimi interaktivnimi posnetki lahko preverjamo razumevanje, spodbudimo debato, kritično razmišljanje ali pa podajamo teoretične vsebine.

Učenci tretje triade so pri pouku slovenščine po obravnavi književnega besedila Potolčeni kramoh napisali scenarij in posneli film Brownie, ki je temeljil na literarni predlogi slovenskega pisatelja Prežihovega Voranca. Delo je vseskozi potekalo v skupinah, učenci so se sami dogovarjali o procesu pisanja, si razdelili vloge in se lotili snemanja filma. Po končanem snemanju so se lotili tudi urejanja video posnetka. Ustrezno so mu dodali glasbeno podlago in vse potrebne zapise. Ko je bil izdelek končan, so ga predvajali vrstnikom, sprva v celoti, nato po posameznih odsekih, z dodanimi vprašanji, ki smo jih dodali z uporabo orodja Edpuzzle. Na ta način je njihov posnetek postal interaktivno učno gradivo, motivacija vrstnikov za reševanje tovrstnih nalog pa je bila izredno visoka, tudi učno okolje, v katerem so učenci reševali naloge, je bilo sproščeno in zabavno.

Tovrstno elektronsko učno gradivo so ustvarili tudi učenci devetih razredov, ki so se lotili snemanja filma Vesolje v meni, posneto po literarni predlogi ljubezenske pesmi Orion, slovenskega pesnika Gregorja Strniše. Ključnim izsekom filma smo z orodjem Edpuzzle dodali vprašanja, njihovi vrstniki pa so po ogledu reševali naloge, vezane na posamezni filmski izsek.



Slika 2: Dodajanje nalog odprtega tipa z orodjem Edpuzzle



Slika 3: Dodajanje nalog zaprtega tipa z orodjem Edpuzzle

2.4 Izdelava e-gradiv z aplikacijo iMovie

Tablični računalniki Apple iPad zaradi svoje enostavnosti in prilagodljivosti omogočajo zabaven in poučen izobraževalni proces ter prinašajo nove in raznolike možnosti za ustvarjanje in urejanje video posnetkov. Ena izmed aplikacij, ki jih Apple iPad ponuja, je aplikacija iMovie, s katero je ustvarjalno poustvarjanje literarnih besedil povsem preprosto. Aplikacijo bogati enostavna uporaba ter preprosti, zabavni in privlačni video izdelki, ki jih lahko opremimo z glasbeno podlago ter napisi in jih naložimo na priljubljena spletišča, kot so YouTube, Facebook in Vimeo.

2.4.1 Filmski napovednik za literarno delo

V učnem načrtu za slovenski jezik je med predlaganimi književnimi besedili za obravnavo pri pouku tudi Levstikov junak, Martin Krpan. Z aplikacijo iMovie je skupina učencev pripravila t.i. filmski napovednik in ga predvajala vrstnikom. Po predvajanem posnetku je v razredu potekala skupinska razprava (učenci so previdevali, kateri glavni junaki v delu nastopajo, kakšne so njihove značajske in vizualne lastnosti, kaj je tema oz. osrednji problem besedila, kako se le-ta razreši). Čeprav kratek, je video posnetek učence pritegnil k ogledu, krajši napisi in akcijska glasbena podlaga pa sta jih navdušila za individualno raziskovanje literarnega dela (Slika 4). Filmski napovednik je dostopen na spletu, na strani https://www.youtube.com/watch?v=6-hY3n26aNk.

Slika 4: Izsek iz Filmskega napovednika Martin Krpan

2.4.2 Digitalni povzetek književnega dela

V osmem razredu so učenci po branju, obravnavi in analizi Tavčarjevega Tržačana dobili nov izziv - izdelavo strnjenega digitalnega povzetka s ključnimi podatki, osebami in njihovimi ravnanji, ki bo učencem vedno na voljo (https://www.youtube.com/watch?v=MPaj6CP4Fg0). Zaradi enostavnega urejanja slikovnega materiala z glasbeno podlago delo ni bilo težko. Ključne besede in besedne zveze za nastali posnetek so v obliki skupinske razprave predlagali učenci sami, kar pomeni, da so morali delo zelo dobro poznati. Tudi ta način dela jih je navdušil, saj so namesto pisanja v zvezek svoje ideje prelili na spletišču YouTube.

Na podoben način so v okviru dodatnega pouka slovenščine ustvarili še povzetek o odlomku iz Kranjčevega dela Otroci, čigavi ste? Naloga učencev je bila, da priskrbijo fotografije, ki najbolj odsevajo vsebino, občutje ter njihovo dojemanje književnega dela in jednrato povzamejo zgodbo (Slika 5). Sami so pripravili tudi oznake književnih oseb in temeljna sporočila ter povzetek objavili na spletni strani (https://www.youtube.com/watch?v=G2fDuelRmGU9).

Slika 5: Izsek iz digitalnega povzetka Otroci, čigavi ste?

2.4.3 Digitalna razlaga književnih pojmov

Povsem proste roke imajo učenci pri uporabi tablice, kadar želijo snov povzeti, utrditi, jo prikazati vizualno in zvočno. S pomočjo aplikacije iMovie so ustvarili digitalni povzetek književnih pojmov za sedmi razred, ki jednrato razloži in povzame osnovne književne pojme in njihove lastnosti. Gradivo je dostopno na spletni strani https://www.youtube.com/watch?v=mDxLHiom7as.

2.5 Snemanje s pametnimi telefoni

Mladi v današnjem svetu, prepletenem s sodobnimi tehnologijami, vse več časa preživljajo za digitalnimi napravami. Čeprav ima lahko prepogosta raba digitalnih interakcij škodljive posledice, ima sodobna tehnologija tudi pozitivne učinke. Z namenom, da bi mladi svoje pametne telefone izkoristili za brezmejni prostor izražanja in kreativnega ustvarjanja, smo v pouk obravnavanja neumetnostnih besedil vključili izdelavo in snemanje neumetnostnih besedil, konkretneje snemanje reklam. V učnem načrtu slovenščine je namreč v osmem razredu osnovne šole eden izmed ciljev prepoznavanje in poznavanje značilnosti reklame. Ker so v vsakdanjem življenju reklame del vsakdanjika, največkrat pa se pojavljajo v medijih in ne v delovnih zvezkih, se nam je zdelo smiselno, da učenci po obravnavi pri pouku posnamejo svojo izvirno reklamo. Preden so se lotili izdelave le-te, smo v razredu skupaj izdelali merila in usmeritve (delo poteka v skupini največ treh učencev, vsi člani skupine morajo sodelovati pri vseh postopkih izdelave, reklama mora oglaševati izdelek ali storitev, vsebovati mora glasbeno podlago, vsebuje naj geslo, biti mora izvirna/duhovita). Po ogledu vseh reklam je sledila analiza in povratna informacija ustvarjalcem. Učencem je snemanje sicer predstavljalo večji izziv, kot so mislili sprva, a so bili vsi enotnega mnenja, da tak način dela vzgojno-izobraževalni proces popestri, ga naredi aktualnega, hkrati pa jih uri v sodelovalnem učenju in strpnem medsebojnem sodelovanju.

Prepletanje književnega pouka s filmsko umetnostjo je le eden izmed sodobnih načinov, kako mladim približati branje daljše in zahtevnejše literature. Mnogi učenci literarni svet lažje razširijo s pomočjo pretvarjanja besedila v filmsko obliko. Ta metoda, podprta predvsem z avdiovizualno prezentacijo, je med osnovnošolskimi učenci izjemno priljubljena, saj jim nudi učno okolje, v katerem si osmišljajo branje in pisanje ter jim hkrati nudi širok prostor za lastno ustvarjalnost. Če dodamo še dejstvo, da veliko mladih dandanes zavrača branje in ga dojema kot velik miselni napor, potem je nujno, da učitelji književni pouk posodobimo in popestrimo. Tudi pouk literature je lahko zabaven in poučen, če v izobraževalni proces občasno vključimo informacijsko tehnologijo, ki v sklopu timskega in skupinskega dela povečuje medsebojno sodelovanje in je dober motivator za aktivno učenje, skupno reševanje problemov ter medsebojno pomoč. Pomembno in tudi zabavno je umetnostna besedila spoznavati, podoživljati in poustvarjati skozi oči sodobne tehnologije. Zaradi vsega zgoraj naštetega so učenci doživljanje obveznih domačih branj lahko predstavili tudi s pomočjo pametnih telefonov in nastalo je kar nekaj posnetkov prebranih domačih branj.

3. ZAKLJUČEK

Hitre spremembe v današnjem svetu, silovito naraščanje znanja, informacij ter razmah sodobne tehnologije učitelje silijo k temu, da spreminjajo svoj odnos do učenja in poučevanja. Šola za učence pogosto postane suhoparna, metode pa zastarele, kar velikokrat vodi k pasivni vlogi učencev pri pouku. V prihodnosti bodo nedvomno veliko vlogo v izobraževalnem procesu igrala elektronska gradiva, ki učence ne le izjemno privlačijo, pač pa jim nudijo učno okolje, v katerem na sodoben način izkazujejo svoje znanje, reševanje problemov, doživljanje sveta in mladostno ustvarjalnost. Za kakovostno učenje z elektronskimi gradivi mora v prvi vrsti poskrbeti šola z zagotovitvijo potrebne tehnične infrastrukture. Sledijo učitelji, ki morajo biti kompetentni za rabo elektronskih gradiv v razredu in izven njega ter učence poučevati o strategijah uporabe in pravilne rabe. Še korak dlje predstavljajo elektronska gradiva, ki jih s sodelovalnim učenjem pripravijo učenci sami. Njihova dodana vrednost je soustvarjanje učnega procesa; razvijanje in nadgrajevanje sodelovalnega medvrstniškega učenja; spodbujanje ustvarjalnosti, spodbujanje kritičnega mišljenja; razvijanje digitalnih kompetenc; ustvarjanje priložnosti za medvrstniško povratno informacijo ter trajna zbirka elektronskih gradiv za prihodnje generacije.

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Konceptualno poučevanje in učenje angleščine kot tujega jezika

Conceptual teaching and learning of English as a foreign language

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POVZETEK

Dijaki, ki danes vstopajo v sistem srednjega izobraževanja, se bodo upokojili leta 2068. Ko bodo vstopili na trg delovne sile, bo ta zelo drugačen od tradicionalnega, na katerega so vstopali njihovi starši in stari starši. Zahteve, ki jih pred mladega človeka postavlja čas, so zdaj bistveno drugačne. Danes je nujno znati poiskati informacije, jih oceniti, ovrednotiti, umestiti v celoto, jih analizirati in raziskati, nato pa novo znanje skupaj s sodelavci uporabiti v novi situaciji. Zato je treba dijake naučiti, kako pridobivati znanje, kako odgovoriti na vedno hitrejše spremembe v tehnološkem, družbenem, gospodarskem in globalnem okolju. Vprašanje pa je, kakšne vrste učenja in poučevanja lahko pripeljejo do teh spretnosti in znanj in kakšne raziskave so bile na tem področju sploh opravljene.

Ključne besede

Gimnazija, konceptualno učenje, konceptualno poučevanje, IKT, sodobna šola, pouk angleščine

ABSTRACT

The students who we teach today, will enter the job market that differs greatly from the one their parents were used to. The demands that people meet when they look for jobs are different, too. Today, it is essential to be able to dig information, critically analyse it and assess it, then evaluate it and work on the newly acquired knowledge within a team. That is why our students need to be taught how to acquire knowledge and find the answer in an ever-changing world in technological, social, economic and global sense. The question arises what types of teaching and learning methods can provide us with such skills and if there were any researches made on this field.

Keywords

Secondary school, conceptual learning, conceptual teaching, ICT, modern school, English classes

1. UVOD

Konceptualno učenje in konceptualno poučevanje

V 21. stoletju je poučevanje dejstev brez širšega konteksta nesprejemljivo. V zadnjem desetletju številni raziskovalci na področju izobraževanja iščejo nove, inovativne pristope v poučevanju in učenju, take, ki bodo primernejši za nove generacije dijakov v današnjih šolah. (Gerlič, 2012)

Nekateri strokovnjaki na področju šolstva današnjo generacijo dijakov imenujejo nintendo ali Z generacija. To je generacija mladih, ki »od učiteljev in šole zahteva znanje za takojšno uporabo in pri tem nima nobene želje ali potrebe, da bi to znanje obogatili ali nadgradili, raziskovanje jih ne zanima. To je generacija, ki ne sprejema avtoritarnih načinov poučevanja, ne prenese tradicionalnih modelov v šolstvu, ne prenese avtoritete in ni sposobna discipline.« (Starlink, 2004) Zato učitelji s starimi, tradicionalnimi pristopi k poučevanju od novih generacij ne moremo pričakovati, da bodo ubogljivo sledile in bodo uspešne po sodobnih merilih in kriterijih.

Konceptualno učenje in poučevanje pomeni odmik od tradicionalnih načinov. Pri konceptualnem učenju gre za to, da umestimo dejstva in informacije v širši kontekst, pri čemer upoštevamo dijakovo predznanje in njegove izkušnje. Bistveno je, kako nato novo pridobljene informacije, znanje in spoznanja organiziramo. Konceptualno učenje in poučevanje torej ne poteka preko delovnih listov, drila ali diskretnega učenja, torej učenja na pamet. (H Lynn Erickson)

Princip konceptualnega modela zahteva najprej predhodno razumevanje konteksta. Faktografsko znanje pri tem seveda ni nepomembno, vendar je lahko le osnova za razširjeno in poglobljeno spoznavanje problemske situacije. Pri tem ne gre za pred-test, ampak eksperimentalno znanje, ki ga imajo dijaki.

Bruner konceptualno učenje imenuje tudi učenje po kategorijah ali pa ustvarjanje konceptov. (Bruner, Goodnow, Austin, 1967) in ugotavlja, da gre pri konceptualnem učenju za iskanje atributov, ki razlikujejo posamezno od splošnega. Koncepti so tako mentalne kategorije, ki nam pomagajo klasificirati stvari, dogodke, ideje in ki nam dajo razumeti, da ima vsak predmet, dogodek ali ideja svoje skupne relevantne poteze. Torej je konceptualno učenje strategija, ki učečega primora, da primerja in kontrastira skupine ali kategorije, ki imajo konceptualno relevantne značilnosti s tistimi skupinami, ki le teh nimajo. (Brunner, Goodnow, Austin, 1967)

Termin konceptualno učenje se nanaša na učenje oziroma usvajanje konceptov (concept learning), pa tudi na izgrajevanje znanja s pomočjo konceptualnih struktur, kot na primer kognitivnih shem in skriptov (conceptual learning). (Rutar Ilc)

Tradicionalen pristop učenja gre od posameznih informacij do celote, pri čemer se konceptualno znanje izkaže kot učinkovit vir za proceduralno znanje za razvoj konceptov. (Lipovec, Gregorčič, Antolin)

2. KAKO SE KONCEPTUALNO UČENJE RAZLIKUJE OD TRADICIONALNEGA?

2.1 Predznanje

Učenje ni le pridobivanje znanj in spretnosti, temveč je proces, pri katerem se človek spreminja, Znanje se nalaga na že obstoječe kognitivne strukture (predznanje) in se tako nadgrajuje. Če bo učenje v šoli aktivno, če bodo dijaki čustveno in intelektualno vpleteni v proces učenja, bo njihova motivacija za učenje večja in bo tudi pomnjenje bolj intenzivno ter dolgotrajno. Dijake spodbudimo, da uporabijo znanje in izkušnje, ki jih imajo o obravnavanem področju. Pri tem ne gre za pred-test, ampak za izkustveno predhodno znanje, ki ga dijaki že imajo. Marentič Požarnik ugotavlja, da je posebej poudarjeno v dognanjih kognitivno-konstruktivistične psihologije, da je predznanje najpomembnejši posamezni dejavnik uspešnosti nadaljnjega učenja.

Primer dobre prakse: pri 6. modulu (Strange foods of the world) se dijaki razdelijo v skupine po tri in v dveh minutah pripravijo seznam nenavadne hrane, ki jo poznajo, so jo kdaj okusili ali so slišali za njo. Na takšen način dijake spodbudimo, da o temi začnejo razmišljati in da pri učenju uporabijo svoje izkušnje in svoje predznanje. Nekatera dejstva poznajo sami, nekatera si bodo zapomnili zaradi sošolcev, ki so kdaj poskusili kaj nenavadnega. Osebna izkušnja je pri tem bistvena. Dijaki si novo informacijo bolje in lažje zapomnijo, če jo postavijo na poznane temelje. Med strategije, ki spodbujajo priklic predznanja, sodijo brainstorming, pojmovne mape, vprašanja pred uvajanjem nove snovi. Ob tem lahko dijaki uporabijo tudi pametne telefone, ko iščejo dodatne informacije in zanimivosti. Dijaki imajo takšne uvode radi, razelektri se ozračje in v sproščeni atmosferi se lažje in bolje učijo.

2.2. Razumevanje

Najpomembnejša vsebina konceptualnega učenja je razumevanje snovi. Dijaki pogosto poznajo vrsto dejstev, vendar jih ne uspejo povezati v smiselno celoto. Del znanja, pridobljenega v procesih učenja, je znanje o dejstvih, torej dejstveno ali faktografsko znanje (Justin). V sodobnih teorijah učenja je to zapostavljena tema, kar je svojevrsten paradoks, kajti po Bloomovi taksonomiji je to znanje umeščeno na najnižjo raven.

Faktografsko znanje tako ni povsem nepomembno ali nekoristno, čeprav so vse glasnejši pozivi strokovne javnosti, naj učitelji pri pouku zmanjšamo vnos faktografskega znanja ali pa naj ta del pouka sploh povsem opustimo, kajti vse informacije so dandanes dostopne s klikom na Google. Kljub temu pa je faktografsko znanje vendarle pomembno, saj omogoča konceptualno učenje, pri čemer je izjemnega pomena ravno to, da faktografsko znanje umestimo v širši kontekst in na tak način pomembne podrobnosti dobijo svoj smisel v celoti. Pri pouku tujega jezika je faktografsko znanje v določeni meri vezano na literarne smeri, pesnike in pisatelje. Če vemo, da je bil Shakespeare renesančni umetnik (dejstvo) in če poznamo značilnosti renesanse (dejstva), potem vemo, s katerimi temami se je Shakespeare v svojih delih ukvarjal (konceptualno učenje).

2.3 Samopreverjanje kot učenje ter čuječnost

Samopreverjanje ni le instrument, s katerim dijaki preverijo lastno znanje, temveč način učenja, ki pomaga dijakom, da razvijejo svoje znanje in so si zmožni sami postavljati cilje, spremljati lasten razvoj, določati naslednje korake in reflektirati lastno razmišljanje in učenje. (EduGains).

Na primer pri besedilu o ogljičnem odtisu si dijaki, ko sledijo besedilu, spotoma postavijo pet vprašanj in odgovori na ta vprašanja jih bodo vodili skozi obnovo besedila. Na primer: Kaj je ogljični odtis? Kako potovanje z letalom doprinese k tvojemu ogljičnemu odtisu? Ali lahko natančno določimo, kakšen je naš ogljični odtis in zakaj? Je kdo že poskušal natančno izračunati ogljični odtis? Kaj lahko naredimo, da zmanjšamo svoj ogljični odtis? Odgovore nato najdejo v besedilu.

Slovenska beseda za čuječnost (Slovar slovenskega knjižnega jezika, 1995) je opredeljena kot pazljivost, skrbnost in opreznost, ter kot budnost (odsotnost spanja). Bishop in sodelavci (2004) ugotavljajo, da je čuječnost samoregulacija pozornosti in usmerjenost na doživljanje tukaj in zdaj. Če so dijaki pritegnjeni k pouku in snov, ki se je učijo, ponotranjijo, smo kot učitelji dosegli svoj cilj. Navodila, ki jih učitelji dajemo dijakom, morajo biti ciljno usmerjena, da .. Dijaki se učijo določenih dejstev, osredotočeni so na temo. Pri učenju uporabijo vrsto diskretnih spretnosti, pri čemer termin diskretne spretnosti (discrete skills) označuje spretnosti, ki zajemajo eno vrsto dejavnosti, običajno gre za dril. Učenje, ki je usmerjeno v standard, je drugačno. Dejstva in dijakove aktivnosti so usmerjeni v razumevanje širše slike Navodila so podana v skladu z dijakovimi vprašanji, ki izhajajo iz globljega razumevanja. Dejstev se dijaki naučijo, da bi lahko z njimi prišli do transferjev konceptov in idej, pri čemer potrebujejo vrsto spretnosti.

Pri učenju jezika je potrebno tudi diskretno učenje, zlasti ko gre za vzorce iz ustroja jezika: slovnične prvine kot so različni časi, na primer. Tovrstno učenje, ki je za dijaka dolgočasno, naporno in se mu zdi neproduktivno, postane sprejemljivejše, ko izhajamo iz širše slike: dijakom najprej pojasnimo, da ima angleščina štiri sedanjike, štiri preteklike in sedem jezikovnih načinov, da tvori prihodnjike. Na tablo zapišemo stavek v vseh časih in dijakom damo na voljo nekaj minut, da stavke poskusijo prevesti, nato pogledamo, kako jim je uspelo. Primer:

Present time:
The students go to the museum.
The students are going to the museum.
the students have gone to the museum.
The students have been going to the musem.

Past time:
The students went to the museum.
The students were going to the museum.
The students had gone to the museum
The students had been going to the museum

Future time:
The students will go to the museum.
The students will be going to the museum.
the students will have gone to the museum.
The students will have been going to the museum.
The students are going to the museum.
The students are going to visit the museum.he students

Na ta način dijakom najprej pokažemo celotno sliko in jim s tem približamo snov. V prejšnjih letih je veljalo, da po učnem načrtu slovnične čase obdelujemo zdaj en slovnični čas, zdaj drugega, do konca četrtega letnika, torej do mature, pa vse in pogosto so dijaki pogosto izgubili pregled nad snovjo in na koncu niso niti vedeli, koliko slovničnih časov v angleščini sploh obstaja. Če izhajamo iz širše slike in se počasi poglabljamo vanjo, dijaki lažje spremljajo snov in vedo, katere od slovničnih časov že znajo, katerih se bodo pa še naučili. Na tak način jim je snov bližja in imajo občutek nadzora. Vedo, kje so in kam gredo. Sodobne teorije čuječnosti so naravnane prav na to.

2.5 Generalizacija in tematsko povezovanje, trajnostno učenje

Posploševanje v akademskem smislu in povezovanje idej je pri pouku nadvse dobrodošlo, ker daje dijaku občutek, da obvladuje področje, ki se ga uči. Zaradi tega občutka, da ni izgubljen v poplavi informacij in podatkov, se bo povečalo dijakovo sodelovanje pri pouku, zanimanje za obravnavano temo in s tem njegova vpletenost v snov. Dijaki "obdelujejo" snov na voden način. H Lynne Erickson meni, da generalizacija vodi v trajno razumevanje.

Tako lahko znanje, ki so ga pridobili pri drugem predmetu, prenesejo na snov, ki se je učijo. Običajno pri tem nastane aha efekt, ki razelektri ozračje v učilnici. V primeru pouka angleščine se snov generalizira v odnosu na ostale jezike, ki jih dijak že zna ali se jih uči. Na primer: ko se naučijo angleški perfekt (pomožnik glagola "imeti" in pretekli deležnik glavnega glagola, znajo perfekt tvoriti tudi v nemščini, španščini, francoščini, ker se dela po istem principu z glagolom imeti in preteklim participom. Ali pa, ko se uči pasiva, pomisli, kako trpnik gradimo v slovenščini, potem pa jezikovno strukturo postavi v nemščino, angleščino, francoščino, španščino, ruščino z glagolom biti in preteklim deležnikom. Ko se dijak uči teme, se jih ne uči samo za to, da odpiše test in potem pozabi na njih, temveč gre za trajnostno učenje.

2.6 Vzrok in posledica

Dijak bo snov lažje in hitreje razumel in si jo bo bolj dobro zapomnil, če bo dojel bistvo snovi. Pri pouku lahko učitelj opozori dijake, naj premislijo, kaj je vzrok in kaj posledica nekega stanja. Ko se pri angleščini učimo o nastanku in razvoju angleškega jezika ter o jezikovnih vplivih na angleški jezik, lahko dijakovo pozornost usmerimo na to, od kod so prihajale in še prihajajo v angleščino nove besede. Včasih je dovolj, da učitelj samo omeni besedo kolonizacija in dijaki povežejo znanje iz zgodovine in vedo, katere dele sveta so Angleži kolonizirali in da so mnoge besede v standardni angleščini pravzaprav od tam. Na primer kenguru, boomerang, bungalov. Ali pa, ko se učimo o ogljičnem odtisu, to besedilo povežemo z izkušnjami, ki jih imajo dijaki v vsakdanjem življenju, povežemo razloge in posledice njihovega/našega onesnaževanja vode, okolja. Dijaki si bodo novo besedišče lažje zapomnili, če bodo razmišljali o neki snovi s stališča vzročnosti in posledičnosti. Da bi razložili svoje gledišče, bodo potrebovali novo besedišče in to bo tisto besedišče, ki ga bodo tudi usvojili, ker bodo za to čutili potrebo.

2.7 Kaj bi rad učitelj od dijaka?

Ko začne učitelj razmišljati o tem, kaj je cilj njegove učne ure, se mora najprej vprašati, kaj želi od dijakov ob koncu ure: da bodo znali našteti pravila o rabi sedanjikov ali da bodo znali razložiti razliko med štirimi sedanjiki; da bodo znali našteti značilnosti angleške romantične poezije ali da bodo znali v poeziji Byrona, Coleridgea, Wordswortha najti elemente romantike in ugotoviti, kako se romantična poezija razlikuje od poezije iz drugih literarnih obdobij in smeri? Da bodo znali našteti dvajset novih besed iz novega besedila ali da jih bodo znali smiselno uporabiti, ko bodo pripovedovali o temi? Da bodo znali našteti prve osvajalce Amerike, kdaj in kam so pripluli ali razmišljati o tem, kako se je angleški jezik in življenje spreminjalo na Novem kontinentu? Cilji se s časom spreminjajo. Če je bilo nekdaj dovolj, da je bil cilj učenja ponavljanje za učiteljem, je danes cilj kritično mišljenje in ko si učitelj postavlja cilje, mora imeti v mislih ravno to.

2.8 Trajnostno razumevanje

Kaj pravzaprav pomeni trajnostno razumevanje snovi? Gre za širše koncepte, ki so osredotočeni na principe ali procese znotraj določene domene. Pri tem zanemarimo diskretne podatke ali spretnosti. zanemarimo dril, ustvarimo širšo sliko. Gre za univerzalno in brezčasno in ne za izjeme ali posebnosti ali enkratne pojave. takšno znanje je mogoče prenašati in je uporabno tako znotraj kot izven konteksta.

To je pravzaprav osnova za kontekstualno učenje. Dijak si bo zapomnil snov, če bo o njej razmišljal v smislu konteksta. Če bo znal umestiti novo snov v že poznana dejstva, bo pri učenju uspešen. To učenje ne bo zajemalo le snov od enega do drugega testa pri posameznem predmetu, temveč bo šitše.

Namen trajnostnega razumevanja je v tem, da bo dijak osvojeno novo znanje vkomponiral v temelje, ki jih že ima in mu nova dejstva zato ne bodo tuja. Logično jih bo povezal in ker bodo tako logična, si jih bo zapomnil brez težav. To so principi, ki jih bo lahko uporabil tudi pri drugih predmetih v drugih situacijah.

3. ZAKLJUČEK

Hitre spremembe v svetu in eksponentno naraščanje znanja nas sili, da učitelji spreminjamo naš odnos do poučevanja in učenja. Stoletja je bilo dovolj, da je učitelj uporabljal tablo in kredo, dijaki pa tablico in kasneje zvezek ter pisalo, ker so učitelji od dijakov pričakovali izključno repeticijo. Samostojno ali celo kritično mišljenje ni bilo dobrodošlo. Dandanes pa želimo od dijakov, da znajo poiskati kvalitetno informacijo, jo povezati v smiselno celoto in jo uporabiti v novem kontekstu. Pri rudarjenju informacij iz podatkovnih baz je treba upoštevati določena pravila, dijaki pa se morajo naučiti ločiti kvalitetne od nekvalitetnih informacij.

Prihodnost pripada ljudem, ki razmišljajo drugače, ljudem, ki so ustvarjalni, so sposobni empatije in ustvarjajo pomene. To so ljudje, ki so umetniki, izumitelji, oblikovalci, pripovedovalci zgodb, tisti, ki skrbijo za bolne, ki znajo tolažiti in ki znajo razmišljati v okviru velike slike. (Pink, 2018)

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Prvi koraki v svet robotike z Makeblock roboti

First steps in the world of robotics with Makeblock robots

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POVZETEK

Znanja programiranja, robotike in elektrotehnike so v sodobni družbi še kako iskana. V praksi le manjši del učencev o tem pridobi nekaj izkušenj preko obstoječih učnih načrtov obveznih predmetov v osnovnih šolah. Zato smo na Osnovni šoli Idrija v začetku leta 2018 z nakupom 12 učnih robotskih kompletov Makeblock omogočili učencem, da na zabaven način osvojijo nekaj osnov zgoraj omenjenih znanj, ki bi jih posledično motivirale k večji izbiri sorodnih študijev, za katere obstaja velik interes v lokalnem delovnem okolju. Učenci predmetne stopnje so v šolskemu letu 2017/18 dobili možnost obiska 10-urnega krožka robotike in delavnice v okviru raziskovalnega tabora CŠOD Cerkno. Zaradi velikega interesa so bile kasneje organizirane delavnice tudi na sosednjih osnovnih šolah v Spodnji Idriji in Črnemu Vrhu. V naslednjem šolskem letu je bil učencem na matični šoli prvič ponujen 35-urni izbirni predmet Robotike v tehniki. Preko omenjenih aktivnosti so učenci spoznali pomen robotike v vsakdanjiku in industriji, pridobili elektrotehnična znanja z ugotavljanjem pomena posameznih motorjev in senzorjev robota, razvijali ročne spretnosti s sestavljanjem posameznih modelov robota, osvajali osnovne koncepte programiranja preko programiranja robotov v Scratch okolju, na koncu pa v praksi spoznali pomen robotov z ogledom lokalnega podjetja Kolektor.

Ključne beside

Robotika, programiranje, elektrotehnika, informacijska tehnologija, Makeblock

ABSTRACT

There is a great demand for the knowledge of programming, robotics and electrical engineering in modern society. In practice, only a small proportion of students gain some experience through existing compulsory elementary school subjects. Therefore, at the beginning of 2018, Primary School Idrija purchased 12 Makeblock learning robotic kits, to enable students to learn in a fun way some of the basics of the mentioned skills. Consequently, this would motivate students to choose more related studies for which there is great interest in the local work environment. In the school year 2017/18, students from 6^{th} until 9^{th} school year were given the opportunity to participate in a 10-hour robotics club and a workshop within the CŠOD Cerkno research camp. Because of great interest among students, workshops at neighboring elementary schools in Spodnja Idrija and Črni Vrh were organized. For the first time a 35-hour optional course of Robotics was offered to Idrija's primary school students in the following year. Students learned the importance of robotics in different areas of life. They gained electro-technical knowledge by understanding the importance of individual motors and sensors of a robot, developed manual skills by assembling individual robot models, mastered basic programming concepts through programming robots in Scratch language, and finally in practice get to know the importance of robots with a visit to the local company Kolektor.

Keywords

Robotics, programming, electrical engineering, information technology, Makeblock

1. UVOD

Trenutne razmere v gospodarstvu kažejo, da bo uporaba robotov v prihodnosti še naraščala. Kljub temu da je robotika mlada veda, se je njena uporaba iz industrije, razširila na vsa področja našega življenja. V preteklosti je bilo največ polemik, da bodo ljudje zaradi robotov izgubili delovna mesta, kar se je izkazalo za nepravilno, saj se je z uporabo robotov odprlo tudi veliko novih delovnih mest. Zaradi skokovitega napredka robotike so se tudi v izobraževanju zgodile določene spremembe. Ker primanjkuje ljudi, ki bi znali robote sestavljati, programirati in uporabljati, so se predvsem razvite države sveta (ZDA, Japonska) še pravi čas odzvale na ta problem in začele spodbujati izobraževanje v tej stroki. Čeprav se vedno več dijakov odloča za študije računalništva, mehatronike, elektrotehnike in strojništva, bi bilo za razvoj tega področja v Sloveniji dobro, da bi večji delež osnovnošolcev čim prej seznanili z robotiko in tako morebiti prebudili zanimanje. [4]

Ob vse večjem številu tehnoloških pripomočkov na trgu narašča tudi veliko več raziskovalnih robotov namenjenih učenju. Take raziskovalne robote izdeluje tudi kitajsko podjetje Makeblock, ki je bilo ustanovljeno leta 2013. Zasebno tehnološko podjetje razvija strojno opremo Arduino in programsko opremo, ki je zasnovana na okolju Scratch za namen robotike. Podjetje zagotavlja tudi izobraževalna orodja za učenje programiranja, inženiringa in matematike. Poleg mobilnih robotov izdelujejo tudi 3D-tiskalnike, risalnike, laserje, letalnike in programirljive elektronske gradnike. Največkrat so to kit kompleti, ki se sestavijo s pomočjo navodil po želji uporabnika. Posebno predznanje za upravljanje teh robotov ni potrebno, saj je programska oprema prilagojena otrokom in najstnikom, ki so željni tehničnega znanja [1].

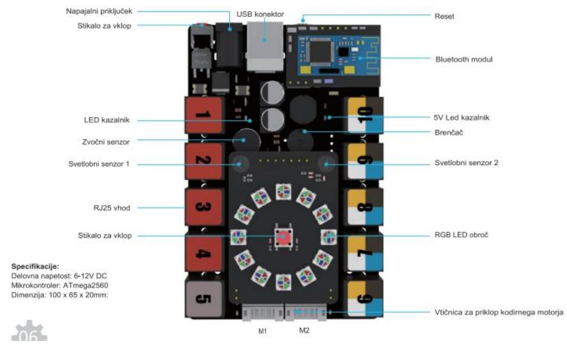
Za nakup različnih Makeblock robotov se je šola odločila, ker njihovo programsko okolje mBlock 3 bazira na programskem jeziku Scratch, prevedeno v slovenščino, katerega se učenci na večini šol že učijo v drugi triadi pri neobveznem izbirnem predmetu računalništva. Na žalost programska verzija za tablice in verzija mBlock 5 trenutno še nimata slovenskega prevoda. Učenci, bolj vešči programiranja, lahko programirajo tudi v jeziku C ali Python. Na spletu obstajajo številni video vodiči in elektronski učbeniki namenjeni učenju, ki so zaenkrat le v angleščini. Želeli smo, da učenci ne bi delali v večjih skupinah na enem robotu, saj se pri tem velikokrat zgodi, da so nekateri učenci v skupini manj aktivni od drugih. Zaradi cenovne dostopnosti, v primerjavi z nekaterimi drugimi bolj uveljavljenimi didaktičnimi roboti, je lahko šola z donatorskimi sredstvi lokalnega podjetja zagotovila 12 robotov, s čimer so lahko učenci delali sami ali v dvojicah. Ker so roboti na trgu relativno novi, pogrešamo večjo skupnost slovenskih uporabnikov, ki bi si izmenjevala primere dobrih praks. Prav tako bi lahko bilo organizirano tekmovanje, kjer bi se učenci različnih šol med sabo pomerili v poznavanju teh robotov.

2. POTEK DELA

Z učenci se ob začetku delavnic glede na razpoložljiv čas pogovorimo o pomenu robotike v vsakdanjiku in industriji. Pri izbirnem predmetu robotike v tehniki pa zasledujemo še številne druge učne cilje zapisane v letnem delovnem načrtu. Ker želimo pouk diferencirati glede na sposobnosti in starost učencev, imamo na šoli na voljo dve vrsti mobilnih robotov, enostavne Mbot in malo bolj kompleksne Ranger. V nadaljevanju sledi kratek opis večjega modela Ranger, ki ima v osnovi več senzorjev, boljše motorje in različne oblike zgradbe v primerjavi z manjšim robotom Mbot. Poučni robotski komplet si lahko učenci sestavijo v treh različnih oblikah: robotski tank, nervozna ptica in poletni predator (Slika 1). Prvi model z gosenicami premaguje malo večje ovire, drugi se s pomočjo žiroskopa giba le na dveh kolesih, tretji pa zaradi specifične konstrukcije dosega večje hitrosti.

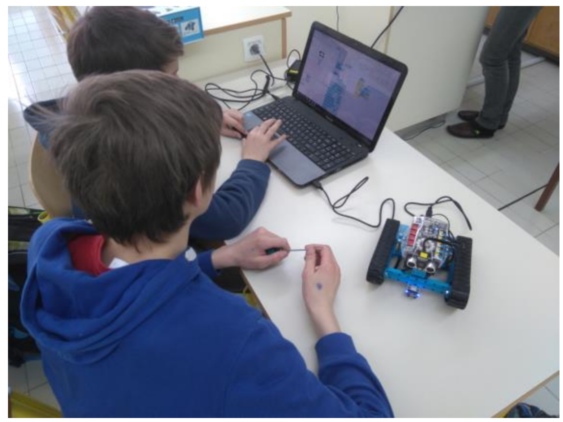
Slika 1: Različne oblike robota Ranger [2]

Da skupine deloma sestavljene robotske komplete ob naslednji šolski uri ne bi zamenjale, si je vsaka izmed njih morala izmisliti ime za robota in škatlo, kjer se hrani robot, in jo ustrezno označiti. Ker je programsko okolje podprto na različnih platformah, so učenci, ki so se prvič srečali z robotiko, sestavljali robote preko 3D animiranih načrtov na android tablicah. Na voljo imajo sicer tudi klasične načrte, a veliko raje posegajo po elektronskih, saj njihova simulacija sestavljanja omogoča pogled iz različnih zornih kotov, s čimer tudi učenci s slabšo prostorsko predstavo brez večjih težav sestavijo robota. Za sestavljanje celotnega robota učenci predmetne stopnje potrebujejo približno eno do dve šolski uri, na razredni stopnji pa še kako uro več. Robot deluje na Arduino vezju imenovanemu Me Auriga, ki vsebuje senzorje za svetlobo, zvok, temperaturo, žiroskop, ultrazvočni senzor za merjenje razdalje do objektov in IR senzorja, s katerima lahko sledimo črni črti (Slika 2). Dva servo motorja poganja šest AA baterij. Smiselna je uporaba polnilnih baterij, saj se lete dokaj hitro izpraznijo. Na ploščo z desetimi priključki je možno priključiti še številne druge senzorje in motorje. Kablov ni potrebno spajati, saj so namesto tega na plošči RJ 25 priključki, ki so ustrezno barvno označeni glede na vrsto priključka.



Slika 2: Sestava kontrolne plošče Me Auriga [2]

Temeljni pedagoški cilj na področju robotike je razvijanje mladostnikove notranje motivacije, razvoj samoiniciativnosti, timskega dela, razvoj programerskih kompetenc in logičnega razmišljanja, ter spoznavanje mehanskih komponent in konstrukcij. Igrifikacija lahko doprinese k omenjenemu cilju, pri tem pa govorimo realnih robotskih izzivih skozi igro. [5]



Slika 3: Programiranje robota v okolju Makeblock [3]

V kratkih dvournih delavnicah so učenci programirali robote na šolskih android tablicah, povezanih preko Bluetooth sprejemnika na robot. S tem so se lažje gibali po prostoru. Android aplikacija učence v svet programiranje popelje preko igre, ki jo rešujejo v svojem tempu na različnih nivojih. Učenci, ki so obiskovali krožek robotike ali pa izbirni predmet robotike, so zaradi večje funkcionalnosti namizne verzije programirali robota v Scratchu na računalniku (Slika 3). Povezovanje je tu bolj zanesljivo preko usb priključka, s čimer izgubimo prednost mobilnosti v razredu ali izven njega. Pri tem so se preizkusili v igrah robo-nogometa, dirke skozi poligon, pokanju balonov navezanih na drugi robot, sledenju črni črti z ali brez dodatnih ovir, programiranju božičnih pesmi in pobegu iz labirinta (Slika 4).

Naloge iz programiranja so bile ustrezno diferencirane, tako da so učenci v začetku ure spoznali koncept delovanja določenega senzorja ali motorja, nato so samostojno reševali programerske izzive, kjer so morali povezati naučene koncepte v ustrezen program. Ob koncu krožka in izbirnega predmeta je sledil ogled robotov v praksi v lokalnem podjetju Kolektor, kjer so učenci z ogledom proizvodne linije spoznali, kako pomembni so roboti pri izdelavi delov za avtomobilsko industrijo. Sledila je kratka delavnica, kjer so se naučili osnov upravljanja robotske roke.

Slika 4: Testiranje pravilnega delovanja robotov [3]

3. ZAKLJUČEK

Ob koncu aktivnosti je sledila kratka anketa, v kateri so učenci izpostavili kot velik plus delo s sodobno tehnologijo, programiranje, igro z roboti in večjo samostojnost pri delu, kjer učitelj pomaga le, če se kaj zatakne. Delavnice s strani učitelja zahtevajo kar nekaj časa za pripravo, vendar ob motiviranosti učencev ta čas ni zaman. Zavedati se je potrebno, da za marsikatero šolo nakup robotov predstavlja velik finančen zalogaj, hkrati pa obstaja pomanjkanje ustreznega izobraževanja za učitelje, s katerim bi lahko več šol ponudilo to vsebino učencem. V prihodnosti si želimo več raznolike robotske opreme, med drugim tudi kako robotsko roko na šoli. Prav tako si želimo več mreženja med učitelji v obliki študijskih skupin ali izobraževanj, ki poučujejo to področje na različnih osnovnih šolah.

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Spodbujanje razvoja digitalnih veščin s pomočjo micro:bita

Promoting the development of digital skills with the help of micro:bits

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POVZETEK

Ob koncu leta 2018 je Osnovna šola Idrija vstopila v projekt Micro:bit na šoli. Namen projekta je uvajati sodobne pristope k spodbujanju razvoja digitalnih veščin, kot so računalniško mišljenje, programiranje in kompetence za ustvarjalno ter odgovorno uporabo digitalne tehnologije – z uporabo mikrokrmilnikov micro:bit pri poučevanju različnih vsebin v 2. in 3. triadi. Gre za relativno nov učni pripomoček, ki zaradi svoje zasnove združuje virtualni svet programiranja in realni svet interakcije s človekom. Na enostaven način je omogočeno interdisciplinarno sodelovanje na področju STEM* (*Science, technology, engineering and mathematics oz. Znanost, tehnologija, inžiniring in matematika). Glede na izdelke učencev je bilo izvedenih več različnih medpredmetnih povezav med tehniko, računalništvom, angleščino in biologijo. Učenci so s pomočjo micro:bita in dodatnih priključkov izdelali zanimive izdelke, kot so interaktivne igre, pametni ventilator in namakalni sistem. Ker so se večinoma prvič srečali s programiranjem, so programe spisali v enostavnem vizualnem okolju Microsoft MakeCode. S tem so lahko v zelo kratkem času izdelali zabavne in uporabne programe. Interakcija programa z zunanjim svetom je v njih sprožila vedoželjnost in ustvarjalnost ob iskanju novih idej za bodoče projekte.

Ključne besede

Micro:bit, digitalne veščine, fizično računalništvo, STEM učenje, vizualno programiranje

ABSTRACT

At the end of 2018, Primary school Idrija entered the Micro: Bit at School project. The aim of the project is to introduce modern approaches to promote the development of digital skills, such as computer thinking, programming and competences for creative and responsible use of digital technology. Therefore the micro:bit microcontrollers were used to teach students aged from 10 to 14 various topics. Micro:bits are a relatively new teaching tool, that are designed to combine the virtual world of programming and the real world of human interactions. Interdisciplinary collaboration is made easy in the field of STEM* learning (Science, technology, engineering and mathematics). In the process of making projects, various cross-curricular links between engineering, computer science, English and biology were made. With the help of micro:bits and additional connectors, students made interesting products such as interactive games, a smart fan and an irrigation system. Most of them encountered programming for the first time, so they wrote programs in a simple visual environment of Microsoft MakeCode. Therefore, they were able to create fun and useful programs in a very short time. The interaction of the program with the outside world has sparked their curiosity and creativity in the search for new ideas for future projects.

Keywords

Micro:bit, digital competences, physical computing, STEM learning, visual programming

1. UVOD

Ker smo vsakodnevno obdani z digitalno tehnologijo, je potrebno razmisliti, kako boljše poučiti učence o temeljnih računalniških konceptih in programerskih veščinah ne glede na njihove bodoče poklicne in življenjske cilje. Z razumevanjem tega pomena je BBC v povezavi s svetovno znanimi računalniškimi podjetji kot so ARM, Microsoft in Samsung, leta 2015 izdelal didaktični mikrokrmilnik imenovan BBC Micro Bit (krajše micro:bit) in med angleške osnovnošolce naslednje leto razdelil kar milijon krmilnikov, s čimer želijo postaviti računalništvo v središče izobraževalnega sistema [2].

Na drugi strani je raziskava ICILS 2013 med slovenskimi osmošolci pokazala, da so informacijsko zelo slabo pismeni in je med njimi velika razlika v digitalnih kompetencah. V slovenskih osnovnošolskih učnih načrtih je razvoj digitalnih veščin vključen v učne načrte vseh predmetov. Ne obstaja pa poseben obvezni predmet, kjer bi učenci pridobivali digitalne kompetence ali bili seznanjeni s področjem računalništva. Za računalništvo obstajajo sicer izbirni predmeti, ki si jih izbere približno 19 % učencev. Za ostale učence ne vemo ali se sploh seznanijo s tem področjem, ki je tako korenito spremenilo svet [1]. Ker so bile podobno velike razlike v digitalni pismenosti zaznane tudi na Osnovni šoli Idrija, je bila sprejeta odločitev, da se premosti te razlike preko uporabe fizičnega računalništva. Raba fizičnega računalništva ima številne pozitivne oblike kot so kreativnost, kognitivni razvoj, zaznavanje in motivacija [3]. Vključevanje fizičnega računalništva v pouk omogočajo številne cenovno dostopne in zmogljive naprave (Micro:bit, Raspberry Pi, Arduino, Sphero krogla, droni…). Izbran je bil micro:bit, saj so njegove ključne prednosti v primerjavi z nekaterimi drugimi napravami da:

- predznanje elektrotehnike ni potrebno, ker predstavlja micro:bit z vgrajenimi senzorji zaključeno celoto.
- je cenovno bolj dostopen kot ostali kompleti. S sodelovanjem v projektu Micro:bit na šoli, je šola

dobila 15 naprav, 10 jih je kupila še sama. S tem je bilo omogočeno, da vsak učenec v razredu dela na svojem micro:bitu.

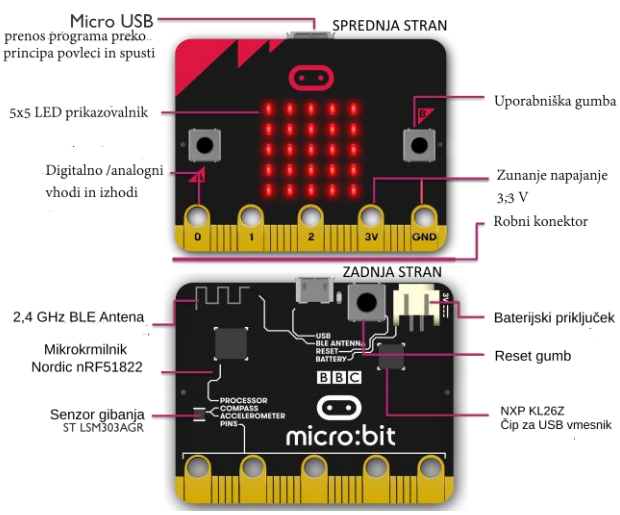
- omogoča izkušnjo »priključi in uporabi«, ker ga lahko programiramo v spletnem brskalniku brez predhodnih priprav in nameščanja namenske programske opreme.
- programsko okolje vsebuje simulator delovanja vseh vgrajenih senzorjev in ostalih komponent vezja, tako da je spisano kodo možno testirati tudi brez priključenega micro:bita.
- poleg blokovnega Makecode programskega okolja je za naprednejše delo programiranje možno tudi v klasičnem načinu preko JavaScripta, Pythona, C ali C++.

2. ZGRADBA BBC MICRO:BITA

2. 1. Strojna oprema

Majhno, a robustno vezje micro:bita (širine 5 cm in višine 4 cm) je zasnovano na ARM krmilniku. Glavne računske operacije izvaja 32-bitni mikrokrmilnik nRF51822 z ARM Cortex-M0 procesorskim jedrom hitrosti 16 Mhz. Dodatni mikrokrmilnik NXP/Freescale KL26Z skrbi za prenos programov preko USB kabla ali brezžično preko Bluetooth vmesnika na micro:bit. Hranijo in izvajajo se programi v 256 KB bliskovitem pomnilniku in 16 KB RAM pomnilniku.

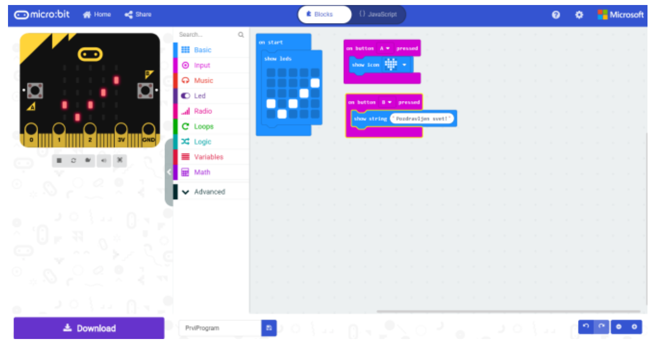
Na voljo imamo številne senzorje, kot so 3D senzor pospeška in magnetnega polja, senzor svetlobe ter temperature, ki preračunava le približno temperaturo okolice glede na temperaturo vgrajenega procesorja. Za sprejem podatkov je na voljo tudi Bluetooth low Energy povezava, tipki A in B, rezultate pa lahko prikažemo preko 5x5 LED prikazovalnika. Za zahtevnejše uporabnike je na voljo 23 pinski robni konektor. Preko treh vhodo-izhodnih kontaktov lahko s pomočjo 4 mm banana vtičev priklopimo zunanje naprave. Paziti moramo le, da ne presegajo napetosti 3 V, saj jih sicer micro:bit ne zmore upravljati. V primeru, da želimo nanj priklopiti motorje z napetostjo od 4 do 6 V (npr. iz kompleta Fischertehnik), je potrebna še dodatna plošča za poganjanje motorjev (angl. Motor Driver Board).



Slika 1: Zgradba micro:bita [4]

2. 2. Programsko okolje Microsoft Makecode

Ker večina osnovnošolcev ni vešča programiranja, je bila sprejeta odločitev uporabljati enostavno grafično okolje MakeCode. Učenci, ki so že programirali v Scratchu, so hitro ugotovili podobno logiko sestavljanja raznobarvnih blokov, preko katerih izdelamo program. Do programa lahko dostopamo brez predhodne prijave na strani https://makecode.microbit.org, najmanj težav je bilo v praksi z odpiranjem le tega v brskalniku Google Chrome. Na žalost prevod vmesnika v slovenščino še ni, kar lahko povzroča težave z razumevanjem pri mlajših učencih.

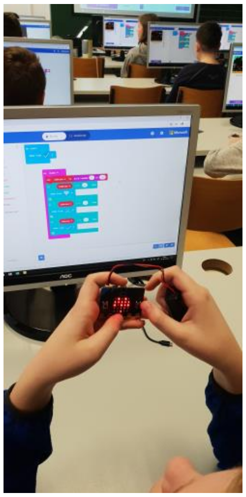


Slika 2: Programsko okolje Makecode

Prehod programa iz blokovnega načina v tekstovni JavaScript način je vedno mogoč, obratno pa le v primeru, če je JavaScript koda napisana tako, da jo je možno pretvoriti v ustrezen blokovni ukaz. V levem delu programa lahko preko simulatorja kadarkoli med programiranjem testiramo pravilnost delovanja programa. V desnem zgornjem kotu lahko dostopamo do pomoči ali dodatnih nastavitev. Levo zgoraj nas gumb Home popelje na uvodno stran, kjer se nam prikažejo nedavno izdelani projekti, gumb Share pa nam omogoča deljenje programa z drugimi. Ko smo s programom zadovoljni, levo spodaj pritisnemo gumb Download. Preden prenesemo program, si je dobro nastaviti brskalnik tako, da nas vsakič posebej vpraša, kam želimo shraniti. V nasprotnem primeru marsikateri učenec ne bo vedel, kam je bila datoteka prenesena. Prav tako je priporočljivo, da si programa ne prenašamo neposredno s spleta na micro:bit, ampak najprej hex datoteko programa shranimo kot varnostno kopijo v izbrano mapo na računalniku in jo šele nato prenesemo na micro:bit. S tem bo kasneje z računalnika možno naložiti obstoječ program nazaj v Makecode okolje, saj neposreden prenos iz micro:bita v programsko okolje Makecode ni mogoč.

3. PRIMERI UPORABE PRI POUKU

Tehnični dan organiziran 14. 2. 2019 za celotne 8. razrede je bil namenjen razvoju tehniške kulture med mladimi in spodbujanju digitalnih veščin. V njem so se učenci razdelili v dve skupini, kjer je prva skupina sestavljala poučne mehanske komplete Fischertehnik, druga pa spoznavala čar programiranja preko fizičnega računalništva s pomočjo micro:bita. Nato sta se vlogi skupin po treh šolskih urah zamenjali. V skupini z micro:biti sta medpredmetno sodelovala učitelj angleščine, ki je skrbel za razumevanje angleškega jezika v programskem okolju, in učitelj računalništva, ki je razlagal osnovne koncepte programiranja in delovanja micro:bita. Ker je bil ta dan hkrati tudi valentinovo, so morali učenci po predstavitvi delovanja osnov micro:bita sprogramirati igro senzor zaljubljenosti (angl. love meter), kjer jim je micro:bit ob tresenju generiral naključno število med 0 in 100 ter s tem zaupal, kako dobro se ujemajo z izgovorjeno osebo. Osnovna naloga je ob tresenju zajemala le prikaz številke, hitrejši učenci so morali na podlagi določenega razpona odstotkov prikazati ustreznega smejkota in pri tem zaigrati izbrano melodijo iz programske knjižnice.



Slika 3: Tudi učenke je izdelava igre senzor zaljubljenosti močno pritegnila [5].

Nato so v svojem tempu samostojno ali v parih izdelovali igre, kjer so sprogramirali simulacijo utripajočega srca, meta kocke, igre kamen-škarje-papir in čarobne krogle, ki je na vprašanje odgovorila z vsekakor, mogoče, verjetno ali nikoli. Skozi igro z micro:biti so spoznali osnovne koncepte programiranja kot so spremenljivke, naključnega števila, vejitve, zanke, hkrati pa osvojili novo angleško izrazoslovje. Vsa navodila nalog in njihove rešitve so na voljo na naslovu: https://tinyurl.com/microbit2019 .

Ker je velik del učencev izrazil zadovoljstvo nad fizičnim računalništvom, so učenci izbirnega predmeta robotike v tehniki dobili priložnost, da nadgradijo svoje znanje poznavanja micro:bita s samostojnimi projekti. Med njihovimi projekti velja omeniti tri zanimive primere.

3. 1. Zalivalni sistem

Skupina učenk iz 8. razreda se je odločila izdelati avtomatski zalivalni sistem za rastline v razredu. Najprej so pri učiteljici biologije spoznale, kaj vse vpliva na to, koliko vode potrebujejo določene rastline in je z njo potrebno ravnati ekološko. Nato so na podlagi sledečih nasvetov pod mentorstvom učitelja računalništva izdelale namakalni sistem, kjer so micro:bit povezale na eni strani s senzorjem vlage, ki je bil vstavljen v zemljo rastline, na drugi strani pa s servomotorjem naveznim na slamico, ki je zajemala vodo iz kozarca. Ko je micro:bit zaznal, da je vlažnost zemlje padla pod določeno vrednostjo, je sprožil premikanje servomotorja in s tem omogočil samodejno zalivanje rože s slamico. Za lažjo predstavo si lahko ogledate kratek video: https://youtu.be/dJ-4fUPfUik

3. 2. Pametni ventilator

Skupina fantov iz 9. razreda je želela povezati micro:bit s kompletom Fischertehnik in izdelati pametni ventilator. Pri učiteljici tehnike so najprej izdelali ventilator z ročnim stikalom, nato pod mentorstvom učitelja računalništva ročno stikalo zamenjali s krmilnikom micro:bit, ki je na podlagi izmerjene temperature v prostoru samodejno sprožil ali ugasnil motor, ki je poganjal ventilator. [1]

Slika 4: Pametni ventilator

3. 3. Scratch 3 in micro:bit

Skupina fantov iz 8. razreda se je navdušila nad idejo upravljanja igre narejene v programskem okolju Scratchu 3 s pomočjo micro:bita. Če želimo v Scratch 3 programskem okolju preko bluetooth povezave zaznati micro:bit, je potrebno na računalnik namestiti program Scratch link in priklopiti usb bluetooth adapter, na micro:bitu pa naložiti ustrezno hex datoteko, ki je na voljo na strani z navodili: https://scratch.mit.edu/microbit. Uporaba tega je smiselna tudi pri neobveznem izbirnem predmetu računalništva v 2. triadi, vendar se je za mlajše učence postopek vzpostavitve povezave izkazal kot dokaj zapleten in je zato priporočljivo, da vse namestitve opravi učitelj še pred začetkom pouka.

4. ZAKLJUČEK

Sodelovanje v projektu Micro:bit na šoli je Osnovni šoli Idrija omogočilo izmenjavo izkušenj z ostalimi 14 šolami vključenimi v projekt. Ob koncu delavnice z micro:biti so učenci podali pozitivno povratno informacijo učiteljem, saj se jim zdi tak način učenja zanimiv in spodbuden za razvoj digitalnih veščin. V prihodnje želimo uporabo micro:bita razširiti še na druga predmetna področja, ki so bila predstavljena s strani drugih šol v projektu. Prav tako si želimo novejših sestavljank Fischertehnik, kjer bi lahko poleg pametnega ventilatorja izdelali še več drugih modelov, ki bi jih lahko krmilili z micro:biti.

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Animirani film v 1. razredu

Animated movie in 1st class

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POVZETEK

Namen prispevka je prikazati primer medpredmetnega povezovanja z uporabo IKT tehnologije, hkrati pa učencem 1. razreda pripraviti zanimivejši in bolj ustvarjalen pouk.
Otroci se z animiranimi filmi srečujejo že zelo zgodaj in vsepovsod, tako v domačem kot v šolskem okolju. Zaradi celostne čutne, čustvene in miselne podobe ter predvsem zaradi privlačnosti animiranega filma za otroke je lahko domiseln in učinkovit učni pripomoček. Je tudi močno motivacijsko sredstvo, s katerim dosežemo veliko učnih ciljev iz učnega načrta za različne predmete. Animirani film mi je bil v veliko pomoč v pedagoškem procesu. Povezala sem ga z različnimi predmeti npr. slovenščino, likovno umetnostjo, matematiko. Pri samem procesu ustvarjanju lastnega animiranega filma so bili učenci zelo inovativni in ustvarjalni.

Ključne besede

Animirani film, medpredmetno povezovanje, IKT, učni načrt, ustvarjalnost

ABSTRACT

The aim of this article is to show an example of cross-curricular learning aided with ICT, and at the same time to prepare more interesting and creative lessons for 1st-grade learners. Children encounter animated movies very early in their lives and in many different environments – at school and at home, among others. Because of the sensual, emotional, and conceptive images integrated in animated movies and because of how attractive they are for children, animated movies can be an inventive and effective teaching aid. They are also a powerful means of motivation, with which various learning objectives from different curricula can be met. My chosen animated movie aided me greatly in the pedagogical process. I connected it with various subjects, for instance with Slovene, Art, and Maths. The learners were extremely innovative and creative in the process of creating their own animated movie

Key words

Animated movie, cross-curricular learning, ICT, curriculum, creativity

1. UVOD

Življenje v današnji hitro spreminjajoči se družbi od učencev zahteva hitro odzivanje. Sodobni učni načrti učitelje odvračajo od tradicionalne strukturiranosti pouka in razdrobljenosti vsebin na predmetna področja. Spodbujajo k medpredmetnemu povezovanju vsebin in ciljev pri pouku. Razlog za to je medpredmetno povezovanje razdrobljenih delov učne vsebine v razumljivejšo, uporabnejšo in bolj življenjsko celoto. Bolj kot znanje posameznih predmetov postaja pomembno, da bi učenci znali povezovati vsebine različnih predmetov in tako pridobiti neka celostna ter uporabna znanja.

2. MEDPREDMETNO POVEZOVANJE

Eno od didaktičnih priporočil devetletke za boljše znanje učencev, zanimivejši in bolj ustvarjalen pouk je tudi t. i. medpredmetno povezovanje. Medpredmetne povezave so mogoče zaradi različnih namenov in izpeljane različno, npr. kot motivacija, nadgradnja znanja, projektni dan ipd.
V učnih načrtih za vse predmete najdemo priporočila za medpredmetno povezovanje.

»Cilj povezovanja predmetov je globalni pristop, ki spodbuja tako imenovano celostno učenje in poučevanje.« (Učni načrt, slovenščina, 2011, str. 109)

»V prvem vzgojno-izobraževalnem obdobju se tako slovenščina z vsebinami in razvijanjem sporazumevalnih dejavnosti učencev tesno povezuje z drugimi predmeti, na primer s spoznavanjem okolja, matematiko, glasbeno in likovno vzgojo. Nekateri cilji pouka slovenščine so povezani z uporabo knjižnice in vključujejo spodbujanje informacijske pismenosti.« (Učni načrt, slovenščina, 2011, str. 108)

3. IKT IN UČNI NAČRT ZA PRVO VZGOJNO-IZOBRAŽEVALNO OBDOBJE

Tako kot imajo učni načrti za vse predmete didaktična priporočila za medpredmetno povezovanje, imajo didaktična priporočila tudi za uporabo informacijske tehnologije. Učni načrt spodbuja zavestno in kritično rabo informacijskih tehnologij pri opravljanju šolskih obveznosti.
Raba informacijskih tehnologij lahko pomembno pripomore h kakovostnejšemu pouku, a mora biti tesno povezana z novimi načini in oblikami dela, predvsem pa s cilji in vsebinami učnega načrta.

Slovenščina
»Na ravni vključevanja medpredmetnih vsebin je v učnem načrtu za slovenščino posebna pozornost namenjena razvijanju digitalne pismenosti učencev. Ti uporabljajo digitalne tehnologije pri razvijanju sporazumevalne zmožnosti in komunikacije (dejavnem stiku) z literaturo, in sicer:

- pri sprejemanju, razčlenjevanju in tvorjenju neumetnostnih in umetnostnih besedil,
- kot podporo kritičnemu mišljenju, ustvarjalnosti in inovativnosti,

- za iskanje, zbiranje, izmenjavo in obdelavo podatkov ter njihovo sistematično rabo pri tvorjenju informacij. Za izdelavo, predstavitev in razumevanje kompleksnih informacij uporabljajo tudi primerno strojno in programsko opremo, samostojno uporabljajo primerne didaktične računalniške programe in internet kot vir podatkov in komunikacijsko orodje«

(Učni načrt, slovenščina, 2011, str. 109)

Likovna umetnost

»Učitelj naj uvaja sodobno tehnologijo v pouk likovne vzgoje premišljeno in postopno. Tehnologija naj ne zmanjšuje vloge učitelja in učencev pri likovnem izražanju. Sodobna tehnologija omogoča večjo nazornost ter možnost prenosa, posredovanja in shranjevanja likovnih vsebin. V učenje in poučevanje likovne vzgoje jo vključujemo kot učno sredstvo, ki daje raznovrstne likovne informacije. » (Učni načrt, likovna umetnost, 2011, str. 29)

Matematika

»Pouk matematike naj učence usposobi za uporabo tehnologije predvsem pri srečevanju z matematičnimi problemi, ob tem pa se posredno usposabljajo tudi za uporabo tehnologije v vsakdanjem življenju.« (Učni načrt, matematika, 2011, str. 80)

»Informacijsko-komunikacijska tehnologija (IKT) je lahko sredstvo za razvoj matematičnih pojmov, sredstvo za ustvarjanje, simuliranje in modeliranje realnih ali učnih situacij, lahko je učni pripomoček ali komunikacijsko sredstvo. Učni načrt pri nekaterih vsebinah predvideva uporabo tehnologije, pri drugih pa je odločitev prepuščena učitelju.« (Učni načrt, matematika, 2011, str. 80)

4. ANIMIRANI FILM, FILMSKA PREDSTVA

Pri animiranem filmu, filmski predstavi gre za disciplini, ki sta sodobni v tem smislu, da sta interdisciplinarni, povezujeta različna področja in omogočata celostno razumevanje in dojemanje sveta. Animacija je tisto področje, ki pokriva in povezuje vsa likovna področja, opredeljena v učnem načrtu za likovno vzgojo v osnovni šoli: risbo, slikarstvo, grafiko, kiparstvo, prostorsko oblikovanje. Širok je tudi razpon medpredmetnega povezovanja, in sicer z glasbo, matematiko, slovenščino...
Namen filmske vzgoje je predvsem otroke in mlade naučiti gledati filme celostno in kakovostno ter jim izostriti kritični pogled. Za ustrezno razumevanje filma (ali drugih avdio-vizualnih izdelkov), jim je potrebno pomagati tudi z dodatnimi vsebinami (pogovori, predavanja, delavnice itd.), ki jim bodo omogočile artikulacijo lastnega mnenja.

S filmom učenci pridobijo marsikatero znanje na bolj dinamičen, zanimiv in s tem bolj obstojen način, učenci pa se ob tem zabavajo in sprostijo. Filmska vzgoja je pomembna za izobrazbo mladih v teh časih, ko prevladujejo vizualne informacije.

5. USTVARJANJE ANIMIRANEGA FILMA V 1. RAZREDU

V sklopu slovenščine naj bi učenci 1. razreda spoznavali tudi risanko in film. Tu se mi je zdela idealna prilika za medpredmetno povezovanje in uporabljanje IKT. Animirani film je pomembno didaktično sredstvo pri pouku.

Najprej sem razmislila, katere predmete bi povezala med seboj. Glede na obravnavane vsebine v času ustvarjanja animiranega filma sem se odločila, da medpredmetno povežem slovenščino, likovno umetnost in matematiko ter sledila operativnim ciljem iz učnega načrta.

5.1 OPERATIVNI CILJI

Slovenščina

***P**ogovarjanje*

Učenci vrednotijo razumljivost in zanimivost pogovora ter utemeljujejo svoje mnenje. Povzemajo temeljna načela vljudnega pogovarjanja (z učiteljevo pomočjo). Vrednotijo svojo zmožnost pogovarjanja in načrtujejo, kako bi jo lahko izboljšali.

Govorjenje

Učenci govorno nastopajo (z vnaprej napovedano temo in besedilno vrsto – glej razdelek Vsebine), in sicer najprej ob učiteljevih vprašanjih in slikovnem gradivu/drugih ponazorilih, nato pa čim bolj samostojno in ob zgledovanju po podobnem že poslušanem besedilu. Vrednotijo zanimivost, živost in razumljivosti besedila, predlagajo popravke/izboljšave in utemeljujejo svoje mnenje ter vrednotijo rabo nebesednih spremljevalcev govorjenja ter utemeljujejo svoje mnenje.. Povzemajo temeljna načela uspešnega govornega nastopanja (z učiteljevo pomočjo). Učenci izražajo svoja občutja med govornim nastopom. Vrednotijo svojo zmožnost govornega nastopanja in načrtujejo, kako bi jo lahko izboljšali. Obnovijo animirani film.

Risanka

Učenci primerjajo svoje razumevanje zgodbe v risanki z razumevanjem sošolcev. Ugotavljajo razlike med risanko, posneto po literarni predlogi, in izvirnim besedilom; spoznavajo temeljne značilnosti medijev.

Filmska predstava

Učenci izražajo doživljanje, razumevanje in vrednotenje otroškega filma. Če je film posnet po literarni predlogi, govorijo o podobnostih in razlikah med besedilom in filmom. Spoznavajo razlike med risanko in filmom; spoznavajo posebnosti medijev.

Proza

Učenci razvijajo zmožnost vživljanja v osebo, »poistovetenja« z njo/privzemanja vloge književne osebe: upovedujejo domišljijske svetove, tako da postavijo sami sebe za osrednjo književno osebo oziroma o književni osebi govorijo in pišejo kot o sebi. Čutnodomišljijsko predstavo književne osebe iz lastnega besedila izrazijo s kombinacijo risbe in zapisa. Kot avtorji besedila pojasnjujejo razloge za ravnanje svojih književnih oseb.

Likovna umetnost

Učenci posnamejo digitalno fotografijo in na njej opazujejo različne barvne in svetlostne vrednosti. Pri slikanju uporabijo preprosta računalniška orodja.

Matematika

Učenci štejejo, zapišejo in berejo števila do 20, vključno s številom 0 ter ocenijo število predmetov v množici.

(povzeto po Učnem načrtu, 2011)

5.2 OD MATEMATIKE, LIKOVNE UMETNOSTI, SLOVENŠČINE DO ANIMIRANEGA FILMA

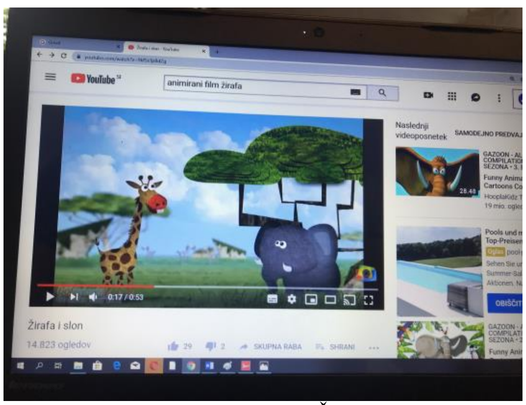
Z obravnavo naravnih števil do 20 smo začeli v 1. razredu novembra. Najprej smo obravnavali število 1. Učencem sem najprej prebrala pesem o številu 1. Na projekcijo sem jim dala sliko, kjer so bila prikazana različna števila. Z učenci smo se pogovorili, kateri zapisi prikazujejo število 1. Večina učencev je že poznalo število 1. Učenci so najprej utrjevali količinske predstave tako, da so po učilnici šteli predmete. Sledil je pogovor o zapisu števila. Vprašala sem jih, na kaj jih spomni število 1. Naštevali so različne možnosti, eden od mnogih odgovorov je bil, da jih spomni na žirafo. Sledilo je »oživljanje« števila 1. Učenci so z risanjem število 1 po domišljiji spremenili v žirafo.

Učence sem nato izzvala, naj povedo »zgodbico-pravljico«, kako se je žirafa spremenila v število 1. Učenci so imeli veliko idej, najbolj izvirna pa jim je bila naslednja:

Nekoč je živela nerodna žirafa Ema, ki je izgubila svoje pike. Iskala jih je in iskala, in ko jih je končno našla, so ji hotele spet pobegniti. Šla jih je lovit. Pike so bile zelo hitre, zato je morala žirafa hitro teči za njimi. Pri teku se je zelo spotila in utrudila. Ko jih je končno ulovila, je bila tako utrujena, da se ji je prav v glavi zavrtelo. In ko si je v glavi zavrtelo, se je spremenila v število 1. Od takrat žirafa E**m**a ni več žirafa, ampak število 1 (E**n**a).

Slika 1. »Oživljanje« števila 1. Foto: V. Gulin, 2017.

V sklopu slovenščine smo nato izsliševali glasove E**m**a, E**n**a, žirafa, število… Sledil je pogovor o filmu Moja žirafa, ki smo si ga ogledali pred časom v kinodvorani. Z vprašanji sem jih spodbudila, da so razmišljali, kako mislijo, da nastanejo taki filmi. Nato smo si ogledali še kratek animirani film na YouTubu z naslovom Žirafa i slon v srbohrvaškem jeziku. Ker so učenci imeli sošolca z znanjem srbohrvaškega jezika, jim je le-ta prevedel risanko v slovenščino.



Slika 2. Animirani film Žirafa i slon.
Vir: https://www.youtube.com/watch?v=9kfSxTpBdZg

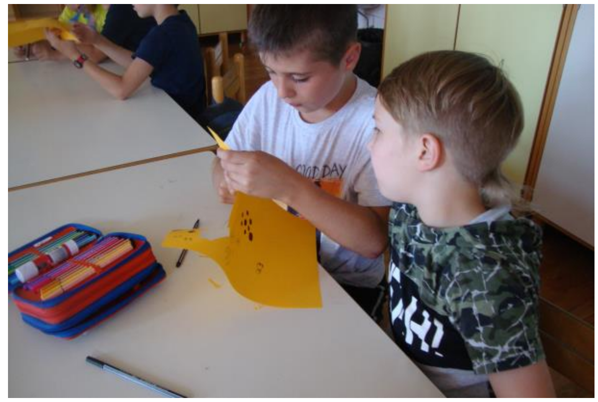
Pogovorili smo se o nastajanju animiranih filmov. Predlagala sem jim, da tudi sami naredimo kratek animirani film o žirafi Emi, ki se je spremenila v število 1. Ker so to zelo majhni otroci, sem seveda že prej planirala način za izvedbo, ki mora biti čim bolj preprost, materiale in pripomočke, izdelavo, pripravo prostora, snemanje, katero tehniko bomo uporabili.

Materiali in pripomočki:
Barvice in flomastri, rumen pisarniški papir, kolaž, darilni papir, škarje, risalni list, plastelin.

Priprava prostora
Vzgojiteljica je pomagala učencem izprazniti mize ter razporedila materiale in potrebščine za izdelavo elementov za animirani film. Jaz sem sestavila preprosto mizo za animacijo in jo osvetlila. Sestavila sem vso tehnično opremo in jo pritrdila.

Tehnika
Digitalni fotoaparat, stojalo (stativ) za fotoaparat, luč za osvetlitev scenografije, osebni računalnik s programom Kool Capture in program za upravljanje HD spletnih kamer.

Izdelava
Najprej smo z učenci ponovili zgodbo za animirani film. in opisali žirafo Emo. Učence sem razdelila v pare, da so narisali like, izdelali ozadje in druge elemente.



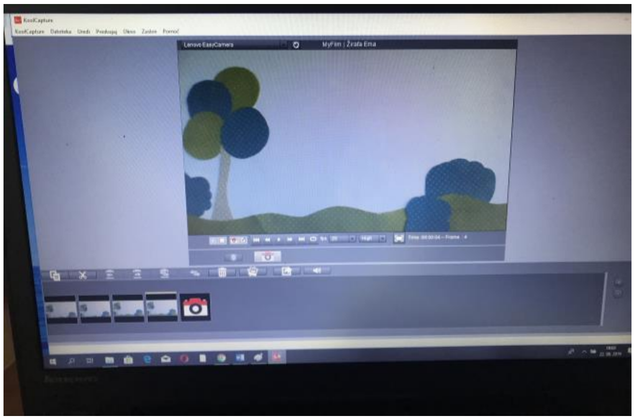
Slika 3. Izrezovanje elementov za animirani film.
Foto: V. Gulin, 2017.

Slika 4. Uporabljeni elementi pri nastajanju animiranega filma Žirafa Ema. Foto: V. Gulin, 2017.

Snemanje
Učence sem razdelila v manjše skupine, da so animirali. Snemali smo približno 20 sličic na sekundo. Postavitve prizorov in premike likov smo določili na podlagi zgodbe.

Slika 5. Animacija in snemanje. Foto: V. Gulin, 2017.

Montaža
Slike sem iz fotoaparata prenesla na osebni računalnik v brezplačni program za zajemanje in manipulacijo slike Kool Capture.
Žal nam čas ni dopuščal, da bi animiranemu filmu dodali še zvok, tako bi film še nadgradili.
Ogled animiranega filma
Z učenci smo si čez nekaj dni njihov animirani film Žirafa Ema pri pouku tudi ogledali. Učenci so bili navdušeni in ponosni na svoj izdelek.



Slika 6. Montaža animiranega filma v programu Kool Capture. Foto: v. Gulin, 2017.

Slika 7. Ogled našega animiranega filma. Foto: V. Gulin, 2017.

6. ZAKLJUČEK

Učenci so spoznali pot od ideje do izdelka (izbiranje ideje za zanimivo zgodbo, izdelovanje scene in animiranih likov, priprava in uporaba IKT naprav, pripomočkov ter programske opreme, snemanje in montažo animacije).
Z ustvarjanjem animiranega filma v razredu so učenci dosegali učne cilje različnih predmetov iz letnega delovnega načrta drugače, bolj prijazno in zanje bolj zanimivo. Razvijali so kritičen odnos in pokazali, kako brezmejna sta njihova domišljija in ustvarjalnost.

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Začetno opismenjevanje v nemščini s pomočjo IKT

The first reading and writing steps in German with the help of ICT

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POVZETEK

Prispevek predstavi začetni metodi opismenjevanja učencev pri pouku neobveznega izbirnega predmeta v drugem triletju. Pri tem se poslužujem računalnika in interaktivne table, zato sem v prispevku želela predstaviti, kako pri pouku nemščine učenci usvajajo osnovne IKT kompetence. Predstavljeno je usvajanje zapisa črk na računalniku in reševanja nalog na interaktivni tabli s pomočjo pisala in zaslonske tipkovnice.

Ključne besede

IKT, interaktivna tabla, bralna značka, opismenjevanje, didaktika

ABSTRACT

This article introduces the first methods for teaching reading and writing in German language for students aged 9-11. It is done with the help of computer and interactive board, so the article wants to present how the basics of ICT are incorporated into the lessons of German. It is described how the writing of new foreign letters is introduced on the computer and how some tasks are done on the interactive board with the help of the screen keyboard and the interactive pen.

Keywords

ICT, interactive board, reading badge, didactics, reading and writing

1. UVOD

Pouk neobveznega izbirnega predmeta nemščina se začne v 4. razredu (učenci z učenjem lahko začnejo kasneje), ko se IKT kompetence šele začnejo usvajati. Kljub temu da so učenci dokaj vešči uporabe mobilnih naprav, je mišljenje, da obvladajo tudi rokovanje z računalnikom pogosto napačno. Prve ure v računalniški učilnici so vedno najprej namenjene IKT osnovam: kje prižgati/ ugasniti računalnik, kako odpreti spletni brskalnik oz. določen program (npr. Word), kako shraniti zapisano besedilo itd. Šele po teh uvodnih korakih postane IKT resnična podpora usvajanju ciljev tujega jezika, kot je zapisano v učnem načrtu [1]. Takrat se lahko začne z zapisovanjem besed in tako tudi z uporabo spletnih slovarjev ali drugih spletnih orodij (npr. programsko orodje za izdelovanje križank, osmerosmerk, reševanje spletnih nalog).

2. ZAPIS TUJEJEZIČNIH ČRK

Del uvodnega spoznavanja jezika je tudi spoznavanje črk, ki jih slovenska abeceda nima. Učenci črke nemške abecede najprej slušno in slikovno spoznajo, nato preko zapisovanja črk v zvezke. Za slikovno, slušno in govorno podporo uporabljam YouTube kanal Lern mit mir [2]. Učencem večkrat predvajam posnetek na interaktivni tabli in ob tem jim vsakokrat dam ob poslušanju dodatno nalogo (ploskanje, vstajanje, različni ritmi …). Začetno poslušanje je namenjeno spoznavanju novih glasov in besed. Ob tem učence nagovorim, da ponavljajo ob poslušanju in opazovanju. Ker je posnetek podprt slikovno, prevajanje ni potrebno in učenci se lahko posvetijo izgovorjavi, torej petju oz. ponavljanju besed in novih glasov. Po potrebi posnetek ustavim, in določene besede predvajam večkrat. Sledi zapis novih črk s preglasi. Učencem le-te ne delajo preglavic, nekoliko bolj zahteven je zapis ostrega s-ja. Po urjenju ročnega zapisovanja učenci spoznajo tudi zapisovanje črk na računalnik.

Vsak učenec pride do računalnika, ki je v učilnici, in s pomočjo bližnjic na tipkovnici natipka male in velike tiskane tujejezične črke: ß, ö, Ö, ä, Ä, ü, Ü. Ostali učenci njegovemu zapisovanju lahko sledijo na interaktivni tabli ter tako utrjujejo nove tujejezične črke. Pouk se v naslednjih urah nadaljuje v računalniški učilnici, kjer vsak učenec dostopa do svojega računalnika in tako uri zapisovanje samostojno. Učenec dobi predlogo (delovni list) z navodili, na katerem so zapisane bližnjice na tipkovnici za zapis črk s preglasi in ostrega s-ja. S prvimi vajami urijo samo zapis posameznih črk (ä), sledi zapisovanje besed, ki vsebujejo te iste črke (npr. Bär, Ägypten, heißen) in na koncu zapis cele povedi (Der Bär heißt Yoyo.). Nadgradnja samega zapisovanja sta sledeča izziva: tekma s časom (kdo pravilno prepiše največ besed v eni minuti/ dveh minutah …; odštevanje časa je projicirano na platno) in tekma brez časovne omejitve (kdo prvi celotno dano besedilo pretipka pravilno).

Kot naloga se zdi pretipkavanje črk, besed in povedi dokaj dolgočasno, a odziv učencev, ki so želeli predloge odnesti domov za vajo, je bil pozitiven in njihova motivacija se je povečala, saj bi bilo pisanje v zvezke veliko bolj nezanimivo. Cilj je bil dosežen – učenci so se učili novih tujejezičnih črk in posledično pravilnega zapisa posameznih besed.

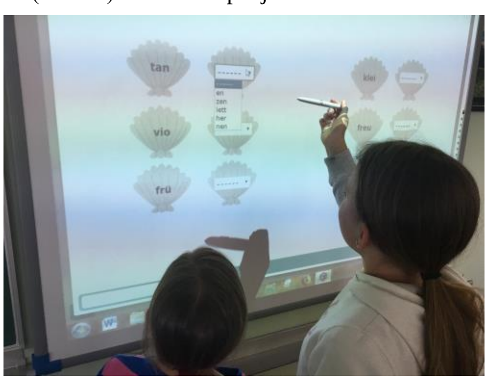
3. BRALNA ZNAČKA

V okviru pouka je vsako leto izvedena nemška bralna značka (Bücherwurm). V šolskem letu učenci preberejo določeno knjižico (določi jo založba), v marcu pa poteka tekmovanje iz znanja, ki so ga usvojili med prebiranjem. Ker tekmovanje poteka preko spleta, je zelo koristno znanje uporabe IKT.

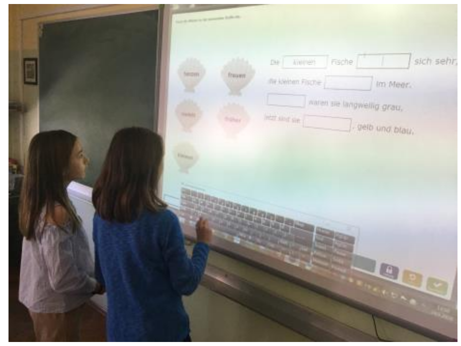
Učenci dobijo svoj izvod, ki ga skupaj z učiteljem najprej prebirajo med poukom, nato ga lahko odnesejo domov in se branja lotevajo sami ali s pomočjo staršev. Ker je knjižica podprta s CD ROM-om, je prvo spoznavanje z zgodbo zelo zanimivo.

Preden dobi vsak svoj izvod, si učenci ogledajo zgodbo v učilnici na interaktivni tabli. Ilustracije so iste kot v knjižici, le animirane in tako bolj privlačne za ogled. S pomočjo gibljivih slik dobijo lažji vpogled v vsebino. Ob drugem ogledu se seznanjajo z besedami in jih poskušajo povezovati z dogajanjem, ki je slikovno prikazano. Zelo hitro ugotovijo bistvo, ker pa je cilj tudi učenje novih besed, se skupaj posvetimo temu. Ker računalniška učilnica v času pouka ni prosta, se v nemški učilnici poslužujem uporabe klasičnih slovarjev, s katerimi si pomagajo pri prevodih. Tudi uporaba le-teh ni več tako samoumevna, zato učenci potrebujejo nekaj namigov za uporabo (kako iščemo besede, kaj pomenijo oznake ob besedi …). Ob tem jim na interaktivni tabli pokažem uporabo spletnih slovarjev, saj večina na začetku pozna samo prevajanje s spletnim brskalnikom Google. Pri tem se pokaže, da predhodne ure namenjene zapisovanju niso bile zaman, saj učenci samostojno zapisujejo besede, ki vsebujejo tujejezične črke. Sledi torej nekaj ur samostojnega dela, ko učenci iščejo neznane besede, jih prevajajo, zapisujejo, izdelujejo osmerosmerke itd., vse po navodilih, ki jim jih pripravim v naprej. Navodila vsebujejo izpolnjevanje različnih nalog – najprej s pomočjo knjižice poiščejo manjkajoče besede v besedilu, ki so ga prejeli. Nato sledi prevod besed in razumevanje odlomka, ki je pred njimi. V kolikor besed ne najdejo v slovarjih, jih poiščemo skupaj s pomočjo spletnih slovarjev. Kasneje se s temi besedami poigravajo še na različne načine, najbolj priljubljena med učenci je sestava osmerosmerke. Le-te se lahko lotijo učenci v računalniški učilnici, kjer se soočijo z dejstvom, da so črke s preglasi težavne pri križankah in osmerosmerkah. Na tem mestu izvejo, da se v računalniškem jeziku velikokrat namesto preglasa črki doda »e« - torej »a« s preglasom (ä) postane »ae«.

Na CD ROM-u v knjižici so dodane vaje za utrjevanje besedišča, ki jih učenci lahko rešijo večkrat, kar je velika prednost interaktivnih iger. Veliko krat se zgodi, da želi priti vsak učenec k interaktivni tabli in reševati posamične naloge. Te naloge so različnega tipa: pri nekaterih nalogah učenci s pomočjo elektronskega pisala izberejo pravilno rešitev iz spustnega seznama (Slika 1), rešitev označijo in/ali jo z drsenjem povlečejo na pravilno mesto v povedi, učenci s pomočjo zaslonske tipkovnice (Slika 2) rešitev natipkajo.



Slika 1. Reševanje interaktivnih vaj – uporaba interaktivnega pisala.



Slika 2. Reševanje interaktivnih vaj – uporaba zaslonske tipkovnice.

4. ZAKLJUČEK

Uporaba IKT pri neobveznem izbirnem predmetu nemščina v drugem triletju je dodatno povečala motivacijo do učenja tujega jezika, hkrati so učenci poleg prvih stikov z nemškim jezikom usvojili nekaj osnovnih IKT kompetenc. Le-te z večkratno uporabo postanejo del človeka in jih učenci posledično lahko uporabijo tudi izven šolskega okolja, predvsem pa postanejo pripomoček pri nadaljnjem učenju. Zdi se mi, da je pomembno, da se učenci učijo večplastno – ne samo jezika, temveč tudi IKT kompetenc, ki pa jih mora najprej obvladati učitelj, da jih lahko uspešno prenaša na svoje učence.

5. VIRI

[1] Pevec Semec, Katica. 2013. Učni načrt. Drugi tuji jezik v 4. do 9. razredu. Neobvezni izbirni predmet. Ljubljana: Zavod RS za šolstvo.

http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/devetletka/program_razsirjeni/Drugi_TJ_izbirni_neobvezni.pdf

[2] YouTube kanal Lern mit mir: https://www.youtube.com/watch?v=dethvmpavTo (dostopno: avgust 2019)

[3] http://www.abcya.com/make_a_word_search.htm (dostopno: avgust 2019)

Uporaba spletnega vprašalnika 1KA malo drugače

Using the 1KA questioner in a different way

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POVZETEK

V prispevku je predstavljena uporaba spletnega vprašalnika, kot obrazca za sporočanje odsotnosti z dela za učitelje. Obrazec je narejen z aplikacijo 1KA in omogoča avtomatizirano, hkratno obveščanje vseh vpletenih v organizacijo dela na šoli o odsotnosti učitelja.

Ključne besede

1KA, spletni obrazec, sporočanje odsotnosti z dela

ABSTRACT

This paper presents usage of web survey as a form for reporting absences from work for teachers. The form is made using the 1KA application and provides an automatic, simultaneous notification of all those involved in the organization of work at the school.

Keywords

1KA, online form, reporting absence from work

1. UVOD

1KA je spletna aplikacija, ki omogoča storitev spletnega anketiranja. Omogoča izdelavo različnih tipov vprašalnikov za spletno anketiranje [1]. 1KA omogoča tudi upravljanje zbranih podatkov in izdelavo različnih analiz in grafičnih prikazov.

Takšna uporaba aplikacije je znana in splošno razširjena tudi v izobraževalnih ustanovah. Lahko pa orodje za zbiranje podatkov uporabimo tudi v drugačne namene, na primer za izdelavo obrazca za odjavo prehrane ali sporočanje odsotnosti zaposlenih, pa tudi za oddajo različnih poročil.

2. SPOROČANJE ODSOTNOSTI ZAPOSLENIH S POMOČJO 1KA ANKETE

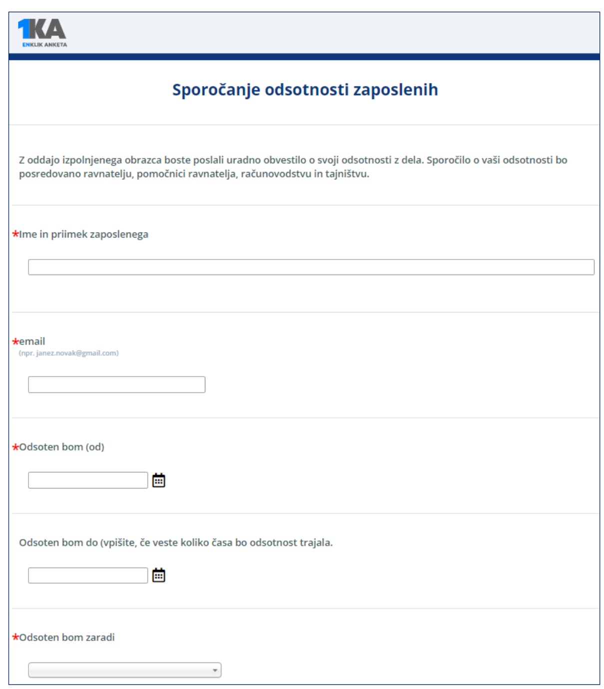
Delavci morajo obveščati svojega delodajalca o bistvenih okoliščinah, ki vplivajo na izpolnjevanje njihovih pogodbenih obveznosti [2]. Med te okoliščine spadajo tudi različne vrste odsotnosti, npr. bolniška, nega otroka,… Zakonodaja ne predvideva načina obveščanja delodajalca o odsotnosti. V osnovni šoli je ob odsotnosti učitelja potrebno urediti nadomeščanje pouka. Ker do odsotnosti učiteljev pogosto pride nepričakovano, je dober sistem obveščanja nujno potreben za organizacijo nadomeščanj.

Na Osnovni šoli Kozara Nova Gorica v preteklosti nismo imeli vzpostavljenega sistema obveščanja v primeru odsotnosti zaposlenih. V primeru bolniške odsotnosti ali odsotnosti zaradi nege družinskega člana so zaposleni to sporočili v tajništvo šole, učitelji pa so običajno obvestili tudi pomočnico ravnatelja zaradi urejanja nadomeščanj. Pogosto se je dogajalo, da je pri prenosu informacij prišlo do napak. Včasih informacija o odsotnosti ni prišla do vseh vpletenih, ali pa je bil podatek o vrsti odsotnosti napačen.

Kolektivna pogodba za dejavnost vzgoje in izobraževanja v Republiki Sloveniji [3] določa, da se v primeru krajše začasne odsotnosti učitelja učitelju, ki nadomešča, lahko dodeli ure dodatne tedenske učne obveznosti. Ko smo se na začetku šolskega leta 2018/2019 pripravljali na uvajanje sprememb, ki jih je prinesla nova Kolektivna pogodba za dejavnost vzgoje in izobraževanja, smo se zavedali, da bomo morali tudi pri organizaciji nadomeščanj natančno voditi vzrok odsotnosti posameznega delavca. Iskali smo možne rešitve, ki bi omogočile učiteljem preprosto sporočanje odsotnosti, tajništvu šole in pomočnici ravnatelja pa potrebne podatke za vodenje evidence prisotnosti na delu in organizacijo nadomeščanj. Kot ena izmed možnosti se je ponudilo oblikovanje spletnega obrazca (vprašalnika) z aplikacijo 1KA.

2.1 Oblikovanje obrazca za sporočanje odsotnosti 1KA

1KA je odprtokodna aplikacija, ki je dostopna na spletu. Za uporabo je potrebna registracija. Lahko pa se prijavimo tudi z Google računom in AII prijavo.



Slika 1. Obrazec za sporočanje odsotnosti

Za potrebe sporočanja odsotnosti z dela in organizacije nadomeščanj smo v šolskem letu 2018/19 v aplikaciji 1KA oblikovali enostavno anketo na eni strani. Iz praktičnih razlogov smo sporočanje odsotnosti razširili iz nenačrtovanih odsotnosti (bolniška, nega otroka) tudi na načrtovane odsotnosti (koriščenje letnega dopusta, izobraževanje,…).

Kot je razvidno iz slike 1, učitelji pri sporočanju odsotnosti navedejo svoje ime in priimek, spletni naslov, datum, oz obdobje odsotnosti in razlog odsotnosti.

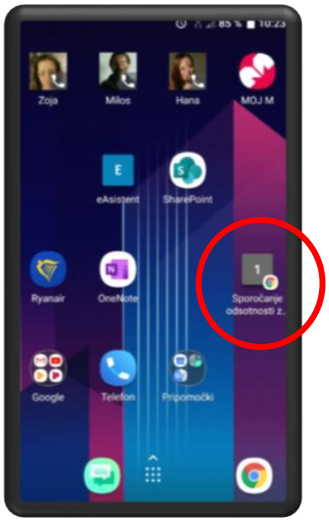
V primeru, ko bodo odsotni zaradi izobraževanja ali službene poti imajo možnost, da priložijo tudi datoteko z vabilom (programom) ali vstavijo povezavo do spletne strani z vabilom oz. programom. To okno se odpre pod pogojem, da je kot razlog odsotnosti izbrano izobraževanje oz. službena pot.

Učitelji majo tudi možnost pisanja opomb.

2.2 Dostop do obrazca za sporočanje odsotnosti z dela

Povezavo do obrazca smo namestili na šolsko spletno mesto (slika 2). Vsem delavcem smo povezavo poslali tudi na njihov spletni naslov, skupaj z navodili kako si povezavo namestijo na zaslon pametnega telefona, kot prikazuje slika 3.

Sika 3. Povezava na šolskem spletnem mestu



Sika 3. Povezava na začetni strani pametnega telefona

2.3 Nastavitve obveščanja

Eden izmed poglavitnih razlogov za oblikovanje spletnega obrazca za sporočanje odsotnosti so bile številne napake v prenosu informacij. Aplikacija 1KA omogoča nastavitev obveščanja o izpolnjeni anketi. To funkcijo smo uporabili za obveščanje vseh vpletenih o tem, da bilo oddano sporočilo o odsotnosti. Nastavimo lahko različne prejemnike obvestila.

2.3.1 Obvestilo o sporočeni odsotnosti z dela

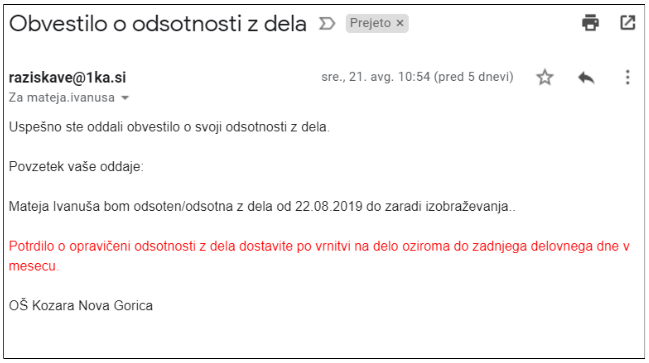
Zaradi lažjega pregleda in organizacije dela imamo nastavljene 4 prejemnike obvestila: ravnatelja, pomočnico ravnatelja, računovodkinjo in tajnico. Vsi nastavljeni prejemniki dobijo sporočilo, ko eden izmed učiteljev anketo odda. Sporočilo dobijo na svoj služben naslov. V sporočilu je zapisano ime delavca, trajanje odsotnosti in razlog odsotnosti. Več podatkov o sporočeni odsotnosti lahko izvemo, če kliknemo na povezavo do PDF ankete.

Sika 4. Obvestilo o sporočeni odsotnosti z dela

Kadar je obvestilu o odsotnosti zaradi službene poti ali izobraževanja priložena tudi datoteka ali povezava do spletne strani z vabilom oz. programom, tajnica na podlagi tega obvestila pripravi potni nalog.

2.3.2 Obvestilo o uspešno sporočeni odsotnosti

Obvestilo o uspešno oddani prijavi odsotnosti je nastalo na pobudo učiteljev. Po sporočeni odsotnosti z dela dobijo učitelji sporočilo na svoj spletni naslov. Sporočilo vsebuje povzetek podatkov, ki so jih oddali v prijavi.

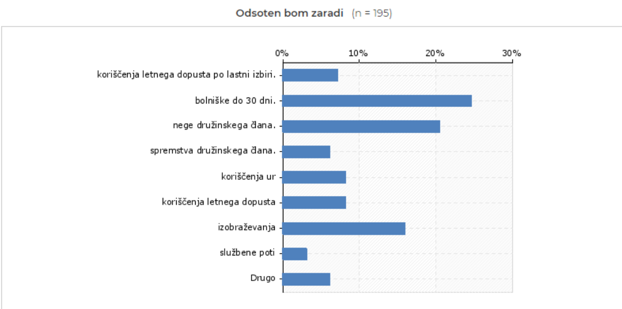


Sika 5. Obvestilo o uspešno sporočeni odsotnosti.

2.4 Dostop do podatkov in hranjenje podatkov

Podatki o oddanih sporočilih o odsotnosti z dela se hranijo v spletni aplikaciji 1KA. Lahko jih izvozimo v Excele ali jih urejamo za potrebe različnih analiz. V grafu 1 je prikazana pogostost posameznih odsotnosti.

Dostop do podatkov imajo ravnatelj, pomočnica ravnatelja in računovodkinja.



Graf 1. Odsotnost učiteljev v %

3. ZAKLJUČEK

V šolskem letu 2018/2019 je obrazec za sporočanje odsotnosti z dela uporabljalo 40 učiteljev in nekateri drugi zaposleni na šoli. Obrazec so uporabljali vsi učitelji, ki poučujejo na šoli. V manjši meri so obrazec uporabljale učiteljice, ki delajo v mobilni specialno pedagoški službi in svojo učno obvezo opravljajo na drugih šolah.

Z izdelavo spletnega obrazca za sporočanje odsotnosti smo poenostavili obveščanje. Obveščanje o odsotnosti s pomočjo vprašalnika 1KA je zanesljivo in prijazno do uporabnika. Vsem pooblaščenim omogoča vpogled v oddana obvestila o odsotnosti takrat, ko to potrebujejo. Učitelji dobijo tudi povratno sporočilo s povzetkom podatkov, ki so jih posredovali. Uvedba takšnega načina obveščanja o odsotnosti je olajšala vodenje evidence o prisotnosti delavcev na delu in pripomogla k boljšemu prenosu podatkov, ki so potrebni za organizacijo nadomeščanj v osnovni šoli.

Večina učiteljev je uporabo spletnega obrazca osvojila brez težav in ga redno uporablja. Posamezni starejši učitelji pa še vedno svojo odsotnost najraje sporočajo preko telefona.

4. VIRI

[1] O 1Ka – Splošen opis. https://www.1ka.si/d/sl/o-1ka/splosen-opis.

[2] Zakon o delovnih razmerjih. http://www.pisrs.si/Pis.web/pregledPredpisa?id=ZAKO5944.

[3] Kolektivna pogodba za dejavnost vzgoje in izobraževanja v Republiki Sloveniji. http://pisrs.si/Pis.web/pregledPredpisa?id=KOLP19

Spletno mesto za učitelje v Office 365

SharePoint for teachers in Office 365

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POVZETEK

Učitelji pri svojem delu v vsakem šolskem letu ustvarijo veliko količino dokumentov. V preteklosti so dokumente prenašali s pomočjo USB ključkov in zunanjih diskov. SharePoint v storitvi Oblak 365 omogoča ustvarjanje javnih in zasebnih spletnih mest s pomočjo katerih lahko učinkovito delimo vsebine med zaposlenimi v šoli, upravljamo z dostopom do posameznih dokumentov, načrtujemo delo s pomočjo koledarja in s pomočjo povezav poenostavimo dostop do drugih spletnih strani in storitev za učitelje.

Ključne besede

SharePoint, Oblak 365, dokumenti v skupni rabi

ABSTRACT

Teachers generate a large number of digital documents each school year. In the past, documents were transferred using USB sticks and external disks. SharePoint in Cloud 365 enables the creation of public and private sites, through which we can efficiently share content among school employees, manage access to individual documents, plan work using a calendar, and facilitate access to other websites and s services for teachers through links.

Keywords

SharePoint, Cloud 365, shared documents

1. UVOD

Informacijsko-komunikacijska tehnologija (v nadaljevanju IKT) je danes prisotna v vseh segmentih posameznikovega življenja. Na Osnovni šoli Kozara Nova Gorica IKT uporabljamo kot didaktični pripomoček, pa tudi pri dejavnostih, ki podpirajo učne procese. Učitelji pri svojem delu v vsakem šolskem letu ustvarijo veliko količino dokumentov, kot so priprave na pouk, delovni listi, različni zapisniki, individualizirani programi, e-gradiva,…, ki jih hranijo v papirni obliki, velika večina pa tudi v elektronski obliki.

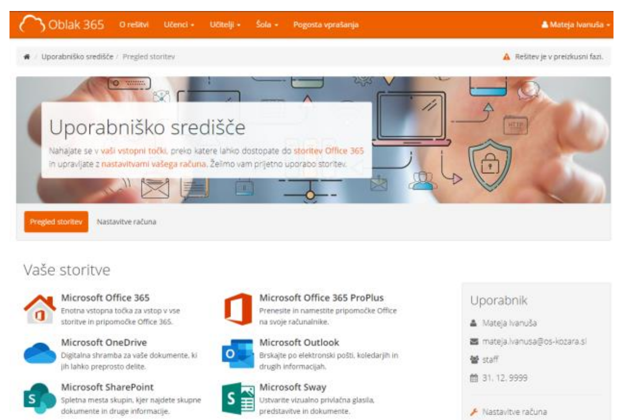
V elektronski obliki so običajno dokumenti shranjeni na enem izmed računalnikov. Ker pa učitelji svoje delo opravljajo v različnih učilnicah, kabinetih, zbornici in tudi doma, so v preteklosti dokumente večinoma prenašali na USB ključkih (slika1), naprednejši pa tudi na zunanjem disku, ali so jih imeli shranjene v Google Drive.

Dokumente, ki so bili namenjeni skupni rabi so imeli shranjene v Google Drive ali so si jih izmenjevali po elektronski pošti.

Pri takšnem načinu shranjevanja in prenašanja dokumentov so pogosto naleteli na težavo, ko pri sebi niso imeli prave verzije dokumenta, občasno pa so se USB ključki tudi izgubili ali pa se več ni dalo dostopati do podatkov na njih.

Slika 1. Zbirka ključkov ene izmed učiteljic

V šolskem letu 2016 – 2017 smo na šoli pridobili dostop do storitev Oblaka 365 (slika2).



Slika 2. Uporabniško središče Oblak 365

Oblak 365 povezuje Arnes AAI s storitvami Microsoft Office 365 [1]. Najprej smo začeli uporabljati storitev Microsoft OneDrive. Učiteljem, ki so jo začeli uporabljati, je zelo poenostavila dostop do dokumentov iz različnih računalnikov, pa tudi souporabo dokumentov, pri katerih sodeluje več učiteljev. Na podlagi dobrih izkušenj smo začeli počasi odkrivati tudi druge storitve Oblaka 365.

2. SPLETNO MESTO ZA UČITELJE V OFFICE 365

Konec šolskega leta 2017/2018 smo na šoli razmišljali o prenovi spletne zbornice. Spletno zbornico smo imeli postavljeno kot eno izmed Arnesovih spletnih učilnic. Pri analizi stanja in potreb smo izvedli anketo med vsemi uporabniki spletne zbornice. Med potrebnimi spremembami so uporabniki izpostavili potrebo po integraciji storitve, ki bo omogočala delitev vsebin med delavci in timsko delo na daljavo. Izpostavili so tudi težavo z razpršenostjo storitev, ki jih uporabljajo in vsaka zahteva svojo prijavo.

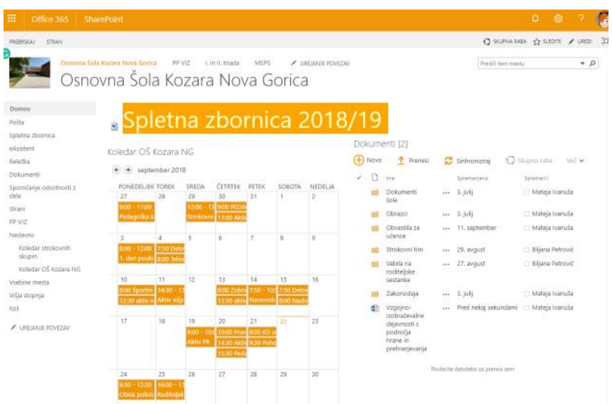
Na podlagi teh potreb smo se odločili, da ob prenovljeni spletni zbornici nastavimo tudi šolsko spletno mesto za učitelje v SharePoint Online, ki je del Office 365 in tako učiteljem in ostalim strokovnim delavcem omogočimo sodoben način timskega dela in poenostavimo delitev vsebin.

SharePoint Online je storitev v oblaku, ki omogoča ustvarjanje spletnih mest za skupno rabo dokumentov in informacij s sodelavci [2]. Do storitve lahko dostopamo preko portala Moj Arnes z AII prijavo.

V SharePoint Online lahko ustvarimo javna ali zasebna mesta. Do javnega mesta lahko dostopajo vsi zaposleni v organizaciji. Do zasebnega mesta pa samo vpisani člani.

2.1 Vsebina spletnega mesta za učitelje

Spletno mesto za učitelje je nastavljeno kot javno mesto za učitelje do katerega lahko dostopajo vsi strokovni delavci šole.



Slika 3. Spletno mesto v začetku šolskega leta 2018/19

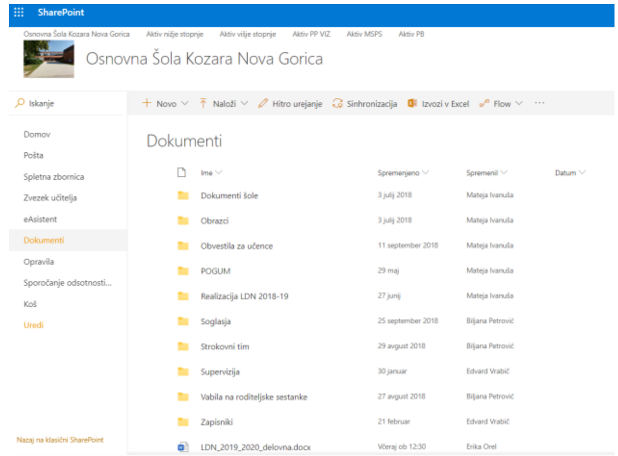
V spletno mesto lahko vgradimo različne spletne gradnike in povezave. Naše spletno mesto (slika 3) sestavljajo posamezni gradniki, ki so del programa in spletne povezave, do storitev, ki jih učitelji najpogosteje uporabljajo.

2.1.1 *Koledar*

Koledar je spletni gradnik, ki omogoča vpisovanje različnih dogodkov. Vsi vpisani dogodki so vidni vsem zaposlenim. Posameznemu dogodku lahko priložimo tudi datoteko, npr. z vabilom. Če želimo si lahko nastavimo opozorilo, ki ga prejmemo na svoj spletni naslov, ko se vpiše nov dogodek, ali si koledar povežemo s svojim Outlook koledarjem.

2.1.2 *Dokumenti*

Dokumenti so spletni gradnik, ki nam omogoča oblikovanje knjižnice dokumentov v skupni rabi. Datoteke lahko urejamo v mape. Naložimo lahko različne vrste dokumentov in nadziramo kdo lahko do njih dostopa ali jih ureja. Dokumente lahko urejajmo v spletnem načinu ali jih odpremo v namizni aplikaciji.

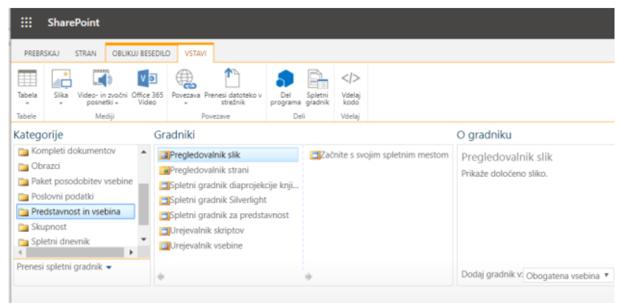


Slika 5. Knjižnica dokumentov

Gradnik je uporaben predvsem za tiste dokumente, ki morajo biti na razpolago vsem zaposlenim, bodisi za branje ali za urejanje.

2.1.3 *Ostali gradniki*

SharePoint omogoča vgradnjo številih gradnikov (slika 6) kot so obrazci, spletni dnevniki in drugi, ki pa jih mi v tem trenutku ne uporabljamo.



Slika 6. spletni gradniki v SharePoint-u

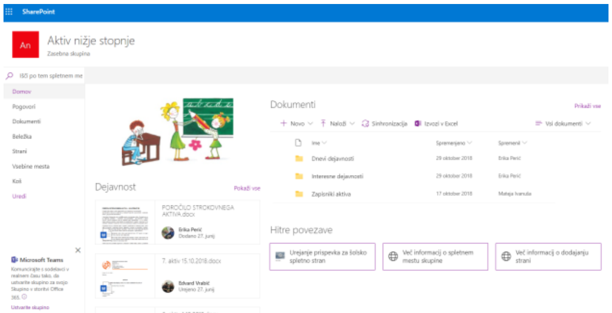
2.1.4 *Spletne povezave*

Na spletno mesto lahko namestimo različne povezave. Na našem spletnem mestu so povezave nameščene zaradi želje po enostavnejšem dostopu do različnih storitev izven SharePointa.

Nameščene povezave omogočajo hiter dostop do različnih aplikacij v Office 365, drugih Share point-ov ter spletnih mest in storitev izven Office 365.

2.1.4.1 *Povezave do drugih spletnih mest*

Na spletnem mestu OŠ Kozara smo, z nameščanjem povezav na spletno mesto, povezali spletna mesta različnih aktivov. Šolsko spletno mesto služi kot vstopna točka za spletna mesta aktivov, ki so nastavljena tako, da lahko do njih dostopajo samo člani aktiva. Za vsebino spletnih mest aktivov skrbijo člani aktiva. Slika 7 prikazuje spletno mesto enega izmed aktivov. Običajno so tukaj nameščeni dokumenti, ki jih člani potrebujejo pri svojem delu: zapisniki aktivov, seznami učencev, delovni dokumenti, ki jih člani soustvarjajo, pa tudi interne zbirke nalog in delovnih listov.



Slika 7. Spletno mesto enega izmed aktivov

2.1.4.2 Povezave do drugih storitev Office 365

Na spletno mesto smo namestili tudi povezave do različnih storitev Office 365 in tako učiteljem olajšali dostop do njih. Na tak način smo z spletnim mestom povezali:

- zvezek učitelja, ki je narejen z aplikacijo Staff Notebook in
- pošto Outlook Online.

2.1.4.3 Povezave do storitev in spletnih strani izven Office 365

Zaradi lažjega dostopa smo na spletno mesto namestili tudi povezave do spletnih strani in storitev izven Office 365.

Preko teh povezav lahko učitelji dostopajo od:

- eAsistenta,
- obrazca za sporočanje odsotnosti (1KA),
- spletne zbornice (Moodle),
- KATIS, …

2.2 Prednosti uporabe spletnega mesta

Prednost spletnega mesta je, da lahko učitelji iz enega mesta dostopajo do večine storitev, ki jih pri svojem delu uporabljajo. Še vedno pa jih moti zapletenost prijave, ko morajo včasih večkrat vnesti svoje uporabniško ime in geslo.

Do vsebin spletnega mesta lahko dostopamo tudi s telefona. Kjer lahko dokumente, ki so v skupni rabi tudi urejamo in sledimo objavam novic ter novim dogodkom v koledarju.

Share point omogoča preprosto upravljanje dokumentov in dodeljevanje pravic za urejanje. Pri soustvarjanju dokumentov, ki so nameščeni v knjižnici dokumentov sodelujejo vsi učitelji. Na tak način smo v zadnjem šolskem letu pripravili večino dokumentov s področja načrtovanja in evalvacije dela šole (letni delovni načrt, različna poročila).

3. ZAKLJUČEK

Informatizacija ustanov je eden izmed ciljev Strateške usmeritve nadaljnjega uvajanja IKT v slovenske VIZ [3], ki podpira uporabo oblačnih storitev tudi pri načrtovanju, vodenju in evalvaciji dela v šoli.

Šolsko spletno mesto je oblačna storitev, ki vsem delavcem šole omogoča preprost dostop do skupnih dokumentov in njihovo soustvarjanje, vodstvu šole pa tudi pregled dela učiteljev po aktivih.

V tem šolskem letu načrtujemo posodobitev izgleda spletnega mesta (slika 8) in dodajanje novih podstrani glede na potrebe kolektiva.

Slika 8. Šolsko spletno mesto avgusta 2019

4. VIRI

[1] Oblak 365. DOI = https://o365.arnes.si/

[2] Kaj je SharePoint? DOI = https://support.office.com/sl-si/article/kaj-je-sharepoint-97b915e6-651b-43b2-827d-fb25777f446f

[3] Strateške usmeritve nadaljnjega uvajanja IKT v slovenske VIZ do leta 2020. 2016. Ministrstvo za izobraževanje in znanost Republike Slovenije. DOI = http://mizs.arhiv-spletisc.gov.si/fileadmin/mizs.gov.si/pageuploads/StrateskeUsmeritveNadaljnjegaUvajanjaIKT1_2016.pdf

Kodiranje za mlajše učence

Coding for young pupils

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POVZETEK
Računalniško razmišljanje je poleg osnovnih spretnosti branja, pisanja in računanja ena ključnih spretnosti, ki jih morajo v okviru izobraževanja pridobiti učenci 21. stoletja. Urjenje računalniškega mišljenja namreč pripomore k razvoju strategij za reševanje problemov. Učenci se ga najbolj učinkovito učijo pri pouku računalništva, natančneje pri kodiranju in programiranju. Čeprav je informacijska in digitalna pismenost navedena med splošnimi cilji učnih načrtov v slovenski osnovni šoli, pa se razvoj računalniškega mišljenja v prvem triletju ne odvija sistematično, pač pa je prepuščen iznajdljivosti učitelja, ki ga v učni proces vpeljuje v okviru medpredmetnih povezav, morebiti celo v obliki interesnih dejavnosti. V uvodnem delu prispevka so predstavljeni različni vidiki računalniškega razmišljanja, predstavljene tri teze, ki govorijo v prid sistematičnemu razvijanju računalniškega mišljenja pri učencih, predstavljen pojem kodiranja, različni načini kodiranja glede na vrsto podatkov, ter predstavljeni štirje primeri vpeljave računalniškega razmišljanja v učni proces. V dveh navedenih primerih gre za razvoj računalniškega razmišljanja brez uporabe računalnika, v dveh pa za predstavitev aplikacije, ki učitelju služi kot pripomoček pri vpeljavi kodiranja s pomočjo računalnika.

Ključne besede
Računalniško razmišljanje, kodiranje, IKT

ABSTRACT
In addition to basic reading, writing and numeracy skills, computational thinking is one of the key skills that 21st century pupils need to acquire in their education. Computational thinking helps pupils to develop problem-solving strategies. They learn it most effectively in computer science classes, specifically in coding and programming. Information and digital literacy is among the general aims of the curricula in Slovenian elementary school. But despite this fact the development of computer thinking in the first three years of education is not systematic, but is left to the ingenuity of the teacher, who introduces it into the learning process in the context of cross-curricular connections, possibly even in form of after school activities. In introduction the paper presents different aspects of computational thinking, present theories that speak in favor of systematically developing computational thinking in students, introduces the notion of coding, different ways of coding according to data type, and presents four examples of the introduction of computational thinking into the learning process. Two of them develop computational thinking without the use of a computer and two if them with the use of computer. All of them serve as a good tool for the teacher to introduce coding to young pupils.

Keywords
Computational reasoning, coding, ICT

1. UVOD
Življenje v sodobni družbi je zelo dinamično, spremenljivo, vsak dan je pred posameznika postavljena vrsta novih izzivov. Zato je zelo pomembno, da je poučevanje zasnovano na način, ki posamezniku omogoča razvoj strategij s pomočjo katerih bo v spremenljivih družbenih okoliščinah lahko samostojno deloval.

V slovenskih šolah še vedno prevladuje frontalni pouk [13]. Znanje pridobljeno na podlagi frontalno zasnovanega pouka je kratkotrajno, njegova uporabnost pa je zelo majhna. V skladu s smernicami sodobno zasnovanega pouka so učitelji v poučevanje pričeli vse bolj in bolj uvajati model problemsko zasnovanega pouka, saj le-ta učencem omogoča, da razvijajo znanje, ki je povezano z življenjskimi situacijami. Raziskave kažejo, da učenci, ki so bili deležni problemsko zasnovanega pouka razvijejo več konceptualnih znanj v primerjavi z vrstniki, ki so znanje pridobivali s tradicionalnim modelom poučevanja. Še več, ugotovljeno je bilo, da so učenci, ki so imeli priložnost problematizirati učne postopke osvojili enako mero proceduralnih znanj kot njihovi vrstniki, ki so bili deležni pouka s tradicionalnimi učnimi metodami [13].

Problemski pouk je način poučevanja in učenja, pri katerem učenec samostojno oziroma v skupini, z večjo ali manjšo pomočjo učitelja sam išče pot od problemske situacije, do njene rešitve. Pri tem je pot pomembna v enaki meri, kot rezultat, saj je novo znanje pridobljeno s pomočjo lastne miselne aktivnosti, po lastnih spoznavnih strukturah in sposobnostih [13].

Ker je temeljni cilj sodobne vzgoje in izobraževanja oblikovanje samostojnega, razmišljujočega in odgovornega posameznika, ki se opira na kakovostno pridobljeno znanje ter socialne in druge spretnosti je šolsko delo po mnenju Kreka [11] potrebno zasnovati tako, da bo znanje, ki ga učenci usvojijo trajno in prenosljivo v različne življenjske situacije.

Način razmišljanja, ki učiteljem omogoča zasnovanje pouka po metodi problemskega pouka je razvoj računalniškega razmišljanja.

2. RAČUNALNIŠKO RAZMIŠLJANJE
Izraz računalniško razmišljanje je leta 1996 prvi uporabil Saymour Papert. Iz poročila strokovne delovne skupine za analizo prisotnosti vsebin računalništva in informatike v programih osnovnih in srednjih šol ter za pripravo študije o možnih spremembah (RINOS) iz leta 2018 je razvidna naslednja definicija računalniškega razmišljanja:

Računalniško razmišljanje se nanaša na miselne procese, ki sodelujejo pri opredeljevanju problema in izražanju njegove rešitve na način, da lahko rešitev predstavimo računalniško. Rešitev je lahko izvedena preko človeka ali računalnika ali v večini primerov v kombinaciji človeka in računalnika. Pri tem iščemo rešitev za odprte probleme tako, da sledimo nizu dobro opredeljenih korakov, ki vključujejo koncepte, ključne za področje računalništva (npr. iteracija, abstrakcija, avtomatizacija). [2]

Računalniško razmišljanje prispeva k razvoju metakognitivnih sposobnosti in boljšemu reševanju problemov na sploh [2]. To je razlog, da se poleg uporabnosti v računalništvu, uporabnost računalniškega razmišljanja vse bolj nakazuje tudi v drugih disciplinah in profesijah zunaj znanosti in inženiringa. Za primere lahko navedemo področja aktivnega učenja, ki jih razvijamo z računalniškim razmišljanjem. To so medicina, arheologija, ekonomija, finance, novinarstvo, pravo, družboslovje in humanistika. Vsebujejo namreč reševanje problemov, oblikovanje sistemov in razumevanje človeškega obnašanja, ki je prikazan na konceptu računalništva. [14]

Selby in Woollard sta definirala pet ključnih konceptov računalniškega razmišljanja [12]. To so:

- algoritmično razmišljanje – način pridobivanja rešitve po jasno definiranih in dobro utemeljenih korakih. Po njem učenci razvijejo niz navodil in pravil, ki jih z doslednim upoštevanjem pripeljejo do rešitve problema. [12]
- evalvacija – proces preverjanja, s katerim ugotavljamo, ali je rešitev algoritma primerna za določen namen in s katerim ocenjujemo različne lastnosti algoritmov. Gre za ugotavljanje, ali algoritmi delujejo, so učinkoviti, dovolj hitri, enostavni za uporabo in ali nudijo ustrezno izkušnjo. V procesu evalvacije lahko tudi preverimo, ali je mogoče rešitev še na kakšen način nadgraditi. [12]
- dekompozicija – razstavljanje problemov, algoritmov, procesov in sistemov v manjše, enostavnejše enote, ki jih lahko lažje urejamo in posledično lažje razumemo. Dekompozicija pripomore k lažjemu reševanju problemov, saj so enote proučevane in rešene posamično. [12]
- abstrakcija – način poenostavljanja problemov, kjer je ključno odstranjevanje lastnosti, za katere menimo, da so pri reševanju določenega problema nepomembne. Z izločanjem odvečnih lastnosti postopoma sestavimo sliko problema, ki ga želimo rešiti. S procesom izločanja dobimo splošno predstavitev problema, oziroma model. Z njegovo izgradnjo lahko rešujemo problem v procesu abstrakcije. [12]
- (5) generalizacija – je način reševanja problemov na podlagi prejšnjih rešitev. Algoritem, ki reši specifičen problem, priredimo tako, da je uporaben za vse podobne probleme. [12]

Nekatere bistvene značilnosti računalniškega razmišljanja so [12]:

- Računalništvo ni samo programiranje, saj zahteva razmišljanje na več nivojih abstrakcije. Poleg programiranja zajema tudi razvijanje konceptov.
- Računalniško razmišljanje je način, kako rešujejo probleme ljudje in ne računalniki. Z računalniškimi pripomočki in svojim umom ljudje lahko rešujemo težave, ki jih pred obstojem računalnikov nismo mogli.
- Računalništvo samo po sebi izhaja iz matematičnega in inženirskega razmišljanja. Omejitve računalniških naprav prisilijo znanstvenika, da razmišlja računalniško in ne le matematično. Računalničar se poslužuje inženirskega razmišljanja pri gradnji navideznih sistemov.
- Programska in strojna oprema nista produkta računalniškega razmišljanja, temveč so računalniški koncepti tisti, ki so del našega vsakdanjega življenja ter komunikacije in s katerimi rešujemo probleme.
- Je temeljna veščina, nekaj kar mora vsak človek obvladovati, da lahko funkcionira v modernem svetu.
- Računalniško razmišljanje bo postalo del vsakdanjika.

3. KODIRANJE

Do leta 2020, naj bi v Evropski uniji potrebovali več kot 800 000 strokovnjakov s področja računalništva. Veliko vzgojiteljev, staršev, ekonomistov in politikov se je začelo zavedati, da morajo učenci usvojiti nekaj osnovnih računalniških veščin in veščin kodiranja [1].

Kodiranje je veščina, ki jo bodo zahtevala vsa najboljša delovna mesta 21. stoletja. V vsakdanjem življenju uporabljamo veliko kod, zato je zelo pomembno, da že mlajšim učencem ponudimo možnost za razvoj veščine. Koda ni rezervirana samo za računalničarje, saj se osnov programiranja lahko nauči vsak [4].

Različne Evropske države v šolske učne načrte vključuje sistematično poučevanje vsebin kodiranja, pri tem pa sledijo različnim ciljem. Med njimi so razvijanje veščin logičnega razmišljanja, veščin reševanja problemov, razvoj ključnih kompetenc, veščin kodiranja, želja po spodbujanju zanimanja za računalniške znanosti, spodbujati zaposljivost v računalniškem sektorju … Pri tem je zanimivo, da v večini primerov sistematično uvajajo vsebine kodiranja v drugo stopnjo izobraževanja, vse bolj pa se navedene vsebine vključuje tudi v osnovnošolsko izobraževanje [1].

V slovenskih osnovnih šolah se od šolskega leta 2014/2015 dalje vsebine računalništva sistematično poučujejo v drugi triadi osnovne šole in sicer v obliki neobveznega izbirnega predmeta računalništvo. Pri tem je pomembno poudariti, da sistematičnega poučevanja računalniškega razmišljanja ni, kljub temu da mu raziskovalci pripisujejo enak pomen kot ostalim pismenostim, torej pisanju, branju, računanju, ki jih pridobivajo v prvi triadi osnovne šole.

Poznavanje veščin kodiranja pri posamezniku namreč razvija akademske spretnosti, gradi vztrajnost, sposobnost organizacije. Pri matematiki kodiranje otrokom pomaga pri vizualizaciji abstraktnih konceptov, omogoča uporabo matematike v realnih situacijah in matematiko naredi zabavno in kreativno. Znanje kodiranja pozitivno vpliva na področje jezika, saj učenci, ki kodirajo, razumejo vrednost zgoščenosti in načrtovanja, kar ima za posledico boljše pisanje. Kodiranje pri učencih spodbuja ustvarjalnost, saj se učijo s pomočjo poskusov in napak. Kodiranje spodbuja učenčevo organiziranost in osredotočenost na delo, samozavest. Učenci se s kodiranjem učijo logične komunikacije, kar krepi tako njihove verbalne kot pisne veščine. Učenje kodiranja namreč pomeni učenje novega jezika. [15].

3.1 Zapis podatkov v računalnik

Z namenom, da bi informacije (števila, znake, slike, zvok, video …) predstavili na čim bolj enostaven način uporabljamo pravila za zapis podatkov s katerimi predstavimo informacijo. To so kodna pravila oziroma koda. Kodiranje je zapis podatka z enim ali več dogovorjenimi znaki (črke, številke, zvok, video) po dogovorjenih pravilih. V računalniku so zapisani različni podatki. To so števila, znaki (male in velike črke, matematični in slovnični znaki) slike, zvok in video. Vsi podatki v računalniku so izraženi s številkami. Zato je potrebno vse druge vrste podatkov pred obdelavo v računalniku pretvoriti v števila, nato pa jih zapisati v določenem številskem sistemu. [5]

3.1.1 Kodiranje števil

Števila predstavljamo v računalniku samo s kombinacijo dveh znakov (0 in 1). Vendar pa jih tako kot pri uporabi brez računalnika tudi pri računanju z računalnikom lahko zapišemo na več načinov. Pri obdelavi z računalniki se uporabljajo dvojiški ali binarni številski sistem z osnovo 2, osmiški ali oktalni številski sistem z osnovo 8, desetiški z osnovo 10 in šestnajstiški ali heksadecimalni z osnovo 16. Za ločevanje med zapisom števila v dvojiškem ali osmiškem številskem sistemu uporabljamo podpisan zapis osnove, npr. 1011_2 (dvojiško). [6]

3.1.2 Kodiranje znakov

Znaki so črke (male in velike), matematični in slovnični znaki, ki so v računalniku predstavljeni z nizom ničel in enic. Vsakemu znaku ustreza točno določena kombinacija bitov [7].

3.1.3 Kodiranje slik

Informacijo lahko predstavimo s točkami, črtami, barvnimi ploskvami in drugimi likovnimi elementi. Za računalnik je grafika (slika) iz pik. Vse črte, barvne ploskve, prelivi, svetlobe in sence, ki jih računalnik izriše na zaslon so rezultat matematičnega računanja z biti.

Slike so lahko predstavljene kot bitne ali točkovne slike, vektorske ali predmetne slike (z opisom).

Bitna slika je sestavljena iz posameznih pik ali pikslov, ki so urejeni v vrstice in stolpce (matrika). Vsak piksel žari na zaslonu v določeni barvi. Če je slika črno-bela potrebujemo za kodiranje barve piksel en bit. Piksel žari belo (1) ali pa je črn (0). Shraniti je potrebno podatek o barvi vsake pike. Z enim bitom lahko definiramo dve barvi. Če za vsako piko uporabimo 4 pike lahko opišemo 16 različnih barv. Kadar govorimo o »milijonih« barv (true colour), opisujemo pike s 24 biti.

Barvna globina opisuje maksimalno število barv, ki jih lahko neka slika vsebuje. Višja kot je barvna globina, več barv bo slika vsebovala.Gostejša kot je mreža, lepša bo slika, posledično pa bo datoteka zaradi svoje velikosti zavzela več prostora, saj je potrebno opisati več kvadratkov. Velikost datoteke se veča tudi z večanjem števila barv, ki jih lahko prikazujemo.

Če je ena od prednosti bitne slike enostavno tiskanje, saj računalnik zmore enostavno sporočati tiskalniku, kako naj natisne posamezne točke je ena od pomanjkljivosti ta, da se pri povečevanju točke večajo v kvadratke, žagaste in ostre robove. Kakovost slike se s transformacijo slabša.

Vektorska slika je slika, prikazana z geometrijskimi liki (krivulje, mnogokotniki, črte, krog). Kvadrat je opisan s površino, ki jo zavzema, dolžino in debelino črte. Rečemo lahko, da je slika opisana z nizom matematičnih enačb. Ena od prednosti vektorske slike je ta, da jih lahko transformiramo (povečujemo in raztegujemo) brez popačenja robov. Kot eno od slabosti vektorske slike pa lahko navedemo dejstvo, da je videz vektorske slike zaradi matematičnega zapisa manj naraven. [8]

3.1.4 Kodiranje zvoka

Zvok je predstavljen z zaporedjem vrednosti zvočnega signala, vzorčenega v različnih časovnih trenutkih. Za dobro kvaliteto zvoka je potrebno za vsako sekundo zvoka imeti vsaj 44100 vrednosti zvočnega signala, vzorčenih v enakomernih časovnih intervalih. Ta številka izhaja iz lastnosti človeškega sluha. Za predstavitev vrednosti zvočnega signala je navadno dovolj 16 bitov. To omogoča predstavitev 65536 različnih vrednosti kar zagotavlja kvaliteten zvok. [9]

3.1.5 Kodiranje videa

Že datoteke s slikami so v primerjavi s tekstovnimi datotekami velike, pri videu pa se mora na zaslonu zvrstiti več slik v sekundi, zato so datoteke ogromne. Za kvaliteten posnetek potrebujemo vsaj 25 slik na sekundo, kar zahteva precejšnjo količino pomnilnika. To je razlog, zaradi katerega so slike videa običajno velike le četrtino, ali pa šestnajstino, lahko še manjši delež zaslona. Razvili so različne algoritme, ki video posnetek pred shranjevanjem na disk stisnejo (KOmpresirajo), ob predvajanju pa raztegnejo na prvotno velikost (DEKompresirajo). Proces na kratko imenujemo KODEK. Kodek je algoritem za kodiranje in dekodiranje analognih signalov v digitalno obliko in nasprotno. [10]

Zaradi vseh prednosti, ki jih ima razvoj računalniškega razmišljanja in usvojitev veščin kodiranja za posameznika v nadaljevanju predstavljamo nekaj dejavnosti, s pomočjo katerih lahko učitelj pri učencih spodbuja računalniško razmišljanje in veščine kodiranja.

4. PREDSTAVITEV DEJAVNOSTI

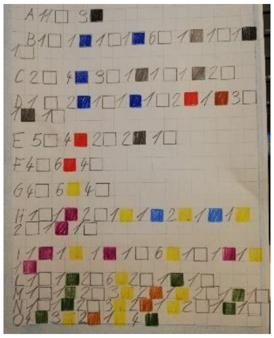
V šolskem letu 2018-2019 smo v okviru interesne dejavnosti Miselni orehi na Osnovni šoli Martina Krpana izvedli nekaj dejavnosti, ki pri učencih razvijajo logično razmišljanje in jim pomagajo pri razvoju veščin kodiranja. Interesno dejavnost obiskujejo učenci 1., 2. in 3. razreda, stari od 6 do 9 let.

Računalništvo brez računalnika: Sledenje navodilom za ustvarjanje slike in oblikovanje lastnih navodil.

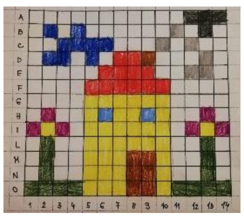
Učenci prejmejo prazno mrežo. Na vodoravni osi so zapisane številke, na navpični pa črke. Na podlagi učiteljevih navodil učenci z barvicami barvajo določeno število kvadratkov v posamezni vrsti (slika 1). Ko zaključimo z navodili ugotovijo, da so v mreži vsi dobili enako sliko hiše z drevesom. Na ta način učenci usvojijo enega od konceptov v računalništvu, to je, da na podlagi enakih programov, ki jih zapiše programer (ukazov s strani učitelja) različni računalniki lahko zadano nalogo rešijo na enak način.

Slika 1: Grad - izpolnjevanje mreže po navodilih učitelja.

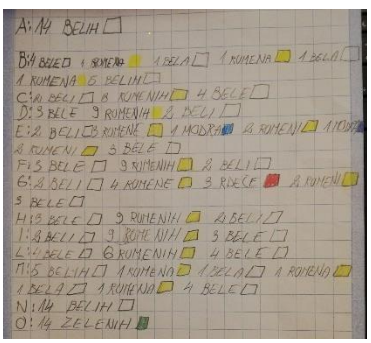
V nadaljevanju aktivnosti pa so učenci tisti, ki zapišejo navodilo za izpolnjevanje mreže (slika 2). Navodila si nato izmenjajo s sošolcem (slika 3). Pri tem je zanimivo, da učenci za zapis navodil uporabljajo različne načine (sliki 2 in 4), ter da so nastali izdelki kreativni (sliki 5 in 6), ter da so za delo zelo motivirani.



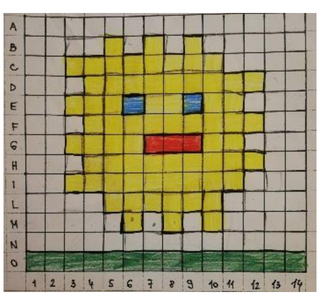
Slika 2: Oblikovanje navodila s strani učenke.



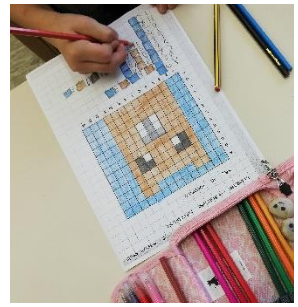
Slika 3: Slika, ki je nastala na podlagi navodil, oblikovanih s strani učenke.



Slika 4: Različni načini zapisa navodil



Slika 5: Izdelki so kreativni



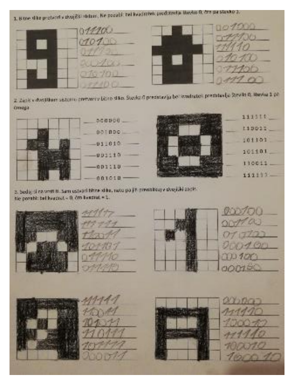
Slika 6: Učenci so za delo zelo motivirani.

Računalništvo brez računalnika: Dvojiški številski sistem – ustvarjanje bitnih slik

Učenci v uvodnem delu ure pridobijo znanje o tem, kaj je koda. Učencem v nadaljevanju ob pomoči drsnic (slika 7) razložimo pojme dvojiška koda, bit, bitna slika, piksel.

Slika 7: Drsnice, uporabljene v uvodnem delu učne ure

V nadaljevanju učne ure učencem razdelimo učne liste (slika 8), s pomočjo katerih učenci najprej bitne slike pretvarjajo v dvojiški sistem, ter zapis v dvojiškem sistemu pretvorijo v bitno sliko, na koncu pa sami ustvarjajo bitne slike in jih preoblikujejo v dvojiški zapis (slika 9).



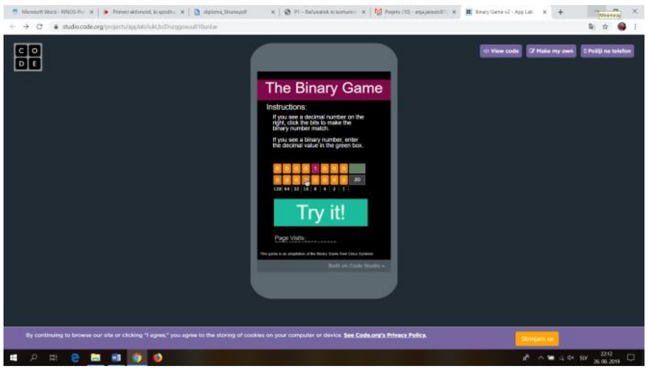
Slika 8: Izpolnjen delovni list.

Slika 9: Učenci samostojno ustvarjajo bitne slike in jih pretvarjajo v dvojiški zapis.

Kodiranje z uporabo računalnika: Pretvarjanje med desetiškim in dvojiškim številskim sistemom.

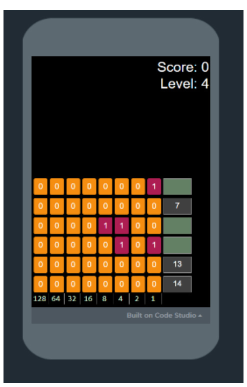
V dvojiškem številskem sistemu pa ne kodiramo zgolj slik, pač pa tudi številke. V vsakdanjem življenju najpogosteje uporabljamo desetiški številski sistem. Ker se pri obdelavi podatkov z računalnikom med drugim uporablja tudi dvojiški številski sistem smo učencem najprej brez uporabe računalnika pojasnili, kako določeno desetiško število zapisati v dvojiškem. Ker v dvojiškem številskem sistemu uporabljamo zgolj potence števila 2, smo na tablo zapisali števila: 32, 16, 8, 4, 2 in 1. Nadnje pa smo zapisali števko 0 ali 1, odvisno od tega, ali je bila določena potenca števila dve uporabljena ali ne. Ko smo ugotovili, da učenci razumejo pretvorbo brez uporabe računalnika, smo jim predstavili igro The Binary game. Do nje lahko brezplačno dostopamo na povezavi: https://studio.code.org/projects/applab/iukLbcDnzqgoxuu810unLw.

Pojavi se uvodna stran z navodili v angleškem jeziku (slika 10).



Slika 10: The Binary game - uvodna stran.

Če učenec na desni strani zagleda desetiško število, potem ga s pomočjo oznake bitov preoblikuje v dvojiško število. V nasprotnem primeru dvojiški zapis števila pretvori v desetiško število (slika 11).



Slika 11: Desetiško število pretvori v dvojiškega, v dvojiškem sistemu zapisano število pa zapiši desetiškega.

Če učenec števila ustrezno pretvarja iz enega številskega sistema v drugega, se vrstica opek podre. Pri tem je pomembno poudariti, da je hitrost pretvaranja iz enega številskega sistema v drugega zelo pomembna, saj se vrstice z opekami sicer polagajo en ana drugo, in ko je celoten prostor zapolnjen z opekami, se igra zaključi (slika 12).

Slika 12: Igra zaradi zapolnjenosti ekrana z opekami z binarnimi in desetiškimi števili zaključena.

Za uvajanje najmlajših učencev v kodiranje s pomočjo računalnika smo uporabili aplikacijo Tommy The Turtle. Najdemo jo med aplikacijami v trgovini Google Play uporaba pa je brezplačna: https://play.google.com/store/apps/details?id=com.Zyrobotics.TommyTurtle&hl=sl.

Slika 13: Aplikacija Tommy The Turtle

Aplikacija Tommy The Turtle (slika 13) učenca vodi preko t.i. vadnice (tutorial), v kateri učenec lahko spremlja, kako se v programu Želvak Tom odziva na različne ukaze. V nadaljevanju se lahko v t. i. prosti igri (free play) sam preizkusi v programiranju želvakovega gibanja, na koncu pa se loti izzivov, ki jih najde v zavihku izziv (Challenge). Na ta način učenci postopoma usvajajo osnove kodiranja s pomočjo računalnika in lahko rešujejo vse bolj zapletene izzive, pri tem pa pridobivajo na samozavesti, saj v primeru, da naredijo napako le-to odpravijo brez posledic, ampak šele potem, ko odkrijejo razloge zanjo. Na ta način pa učenci pridobivajo vztrajnost.

5. ZAKLJUČEK

Računalniško razmišljanje je splošna veščina, ki ni namenjena samo tistim, ki se izobražujejo na področju računalništva. Razmišljati kot računalnikar pomeni več kot le zmožnost programiranja računalnika, saj zahteva razmišljanje na več abstraktnih ravneh. Računalništvo nam ponuja samo teoretično ozadje, ki odgovori, kako težko je problem rešiti in kako ga lahko najbolje rešimo. Tovrstno razmišljanje vključuje reševanje problemov, oblikovanje sistemov in razumevanje človeškega obnašanja s sklicevanjem na temeljne koncepte računalništva.

Prednosti razvijanja računalniškega razmišljanja pri posamezniku so [3]:

- spodbuja samozavest pri reševanju kompleksnih problemov,
- spodbuja vztrajnost pri delu s težjimi problemi,
- zvišuje tolerantnost za dvoumnost,
- spodbuja sposobnost za reševanje odprtih problemov,

- razvija sposobnost sodelovanja z drugimi za skupen cilj ali rešitev (ISTE, CSTA, 2011),
- učencem poleg tehnološke pismenosti omogoča višje znanje,
- predstavlja neskončno možnosti za ustvarjalno reševanje problemov,
- izboljšuje že poznane tehnike reševanja problemov.

Tovrstno razmišljanje je temeljni cilj za vsakogar, ne samo za računalniške znanstvenike. Zato bi bilo poleg branja, pisanja, računanja in zmožnosti analitičnega razmišljanja pri vsakem otroku priporočljivo razvijati tudi računalniško razmišljanje [14]. Vse naštete prednosti računalniškega razmišljanja nakazujejo potrebo po uvedbi računalništva in računalniškega razmišljanja v šole, za kar se je zavzemala Jeannette Wing, ki je idejo računalniškega razmišljanja predstavila in popularizirala [14].

Naše izkušnje z uvedbo dejavnosti kodiranja, ki pri posamezniku razvijajo računalniško razmišljanje so, da so učenci za delo zelo motivirani, hkrati pa pridobljene veščine s pridom uporabljajo tudi na drugih predmetnih področjih. Učenci sami so navajali, kako jim je dejavnost "marsovsko sporočilo" pomagala pri reševanju nalog tekmovanja iz logike, saj so posedovali veščine za spopadanje s tovrstnimi nalogami. V nadaljnem raziskovanju bi to njihovo opažanje želeli ugotavljati z empirično raziskavo.

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Odnos dijakov do poučevanja s tehnologijo in pogoji za delo

Students' perception to technology enhanced teaching and working conditions

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POVZETEK

Prispevek predstavlja odnos dijakov do tehnološko dovršenega pristopa k poučevanju. Poučevanje (ali usposabljanje) s tehnologijo (technology enchanted teaching − TET), je inovativna metoda poučevanja, ki uporablja informacijsko-komunikacijsko tehnologijo. Metoda temelji na uporabi informacijsko-komunikacijskih naprav (prenosniki, tablični računalniki, pametni telefoni itd.) med poukom: uporaba interaktivnih učnih enot na pametnih telefonih, ponavljanje in utrjevanje znanja s pomočjo Googlove učilnice, ogled videoposnetkov, strukturirana poglavja z naslovi, paketi grafike in slik, ki jih je treba vstaviti v besedilo med lekcijo in dodatnim gradivom na osnovi multimedije.

Predavana vsebina je podana z uporabo Googlovih dokumentov in predstavitev, z možnostjo učenčevega dopolnjevanja vsebin. Učenci interaktivno sodelujejo med poukom, hkrati pa jim omogočimo aktivno učenje.

Ključni element inovativnega pristopa je uporaba tehnologije v kombinaciji s sistemom za ustvarjanje zapiskov. Pametne naprave nadomeščajo papir in svinčnik ter ponujajo dodaten dostop do multimedijskega gradiva ali ogled video posnetkov v razredu oziroma doma. Učenci sproti ustvarjajo datoteke in delajo lastne zapiske. To pospeši razmišljanje posameznika, podpira učenje in spodbuja aktivno sodelovanje. Za metodo poučevanja, ki je bila preizkušena pri poučevanju naravoslovnih vsebin v srednješolskem programu poklicnega in strokovnega izobraževanja, rezultati vprašalnika kažejo na prenosljivost metode na druge predmete in druga izobraževalna področja, kot je izobraževanje odraslih.

Ključne besede

Inovacija, poučevanje s tehnologijo, na učenca naravnano učenje in poučevanje, Googlova učilnica

ABSTRACT

The paper presents students' perception to a technologically enhanced teaching. Technology enchanted teaching-TET is an innovative teaching method that intensively uses communication information technology (ICT). Methods based on information communication devices (laptops, tablets, or similar devices) are used: use of teaching accessories on smart phones, revision in connection with the Google classroom, viewing, containing structured chapters in title, graphics and image packages that need to be inserted between the lesson in additional materials based on multimedia. Content is provided through lectures using Google Docs, presentations, including the ability to update content from learners. Students interact with the lesson while at the same time allowing them to learn actively.

The key element of an innovative approach is the use of technologies in combination with the record-keeping system. The mobile phone or tablet replaces paper and pencil and offers additional access to the material on multimedia bases or video clips in a classroom or at home. To increase individual thinking, it supports learning in the promotion of active participation. The teaching method that has been tested in teaching of natural sciences, indicate the transferability of methods to other subjects in a second educational area, such as adult education.

Keywords

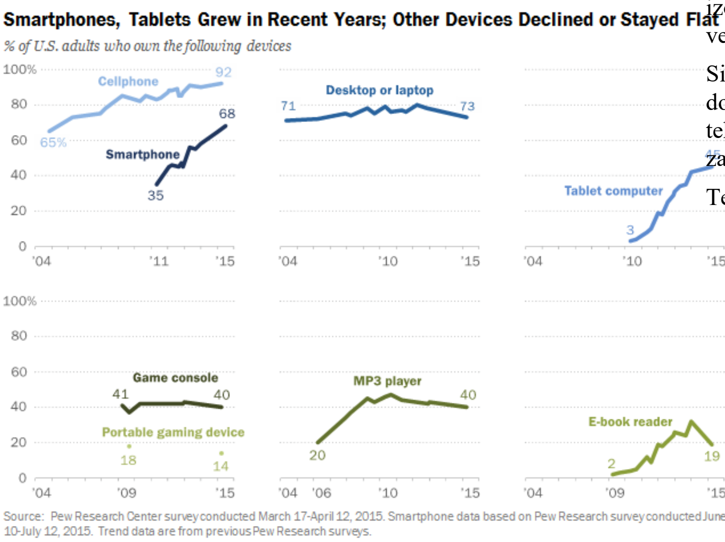
Innovation, technology teaching, learner-oriented learning and teaching, Google's classroom

1. UVOD

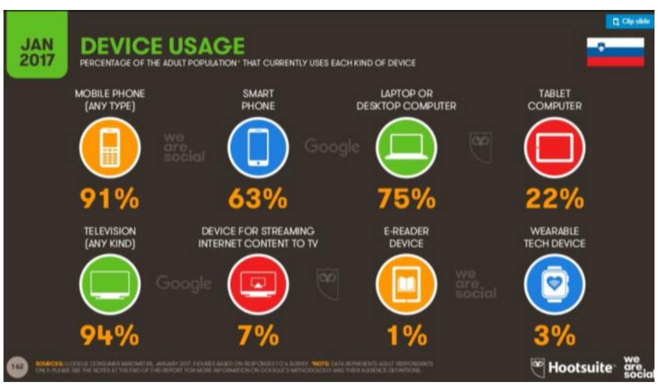
Razvoj tehnologije je spremenil marsikaj tudi v načinu izobraževanja. Komunikacijske storitve nenehno napredujejo in se hkrati izboljšujejo, računalniki in pametni telefoni pa so močno prisotni v posameznikovem vsakdanjiku. Zaradi lažjega dostopa do informacij pomembnost mobilnih in pametnih telefonov in informacijsko-komunikacijskih naprav narašča iz dneva v dan. Na izobraževalnem področju je dostopnost do najnovejših informacij zelo pomembna, zato imajo pametni telefoni velik razvojni potencial v izobraževalnih ustanovah. Z vedno večjo multimedijsko podporo pametni telefoni omogočajo učenje kjerkoli in kadarkoli. [5]

Večina evropskih učencev, dijakov in študentov ima svojo osebno računalniško opremo. To so prenosni računalniki, tablice, dlančniki, pametni telefoni, ki se jih zlahka uporablja tudi v šolski učilnici. Tisto, kar manjka učiteljem, so pogosto ideje za poučevanje s temi napravami v razredu, doma ali na delovnem mestu. Številni učitelji so skeptični glede uporabe pametnih telefonov in tablic, učenci, dijaki in študentje pa jih množično uporabljajo za pridobivanje informacij, znanja, potrditev razmišljanja in raziskovanja. Učitelji potrebujemo različne koncepte za uspešno in raznoliko poučevanje z uporabo tehnologije v času, ki je že zdavnaj presegel tradicionalen način poučevanja z učbenikom in delovnim zvezkom. [2].

Graf 1: Grafični prikaz števila (v odstotkih) uporabnikov mobilnih telefonov, pametnih telefonov, prenosnih računalnikov, tablic, igralnih konzol, mp3-predvajalnikov in bralnikov. Vir: http://www.siliconbeat.com/2015/10/29/pew-survey-how-many-u-s-adults-own-a-smartphone-a-c



Graf 1 prikazuje grafični prikaz ameriške populacije, ki uporablja pametne naprave, kot so pametni telefon, mobilni telefon, tablica in računalnik. Najbolj strmo narašča uporaba pametnih telefonov in tabličnih računalnikov. Stanje pa je podobno tudi drugod po svetu.



Slika 1: Uporaba tehnologije v Sloveniji januarja 2017 [3]

Slika 1 prikazuje odstotek uporabnikov tehnologije med slovenskim prebivalstvom. Tudi tukaj ne zaostajamo za evropskim in svetovnim povprečjem.

Ker vsaka novost na področju informacijsko-komunikacijske tehnologije vzbudi zanimanje uporabnikov, je to hkrati tudi priložnost za nova izobraževalna okolja.

Ena od študij poroča, da je bilo veliko raziskav na področju poučevanja s pametnimi napravami, vendar pa je malo tistih, ki raziskujejo učenčeve reakcije na uporabo pametnega telefona kot izobraževalnega orodja [1].

2. METODOLOGIJA

Opisan sistem poučevanja omogoča učiteljem poučevanje v razredu s pomočjo informacijsko- komunikacijske tehnologije, ki jo pri pouku uporabljajo učenci. Metoda je uporabna na vseh nivojih izobraževanja, zlasti pa je uporabna v srednješolskem izobraževanju, kjer imajo dijaki že izoblikovane in usvojene veščine dela s tehnologijo.

Sistem vključuje tri glavne stebre: ustrezno pedagoško ozadje, dobro pripravljene materiale za učence, dijake ali študente in tehnično podporo, ki omogoča poučevanje s pomočjo tehnologije za dosego učnih ciljev.

Temelji poučevalnega sistema s tehnologijo so:

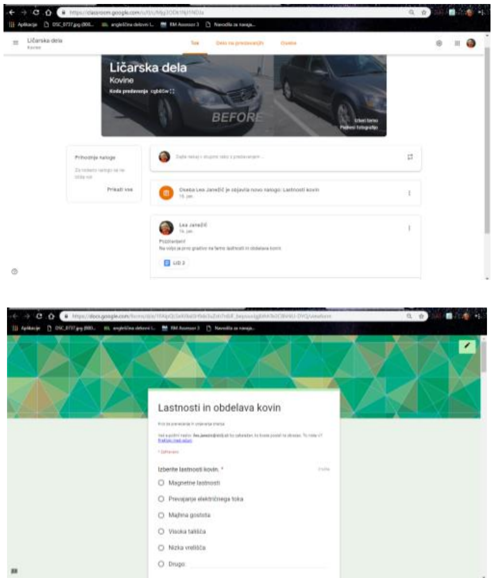
- poučevanje v šoli v običajni učilnici z dijaki;
- predstavitve na prosojnicah z uporabo programov PowerPoint, Prezzi ali podobnih predstavitvenih orodij;
- uporaba različnih naprav za pisanje lastnih zapiskov, ogled multimedijskih vsebin, reševanje interaktivnih kvizov, uporabo spletnih učilnic itd.;
- brezžično delovanje interneta in ustrezno okolje z možnostjo shranjevanja podatkov v oblakih;
- ustrezen paket literature, razdeljene na poglavja, dodatno razložene s pomočjo animacij, video vsebin itd.;
- učno okolje, kjer je dijakom omogočena samoevalvacija in preverjanje lastnega znanja s pomočjo povzetkov poglavij in opredeljenimi cilji znanja pri posameznem učnem sklopu;
- na dijaka osredotočen učni pristop, na njegovo aktivno učenje.

2.1 Osnovni opis sistema poučevanja s tehnologijami

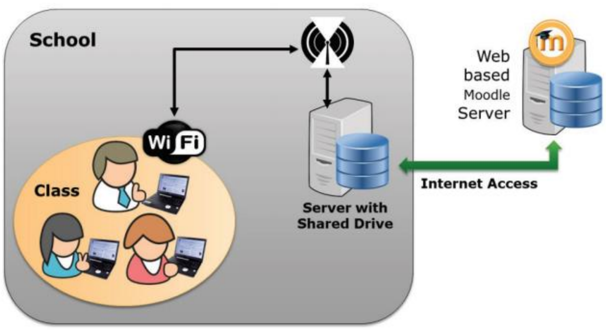
Za uporabo metode poučevanja s pomočjo tehnologije morajo dijaki imeti ustrezne kompetence dela s tehnologijo, poleg tega pa še kompetenco urejanja besedil in organizacijske veščine.

Dijaki morajo za poučevanje s tehnologijami imeti omogočen dostop do svetovnega spleta in nalaganje materialov preko elektronskih medijev. Dijaki, ki so sodelovali v raziskovalni skupini, so dobili v Googlovi učilnici naloženo elektronsko gradivo, ki je vključevalo učno snov in predstavitve za ponazoritev snovi. Dijaki so učno snov »Lastnosti kovin« v okviru predmeta ličarska dela predelali sami z uporabo naprav (računalnik, pametni telefon, tablica itd.). Učni paket z učnim gradivom (Slika 2) je vir dijakovih zapiskov. Učni paket je vseboval učno gradivo ter preizkus znanja in samoevalvacijo v Googlovi učilnici.

Dijaki dopolnjujejo osnovno besedilo in vstavljajo ustrezne grafike. Rezultat dela so izpopolnjeni zapiski za učenje in samoevalvacijo. Dijaki med poukom sledijo predstavitvam s pomočjo multimedije, hkrati pa so aktivno vključeni v razprave, skupinsko delo, izkustveno učenje itd. Dijaki svoje znanje preverjajo z reševanjem kvizov in spletnih preverjanj znanja z uporabo Googlove učilnice in njenih aplikacij.



Slika 2: Slika Googlove učilnice.



Slika 3: Učno okolje med poučevanjem (povzeto po: Mazohl, 2016)

2.2 Vprašalnik in fokusna skupina

S pomočjo vprašalnika smo preverjali dve glavni dilemi:

1. Ali je dijakom všeč metoda uporabe tehnologije za pripravo učnih okolij učenja in poučevanje z uporabo tehnologije?
2. Ali je uporaba tehnologije, aplikacij in spletnih orodij dijakom prijazna metoda poučevanja?

Različna področja vprašalnika vključujejo uporabo tehnologije med poukom, uporabo različnih materialov, pedagoški vidik in uporabo multimedijskih vsebin za poučevanje. Vprašalnik je bil poslan dijakom preko spletnega vprašalnika 1ka.si. Vprašalnik je bil poslan 32 dijakom. Vprašalnik je sestavljen iz 16 vprašanj. Za 16 zaprtih vprašanj je bila uporabljena Likartova merska lestvica s štirimi možnostmi (se popolnoma strinjam, se deloma strinjam, se deloma ne strinjam, se popolnoma ne strinjam).

3. REZULTATI

Dijaki se strinjajo z uporabo tehnologije pri poučevanju in so potrdili visoko stopnjo uporabnosti sistema za učenje.

3.1 Evalvacija metode poučevanja

Spodnja tabela prikazuje pregled vprašanj iz vprašalnika, ki se nanašajo na metodo poučevanja, uporabo multimedije in predstavitev.

Tabela 1: Vprašanja organizacije metod poučevanja

Vprašanje	Se popolnoma strinjam	Se deloma strnjam	Se deloma ne strinjam	Se popolnoma ne strinjam
1. Ob uporabi računalnika lažje sledim učni snovi.	16	13	2	1
2. Dostop do vsebine učne ure omogoča kvalitetnejšo učno uro.	20	10	2	0
3. Uporaba prosojnic omogoča lažje sledenje pouku in pisanje zapiskov.	18	10	4	0
4. Uporaba standardiziranih grafik (ppt, doc, pdf, wma, mp 4) omogoča lažje sledenje učnim vsebinam in pisanju zapiskov.	21	9	2	0
5. Multimedijske predstavitve učne snovi, ki so naložene v Googlovi učilnici, pomagajo pri učenju.	10	17	5	0
6. Uporaba videa in animacij omogoča razumevanje učne vsebine.	19	11	2	0
7. Želim si več ogledov video posnetkov z vsebinami učne snovi.	16	13	2	1

Iz rezultatov vprašalnika v Tabeli 1 lahko sklepamo, da si dijaki želijo vključevanja tehnologije v poučevanje in so zadovoljni s pripravljeno učno vsebino. Prav tako je razvidno, da dijaki lažje dopolnjujejo svoje zapiske med samim učenjem, če so vsebine dostopne v spletni učilnici.

Drugi sklop vprašalnika se nanaša na uporabo izkustvenega učenja, eksperimentov in aktivno vlogo učitelja.

Tabela 2: Aktivno učenje dijakov

Vprašanje	Se popolnoma strinjam	Se deloma strnjam	Se deloma ne strinjam	Se popolnoma ne strinjam
8. Eksperimenti izboljšujejo kakovost učne ure.	22	9	1	0
9. Želim si pogostejšega sodelovanja s sošolcem v razredu za lažje razumevanje učne vsebine in razpravo.	8	8	14	2
10. Učitelj v razredu mora predavati o učni snovi in se pogovarjati z dijaki o učni vsebini.	23	9	0	0
11. Med učno uro bi moral učitelj spodbujati dijake k aktivnemu sodelovanju s pomočjo dodatnih vprašanj ali vodenjem razprave.	24	5	1	2
12. Spletna platforma omogoča dijakom ogled dodatnih multimedijskih predstavitev in predstavitev, ki so bile prikazane med učno uro. Redno pregledujem spletno učilnico.	6	16	2	8

Iz rezultatov Tabele 2 je razvidno, da si dijaki ne želijo delati v paru, velika večina pa se strinja, da je učitelj odgovoren za aktivnost dijaka v razredu. Kljub podatku, da veliko dijakov uporablja tehnologijo, je presenetljivo, da 8 dijakov od 32 ne pregleduje redno spletne učilnice in ne pregleduje vsebin, ki so ponujene kot dodatna pomoč. Velik delež dijakov se strinja, da z eksperimentalnim delom in izkustvenim učenjem učitelji povečujemo kakovost učne ure. Zanimiv podatek iz rezultatov je tudi, da si dijaki želijo učiteljevo razlago, ki jim kljub večji rabi tehnologije še vedno služi kot prvi in osnovni vir informacij o učni snovi.

Tretji sklop vprašalnika se nanaša na uporabo informacijsko-komunikacijske tehnologije (IKT), stranske učinke uporabe računalnika in dodatne uporabe video posnetkov.

Tabela 3: Vloga IKT in učni učinki pri poučevanju s tehnologijo

Vprašanje	Se popolnoma strinjam	Se deloma strnjam	Se deloma ne strinjam	Se popolnoma ne strinjam
13. Delo z računalnikom je izboljšalo moje veščine uporabe računalnika.	6	8	10	8
14. Delo na računalniku je izboljšalo moje veščine dela z računalniškimi programi (word, excel, power point, pdf).	8	8	10	6
15. Znanje slepega tipkanja je nujno potrebno za tak način učenja.	4	8	9	11
16. Objavljene in izdelane video posnetke iz spletne učilnice bom uporabljal za učenje doma.	9	16	5	2

Iz Tabele 3 lahko razberemo, da dijaki brez težav uporabljajo IKT in se med učnimi urami posebej ne učijo dela s tehnologijo, prav tako ne pridobivajo novega znanja glede uporabe računalniških orodij. Poznajo orodja in delo z najosnovnejšimi računalniškimi programi. Zanimivo je, da se dijaki ne strinjajo, da za uporabo informacijske tehnologije potrebujejo desetprstno slepo tipkanje oziroma je obvladovanje te veščine za njih nepomembno.

4. ZAKLJUČEK

Raziskava, čeprav opravljena na manjšem številu dijakov, kaže, da so dijaki poučevanje s tehnologijo zelo dobro sprejeli, da metodo vidijo kot koristen in dobro strukturiran način poučevanja. Uporaba »pametne« tehnologije se je izkazala za učinkovito metodo, ki je dijakom blizu glede na njihovo obvladovanje tehnologije. Raziskava kaže tudi visoko stopnjo zadovoljstva dijakov, saj imajo občutek, da je njihovo učenje podprto s strani učnega procesa in učitelja. [6]

Tehnološko zasnovano poučevanje se je izkazalo za zelo uspešno metodo. V Evropi narašča uporaba pametnih naprav. V letu 2018 je slabih 56 % Evropejcev uporabljalo pametne telefone, do leta 2021 jih naj bi že 61 % [4].

Ustvarjanje lastnih zapiskov dijakom povzroča nemalo težav, kar je razvidno tudi iz odgovora, da si želijo vpogled v učno snov, ki jo je učitelj že predaval ali jim je bila posredovana preko spletne učilnice. Dijaki imajo veliko težav z zapisovanjem predavane učne vsebine, zato bi bilo smiselno nadaljevati z raziskavami, katere strategije in metode so najučinkovitejše za hitro pisanje zapiskov z učinkovito uporabo pametnih naprav.

Zelo pomembno je, da dijaki znajo uporabljati pametne naprave in multimedijske vsebine, sicer metoda ne učinkuje in izgubi svoj pravi pomen nadgrajevanja znanja in aktivnega učenja. Raziskava kaže, da dijaki z uporabo tehnologije niso napredovali v znanju uporabe tehnologije. V nadaljevanju bi raziskavo lahko razširili v smislu, katere veščine in kompetence mora dijak imeti pred samim začetkom uporabe tehnološko zasnovanih učnih ur. Tukaj je treba upoštevati tudi naravo samega predmeta, saj se na primer poučevanje tujega jezika razlikuje od poučevanja naravoslovja.

5. VIRI

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Uporaba aplikacije Kahoot! pri pouku in doma

The usage of Kahoot! application at school and at home

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POVZETEK

Učenje s pomočjo sodobne tehnologije ni več le popestritev vsakodnevnega učnega procesa, ampak je postala že stalna praksa pri mnogih predmetih in v vseh razredih. Učenci živijo s sodobno tehnologijo na vsakem koraku, prav tako pa se s pomočjo sodobnih spletnih aplikacij lahko veliko naučijo. Te niso le način njihovega komuniciranja, ampak tudi močno motivacijsko orodje za učenje in utrjevanje znanja. Z različnimi aplikacijami se lahko tudi veliko naučijo, ne le zabavajo. Podrobneje vam bom predstavila aplikacijo Kahoot!, ki ponuja učencem, da razvijajo svojo kreativnost, kritično mišljenje in spodbuja timsko delo. Aplikacija daje učencem možnost, da so slišani in vključeni v proces tvorbe novih nalog – tako postanejo učenci učitelji. Učiteljem pa daje aplikacija veliko vpogleda v njihovo delo in razumevanje ter omogoča lažje načrtovanje nadaljnjega dela. S pomočjo te aplikacije lahko učence tudi formativno spremljamo.

Ključne besede

Sodobna tehnologija, aplikacija Kahoot!, formativno spremljanje, kreativnost, kritično mišljenje, timsko delo

ABSTRACT

Learning with the help of modern technology is no longer just a diversification of the everyday learning process, it has become a regular practice at many school subjects and in all classes. Students live with modern technology and they can also learn a lot through modern web applications. They are not only their way of communication, but also a powerful motivational tool for learning and reinforcing. They can use applications for learning, not only for having fun. I will present the use of Kahoot! app, which offers students the opportunity to develop their creativity, critical thinking and encourage teamwork. The app gives students the opportunity to be heard and involved in the process of creating new assignments – students become leaders. The application gives teachers a great deal of insight into their work and results and makes it easier to plan for further work. This application also helps teacher to do formative assessment.

Keywords

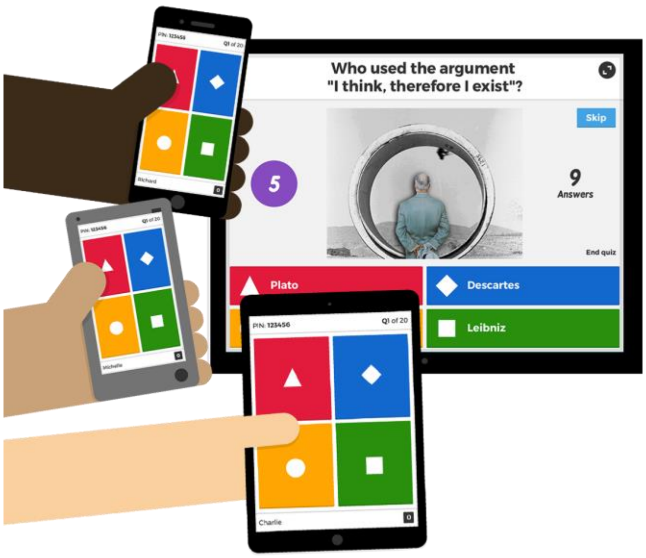
Contemporary technology, Kahoot! app, formative assessment, creativity, critical thinking, teamwork

1. UVOD

Na spletu obstaja več kot petdeset orodij ali aplikacij, ki nudijo kvize in igre, s pomočjo katerih lahko popestrimo vsakodnevno rutino v razredu. Aplikacija Kahoot! je orodje, ki se lahko zelo hitro in preprosto ter brezplačno namesti na računalnik, tablico ali pametni telefon, pri tem potrebujemo le spletno povezavo. Omogoča izdelavo kvizov, razprav, vprašalnikov in razvrščanje odgovorov v pravilni vrstni red. Gre za eno najbolj priljubljenih aplikacij (glede na osebno izkušnjo) in jo lahko uporabimo tako pri uvajanju nove snovi, kot tudi preverjanju in utrjevanju. Z njo učencev ne ocenjujemo, ampak spremljamo njihovo razumevanje in napredek (formativno spremljanje). Aplikacija ima veliko prednosti ter ponuja še več idej za uporabo, tudi izven pouka, ki bodo podrobneje prikazane v nadaljevanju.

2. KAKO ZAČETI?

Najprej moramo obiskati spletno stran www.kahoot.com in si ustvariti svoj račun. Izberemo opcijo new Kahoot in stran nas enostavno vodi skoz process ustvarjanja kviza. Najprej kviz poimenujemo, nastavimo časovne omejitve ter točkovanje in začnemo s tvorjenjem vprašanj, ki morajo imeti vsaj dva in največ štiri možne odgovore. Vprašanja popestrimo z uporabo slik, grafov ali video posnetkov. Učenci si zelo hitro, enostavno in brezplačno naložijo aplikacijo na svojo mobilno napravo. Igra se lahko prične (slika 1). Ko pričnemo s kvizom, se na glavnem zaslonu izpiše koda kviza (game pin), ki jo mora tekmovalec vnesti v aplikacijo, s tem se prijavi, hkrati pa mora izbrati tudi ime ali vzdevek (neprimerne vzdevke lahko učitelj izbriše oz. onemogoči). Tekmuje lahko vsak zase (preverjamo znanje, napredek posameznika) ali v skupini (razvijamo timski duh).



Slika 1: Aplikacija Kahoot!

3. MOŽNOSTI UPORABE ORODJA *KAHOOT!*

3.1 Utrjevanje snovi

Največkrat uporabimo to orodje za preverjanje in utrjevanje znanja med usvajanjem znanja ali ob koncu določenega učnega sklopa. Uporabi se lahko pri kateremkoli predmetu in pri učenci od 1. do 9. razreda. Učenci so nad uporabo tega orodja navdušeni, saj je orodje tekmovalnega značaja, kar v tem času otrokom veliko pomeni. Časovna omejitev, točkovanje in atraktivna glasba (lahko se tudi utiša) dvigujejo napetost med reševanjem kviza.

3.2 Učenci postanejo učitelji

Kahoot! omogoča sestavljanje lastnih kvizov ali uporabo že obstoječih, ki jih ustvarjalci delijo z drugimi uporabniki portala. Še tako tihi učenci lahko postanejo voditelji oz. učitelji, saj aplikacija omogoča, da vsak lahko sestavi svoj kviz na določeno temo ali snov in nato vodi izvedbo. Zabaven in drugačen način učenja daje učencem večjo samozavest, ti pa se navajajo na javno nastopanje, ki je v današnjem času velikega pomena. Ob sestavljanju vprašanj učenci spoznavajo, kaj so cilji oz. nameni učenja. Hkrati spoznavajo, kaj znajo in česa še ne. Ob tvorbi razmišljajo tudi o težjih vprašanjih, ki zahtevajo višje miselne procese (vprašanja višje taksonomske stopnje). Učenci tekmovalci imajo radi, da jih vodi nekdo drug, ne učitelj. Zelo koristno je, če starejši učenci učijo mlajše in izvedejo kakšno uro v razredu s pomočjo orodja Kahoot!

3.3 Kviz kot domača naloga

Naloge iz delovnega zvezka ali učnega lista pri učencih niso najbolj priljubljene, čeprav so tudi koristne. A večjo motivacijo za delo doma in hkrati izziv predstavljajo ravno spletna orodja. Učenci imajo po večini dostop do spleta, večinoma preko pametnih telefonov. Naloga se poda zelo preprosto. Na spletni strani www.kahoot.com izberemo kviz, ki ga želimo, da ga učenci rešijo, in kliknemo na gumb challenge (izziv), nastavimo časovno omejitev za nalogo in gumb create (ustvari), nato delimo povezavo in pin kodo ter pošljemo učencem. Učenec s klikom sprejme izziv na svoji mobilni napravi in reši nalogo. Učenec lahko tudi za nalogo sestavi kviz na določeno temo. Učitelj z ogledom na postavki reports (poročila) ugotovi, kako uspešen je bil določen učenec pri reševanju in dobi nemudoma povratno informacijo o njegovem znanju. Tako lahko učitelj že načrtuje delo za naslednjo uro. Poročilo si lahko snamemo s spleta in ga shranemo na svoj računalnik. Lahko nam je tudi v pomoč pri govorilni uri s starši.

3.4 Kahoot! kot anketa

Če moramo hitro pridobiti mnenja učencev o določeni temi, lahko uporabimo orodje Kahoot! Lahko je anketa del raziskovalne naloge ali kot raziskava znotraj razreda ali šole o določeni temi. Rezultati pa so lahko odlično izhodišče za vodenje pogovora na razrednih urah.

3.5 Formativno spremljanje

Formativno spremljanje postaja stalna praksa tudi v slovenskem šolskem sistemu. Vse več učiteljev ugotavlja pozitivne učinke tovrstnega načina poučevanja. Eden izmed korakov formativnega spremljanja je takojšnja povratna informacija. Orodje Kahoot! daje učiteljem in učencem takojšnjo povratno informacijo o znanju. Učitelj ima v zavihku poročila vpogled v posameznikovo reševanje in lahko na podlagi tega ugotovi, kaj učenec še ne zna. Učenci tudi sami spoznajo, kaj še ne znajo oz. kaj morajo znati, da bodo uspešni. Učenci začnejo sprejemati odgovornost za lastno znanje. (Brunauer, idr., 2017)

3.6 Spoznajmo se!

Orodje Kahoot! lahko pomaga, da spozna razred novega učitelja ali razrednika. Učitelj se lahko učencem predstavi s to aplikacijo, vanjo vključi svoje slike ali video posnetke, učenci ugibajo, kje učitelj živi, koliko je star, kaj ima rad in česa ne mara, s čim se rad ukvarja ipd. Gre za odličen način prebiti led na začetku šolskega leta in se spoznati na zabaven način. Prav tako lahko učenci naredijo podoben kviz o sebi in se predstavijo svojim sošolcem, da jih ti še bolje spoznajo. Že na začetku leta lahko ustvarimo pogoje za spodbudno učno okolje. Ker ima že vsak človek pametni telefon vedno pri sebi, lahko to idejo uporabimo tudi doma, v zasebnem življenju na raznih zabavah ali tako pripravimo presenečenje za druge.

3.7 Igrajmo se globalno

Kahoot! domuje v več kot 180 državah po vsem svetu. Učenci radi spoznavajo vrstnike iz drugih držav in ohranjajo stike preko družbenih omrežij. Mogoče vasa šola že sodeluje v kakšnem mednarodnem projektu. Tudi če ne, se lahko kviz izvede z učenci iz drugih držav. Pozorni moramo biti le na morebitno razliko v času. S pomočjo dobre spletne povezave, spletne kamere in programa Skype Kahoot se lahko učenci tudi vidijo in tako doživijo nepozabno izkušnjo. Kviz se lahko pripravi za obeležitev določenih mednarodnih dnevov in praznikov ali na koncu osvojenega tematskega sklopa (npr. pri angleščini - besedišče). Na začetku se lahko pripravi tudi kviz, da se spozna državo in kulturo ter šolo. Učenci tako spoznavajo drugo kulturo, državo in urijo sporazumevanje v tujem jeziku. V naslednji uri lahko učenci napišejo, kaj so se novega naučili o tuji državi, kulturi, jeziku, naredijo mini predstavitve ipd. Učence in šolo za sodelovanje se lahko najde tudi preko Kahoot!-ove facebook strani.

3.8 Nova snov

Za predstavitev in uvajanje nove snovi lahko prav tako uporabimo orodje Kahoot! Učence spoznamo s cilji določenega učnega sklopa in jim vzbudimo radovednost. Z vprašanji jim pokažemo, kaj bodo morali znati. Prav tako lahko s pomočjo vprašanj ugotovimo stopnjo predznanja. Dobimo nemudoma povratno informacijo o tem, kje začeti. (povz. po www.kahoot.com)

4. ZAKLJUČEK

Generacije učencev se spreminjajo in prav tako se moramo učitelji na določenem področju prilagoditi učencem. Sodobna tehnologija je del njihovega življenja in s pomočjo le-te lahko današnje učence motiviramo za učenje in delo. Pokazati jim moramo, da se lahko tudi s spletnimi orodji učimo in hkrati zabavamo. Dandanes je domača naloga nujno zlo za marsikoga, vendar je lahko s pomočjo spletnega orodja tudi izziv in učenje. Z orodjem Kahoot! lahko dosežemo vse novodobne zahteve in vrednote bodočih delodajalcev, in sicer: kreativnost, kritično mišljenje in timsko delo.

5. VIRI

[1] Kahoot!: https://kahoot.com/ (7. 8. 2019)

[2] Brunauer, A. H., Bizjak, C., Borstner, M., Cotič Pajntar, J., Eržen, V., Kerin, M. idr. (2017). Formativno spremljanje v podporo učenju. Ljubljana: ZRSŠ.

Poučevanje programskih konceptov: Spletna zbirka nalog s samodejnim preverjanjem

Teaching basic programming concepts: Online handbook with automated verification

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POVZETEK

Nov slovenski portal za poučevanje osnov programiranja s pomočjo besedilnih nalog z miselnimi izzivi je namenjen osnovno- in srednješolskim učiteljem, ki želijo pri pouku ali krožkih učence spodbujati k razumevanju osnovnih programskih konceptov. Med reševanjem raznolikih nalog, razporejenih v štiri sklope, osnovno- in srednješolci spoznavajo spremenljivke, zanke, pogojne stavke, tabele in druge koncepte, s čimer Pišek predstavlja tudi most med nalogami v Mednarodnem tekmovanju iz računalniškega mišljenja Bober in Srednješolskem tekmovanju ACM iz računalništva in informatike RTK. Osnutek portala je nastal leta 2018, večino nalog pa so 2019 ustvarili študentje v sklopu projekta Naloge za poučevanje in učenje računalniškega mišljenja – Portal Pišek (NPUR), pri katerem so sodelovali Fakulteta za matematiko in fiziko Univerze v Ljubljani, Kreativni center Poligon ter Code Week Slovenija.

Ključne besede

Poučevanje, osnovna šola, programiranje, programski koncepti, slikovni programski jezik, Blockly

ABSTRACT

The new website 'Pišek' for teaching the basics of computer programming uses text assignments with different challenges for elementary and high school children. The Pišek website is aiming for teachers who want to encourage students to learn the basic concepts of computer programming. While students are solving various tasks from the four available sections, they learn about variables, loops, conditional statements, tables, and other computing concepts. That also makes Pišek a bridge between assignments in the International Algorithmic Thinking Competition Bober and the ACM High School Computer Science and Informatics Competition RTK. The website was first developed in 2018. However, most of the learning assignments created students within the 2019 project 'Tasks for Teaching and Learning of Computational Thinking - Portal Pišek (NPUR)'. The project partners were the Faculty of Mathematics and Physics from the University of Ljubljana, Poligon Creative Center and Code Week Slovenia.

Keywords

Teaching, elementary school, computer programming, programming concepts, visual programming languages, Blockly

1. UVOD

Pomembna kompetenca v informacijski družbi je algoritmični način razmišljanja. Tega uspešno razvijamo s poučevanjem različnih računalniških in predvsem programskih konceptov. Osnovno znanje katerega od programskih jezikov namreč pomembno pripomore pri opismenjevanju sodobnika. Prav zato je koristno učence seznanjati tudi z osnovami programiranja. Drugi cilj, vendar mogoče še pomembnejši [17], je mlajše učence navdušiti za računalništvo in informatiko in jim pokazati, da je učenje na tem področju lahko tudi ustvarjalno ter zabavno. Žal je učenje programiranje za določen del populacije težko dostopno: v šoli se poučuje v manjšem obsegu, izvenšolske iniciative pa prav tako dosegajo le manjši del populacije [13]. Samoučenje na drugi strani pa je zahtevno, saj pri njem učencu običajno manjka povratna informacija. Ta je pri začetnih korakih v programiranju neprecenljiva, vendar pa to zahteva bodisi pravočasno udeležbo učitelja, ki jo je pri prenapolnjenih učilnicah težko zagotoviti, bodisi uporabo sistemov za samodejno preverjanje pravilnosti programov. Poleg tega tudi kritično primanjkuje kakovostnih nalog v slovenskem jeziku.

Ker je programiranje veščina, se je učenci lahko naučijo le z veliko vaje. O tem pričajo številne raziskave, med drugim [18]. A pri tem moramo upoštevati [6], da ni pomembno le samo pisanje kode, ampak tudi zgoraj omenjena povratna informacija o tem, ali napisani programi izpolnjujejo zahteve zastavljenega problema.

Večina začetniških napak je namreč preprosto rešljivih, če učence pravočasno usmerimo v pravo smer. Pri tem so dobre in sprotne povratne informacije bistvene za hiter napredek. Če pa učenci povratne informacije ne dobijo že med samim reševanjem nalog, lahko to lahko močno upočasni njihov napredek učencev.

Pri poučevanju programiranja je prav tako pomembna izbira okolja, v katerem se začetnik prvič sreča s programiranjem. V zadnjem času vrsta strokovnjakov proučuje, ali niso za začetnike morda najprimernejši slikovni programski jeziki, ki uporabniku omogočajo ustvarjanje programov s sestavljanjem vnaprej pripravljenih blokov oziroma kock programskega jezika. S tem se izognejo sintaktičnim napakam, kar učenje programiranja najbolj olajša začetnikom. Ti se lahko namesto s sintakso, tj. s pravilnostjo zapisa programa, ukvarjajo s postopkom, ki jih bo privedel do pravilne rešitve. Glavna prednost, ki jo torej prinaša uporaba slikovnih jezikov, je zmanjšana raven kognitivne obremenitve [15], ki ji je izpostavljen učenec med programiranjem. Zato je več lahko posveti reševanju problema.

Med učitelji poteka živahna debata o ustrezni izbiri prvega programskega jezika. Pogosto je glede uporabe slikovnih programskih jezikov slišati pomisleke, da je učenje programiranja na ta način preveč podobno igranju igric in ne nudi ustreznega uvoda v "pravo" programiranje, kjer se praviloma uporabljajo tekstovni programski jeziki. A obstaja več študij [5], ki kažejo, da je znanje slikovnih programskih jezikov prenosljivo na tekstovno usmerjene jezike. Nekateri raziskovalci opozarjajo na preprostost, s katero učenci prenesejo znanje (npr. glede spremenljivk, iteracijskih struktur in pogojev) iz slikovnih jezikov (kot so Blockly, Alice, Scratch in drugi) v tekstovne jezike (npr. Java ali Python). Weintrop v svoji disertaciji [18] poroča, da se učenci učijo več in hitreje, ko uporabljajo slikovne jezike, kot takrat, ko uporabljajo tekstovne.

Kot smo omenili, je večina začetniških napak dokaj preprosto rešljivih, če učence s pomočjo ustreznih informacij pravočasno usmerimo. Pri preverjanju pravilnosti rešitev učitelju lahko priskočijo na pomoč sistemi za samodejno preverjanje programskih rešitev. Ti učitelju pomagajo pri zagotavljanju hitrega odziva. Tako se učitelj lažje sooči z večjimi skupinami učencev in svojo pozornost usmeri k tistim učencem, ki jo najbolj potrebujejo.

Vendar je priprava tovrstnih sistemov za slikovne programske jezike precej težja naloga kot pri tekstovno usmerjenih jezikih. O tem priča že dejstvo, da obstajajo številni sistemi, ki podpirajo klasične jezike, kot so Java, C, Python in drugi (enega od pregledov obstoječih sistemov za samodejno preverjanje pravilnosti programov najdete npr. v [6]), za slikovne jezike pa je teh orodij bistveno manj.

Na Fakulteti za matematiko in fiziko Univerze v Ljubljani smo že pred časom razvili sistem Projekt Tomo (https://www.projekt-tomo.si/), ki podpira programske jezike Python, MATLAB in R [12].

Med tistimi redkimi sistemi za preverjanje pravilnosti programskih rešitev, ki podpirajo slikovne jezike, izstopa francoski sistem Algorea (http://www.france-ioi.org). V sodelovanju z njimi smo ga priredili za uporabo tudi v našem jeziku, poimenovali Pišek in ga postavili na spletni naslov http://pišek.acm.si/.

S tem smo želeli učiteljem v slovenskih šolah dati na voljo učna gradiva in pripomočke, ki bi jim omogočala, da se bodo po lastni presoji odločali, ali bi pri poučevanju uporabljali slikovne ali tekstovne programske jezike. Menimo namreč, da učni položaj v razredu najbolje oceni vsak učitelj sam. V skladu s svojo strokovno presojo se odloči o primernem pristopu. Seveda pa mora v ta namen imeti ustrezna sredstva (predvsem učna gradiva in pripomočke).

2. NAMEN PROJEKTA

Namen projekta je bil ustvariti portal za poučevanje osnovnih programskih konceptov, ki bo dovolj preprost, da ga bodo učencem predstavili učitelji – tudi tisti, ki se s poučevanjem tovrstnih vsebin še niso ukvarjali. Hkrati mora biti zbirka nalog na portalu dovolj raznolika, da bo nagovarjala učence in učenke različnih starosti in z različnimi predznanji. Posebno pozornost smo namenili tudi sestavljanju nalog, ki nagovarjajo dekleta, torej tisto polovico šolajoče se populacije, ki jo programi poučevanja računalništva prevečkrat spregledajo [13].

2.1 Vzpostavitev odprte zbirke nalog

Portal Pišek je nastal v okviru projekta Naloge za poučevanje in učenje računalniškega mišljenja. Financiranje prek Javnega razpisa Projektno delo z negospodarskim in neprofitnim sektorjem – Študentski inovativni projekti za družbeno korist nam je omogočilo, da smo k sodelovanju povabili študente, bodisi pedagoških znanosti, računalništva, matematike, medijskih študij idr. smeri, ki so ustvarili večino nalog na portalu. Z združevanjem različnih strokovnih področij in ob podpori mentorjev z Univerze v Ljubljani, Fakultete za matematiko in fiziko in Fakultete za računalništvo in informatiko, Kreativnega center Poligon ter iniciative Code Week Slovenija, so študentje objavili 250 avtorskih nalog, 69 pa so jih prilagodili ter prenesli iz učbenika Slikovno programiranje [1].

2.1.1 *Pomoč učiteljem*

Vzpostavljen portal je namenjen uporabi v slovenskem šolskem prostoru kot pomoč pri poučevanju programiranja. Ker je javno dostopen in brezplačen, omogoča, da se bodo učenja programiranja na zanimiv način lotili tudi drugi – na primer organizatorji izvenšolskih aktivnosti na področju digitalne vzgoje.

Z odprto in brezplačno zbirko nalog za urjenje računalniškega mišljenja so slovenske šole dobile orodje za poučevanje računalniškega mišljenja, ki bo (tako si želimo avtorji portala Pišek) pomembno prispevalo k dvigu digitalne pismenosti bodočih generacij osnovno- in srednješolcev in njihovih učiteljev.

Z nalogami, ki od učitelja ne zahtevajo posebnih znanj s področja računalništva ali programiranja, prispevamo k preseganju digitalne ločnice, zaradi katere učenci kot *digitalni nomadi* in učitelji kot *digitalni imigranti* [3] v digitalnem svetu stojijo na ločenih bregovih. Otroci so v ta svet rojeni, zaradi česar se jih odrasli – učitelji in starši, ki vstopajo v novi svet kot priseljenci - nemalokrat bojijo oziroma se ogibajo interakcij z otroki, ki bi lahko razkrile, da to področje slabše obvladajo. Učitelji pa se morajo »jeziku domorodcev« prilagoditi, saj je to edini način, da bodo učencem pomagali pri pridobivanju digitalnih veščin ter kritični oziroma odgovorni rabi tehnologije. [16]

Portal Pišek s priročnostjo vsebin in nalog zasleduje prav to, da bo v prvi vrsti opogumil učitelje in dvignil njihov interes za poučevanje računalniškega mišljenja ter drugih digitalnih kompetenc. Te so še posebej pomembne za opolnomočenje današnjih otrok in prihajajočih generacij – za njihovo participacijo, raziskovanje in ustvarjanje v informacijski družbi.

2.1.2 *Spodbujanje deklet*

Posebno pozornost pri pripravi nalog smo posvetili dekletom, saj je to skupina z manj interesa za učenje programiranja. Poleg tega raziskave kažejo, da se interes za učenje STEM pri dekletih z leti oziroma odraščanjem še zmanjšuje, kar se odraža tudi v manjšem deležu deklet, ki se odloča za študij na naravoslovnih ali tehniških smereh. Microsoftova študija iz leta 2018 v zvezi s tem ugotavlja, da so med razlogi za manjši interes deklet za naravoslovne in tehnične poklice tudi pomanjkanje podpore in spodbude s strani staršev ter učiteljev. Kot enega od ukrepov za dvig interesa deklet za to področje pa študija predlaga navduševanje deklet s pomočjo vključujočega učnega okolja [2]. To idejo o vključujočem okolju za dekleta smo prenesli tudi na Portal Pišek. Zato smo pripravili in objavili posebne sklope nalog za učenje programiranja, ki so zaradi izbire junakov/junakinj ali zgodbe, v katero je umeščen programski izziv, portal naredili zanimiv tudi za dekleta. Tako smo na primer v pilotski raziskavi med uporabniki portala v razredu učence in učenke spraševali, katere teme so jim blizu oziroma naloge s katerega področja bi si želeli reševati in tako prišli do ideje za sklop nalog Ples, v katerem se po mreži gibljeta plesalec in plesalka. Z mislijo na dekleta smo objavili tudi sklopa nalog Gasilka in Gosenica Eva.

2.1.3 *Podpora izvenšolskim iniciativam*

Portal Pišek je brezplačno dostopen brez registracije, saj si avtorji želimo, da ga bo uporabljalo čimveč učiteljev in mentorjev ter bo na ta način dostop do nalog imelo čimveč otrok. S tem namenom smo zasnovali poseben sklop Code Week, ki je namenjen podpori istoimenske iniciative, ki vsako leto v sklopu vseevropskega dogodka organizira tudi Slovenski teden programiranja. Pod naslovom Code Week so izbrane naloge združene glede na starost učencev in zahtevnost. Poleg tega s poglavjem Za pokušino učitelje nagovarjamo, naj v času Tedna programiranja v vsakem razredu vsaj del šolske ure namenijo programiranju, tako da učence usmerijo k reševanju teh izbranih nalog.

2.2 Sodelovanje s študenti

Projekt je omogočal vključitev desetih študentov s petih fakultet[1] iz različnih področij (matematika, računalništvo, družboslovje in pedagogika), ki so delovali v interdisciplinarni ekipi. Na ta način smo omogočili pripravo vsebinsko, strokovno, pedagoško in jezikovno ustreznih nalog.

3. UPORABA PIŠKA

Na vstopni strani portala boste našli štiri sklope nalog – Zgodbe, Programski koncepti, Učbenik in Code Week. Ti so podrobneje predstavljeni v poglavju 3.3 Štirje sklopi nalog.

Po izbiri sklopa se učenec skozi sistem map premika do željene naloge.

3.1 Reševanje naloge

Ob kliku na nalogo se prikaže stran z besedilom naloge, slika situacije ter delovni prostor, kjer gradimo svoj program. Kot je razvidno iz primera (Slika 1), je naloga lahko sestavljena iz več težavnostnih stopenj, ki jih označujejo zvezdice. Ko učenec uspešno reši nalogo, napreduje na naslednjo, zahtevnejšo stopnjo, na kateri razumevanje problema utrdi.

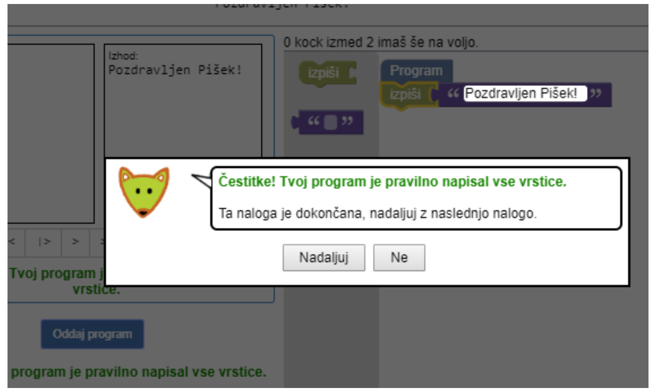
Slika 1. Primer naloge

3.1.1 *Samodejno preverjanje pravilnosti*

Ko učenec na delovni površini bloke z ukazi poveže med seboj in zaključi program, ga odda v ocenjevanje. Samodejni ocenjevalnik preveri, ali je uporabnik nalogo uspešno rešil in uporabniku sporoči povratno informacijo.

3.1.2 *Pravilna rešitev*

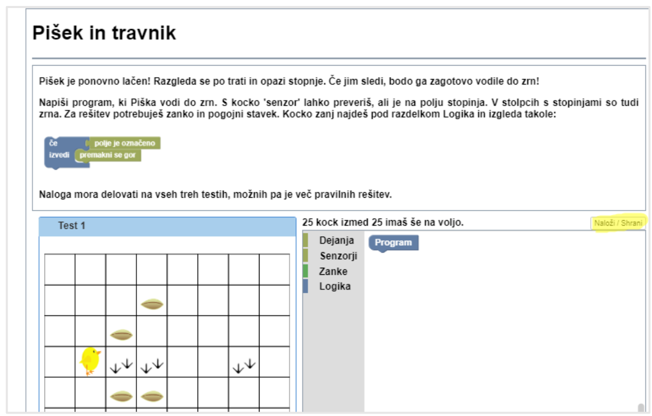
Kadar učenec nalogo reši uspešno, mu sistem to jasno sporoči (Slika 2) in mu predlaga napredovanje na zahtevnejšo stopnjo izziva ali naslednjo nalogo.



Slika 2. Sporočilo ob pravilni rešitvi

3.1.3 *Naloži/shrani rešitev*

Pri določenih nalogah, predvsem tistih bolj zapletenih, ima učenec možnost, da rešitev shrani na svoj računalnik oziroma jo od tam naloži (glej rumeno pobarvana gumba Naloži/Shrani).

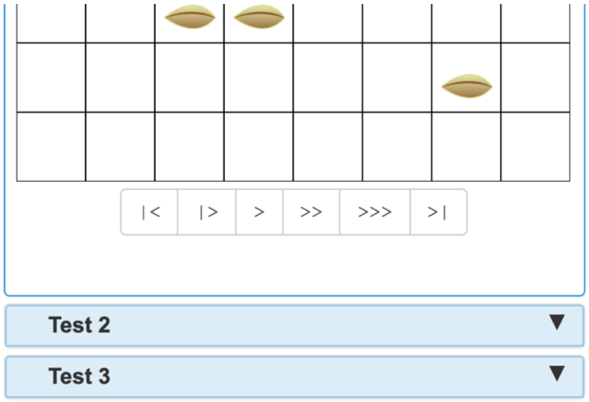


Slika 3. Možnost shranjevanja in nalaganja kode

3.1.4 *Iskanje hroščev*

V nekaterih primerih je pod sliko tudi nekaj gumbov, ki učencu pomagajo pri iskanju hroščev v programu. Omogočajo izvajanje programa po korakih oz. z različnimi hitrostmi, kar močno olajša iskanje napak v programih.

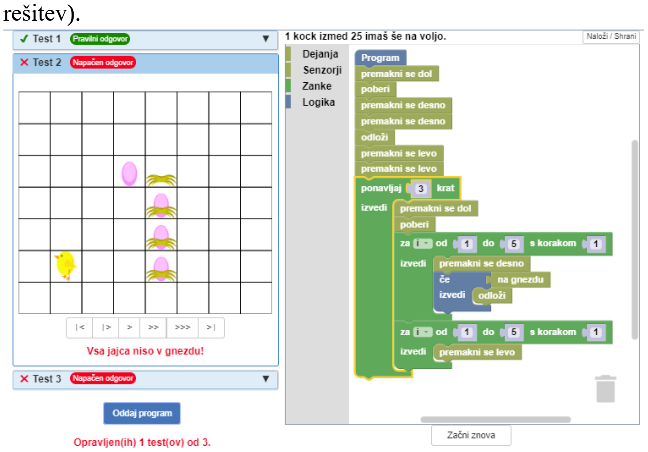
[1] Sodelujoči študentje: Luka Čušin, UL PeF, Blaž Dobravec, UL FMF, Urška Erjavec, UL PeF, Zoran Fijavž, UL FF, Žiga Flajs, UL FMF, Karel Križnar, UL FMF, Ajda Lah, UL FDV, Anže Lokar, UL FS, Aleš Poklukar, UL FMF, Dimitar Stoilkov, UL FMF, Krištof Špenko, UL FMF in Maks Valenčič, UL FDV.



Slika 4. Iskanje hroščev

3.1.5 *Napačna rešitev*

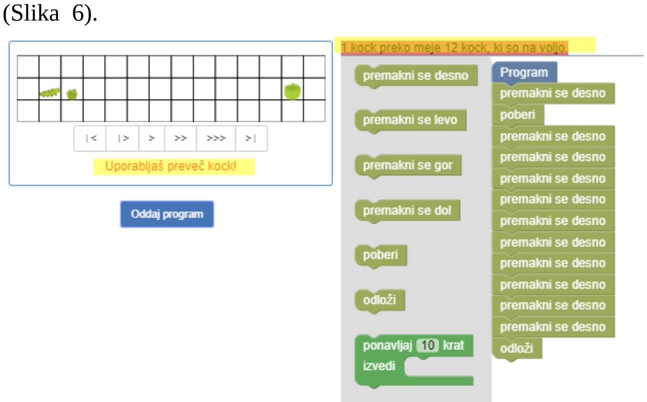
Če je oddana naloga rešena napačno, bo portal to učencu sporočil. Možno je, da program uspešno prestane nekaj testov, vendar ne vseh, kar je pogoj za uspešno rešitev naloge (Slika 5. Napačna rešitev).



Slika 5. Napačna rešitev

3.1.6 *Preveč porabljenih blokov oziroma kock*

Prav tako je možno, da bi program sicer pravilno rešil zastavljeno nalogo, a je učenec uporabil preveliko število blokov oziroma kock (Slika 6).



Slika 6. Preveč porabljenih blokov

3.1.7 *Ocenjevanje kakovosti rešitev*

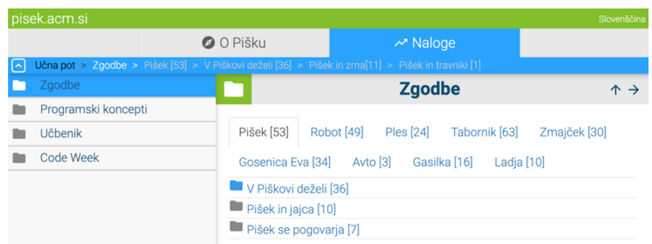
Ocenjevalni sistem lahko preverja ne le pravilnost ampak tudi kakovost uporabnikove rešitve. Takšna naloga je na primer »Pišek in škatle«, kjer kakovostnejša rešitev za dosego cilja porabi kar najmanj korakov, čeprav je končni rezultat enak. Na tak način uporabnik dobi hitro povratno informacijo, ki je pri začetnih korakih programiranja še kako pomembna. Tako lahko sistem Pišek uporabniki uporabljajo tudi samostojno in pri reševanju dobijo takojšen odziv glede kakovosti in pravilnosti svojih programov.

3.2 Zgradba Piška

Kot že omenjeno, je portal Pišek nastal na osnovi francoskega sistema Algorea. Ta nam omogoča sestavljanje nalog v programskih jezikih Scratch, Blockly ali Python. Za nas je bil od teh najbolj zanimiv slikovni jezik Blockly. Namenoma smo se odločili, da pri portalu ne uporabimo jezika Scratch (ki je prav tako slikovni), ki je v naših šolah sicer bolj razširjen. Po več razgovorih s kolegi iz različnih ustanov, ki se ukvarjajo z začetnim poučevanjem programskih jezikov, Scratch ni tako primeren za reševanje nalog, ki jih želimo imeti na Pišku. Scratch je namreč primarno zasnovan kot jezik in okolje za izražanje [6].

3.2.1 *Navigacija*

Ob obisku portala se odpre vstopna stran (Slika 7). Na voljo sta dva nivoja navigacije. Prvi nivo je predstavljen na zgornji horizontalni navigacijski vrstici ima dve možnosti: »O Pišku« in »Naloge«.



Slika 7. Vstopna stran in navigacija

V levem stolpcu uporabnik izbira med štirimi sklopi nalog: Zgodbe, Programski koncepti, Učbenik in Code Week, ki so razporejen v imenike z drevesno strukturo, podobno kot datoteke v datotečnem sistemu računalnika.

3.3 Štirje sklopi nalog

Kot smo zapisali zgoraj, portal Pišek trenutno ponuja štiri sklope nalog: Zgodbe, Programski koncepti, Učbenik in Code Week, od katerih ima vsak svojo vlogo.

3.3.1 *Zgodbe*

V Zgodbah se nahaja osem tematsko urejenih poglavij: Pišek, Robot, Ples, Tabornik, Zmajček, Gosenica Eva, Gasilka in Ladja, v katerih je zbranih prek 250 različnih nalog. Vsaka od zgodb deluje kot samostojna avantura, ki zbuja zanimanje učencev in učenk z različnimi interesi. Poleg tega učenci pri prehajanju med avanturami, torej ko zaključijo z reševanjem nalog v eni zgodbi in se nato lotijo naslednje, utrjujejo iste programske koncepte, ne da bi se pri tem dolgočasili.

3.3.2 *Programski koncepti*

Drugi sklop je namenjen seznanjanju z oziroma utrjevanju že pridobljenega znanja o izbranih programskih konceptih (zaporedje ukazov, zanke, vhod/izhod in spremenljivke, pogojni stavki, podprogrami, tabele in nizi). S koncepti se učenci srečujejo tudi pri reševanju ostalih sklopov, vendar pa je zaradi sistematične ureditve in preglednosti ta učna pot kot nalašč za izboljšanje učnega procesa, kadar želimo z učenci poglabljati prav specifičen koncept.

3.3.3 Učbenik

Te naloge temeljijo na e-učbeniku Slikovno programiranje, namenjeno uvodu v programiranje, do katerega lahko prosto dostopamo na spletu [1]. Naloge smo iz učbenika preselili na portal Pišek, ker je na Pišku reševanje nalog iz učbenika, ki sicer ponuja teoretski in praktični uvod v programiranje, uporabniku prijaznejše.

3.3.4 Code Week

V četrtem sklopu so izbrane naloge razvrščene glede na starostne skupine otrok oziroma težavnost. Kot predlaga že ime sklopa, je ta v prvi vrsti namenjen izvajanju dejavnosti v okviru Slovenskega tedna programiranja – Code Week, ko učitelji ter mentorji prostovoljci iz vse Slovenije poskrbijo, da čim več otrok spozna programiranje.

3.4 Tipi nalog na Pišku

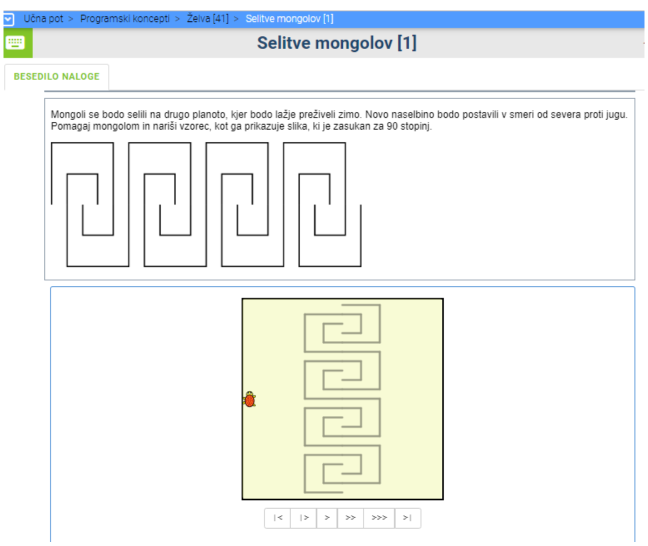
Strokovnjaki ugotavljajo, da ima pri začetnem uvajanju programskih konceptov [4], [8], [9] branje kode zelo pomembno vlogo. Zaradi tega je učence potrebno izpostaviti nalogam, kjer spreminjajo vnaprej podane programe, jih dopolnjujejo in popravljajo. Zelo primerne so naloge, ki omogočajo zlaganje koščkov kode v ustrezen vrstni red, o čemer pišemo v poglavju 3.4.5 Parsonsov tip nalog.

3.4.1 Naloge na mreži

Pri večini nalog na Pišku reševanje poteka na mreži (npr. Slika 5 ali Slika 6). Junak se po mreži pomika in pri tem izvaja določena opravila (npr. Pišek pobira zrna).

3.4.2 Želvja grafika

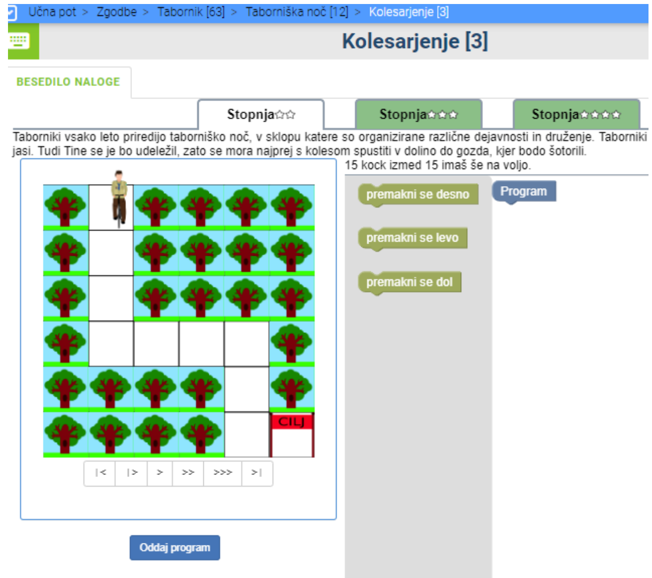
Vrsta nalog predvideva uporabo želvje grafike, pri katerih mora učenec z ustreznimi ukazi poustvariti zahtevano sliko/vzorec. Večina teh nalog je v sklopu Programski koncepti/Želva.



Slika 8. Naloga z želvjo grafiko

3.4.3 Naloge tipa »sestavi program«

Večina nalog zahteva, da reševalec sestavi ustrezen program od začetka. Pri tem ima lahko na voljo le izbrane ukaze (Slika 9), kjer so na voljo le trije osnovni ukazi za premikanje (ni pa ukazov za npr. zanko).



Slika 9. Napiši program z izbranimi ukazi

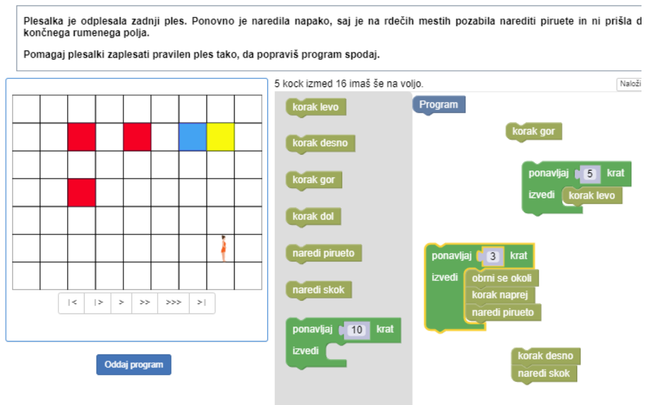
3.4.4 Naloge tipa »popravi program«

Določene naloge so klasične programerske, kjer program prebere določene podatke in izpiše rezultat (Slika 10). Spodaj je primer naloge, kjer je program že dan, vendar pa naloge ne reši pravilno. Učenec mora poiskati napake in jih odpraviti.

Slika 10. Popravi program

3.4.5 Parsonsov tip nalog

Pri teh nalogah imamo delčke kode že na delovni površini. Naloga učenca je, da jih zloži v pravilni vrstni red (Slika 11). Obstaja več različnih podvrst Parsonsonovega tipa nalog [17], ko je npr. delčkov kode preveč oziroma so med ustreznimi skriti tudi napačni ali pa so zloženi na napačnih mestih ipd.



Slika 11. Naloga Parsonsonovega tipa

3.4.6 Druge logične naloge

Poleg naštetih se v razdelku Programski koncepti / Razno nahaja nekaj nalog, ki se ne rešujejo s povezovanjem blokov v programe. Pri teh nalogah mora uporabnik predvsem razmisliti, kako sploh priti do rešitve, ter jo potem na določen način (ne nujno s povezovanjem blokov) vpisati v računalnik. Tako morajo na primer pri nalogi Pacman ubežati duhcu, pri nalogi Zlaganje paketov pa z žerjavom premikajo škatle zložene v stolpce.

Med drugim sestavljalci nalog ta razdelek uporabljamo kot peskovnik, v katerem preizkušamo nove tipe nalog.

4. NAMESTO ZAKLJUČKA

Del Portala Pišek je nastal v okviru projekta *Naloge za poučevanje in učenje računalniškega mišljenja – Portal Pišek (NPUR)*, ki je potekal v okviru javnega razpisa *Projektno delo z negospodarskim in neprofitnim sektorjem – študentski inovativni projekti za družbeno korist 2016–2020*, sofinanciranega s strani Evropskega socialnega sklada, Ministrstva za izobraževanje, znanost in šport Republike Slovenije ter Javnega štipendijskega, razvojnega, invalidskega in preživninskega sklada Republike Slovenije.

Osnovnošolski učitelji so Piška že testirali v razredih in avtorjem posredovali večinoma pozitivne odzive. Podrobneje pa je portal in naloge na njem spoznalo 22 udeležencev Počitniške šole programiranja, umetnosti in etike v organizaciji Zavoda Vsak, ki je avgusta potekala v Poligon kreativnem centru. Mentorji so nam sporočili, da so se učenci in učenke, stari 11-13 let, med reševanjem nalog poglobili in za dve uri popolnoma umolknili ...

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Izdelava šolskega časopisa in medijsko opismenjevanje

Creating a school newspaper and media literacy

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POVZETEK

Multimedijska družba, v kateri danes živimo, je zasičena s številnimi podatki in informacijami. Za mlade, ki ustvarjajo šolski časopis, je nadvse pomembno, da znajo dostopati do informacij, jih ustrezno selekcionirati, kritično vrednotiti in na podlagi tega ustvariti prispevke, primerne za objavo. Na Osnovni šoli Antona Martina Slomška Vrhnika že vrsto let izhaja šolski časopis, z izdelavo katerega spodbujamo njihovo medsebojno sodelovanje, medpredmetno povezovanje in razvijanje veščin medijskega opismenjevanja.

Ključne besede

Medijsko opismenjevanje, šolski časopis, IKT (informacijsko-komunikacijska tehnologija)

ABSTRACT

The multimedia society we live in today is burdened with the abundance of data and information. It is of utmost importance for young people creating a school newspaper, to be able to access information, select it appropriately, critically evaluate it and to form satisfactory contributions ready for publication. At the Anton Martin Slomšek Vrhnika Elementary School the school newspaper has been published for many years. In its' production the pupils have been encouraged in developing their mutual cooperation, cross-curricular integration and the development of media literacy skills.

Keywords

Media literacy, school newspaper, ICT (information and communication technology)

1. UVOD

Različni mediji in z njimi povezane tehnologije so se skozi čas prostorsko, zgodovinsko in kulturno različno razvijali. Prav tako je s šolskimi časopisi, ki se navezujejo na bogato izročilo osnovnošolskih novinarskih oziroma dopisniških krožkov ter uredništev šolskih glasil. Številne osnovne šole v Sloveniji izdajajo različna šolska glasila, vsem pa je skupno, da vsebujejo prispevke učencev in njihovih učiteljev, ki so povezani s šolsko ali obšolsko tematiko.

»Medijska pismenost je zmožnost dostopa, analize, ocene in ustvarjanja sporočil v najrazličnejših medijih.« [1] . Zato je glavni cilj pri ustvarjanju šolskega časopisa, da učencem poleg tehnične usposobljenosti pridobiti določene informacije privzgojimo tudi sposobnost kritičnega razmišljanja in vrednotenja le-teh. Spodbujamo jih tudi, da na podlagi pridobljenih informacij tvorijo lastna (publicistična, propagandna) besedila ter se pri tem posvečajo tudi opazovanju jezika in sloga. »Ključna vloga, ki jo imajo mediji v vsakdanjiku osnovnošolcev, pogosta raba medijev in vsepovsod navzoča medijska kultura kažejo na potrebo po vključitvi učenčevih zunajšolskih izkušenj v šolski predmetnik, razpravi o njih in obdelavi ter izmenjavi le-teh.« [2]

2. ŠOLSKI ČASOPIS NA OSNOVNI ŠOLI ANTONA MARTINA SLOMŠKA VRHNIKA

Šolski časopis, ki smo ga na naši šoli poimenovali Glas izpod Hruševce, nastaja skozi celo šolsko leto, izide pa ob njegovem zaključku, v juniju.

Gre za že tradicionalno vsakoletno šolsko dejavnost, pri kateri sodelujejo učenci od prvega do devetega razreda in tudi njihovi učitelji. Vsi imajo možnost, da se v različnih rubrikah predstavijo s svojimi prispevki (umetnostnimi ali neumetnostnimi besedili, likovnimi izdelki, fotografijami ipd.), ki nastanejo v sklopu pouka, dnevov dejavnosti, raznih prireditev ali v njihovem prostem času. Izmed vseh prispelih prispevkov v šolskem časopisu objavimo najizvirnejše in najboljše.

Do sedaj je izšlo že kar nekaj številk šolskega časopisa, vsaka pa je nekoliko drugačna. Njegovi ustvarjalci se trudijo, da vsak naslednji izvod nadgradijo in izboljšajo.

Slika 1: Različni izvodi šolskega časopisa Glas izpod Hruševce.

Veliko vlogo pri nastajanju šolskega časopisa imajo šolski novinarji. Ti se tekom šolskega leta seznanjajo z novinarskim delom in urijo v vlogi novinarjev, spoznavajo različne oblike publicističnih besedil, pomagajo ustvarjati in zbirati prispevke, sodelujejo pri izboru primernih prispevkov za tisk, te pa nato s pomočjo IKT tudi pretvorijo v digitalno obliko, primerno računalniško oblikujejo in pripravijo za tisk.

3. OD IDEJE DO IZDELAVE ŠOLSKEGA ČASOPISA

Izdelava šolskega časopisa na Osnovni šoli Antona Martina Slomška Vrhnika je glavna dejavnost, ki jo izvajamo v sklopu izbirnega predmeta šolsko novinarstvo. Zahteva posebna znanja in obvladovanje veščin medijske pismenosti.

Zelo pomembno je, da ustvarjalci šolskega časopisa znajo dostopati do različnih podatkov in informacij, do njih ustvarjajo kritičen odnos, jih znajo ustrezno selekcionirati ter na podlagi dobljenih podatkov izdelati vsebinsko in slogovno ustrezen izdelek za objavo.

V veliko pomoč pri ustvarjanju časopisa pa so jim tudi znanja in veščine, ki jih pridobivajo pri drugih šolskih predmetih (npr. pri slovenščini, likovni umetnosti, računalništvu ipd.), zato gre tukaj tudi za medpredmetno povezovanje.

Delo je raznoliko in poteka po točno določenih korakih in pod budnim očesom mentorja, ki za učence načrtuje posamezne aktivnosti, jih pri tem ustrezno spodbuja in usmerja.

Učence najprej usmerjamo k branju različnih vrst tiska (revij, časopisov), spremljanju radijskega in televizijskega programa ter oblikovanju kritičnega odnosa do medijev. S sošolci nato izmenjujejo svoja mnenja. Prebirajo tudi časopise, ki so jih izdelali njihovi vrstniki z drugih šol, jih primerjajo s svojim časopisom ter jih kritično vrednotijo.

Prav tako zbirajo izrezke iz tiskanih medijev ter jih razvrščajo glede na novinarske zvrsti, dodajajo svoje zaznamke in opombe ter podčrtujejo bistvene podatke (zgradbene prvine, tipične izraze ipd.). Seznanjajo se z različnimi vrstami publicističnih besedil (npr. novica, poročilo, reportaža, intervju, anketa, članek, ocena ipd.) ter določajo njihove bistvene sestavine. V pisanju različnih vrst besedil pa se preizkušajo tudi sami.

S publicističnimi besedili pokrivajo aktualno dogajanje na šoli in njeni neposredni okolici. Zelo dobrodošle za mlade novinarje in njihovo delo pa so tudi informacije poklicnih novinarjev, ki jih povabimo v goste ali pa obiščemo kakšno od televizijskih, radijskih ali časopisnih hiš.

3.1 Uredniški odbor

Šolski časopis nastaja po točno določenih korakih. Najprej je potrebno oblikovati uredniški odbor. Vsak od sodelujočih tako dobi naloge, ki so skladne z njegovimi zanimanji in sposobnostmi. Potrebno je izbrati tudi glavnega urednika, ki mu pomaga pomočnik, med ostalimi člani uredniškega odbora pa je potrebno določiti tudi urednike posameznih časopisnih rubrik.

Člani uredniškega odbora imajo nalogo, da določijo, kako se bo šolski časopis imenoval. Pri tem morajo upoštevati, da bo njegovo ime izvirno, zanimivo, ustrezne dolžine, ter da se bo ujemalo z vsebinami, ki jih predstavlja. Naš šolski časopis smo poimenovali Glas izpod Hruševce in mu tako dodali še prostorsko noto.

3.2 Zbiranje in urejanje gradiva

Da lahko šolski časopis izide, je potrebno zbrati dovolj kakovostnih prispevkov, k čemur pripomore dobra promocija novinarskega dela in spodbujanje vseh učencev naše šole k sodelovanju.

Učenci se aktivno udeležujejo tudi vseh šolskih prireditev in dogodkov, ki jih nato obeležijo z različnimi besedili (članki, intervjuji, poročili ipd.) ter fotografijami. Pri svojem delu pa si pomagajo tudi z raznimi priročniki, leksikoni, slovarji in drugimi viri.

Skozi vse šolsko leto poteka zbiranje različnih prispevkov za objavo v šolskem časopisu. Pri tem lahko sodelujejo prav vsi učenci in učitelji naše šole. Najboljše izdelke iz posameznih razredov zberejo razredniki in jih posredujejo uredniškemu odboru, ki jih nato skrbno pregleda, prebere, argumentira, kritično presodi njihovo ustreznost in za objavo izbere najboljše.

Glede na prispele prispevke uredniški odbor izdela osnovni koncept časopisa in določi časopisne rubrike, kamor uvrsti posamezne prispevke. Kot naslov časopisa morajo biti tudi naslovi posameznih rubrik izvirni, zanimivi in odražati morajo tematiko, ki jo posamezne rubrike predstavljajo. Pri tem se pogosto poslužujemo metode debate in viharjenja možganov. Tako nastajajo zanimive ideje, prebliski, izvirne besedne zveze ipd. Pa tudi vsebine morajo biti pestre in v raznolikih besedilnih vrstah, ki jih učenci spoznavajo v okviru pouka slovenščine oziroma izbirnega predmeta šolsko novinarstvo.

Šolski časopis običajno zajema naslednje vsebine:

- uvodnik (napiše ga glavni urednik);
- kolofon (zajame osnovne podatke o publikaciji, založniku, nakladi, letu izida ipd.);
- kazalo strani;
- informativne oblike (vsebujejo novice o šolskih in obšolskih dogodkih);
- literarni del (v njem objavljamo umetnostna besedila);
- zabavne strani (namenjene so zabavi in razvedrilu).

Da pa je šolski časopis zanimivejši in lepši, vanj umestimo tudi slikovno gradivo. To so običajno izdelki, ki jih učenci ustvarijo v okviru pouka likovne umetnosti in fotografije z različnih dogodkov, ki se zvrstijo tekom šolskega leta.

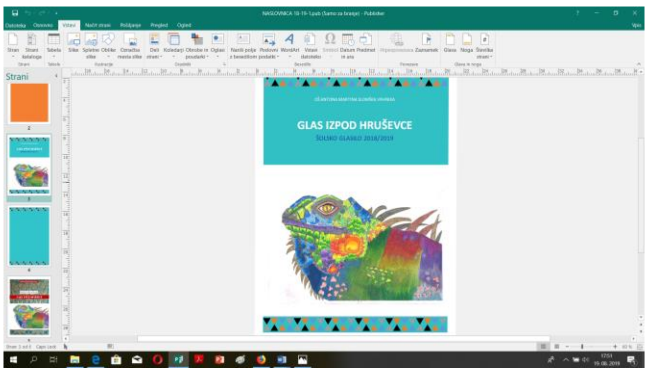
3.3 Digitalizacija in tisk

Ko je osnovni koncept časopisa izdelan, sledi njegova pretvorba v digitalno obliko s pomočjo IKT (informacijsko-komunikacijske tehnologije), zato delo običajno poteka v sodobno opremljeni računalniški učilnici. Ta zajema tipkanje besedil, preslikavo grafičnega gradiva (risb, slik, fotografij) s pomočjo skenerja ter oblikovanje v različnih računalniških programih.

V zadnji fazi izdelave šolskega časopisa se priključita še likovni in tehnični oblikovalec. Vlogo korektorjev besedil in lektorjev pa prevzamejo udeleženci, ki najbolje obvladujejo slovenski jezik in pravopis.

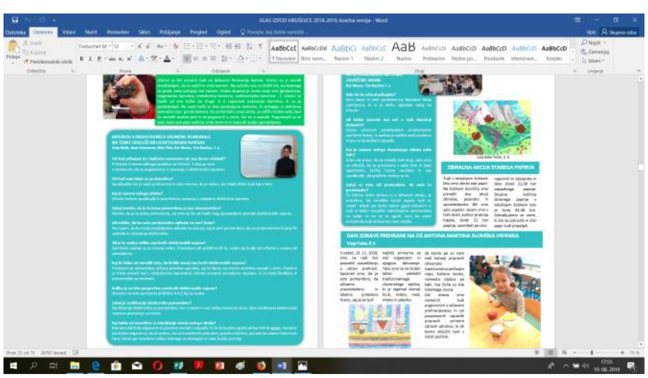
Pri izdelavi našega šolskega časopisa najpogosteje uporabljamo računalniška program Word, ki je namenjen urejanju in oblikovanju besedil ter Slikar, ki je namenjen enostavnemu grafičnemu oblikovanju, časopisne platnice pa oblikujemo v Publisherju. To so relativno enostavni računalniški programi, ki nudijo pestro paleto možnosti za oblikovanje besedil in slik. Osnovnošolci običajno obvladajo osnovno oblikovanje le-teh, za primer zahtevnejšega oblikovanja pa za pomoč prosijo njihovega mentorja ali pa si pomagajo s spletnimi navodili za uporabo.

Za izdelavo platnice v Publisherju je potrebno pripraviti ustrezen format podlage, na kateri bomo ustvarili platnice (naslovna in zadnja stran časopisa). Izberemo ustrezne barve in vzorce, ki jih bomo uporabili na platnicah in se bodo kot rdeča nit pojavljale tudi v vsaki izmed časopisnih rubrik. Najbolje je, če se odločimo za manjše število barv (npr. od ene do treh različnih barv). Posebno pozornost pa je potrebno nameniti tudi izbiri naslovnih slik, ki morajo biti ustrezne kakovosti. Tudi tukaj velja pravilo manj je več. Platnice pa opremimo še z naslovom, imenom šole, dodamo pa lahko tudi drugo poljubno besedilo (npr. pesem).



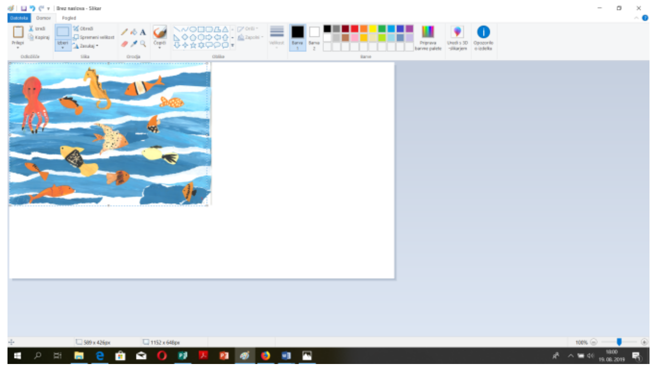
Slika 2: Primer izdelave časopisne platnice v Publisherju.

Ostale strani šolskega časopisa oblikujemo v programu Word. Najprej izberemo ustrezen format podlage in nastavimo širino robov. Nato pričnemo z izdelavo časopisnih rubrik, kamor vstavljamo posamezne prispevke, ki jih razvrstimo glede na tematiko. Pozorni smo tudi na izbiro pisave in njeno velikost. Običajno uporabljamo pisavo Times New Roman, Colibri ali Arial, ki so tudi ustrezno čitljive. Tudi za slikovno gradivo v posameznih rubrikah velja, da mora biti ustrezne kakovosti in velikosti. V spodnji del (nogo) vstavimo tudi število strani.



Slika 3: Primer izdelave časopisnih strani v Wordu.

V primeru, da slikovno gradivo ni ustreznih dimenzij, ga obrežemo v Slikarju. Slikar nam omogoča tudi, da ga obrnemo, zrcalimo ipd. V slikarju pa lahko izdelamo tudi razne oblike (kvadrate, puščice ipd.), nudi pa tudi številne druge možnosti.



Slika 4: Primer obdelave grafičnega gradiva v Slikarju.

Za zunanjo podobo poskrbijo likovni in tehnični oblikovalci, lektorji pa za pravopisno in slogovno ustreznost.

Ko je časopis tehnično in lektorsko urejen, sledi tisk. Časopis v manjši nakladi (približno 80 izvodov) barvno natisnemo na šolskem tiskalniku in zvežemo s spiralno vezavo.

4. ZAKLJUČEK

Izdelava šolskega časopisa ima številne pozitivne učinke. Na naši šoli je to že dobro utečena dejavnost, ki zajema sodelovanje vseh učencev in učiteljev in s tem tudi krepitev socialnih veščin.

Preplet specifičnih znanj različnih šolskih predmetov, ki so potrebna pri nastajanju časopisa, nakazuje tudi na medpredmetno povezovanje. Učenci se urijo v branju ter pisanju umetnostnih in neumetnostnih besedil, fotografiranju in likovnem ustvarjanju. Uporabljajo tudi IKT, predvsem pri pretvorbi pisnega in slikovnega gradiva ter njegovem oblikovanju v različnih računalniških programih.

Izdelava šolskega časopisa pa igra tudi veliko vlogo pri medijskem opismenjevanju, saj učence spodbuja k pridobivanju podatkov in informacij ter njihovemu kritičnemu vrednotenju. Spodbuja pa tudi, da še sami izdelajo različne prispevke, ki so primerni za objavo.

5. VIRI IN LITERATURA

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[3] Učni načrt za izbirni predmet gledališki klub, literarni klub, šolsko novinarstvo. Ljubljana: Ministrstvo za šolstvo, znanost in šport, Zavor Republike Slovenije za šolstvo: Dostopno na naslovu: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/devetletka/predmeti_izbirni/Slovenscina_izbirni.pdf (19. 8. 2019) (2003).

Obravnava poezije s pomočjo video ustvarjanja

Teaching poetry through video making

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POVZETEK

Prispevek predstavlja enega od načinov video ustvarjanja pri pouku slovenščine v 3. triletju osnovne šole. V svoje učne ure smo ga uvedli kot odziv na naraščajoče upadanje interesa za branje leposlovja, konkretno poezije. Na praktičnem primeru obravnave Prešernove *Turjaške Rozamunde* v 8. razredu opišemo potek dela po korakih od idejne zasnove do končnega izdelka in evalvacije. Naš namen je deliti praktične izkušnje in podati nekaj osnovnih smernic za to dejavnost. Pri svojem delu smo izhajali iz ciljev, standardov znanj in priporočil učnega načrta za slovenščino. Soočanje klasičnih književnih vsebin in digitalnih spretnosti je pokazalo številne pozitivne učinke: omogočilo je izčrpno in privlačno vsebinsko-idejno razčlembo in aktualizacijo poezije, razvijanje digitalnih kompetenc, kritičnega mišljenja, učenci so bili pri delu motivirani in aktivni, delovali so projektno in timsko. Vizualizacija s pomočjo video orodij je zaradi svoje učinkovitosti postala stalnica pri našem pouku slovenščine. Opisani praktični primer potrjuje mnenje stroke, da je uvajanje digitalnih spretnosti v književni pouk smiselno in zaželeno.

Ključne besede

Osnovna šola, poezija, video ustvarjanje

ABSTRACT

The article presents a way of integrating video making into Slovene literature lessons in the third triad of primary school, with the intention of improving our students' motivation to read poetry. Based on a practical example of the eighth grade students and their video made on the literary basis of France Prešeren's poem *Turjaška Rozamunda*, we illustrate the stages leading the mentor and her students from the initial idea to its final realisation and evaluation. Following the national curriculum propolsals, the article aims to share practical experience and provide some basic guidelines for such activity. During the creative process of joining literary education and digital learning, it was possible to identify several benefits of the activity, namely profound and attractive content analyses and actualisation of the poem, developping digital skills, critical thinking, greater motivation of the students in Slovene literature lessons, good project and team work. Due to its efficiency, using video tools has become very appreciated and regulary used method in our Slovene classroom. The presented practical example confirms the favorable opinion of the profession of introducing digital activities into the literature lessons.

Keywords

Primary school, poetry, video making

1. UVOD

Znano je, da učitelji slovenščine že leta zaznavamo velik upad interesa za branje leposlovja, kar potrjujejo številne raziskave[1]. Enotno mnenje stroke je, da lahko k temu pozitivno doprinesejo le ustrezni motivacijski dejavniki[2]. Digitalno pripovedovanje zgodb (ang. *digital storytelling*) je eden učinkovitih načinov motiviranja učencev za branje leposlovja. Med zanimive oblike pripovedovanja zgodb sodijo tudi video posnetki v obliki kratkih filmov, zato jih kot eno od oblik umetnosti vidimo tesno povezanega s poukom književnosti. Njihov glavni motivacijski potencial pripisujemo predvsem enemu razlogu: učencu omogočajo avtonomnost in svobodo pri ustvarjanju. Mladi na ta način stika z leposlovjem ne doživljajo kot šolsko delo, temveč kot način komunikacije v sodobnem svetu [6]. Do filma izkazujejo velik interes in so ob začetnih srečanjih z različnimi oblikami filmske vzgoje praviloma že vešči uporabniki avdiovizualne ustvarjalnosti; pridobijo nove izkušnje z javnim nastopanjem, organizacijo, sodelovalnim učenjem in delu s sodobnimi tehnologijami; uporabljeno znanje jim koristi pri nadaljnjem delu na področju umetnosti in tudi širše. Predvsem pa je pomembno, da učenci proces ustvarjanja filma praviloma doživljajo kot razgibanega, zanimivega in zabavnega.

Poleg motivacije za stik z leposlovjem obstajajo tudi drugi, širše zaznavni pozitivni učinki. Po *Strategiji razvoja nacionalnega programa filmske vzgoje* gre za skupinsko, projektno delo, ki učence povezuje in ustvarja dobro razredno klimo. Učence postavlja pred specifične izzive, ki jih morajo reševati sproti, samoiniciativno, ob uporabi vrste znanj z različnih področij, tako jezikovnih kot tehničnih in naravoslovnih. Zahteva uporabo različnih novih tehnologij (video, avdio), ki razvijajo digitalno pismenost. Delo zahteva potrpežljivost, kar krepi koncentracijo in delovno disciplino. Zahteva natančno načrtovanje, kritično mišljenje, ustvarjalnost. Glede na vse v strokovnih virih navedene pozitivne učinke smo se odločili s svojimi učenci posneti film in preveriti, v kolikšni meri držijo.

[1] Raziskava Razvoj bralnih zmožnosti učencev v osnovni šoli z bralno značko kaže na upad branja z leti šolanja: v prostem času bere vsak dan 37 % učencev 3. razreda, medtem ko v 7. razredu to počne le še 18 % učencev. Raziskava Socialna ranljivost mladih je pokazala, da kar 23 % osmošolcev knjig nikoli ne bere [1].

[2] Rezultati mednarodne raziskave bralne pismenosti PIRLS iz leta 2001, v kateri so sodelovali slovenski tretješolci, so pokazali, da slovenski učenci in učenke, ki imajo pozitiven odnos do branja, dosegajo višje bralne dosežke od mednarodnih povprečnih rezultatov, medtem ko ostali ne dosegajo niti mednarodnega povprečja [1].

Povod za dejavnost je bil razpis tekmovanja Slovenščina ima dolg jezik 2015/2016[3], v okviru katerega so bili učenci povabljeni k snemanju kratkega filma po predlogi poljubnega literarnega besedila. Za naše učence so bili to prvi usmerjeni koraki k filmu, zato smo se kot mentor bolj kot v naravnanost k tekmovalnemu dosežku usmerili k pridobivanju novih spretnosti, v smislu Konfucijevega načela »Če slišim, pozabim. Če vidim, si zapomnim. Če poskusim narediti sam, razumem.«. Na spletu je na voljo veliko pedagoškega gradiva za vključevanje filma v smislu filmske vzgoje skozi oglede zanimivih filmov, gradiv za učenje snemanja filmov pa je manj. Opremljeni z nekaj začetniškega znanja smo delo zastavili tako, da je bil učitelj usmerjevalec procesa, učenci pa so sodelovali z idejami in opravljali delo. Ves čas smo imeli v zavesti pozitivno izkušnjo, ki jo bodo dobili učenci.

V nadaljevanju bomo po korakih predstavili proces nastajanja našega videa na temo Prešernove pesmi *Turjaška Rozamunda*. Pri delu smo se orientirali po priporočilih spletnih strani *VISION - video school online*, *BFI classroom resources for teachers*[4] in predavateljev Mihe Hočevarja in Matevža Luzarja na seminarju za mentorje filmske dejavnosti[5]. Končni izdelek učencev je na ogled na povezavi https://www.youtube.com/watch?v=JhcpfUPfr8E.

2. USTVARJANJE KRATKEGA FILMA »TA SLADKA ROZA«

2.1 Priprava na snemanje filma

Dela smo se lotili z učenci 8. razreda. Ob obravnavi Prešernove pesmi *Turjaška Rozamunda* v razredu smo jih povabili k izzivu – posneti 10-minutno video predstavitev pesmi v obliki kratkega filma. Po začetnih pogovorih se je izoblikovala skupina 10 učencev, s katerimi smo začeli resneje ustvarjati. Srečevali smo se enkrat tedensko v okviru dodatnega pouka, po potrebi večkrat in po sprotnem dogovoru, komunikacija je velikokrat potekala tudi po elektronski pošti. Učenci so k dejavnosti pristopili z veliko začetniškega entuziazma. Takoj bi začeli s snemanjem. Zato je bil glavni mentorski napotek v tej fazi to, da je pogoj za kakovosten filmski izdelek dobra predpriprava. Učence smo želeli usmeriti k načrtovanju pisanja scenarija, izbire igralske ekipe, uporabe tehnologije. Pred začetkom snemanja so morali imeti jasno predstavo o tem, kakšen film želijo narediti.

V nadaljevanju predstavljamo, iz katerih izhodišč smo izhajali med pripravo na film, kaj vse smo z mentorske plati izpostavili. Posebno pozornost namenjamo pripravi scenarija, opišemo načrtovanje snemanja in dejansko snemanje ter postopek montaže.

2.1.1. Kakšen film želimo posneti?

a) Izberemo žanr.

Za potrebe tekmovanja smo bili po dolžini omejeni na 10-minutni kratki film. Takoj na začetku so bili učenci soočeni z dilemo, v kateri žanr naj preoblečejo izvirno zgodbo; bo to akcijski film, ljubezenski, komedija itd.? Vsak učenec je na list zapisal svojo izbiro in jo ustrezno utemeljil. Ideje učencev so bile drzne, zanimive, a s praktičnega vidika težko izvedljive. Zelo očitno je bilo, da jih pri razmišljanju vodi njihova izkušnja s hollywoodskimi filmi. Na koncu smo se odločili za žanr telenovele. Pobrskali smo po spletu in našli naslednjo definicijo: Telenovela je televizijska nadaljevanka, ki predstavlja življenja oseb s poudarkom na čustvenih odnosih med njimi (Wikipedia, geslo *soap opera*). Učenci so jo sami opredelili še z naslednjimi značilnostmi: polna je ljubezenskih zapletov, ki so za junake usodni; ljubezen junake vodi v nepremišljena dejanja; med junaki je polno konfliktov; besedilo ni zapleteno; posnete so v preprostih pogojih, največkrat kar v studiu; kadri so preprosti. Ko smo potegnili vzporednico s Prešernovo pesmijo, smo dobili kar nekaj skupnih točk: usodna ljubezen Rozamunde in Ostrovrharja, Rozamundina nepremišljenost, Ostrovrharjeva ljubezen do Lejle …, kar se je zdela izvrstna snov za našo šolsko telenovelo.

b) Seznanimo se z osnovnimi strokovnimi izrazi.

Zaželeno je, da učenci poznajo osnovno filmsko terminologijo. Uvedli smo jo s pomočjo spleta in literature (*Filmskega pojmovnika za mlade*) v obliki skupinskega dela. Da tega dela priprav učenci ne doživljajo kot monotonega, je pomembno, da so tudi v tej fazi samostojni in aktivni. Posamezne skupine smo zadolžili za razlago določenih terminov, o katerih so na naslednjem srečanju poročali sošolcem. Za ponazoritev smo uporabili odlomke iz filmov – opazovali smo npr. iz koliko kadrov so sestavljeni. Uvedli smo naslednjo terminologijo: filmski plan, načini gibanja kamere, kader, prizor, prehod, rez, smer pogleda, scenarij in snemalna knjiga.

c) Določimo kriterije.

Ker se nam je zdelo pomembno, da so učenci med delom samokritični, smo jih pred pisanjem scenarija spodbudili k razmisleku, katerim kriterijem želijo s filmom zadostiti. Sklenili so, da mora imeti zanimivo zgodbo, biti mora izviren, zabaven, imeti mora čist zvok in sliko, igralci morajo biti prepričljivi, v skladu s pravili tekmovanja pa smo dodali še, da se mora držati literarne predloge, imeti mora jasno izraženo sporočilo, narejen pa mora biti do določenega datuma.

2.1.2 Kako napisati dober scenarij?

a) Odločimo se, katere elemente izvirnika želimo ohraniti in katere bomo spremenili.

Pri odločitvi je učence usmerjalo dejstvo, da gre za žanr telenovele in da je dogajanje aktualizirano, torej postavljeno v sodobni čas in prostor. Najprej smo skupaj določili ključne elemente izvirne zgodbe, nato pa so aktualizacijo učenci po dolgi diskusiji predstavili v pisni obliki, kar prikazuje tabela 1.

Tabela 1: Primerjava izvirnega in prirejenega scenarija

IZVIRNIK	PRIREDBA
Glavni junakinji je ime Rozamunda.	Glavni junakinji je ime Roza.
Rozamunda je graščakova hči, živi na gradu.	Roza prihaja iz bogate družine, živi v moderni vili.
Rozamunda je samovšečna in prevzetna.	Roza je samovšečna in prevzetna.
Rozamunda daleč naokrog slovi po svoji lepoti.	Roza daleč naokrog slovi po svojem talentu za peko slaščic.
Rozamundi oče priredi zabavo,	Rozi oče priredi zabavo, na

[3] Informacije o tekmovanju so objavljene na https://sites.google.com/site/slavisticnodrustvo/znam.

[4] http://vision.wettintv.de/?lang=sl_si, https://www.bfi.org.uk/education-research/teaching-film-tv-media-studies.

[5] Izobraževanje za mentorje in somentorje tekmovanja Slovenščina ima dolg jezik, Ljubljana, 20. 9. 2015.

na kateri bo izbrala moža.	kateri bo izbrala pekovskega asistenta.
Na zabavo pridejo tudi pomembni baroni: *troje iz dežele nemške, troje iz dežele laške*.	Na zabavo pridejo tudi pomembni gostje, npr. nemški chef in italijanski chef.
Med snubci izstopa Ostrovrhar, *ki so boji mu igrače*.	Med kandidati za asistenta izstopa Vili Špica, ki so pogače mu igrače.
Potujoči pevec pove, da je v Bosni dekle Lejla, ki je lepše od Rozamunde.	Pevec zapoje pesem o Lejli, ki na drugem koncu mesta peče boljše pecivo od Rozinega.
Rozamunda zahteva od Ostrovrharja, naj gre v Bosno preverit, če je Lejla res lepša.	Roza zahteva od Vilija Špice, naj gre na drugi konec mesta preverit, če je Lejlino pecivo res boljše.
Rozamunda se zaobljubi, da bo šla v samostan, če je Lejla res lepša od nje.	Roza se zaobljubi, da bo opustila peko in šla študirat medicino, če je Lejlino pecivo res boljše od njenega.
Ostrovrhar odide in se sooči z izzivom.	Vili Špica odide in se sooči z izzivom.
Lejla je muslimanka, bašetova sestra (sestra turškega dostojanstvenika).	Lejla je muslimanka, rada peče baklave. Lastnik lokala je njen brat Baše (njegov vzdevek, saj se ves čas »baše« s hrano).
Ostrovrhar mora premagati muslimansko vojsko, če hoče odpeljati Lejlo.	Vili Špica mora prepričati brata Baša, da je dovolj dober za Lejlo.
Ostrovrhar se zaljubi v Lejlo in zapusti Rozamundo.	Vili Špica se zaljubi v Lejlo in zapusti Rozo.
Lejla opusti muslimansko vero in se spreobrne v krščanstvo.	Lejla sklene, da odslej ne bo več pekla samo baklav, ampak tudi potice in druge slovenske jedi.
Rozamunda izpolni obljubo in odide v samostan.	Roza izpolni obljubo in odide na medicinsko fakulteto.

b) Odločimo se, katero sporočilo želimo posredovati.
Aktualizaciji navkljub so se učenci strinjali, da izvirnega sporočila ne bodo spreminjali. Obdržali bodo idejo o prevzetnem dekletu, ki je zaradi samovšečnosti in zavisti kaznovano.

c) Lotimo se pisanja scenarija.
Ta del ustvarjalnega procesa je bil za učence najbolj zahteven, potrebovali so veliko mentorskih napotkov in usmeritev. Še vedno smo jim želeli pustiti proste roke in smo posredovali le na mestih, kjer se je scenarij preveč oddaljil od zgodbe, kjer je postal nerazumljiv, dolgovezen, kjer so učenci dodajali preveč besedila, ki za potek zgodbe ni bilo bistveno ali kjer nismo videli realnih možnosti za uresničitev.

Pri sestavljanju scenarija smo se ravnali po klasični strukturi, ki smo jo za šolsko rabo poenostavili. Posamezne stopnje scenarija prikazuje tabela 2. Pri zapisu scenarija pa smo izhajali iz klasičnih priporočil, ki so dostopna tudi na spletu (na primer https://www.writersstore.com/how-to-write-a-screenplay-a-guide-to-scriptwriting/).

Tabela 2: Struktura scenarija

UVOD	Kdo je protagonist, kdo je antagonist?	Protagonist – Roza, antagonist – Lejla.
	Kdo so ostali liki?	Ostali liki so: Rozin oče, Rozine prijateljice, Hans Schtrudel, Raffaello Baci, gostje na zabavi, pevec, Baše, Lejla.
	Kje se zgodba dogaja?	Zgodba se dogaja: pri Rozi doma, v slaščičarni »Pri sladki Rozi«, na ulici, v slaščičarni »Pri Bašetu«, v učilnici medicinske fakultete.
	Kaj je glavni problem, zaplet?	Roza bi rada postala še uspešnejša, išče novega asistenta.
JEDRO	Protagonist rešuje problem.	Roza priredi zabavo.
	Na začetku mu uspeva.	Zanjo se zanimajo številni uspešni kuharski chefi, tudi najboljši med njimi – Vili Špica.
	Nato pride neuspeh.	Izve, da neko dekle peče boljše slaščice od nje.
	Protagonist je na dnu.	Ne ve, kako bi se rešila iz negotovosti.
	Potrebuje idejo.	Zadolži Vilija, da ji pomaga priti resnici do dna.
ZAKLJUČEK	Rešitev problema.	Problem se razreši v nasprotju z Rozinimi pričakovanji, Vili jo zapusti.
	Naš protagonist ni isti človek kot je bil na začetku.	Spozna svojo napako.
	Izkušnja ga je spremenila.	Opusti svojo največjo ljubezen, peko pečic, in se posveti študiju medicine.

d) Napišemo storyboard oz. snemalno knjigo.
Ko je scenarij napisan, je potrebno poskrbeti, da imajo vsi, ki sodelujejo pri snemanju, isto vizijo, kako naj bi posnetki izgledali. Izdelati smo morali storyboard. Pomemben je za nazoren načrt snemanja. Podoben je stripu: vsak prizor je narisan, kader za kadrom, in sicer v ustreznem kotu snemanja in filmskem planu. Za storyboard najdemo na spletu številne predloge (npr. http://www.videa.si/storyboard-oziroma-snemalna-knjiga/), lahko pa ga naredimo čisto po svoje. Pomembno je, da učencev pri tem ne omejujemo. Ob izdelovanju storyboarda smo se že začeli pogovarjati tudi o:

- planih – katere plane bomo uporabili in zakaj? Opozorili smo jih na premišljeno rabo bližnjega plana – za prikaz izraza na obrazu, čustvenih stanj;
- kotih – če igralce snemamo od spodaj, bodo videti večji, če jih snemamo od zgoraj, bodo videti manjši, ranljivejši;

- premikih kamere – se bo premikala hitro ali počasi in zakaj? Kakšen učinek želimo doseči s takšno izbiro premikov?

2.1.3 Kako čim bolje načrtovati snemanje?

a) Razdelimo si delo.

Pri tem je zelo pomembno, da so vključeni prav vsi učenci. Iz praktičnega razloga le nekaj učencev, morda samo eden, upravlja s kamero, ostali pa dobijo druge zadolžitve – sodelujejo pri igranju, montaži, pripravi scene, rekvizitov, kostumov, organizaciji snemanja itd. Režijo zaupamo učencu, ki je vpet v nastajanje filma že od vsega začetka, ki izkazuje močno angažiranost in ima morda tudi določene vodstvene sposobnosti.

b) Določimo snemalne lokacije in čas snemanja.

Za snemalne lokacije smo sprva želeli uporabili šolske učilnice, hodnike, igrišče. Po temeljitem razmisleku pa smo se odločili vsaj del dogajanja preseliti na bolj avtentično lokacijo. Če bi hoteli v šolskih prostorih imitirati npr. slaščičarno, bi gledalec to hitro opazil. Učenci so kontaktirali lastnika bližnjega lokala, ki jim je prijazno dovolil snemanje. Ker nismo mogli zahtevati, da bo lokal v času snemanja za goste zaprt, nam je hrup povzročal nemalo težav.

c) Razmislimo o potrebnem tehničnem znanju in opremi.

Načrtovali smo nekaj ur v šolski računalniški učilnici za preizkušanje različnih programov za montažo. Ugotovili smo, da ima veliko učencev široko filmsko in tehnično znanje, ki so ga delili z ostalimi učenci. Na ta način so pomembno doprinesli k procesu nastajanja filma, pridobili spoštovanje sošolcev in učiteljev ter okrepili samozavest. Pred odločitvijo za opremo smo morali tudi razmisliti, ali potrebujemo vrhunsko kamero in profesionalni program za montažo ali pa bo za naše potrebe bolj smiselno, če uporabimo osnovno kamero, mobilni telefon ali digitalni fotoaparat s funkcijo snemanja. Odločili smo se za opremo, ki je bila dostopna na šoli: šolsko kamero, prenosni računalnik, slušalke in za preprost brezplačen Windows program Movie Maker, za katerega smo ocenili, da zadošča začetniškim potrebam[6].

2.2 Snemanje in montaža

a) Pred snemanjem se dobro seznanimo z besedilom.

Da bi se izognili zapletom na snemanju, smo organizirali nekaj predhodnih srečanj z igralci in vadili posamezne prizore. Na vaji je bila prisotna tudi režiserka, ki je pomagala voditi igralce na način, kot si ga je zamislila.

b) Lotimo se snemanja.

Snemalec se je pred snemanjem prepričal, ali ima kamera napolnjene baterije, ali je prižgana, ali je vklopljen pravi način. Vedno mora biti iti vklopljen način 'landscape', sicer bomo imeli pri montaži s preprostimi programi težave. Raje kot dolge sekvence smo snemali kratke kadre. Kamero je čim manj premikal, če že, pa je bilo premikanje počasno. Med snemanjem je pazil, da ni uporabljal zooma. Poskusili smo ujeti kar najboljšo svetlobo; nismo snemali proti luči ali proti zelo temnemu ozadju. Vedno smo skušali posneti dovolj materiala (vsaj 10 sekund brez prekinitve, sicer so lahko pri montaži težave). Na snemanju smo učence spodbujali k redu in disciplini, kar pa je bilo velikokrat težko; želeli so sodelovati s predlogi, obenem pa je nekajkrat postalo utrujajoče in so izgubili koncentracijo.

c) Posneto gradivo zmontiramo.

Montaža filma je izjemno kompleksno delo, ki zahteva natančnost in čas. Razdelili smo ga med več dvojic učencev, ki so sestavili posamezne dele filma. Pred montažo smo se pogovorili o:

- *dodajanju glasbe, zvokov, posebnih efektov*: Želeli smo jih usmeriti k uporabi avtorske, nekomercialne glasbe, k premišljeni izbiri. Stališče učencev se je na tej točki razlikovalo od mentorjevega; z različnimi glasbenimi in zvočnimi dodatki so na določenih mestih pretiravali.
- *uporabi prehodov*: Kateri prehodi so najbolj smiselni – bomo uporabili čisti rez ali preliv (za premostitev časa), črno-belo sliko (za flashback)?
- *vstavljanju naslovov, podnapisov in zaključnih napisov*: Za kakšen stil pisave in pojavitve se bomo odločili? Poskusimo najti takšnega, ki se najbolj ujema z žanrom in zgodbo.

2.3 Utemeljenost video ustvarjanja z učnim načrtom za slovenščino

Pri dejavnosti smo izhajali iz določil učnega načrta za slovenščino. Video ustvarjanje po motivih literarnega dela sledi naslednjim ciljem, standardom znanj in priporočilom[7]:

- učenci razvijajo recepcijsko zmožnost (doživljanje, razumevanje, vrednotenje književnih besedil);
- zaznavajo, primerjajo, presojajo ravnanje in govorjenje, mišljenje osebe ter do nje vzpostavijo kritično razdaljo;
- razvijajo sposobnost vživljanja v književno osebo, ki je drugačna od njih;
- prepoznajo značilnosti socialnega položaja književnih oseb in poskušajo razumeti tudi psihološke in etične lastnosti posamezne osebe;
- oblikujejo čutnodomišljijske predstave književnega prostora in časa;
- opazujejo vzročno-posledična in časovna razmerja med dogodki v besedilu;
- kronološko razvrščajo dogodke;
- obnavljajo, strnjeno povzemajo dogajanje;
- določajo motive v književnem besedilu;
- doživljajo pesemske slike in se zavedajo njihovega učinka na bralca;
- zluščijo osrednjo idejo in temo književnega besedila;
- ustvarjalen in kritičen dialog z besedilom ustvarijo tako, da ga slogovno preoblikujejo (prestavljanje dogajanja v sodobnost ali drug prostor);
- pri sprejemanju, razčlenjevanju in tvorjenju umetnostnih besedil kot podporo kritičnemu mišljenju, ustvarjalnosti in inovativnosti, za izdelavo, predstavitev in razumevanje kompleksnih informacij uporabljajo digitalno tehnologijo in razvijajo digitalno pismenost.

[6] Opisano dejavnost smo izvajali leta 2015, vsi filmi, ki so nastali v kasnejših letih, so bili posneti z mobilnim telefonom in zmontirani z brezplačnimi on-line movie editing programi.

[7] Učni načrt za slovenščino, str. 56-109.

3. ZAKLJUČEK

Predstavljena izkušnja snemanja filma kot del pouka književnosti je pokazala številne pozitivne učinke, soočili pa smo se tudi z nekaterimi težavami. Kot smo predvidevali, se je močno dvignil nivo motiviranosti za raziskovanje književnih del, v našem primeru *Turjaške Rozamunde*. Učenci so pokazali velik interes do podrobne vsebinsko-idejne analize, ki so jo oplemenitili s svojimi predlogi za aktualizacijo zgodbe. Ob pisanju scenarija smo razvijali njihovo zmožnost pisnega izražanja. Za izvajanje dejavnosti je bilo potrebno veliko diskusije, pri čemer so učenci razvijali občutek za strpno izmenjavo mnenj in sodelovalno, problemsko naravnano učenje. Odnos z učiteljem je postal manj formalen, bolj sproščen. Med delovnim procesom so veliko pridobili učenci s slabšim učnim uspehom ali socialno bolj izločeni učenci, ki so lahko tvorno sodelovali pri različnih zadolžitvah, krepili socialne spretnosti, sposobnost koncentracije, bili so sproščeni in usmerjeni k cilju. Prinesel je veliko novih tehničnih znanj, ki jih bodo učenci v prihodnjih letih lahko še izpilili. V pripravo filma je bilo vključenih veliko predmetnih področij: jezikovno, likovno, računalniško, glasbeno. Film je zaznamoval celotno življenje na šoli, saj so ob opazovanju snemanja tudi ostali učenci in učitelji težko pričakovali končni izdelek. Proces smo zaključili s slovesno podelitvijo priznanj, saj se nam zdi pomembno ustvariti primerno vzdušje in sodelujoče simbolično nagraditi z javnim priznanjem. Na ta način pritegnemo tudi zanimanje mlajših učencev za sodelovanje v prihodnjih letih.

Med ustvarjanjem filma nam je delo nekajkrat ušlo izpod nadzora, zdelo se nam je, da smo si zastavili previsoke cilje. Čeprav smo bili z izdelkom zadovoljni, smo ugotovili, da bi bilo bolje narediti še krajši film, ki bi bil v celoti dobro premišljen in izveden. Obremenjeni smo bili namreč z dolgimi urami dela, ki mu učenci pri svoji starosti in izkušnjah včasih niso bili kos, kar jih je na trenutke demotiviralo. To pa nikakor ni bil naš cilj. Prav tu se je mentorska naloga izkazala za najzahtevnejšo: ko smo učence želeli usmerjati k sistematičnosti, organiziranosti, ne da bi jim pri tem odvzeli veselje in samoiniciativnost.

Z mentorskega stališča menimo, da bodo učitelji filmsko vzgojo lažje vključevali v pouk, če bodo imeli naslednje spretnosti in znanja:

- osnovno znanje filmskega jezika in ustvarjanja,
- osnovno scenaristično znanje in
- osnovno tehnično znanje (snemanje, montiranje, snemanje zvoka).

V ta namen bi si želeli več usmerjenih izobraževanj na to temo in več vključenosti filmske vzgoje v učne načrte.

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E-gradiva za učitelje športne vzgoje

E-materials for sports education teachers

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POVZETEK

Mnogokrat se učitelji športne vzgoje znajdemo v situaciji, v kateri ne zmoremo več demonstrirati vseh elementov tehnike športa, ki je na programu učnega načrta, zato lahko zaidemo v težave, a se mnogokrat znajdemo vsak po svoje. Da bi lahko kvalitetno in brez težav poučevali tudi športe, v katerih ne obvladamo vseh tehničnih elementov, bi nam prav gotovo prišla prav E-gradiva v obliki slik, video posnetkov, grafik, kinematik in podobnega, kar bi nam omogočilo še kvalitetnejšo športno vzgojo in tudi poučevanje športov, s katerimi nismo bili seznanjeni med študijem ali pa so nam predstavljali težavo in jih kasneje v karieri nismo obnavljali in utrjevali, saj jih tudi nismo vključili v svoje učne načrte prav zaradi tega, ker jih nismo bili sposobni demonstrirati. S tega vidika bi tudi dijaki dobili na področjih, kjer je učitelj slabše tehnično podkovan, kakovostno demonstracijo in vpogled v res pravo izvedbo vseh tehničnih elementov pri različnih športih. Zatorej bi se lahko ta gradiva pripravila na nacionalni ravni znotraj resornega ministrstva za šport, kjer bi lahko nato šole dostopale do takšnih gradiv preko spletnih aplikacij, ki bi jih pripravilo ministrstvo. Po mojem mnenju je kar nekaj športnih pedagogov, ki si že pomagajo na tak način in bi lahko sodelovali s svojimi idejami in nasveti pri pripravi takih gradiv. Prav tako mislim, da bi se na ta način paleta športov, ki jih šole ponujajo svojim učencev oziroma dijakom, precej povečala in hkrati bi se dvignila kakovost demonstracij pri urah športne vzgoje. Prav tako bi lahko učitelji sprotno preverjali svoje znanje v različnih športih in sledili razvoju tehnike v posameznih športih ter se tako seznanjali tudi v smislu taktične priprave ekip, ki jih vodijo na tekmovanja. Zato menim, da bi kvalitetna E-gradiva vsekakor pripomogla h kvalitetnejši športni vzgoji.

Ključne besede

Šport, športna vzgoja, E-gradiva

ABSTRACT

Many times, teachers of sports education find themselves in a situation where we can no longer demonstrate all the elements of the technique of sport that is on the curriculum. This is how we can get into trouble, many times we find ourselves in different ways. In order to be able to teach sports without problems in which we do not master all the technical elements, the E-materials in the form of pictures, videos, graphics, cinematics and similar matters would certainly come to us, which would enable us to have even better quality sports education and also teaching sports that we were not familiar with during our studies, or were a problem for us and were not renewed and consolidated later in our careers because we did not include them in our curricula precisely because we were unable to demonstrate them. From this point of view, students would also get in areas where the teacher is technically underperformed with a quality demonstration and insight into the true implementation of all technical elements in various sports. Therefore, these materials could be prepared at the national level through the line ministry of sport, where schools could then access such materials through online applications prepared by the ministry. In my opinion, there are quite a few sports educators who are already helping themselves in this way and could work with their ideas and tips to produce such materials. In my opinion, in this way the range of sports offered by schools to their pupils or students would be greatly increased and at the same time the quality of the demonstrations themselves during the classes of sports training would be raised. Teachers could also keep checking their skills in different sports and keep up with the development of techniques in individual sports, thus learning about the tactical preparation of the teams leading them to competitions. That is why I believe that quality E-material would definitely help in the quality of sports education.

Key words

Sport, Physical education, E-materials

1. UVOD

Že kar nekajkrat sem se znašel pred izzivom, kako pokazati oziroma demonstrirati elemente v kakšni športni panogi, o kateri imam bolj slabo znanje ali pa ga celo sploh ne znam, a bi dijaki radi ta šport igrali. Na fakulteti za šport tudi ni možno osvojiti znanja iz vseh športov, ki bi jih dijaki radi spoznali ali jih celo igrali pri urah redne športne vzgoje. Normalno je tudi, da smo učitelji v nekaterih športih, pa čeprav smo jih imeli na predmetniku na fakulteti za šport, slabše strokovno podkovani, ker nam ti športi niso blizu. Za izpit smo opravili obvezne vaje, opravili teoretični in praktični del izpita in tu se z nekaterimi športi zgodba lahko konča. Potem pa se po dvajsetih letih soočiš na šoli z oddelkom dijakov, ki bi rad spoznal ali igral ta šport. Kaj pa sedaj? Nastane rahla zagata. Ko nekega športa deset ali dvajset let ne demonstriraš, ga niti ne spremljaš, se ne seznanjaš z novimi pravili, torej si lahko v veliki zagati. Še posebej morda to velja za srednjo šolo, kjer težko pred dijaki nekaj opraviš na »blef«. Na fakulteti za šport tudi ne morejo ponuditi vseh možnih športov, zato ponujajo osnovne športe, pa tudi ti zadnje čase, če izhajam iz informacij, ki jih dobim od študentov, ki prihajajo k meni na obvezno prakso, niso več v takem obsegu, kot so bili v času mojega študija v devetdesetih letih prejšnjega tisočletja, ko smo mi opravljali izpite na fakulteti za šport. Verjamem, da se je s povečevanjem vpisa v prvi letnik fakultete število študentov toliko povečalo, da profesor določenega praktičnega predmeta potrebuje kar nekaj asistentov, da lahko opravijo obvezne vaje pri tem predmetu, hkrati pa se tudi število ur praktičnega dela zmanjša, da bi lahko profesor z asistenti uspel izvesti praktični del predmeta za vse študente. Jasno je, da ker smo si ljudje različni, se tudi pri obveznih vajah dogaja, da asistenti bolj poudarjajo določene elemente tehnike in taktike, na izpitu pa profesor zahteva poudarek na drugih tehničnih in taktičnih elementih. V drugih državah imajo tudi na študiju športne vzgoje vzporedno še en predmet, ki zagotovi širše znanje in večjo možnost zaposlovanja v starejših letih, saj je jasno, da učitelj pri šestdesetih letih najbrž ni več zmožen v celoti opraviti praktičnega dela demonstracij pri določenih osnovnih športih, pa tudi različne poškodbe so lahko ovira za takšne demonstracije.

2. JEDRO

Zato sem si že pred nekaj leti sam pripravil nekatera e-gradiva, ki so mi bila že takrat v pomoč in so mi, moram priznati, iz leta v leto bolj. Nekatere tehnične elemente sem že takrat našel na spletnih straneh, nekatere pa sem posnel sam. Takrat še s spletnimi kamerami in slabe kakovosti. Prosil sem dijake, ki so trenirali določen šport, če mi pomagajo pri demonstraciji, prosil nekatere kolege, ki so bili vešči v določenem športu, da mi pomagajo pri demonstraciji, ali pa sem se posnel sam. Nekajkrat pa sem za pomoč prosil študente fakultete za šport, ki so bili pri nas na praktičnem usposabljanju. Skozi leta se je nabralo kar nekaj gradiva, ki pa je interne narave za poučevanje športne vzgoje na Gimnaziji Bežigrad. Takrat se je na spletnih straneh dobilo še vse gradivo. Danes je veliko gradiva plačljivega, tudi glede uporabe spletnega gradiva se stvari lahko zapletejo, saj so lahko avtorsko zaščitena. Sam sem si pripravil gradiva iz odbojke (Meusel, A., 2016, Marion, A., 2018), košarke, nogometa, badmintona (Everything About Badminton, 2014), gimnastike (Športna vzgoja, 2018), namiznega tenisa (Letts, G., 2018), atletike, fitnesa (Luketina, N., 2008), v novejšem času, ko pa sem začel s predstavitvami osnovnih motoričnih sposobnosti, dijakom pripravljam še ta gradiva. To so gradiva iz ravnotežja, preciznosti, koordinacije, hitrosti, moči, gibljivosti. Hkrati pa tudi različne vaje za osnovno telesno pripravo športnikov ali dijakov, ki bi želeli začeti ali nadaljevati z vadbo.

E-gradiva, ki so povezana s športom, so sestavljena iz osnovnih podatkov o športu, opremi, ki jo potrebujemo za ta šport, pravili, ki veljajo v tem športu, tehničnih in taktičnih elementih tega športa in ne nazadnje tudi z vprašanji ali kvizom na temo določenega športa. V gradivu so razne slike ali animacije, ki so vezane na tehnične elemente tega športa, slike določenih pomembnih elementov, na katere je potrebno posebej paziti. Lahko pa so tudi razni filmčki, ki govorijo o metodiki učenja določenih elementov. To posebej velja za osnovne motorične sposobnosti, kjer za določene elemente učitelj potrebuje ali veliko časa in želje, da se jih nauči, zato bi bili dobrodošli filmčki, ki so dosegljivi na raznih omrežjih in spletnih straneh, da dijakom pokaže tehniko in izvedbo določenih vaj, hkrati pa tudi metodiko vaj, da se te elemente naučijo. Uporaba računalnika pri športni vzgoji dejansko lahko pomaga učitelju. Tako je recimo aerobika (Zagrajšek, J. 2018), oziroma sestavljanje raznih koreografij in sklopov vaj pri aerobiki, lahko precej lažja oziroma omogoča tudi učitelju s poškodbo ali kako drugače handikapiranemu učitelju, da poučuje takšne športe oziroma elemente določenega športa, pa čeprav jih sam ne zna ali jih ne zmore več narediti, je pa usposobljen za asistenco ali opozarjanje na napake oziroma metodične postopke pri posameznih elementih določenega športa.

Prav tako bi se na resornem ministrstvu za šport lahko pripravila E-gradiva na nacionalni ravni za učitelje športne vzgoje; lahko bi jih pripravili ločeno za vrtce, osnovne šole, srednje šole in fakultete oziroma univerze, kjer je športna vzgoja na programu. Vsekakor bi lahko to pripomoglo k večji kakovosti ur športne vzgoje, prav tako pa tudi k večji pestrosti športne vzgoje v šolah, saj se pogostokrat zgodi, da so učitelji športne vzgoje pri svojem delu postali tako rekoč rutinerji. Kar pomeni, da so po začetni vnemi zapadli v krog ustaljenih navad in metod poučevanja, ki se jim zdi najboljši. Prav zaradi tega ne iščejo možnosti za raznovrstnost, posebej še ne na področjih, kjer so malo manj usposobljeni in kjer imajo manjši interes, ker pač teh športov ne obvladajo ali pa z njimi v času svojega študija sploh niso bili seznanjeni. Tudi tehnika in taktika pri posameznem športu se razvijata in napredujeta in učiteljem je težko spremljati razvoj vsega. Zato menim, da bi ponudba gradiv, ki bi bila na voljo učiteljem, najverjetneje popestrila športno vzgojo dijakom v mnogih šolah, hkrati naredila ure bolj zanimive in pestre. Po drugi strani bi olajšala delo učiteljem športne vzgoje in jim pokazala, da lahko s pomočjo teh gradiv poučujejo tudi športe, v katerih so slabše tehnično in taktično podkovani ali pa jih celo ne poznajo, saj bi se jih učili skupaj z učenci ali dijaki.

Že nekaj let pri svojem delu uporabljam tudi svojo spletno učilnico, kjer imajo dijaki na voljo raznolika gradiva v zvezi s športi, ki jih izvajamo v sklopu pouka športne vzgoje na Gimnaziji Bežigrad. Poleg tega imajo na voljo tudi gradiva v zvezi s športno prehrano, dopingom, zgodovino fitnesa, športnimi poškodbami, osnovami anatomije in fiziologije mišic ter osnovnimi motoričnimi sposobnostmi. Na voljo imajo tudi nekatere zanimivosti iz sveta športa: najboljši košarkarji, nogometaši, nosilci olimpijskih medalj z zimskih in letnih olimpijskih iger, svetovnimi rekordi v atletiki, pa tudi nekaj smešnic iz sveta športa, ki so se zgodile na raznih tekmovanjih. Na koncu jim je na voljo tudi kviz v zvezi s športom, ki ga spoznavajo ali dopolnjujejo svoje znanje o njem.

3. ZAKLJUČEK

Vsekakor menim, da športni pedagogi potrebujemo E-gradiva. Prav tako menim, da bi se morala E-gradiva pripraviti v sodelovanju z učitelji športne vzgoje na nacionalni ravni, tako kot so se pripravljali učni načrti oziroma cilji in kompetence učiteljev športne vzgoje. Na ta način bi lahko olajšali delo marsikateremu učitelju športne vzgoje, ki ima težave pri demonstracijah pri določenih športih ali pa se jih celo izogiba in jih ne vključuje v svoje delo. Posledično pa so prikrajšani učenci ali dijaki, ki jih tak učitelj poučuje. V seznamu literature je le nekaj naslovov, kjer sem poiskal za svoje delo potrebne ilustracije, slike, kinematike ali video gradivo. Nekatere spletne strani so plačljive, nekatere so brezplačne. V kolikor bi se problem reševal na nacionalni ravni bi bilo seveda tudi lažje glede plačljivih spletnih strani.

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Spoznavanje kulturne dediščine kraja z uporabo IKT

Discovering your local cultural heritage by using ICT

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POVZETEK
V prispevku je predstavljeno medpredmetno sodelovanje med zgodovino in informacijsko-komunikacijsko tehnologijo z uporabo aplikacije Actionbound. Dejavnost je bila izvedena med dijaki Srednje šole Veno Pilon Ajdovščina in udeleženci konference Skupaj (se) učimo. Aplikacija je pripomoček za popestritev pouka, spoznavanje kraja in krepitev digitalnih kompetenc tako učencev kot učiteljev. Uporaba aplikacije je uporabna pri vseh predmetih in različnih dejavnostih v osnovni in srednji šoli. V prispevku je opisana ena izmed možnosti uporabe, predvidena za eno šolsko uro.

Ključne besede
Kulturna dediščina, digitalna pismenost, delo v skupinah, medpredmetno sodelovanje, spoznavanje kraja

ABSTRACT
The article presents interdisciplinary team-teaching between history and computer science by using the application Actionbound. The activity was carried out among students of Secondary school Veno Pilon Ajdovščina and participants of the conference Skupaj (se) učimo. The application is a tool meant to enrich lessons, discovering the town's landmarks as well as strengthening the digital competences of teachers and students alike. Such a teaching approach is useful for various activities within all subjects and in both primary and secondary schools. The article describes one of the possible ways of using the application, intended for a single lesson.

Keywords
Cultural heritage, digital literacy, group work, interdisciplinary team-teaching, discovering town’s landmarks

1. UVOD
Poučevanje in učenje v šoli zahteva nenehno prilagajanje tako učencev kot tudi učiteljev. V srednješolskih klopeh sedi t. i. generacija Z [1], ki je od rojstva v stiku s tehnologijo. Mladostniki večino časa preživijo na spletu in multimedijskih napravah, kjer imajo na voljo ogromne količine informacij, ki jih lahko težko razberejo oz. presodijo, ali so verodostojne. Pri iskanju odgovorov se najprej obrnejo na splet. Živijo v času, ko študij ni dovolj za zaposlitev in iskanje službe zahteva večjo osebno angažiranost.

Digitalna pismenost je v bodočem delovnem okolju neizogibna. Zato ima tudi šola veliko vlogo pri oblikovanju takega učnega procesa, ki bo razvijal prilagodljive, samostojne in odgovorne mlade odrasle.

2. IZZIVI SODOBNEGA POUČEVANJA
Učenci, ki so izpostavljeni nenehnim impulzom sodobne tehnologije potrebujejo drugačen pristop. Učitelji jim moramo omogočiti, da so pri pouku čim bolj aktivni, da samostojno pridobivajo potrebne informacije ter da razvijajo veščine, ki jim bodo pomagale pri vseživljenjskem učenju. Razvijati morajo kritično mišljenje, biti sposobni samovrednotenja in samokritičnosti. V poplavi informacij morajo biti sposobni presoditi, ali so informacije, ki jih pridobijo na spletu pridobljene iz verodostojnih virov. Pomembno je, da za svoje delo prejmejo povratne informacije, ker jih spodbudijo k nadaljnjem raziskovanju, sami pa morajo biti pripravljeni v delo vložiti svoj čas in trud.

Učitelji smo vsakodnevno postavljeni pred izzive sodobnega časa in digitalizacije pouka. Pri svojem delu moramo ponujati inovativne pristope in ustvarjalne dejavnosti, čeprav je to včasih težko zaradi preobremenjenosti učiteljev in slabše pripravljenosti učencev za opravljanje obsežnega samostojnega dela. Zavedati se moramo izrednega pomena izobraževanja s področja uporabe inovativnih pristopov, medpredmetnih povezav in izmenjav izkušenj med sodelavci [5].

3. DEJAVNOST
3.1 Ideja in oblikovanje dejavnosti
V Katalogu znanja za zgodovino za srednje strokovno izobraževanje [2] je priporočena uporaba različnih oblik in metod dela ter je poudarjeno samostojno delo učencev. Učenci naj bi pri samostojnem delu uporabljali različne zgodovinske vire in sodobno tehnologijo. K trajnostnemu učenju pripomore tudi obisk lokalnih zgodovinskih posebnosti in kraja, v katerem se nahaja šola. Terensko delo dijakom pomaga pri oblikovanju estetskega čuta in pozitivnega odnosa do ohranjanja lokalne kulturne dediščine. Za dijake programa Predšolska vzgoja je pomembno, da so pri delu ustvarjalni, saj bodo pridobljeno znanje prenašali na najmlajše v družbi.

Pri predmetu informacijsko-komunikacijska tehnologija na programu Predšolska vzgoja dajem poudarek na medpredmetnih povezavah, saj sodijo digitalne kompetence med ključne kompetence posameznika v hitro spreminjajoči se družbi. Povezovanje predmeta pa je pogoj za kakovostno poučevanje.

Pred kratkim sva se avtorici udeležili seminarja Računalniško mišljenje – delo z zgodovinskimi viri, na katerem sva spoznali aplikacijo Actionbound, ki omogoča izdelavo lova na zaklad na poljubni lokaciji. Ugotovili sva, da lahko s pomočjo aplikacije obe uresničiva določene cilje učnega načrta, zato sva se odločili za medpredmetno povezavo zgodovine in informacijsko-komunikacijske tehnologije. Skupaj sva pripravili učno uro na temo kulturne dediščine Ajdovščine, ki tudi dijakom iz drugih krajev omogoča spoznavanje središča mesta. S postavljenimi vprašanji so dijaki ponovili obravnavano snov zgodovine iz 1. in 2. letnika ter uro preživeli na malce drugačen način. Snov se je nanašala na zgodovino naroda, ki je v Katalogu znanj zelo poudarjena, s poudarki na lokalni zgodovini. Z vidika predmeta IKT sva želeli preveriti iznajdljivost, rokovanje s pametnim telefonom in sposobnost iskanja informacij na spletu.

V istem šolskem letu se nama je ponudila priložnost, da podobno oblikovano dejavnost predstaviva še učiteljem Srednje šole Veno Pilon in učiteljem okoliških osnovnih šol. Pripravili sva krajšo predstavitev in izvedbo dejavnosti na konferenci Skupaj (se) učimo. Namen in cilji so bili pri dijakih in učiteljih dokaj podobni. Dijakom sva želeli predstaviti novo obliko pouka, učitelje pa spodbuditi, da aplikacijo uporabijo pri svojih urah. Aplikacija namreč omogoča vsestransko uporabo (učna ura, naravoslovni dan, fotoorientacija …) in je prosto dostopna.

3.2 Cilji

Načrtovana dejavnost je primerna tako za učence kot tudi za učitelje, zato povzemava cilje, ki sva jih želeli doseči v obeh skupinah. Udeleženci dejavnosti:

- razvijajo zanimanje za zgodovino kraja, v katerem živijo/se šolajo/delajo;

- spoznavajo pomen ohranjanja in varovanja lokalne in slovenske kulturne dediščine;

- razvijajo veščine dela v skupini in iskanja kompromisov za doseganje ciljev ter razvijajo ustvarjalnost in samoiniciativnost (elementi podjetnosti);

- razvijajo sposobnosti zbiranja, analize, kritične presoje verodostojnosti informacij iz spletnih virov;

- razvijajo digitalno pismenost (uporaba aplikacij na pametnem telefonu in iskanje informacij po spletu);

- razvijajo sposobnosti iskanja rešitev pri nastalih problemih (vseživljenjsko učenje);

- spoznavajo nove oblike učnih ur za popestritev frontalnega pouka.

Učitelji pridobijo znanje za uvajanje novosti v pouk pri svojem predmetu.

3.3 Načrtovanje dejavnosti

Načrtovanje dejavnosti se je začelo z uskladitvijo učnih ciljev in pripravo poteka učne ure, nato je bilo potrebno določiti lokacije/točke v središču Ajdovščine, ki jih bi učenci/učitelji obiskali in izbrati ostale izzive oz. dejavnosti. Izbirali sva med kvizom (vpis besedila, izbirni tip vprašanja, ocena vrednosti ali razvrščanje) ali t. i. misijo (nalaganje fotografije/sebka, videoposnetka, zvočnega posnetka ali vpis besedila). Vprašanja so se nanašala na zgodovino naroda iz obdobja rimske zgodovine, časa pred prvo in drugo svetovno vojno. Dejavnost je bila pri obeh skupinah omejena na eno šolsko uro, vključno s predstavitvijo, izvedbo in evalvacijo dejavnosti.

Dejavnost Kulturna dediščina Ajdovščine (za dijake) in Vse poti vodijo v SŠVP (za učitelje) sva izdelali na spletni strani https://en.actionbound.com, ki omogoča brezplačno registracijo. Med dejavnostima so bile zelo majhne razlike, prilagodili sva dve vprašanji in učiteljem dodali eno lokacijo.

Pred izvedbo sva dejavnost preizkusili na terenu, preverili sva natančnost lokacij, pravilnost odgovorov, delovanje aplikacije in odpravili pomanjkljivosti.

3.4 Izvedba dejavnosti

Dejavnost se je začela s kratko predstavitvijo aplikacije, udeleženci so se nato razdelili v manjše skupine. En član skupine si je moral namestiti aplikacijo na pametni telefon iz spletne trgovine (Google Play oz. App Store) ter vključiti prenos podatkov in lokacijo. Pred odhodom na teren so dobili še navodila za uporabo in nasvete za timsko delo (eden vodi, ostali iščejo informacije po spletu). Skupine so tekmovale na čas in zbrano število točk s pravilnimi odgovori in izzivi. Dejavnost se je začela pred našo šolo, skupine sva na pot pošiljali v razmaku ene minute. Udeleženci so morali biti pozorni na navodila, iskati pravilne odgovore, pri video posnetkih in fotografijah pa so morali pokazati tudi ustvarjalnost. Po končani dejavnosti smo si v učilnici ogledali delo posameznih skupin in razglasili zmagovalno ekipo, ki sva jo nagradili s čokolado (dijaki) oz. s priznanjem (učitelji).

Po končani dejavnosti so tako učenci kot učitelji opravili še evalvacijo v obliki anketnega vprašalnika. Odgovarjali so na vprašanja, kaj jim je bilo pri takem načinu dela všeč in zakaj ter kje so se pojavile težave. Učenci so morali navesti vsaj eno novo informacijo, ki so jo izvedeli o Ajdovščini. Učitelji so ovrednotili smiselnost uporabe dejavnosti pri svojem predmetu.

4. EVALVACIJA UDELEŽENCEV

4.1 Evalvacija dijakov

Dijakom je bil način dela zanimiv, zabaven in poučen, želeli bi ga še kdaj ponoviti. Pri izvedbi so bili vsi člani skupine aktivni, saj je vsak član prispeval svoj del k uspešni izvedbi. Pozitivno so izpostavili sodelovalni duh, tekmovalnost med skupinami ter inovativno pridobivanje informacij. Večjih težav z uporabo aplikacije niso imeli. Največ dijakov je med novo pridobljene informacije vpisalo leto poimenovanja Srednje šole Veno Pilon, Pilonovo sodelovanje pri snemanju filma Na svoji zemlji ter vlogo rimskih term. Najbolj so se zabavali pri snemanju krajšega video posnetka, v katerem so prikazali boj med Evgenijem in Teodozijem pri Mrzli reki ter izdelavi sebkov pred spomenikom Ivanu Cankarju [Slika 1]. Nekatera vprašanja iz obdobja druge svetovne vojne na Slovenskem sem nato vključila še v pisno ocenjevanje znanja.

Slika 1. Skupina dijakinj pred spomenikom Ivanu Cankarju

4.2 Evalvacija učiteljev

Osnovnošolski in srednješolski učitelji, ki so sodelovali na konferenci Skupaj (se) učimo so se s to aplikacijo srečali prvič. Po uvodni predstavitvi so jo preizkusili še na terenu. Všeč jim je bila dinamičnost dela, delo v skupini in enostavna uporaba. Kot zanimivo so izpostavili vsebino vprašanj, ki je zajemala različne predmete (zgodovina, geografija, slovenščina) in ustvarjalnost pri snemanju video posnetka in fotografiranju [Slika 2]. Opazili sva, da so imeli več težav pri uporabi aplikacije kot dijaki (nalaganje aplikacije in vsebine na koncu dejavnosti, zagon izbrane dejavnosti, ne vklopljen prenos podatkov in lokacije). Glede smiselnosti uporabe aplikacije pri pouku so si bili enotni, da je primerna za popestritev pouka, ponovitev snovi ali kot motivacija za uvod v daljše sklope snovi [4]. Taka dejavnost je primerna za mlade, spodbuja sodelovanje, ustvarjalnost in omogoča doseganje zastavljenih ciljev na bolj zabaven način.

Slika 2. Skupina učiteljev pred spomenikom Ivanu Cankarju

5. EVALVACIJA IZVAJALCEV

S stališča pouka zgodovine smo še vedno premalo vključeni v ohranjanje snovne in nesnovne dediščine. Pomembno je, da se začnemo zavedati pomena ohranjanja kulturne dediščine, saj pomembno vpliva na krepitev lokalne in narodne identitete. Za izvedbo dejavnosti je nujno, da sta izvajalca usklajena, imata skupne cilje in način dela. Učenci si želijo čim več takega načina dela, ki pa je učinkovit, če so zastavljeni cilji dosegljivi vsem, niso preveč zahtevni in dejavnosti niso prepogoste.

Kot navaja delovna skupina v nalogi Razvoj vseh vrst pismenosti na ZRSŠ, je digitalna kompetenca zmožnost živeti, učiti se in varno ter odgovorno delovati v digitalni družbi [3], kar je v današnjem času zelo pomembno tako za učence kot tudi za učitelje. Kot učiteljica informacijsko-komunikacijske tehnologije opažam, da dijaki ne znajo učinkovito uporabljati aplikacij, še večji problem pa jim predstavlja iskanje, ocenjevanje in shranjevanje informacij. Podobno opažam tudi pri učiteljih, pri katerih je velikokrat prisoten strah pred uporabo tehnologije pri pouku. Zato imajo medpredmetna sodelovanja še večjo vrednost, saj lahko tehnologija nudi oporo pri doseganju vsebinskih ciljev drugih predmetov.

6. ZAKLJUČEK

Aplikacija je prosto dostopna in enostavna za uporabo, čeprav je za izdelavo potrebno vložiti precej časa in truda. Uporabna je za različne aktivnosti, saj se lahko prilagodi trajanje dejavnosti in se jo izdela npr. tudi za ekskurzijo, ki poteka izven kraja šolanja. Primerna je tudi za osnovnošolce, saj je dovolj en pametni telefon na skupino. Čeprav so skupine na terenu same in ne moramo nadzorovati dogajanja med potekom dejavnosti, pa so rezultati na koncu pregledno zbrani in jih lahko razvrstimo glede na več kriterijev (čas in točke). Izpostavili bi še natančnost pri določanju lokacije, da se izognemo porabi časa pri iskanju le te. Kljub temu, da je za delovanje aplikacije potrebna poraba mobilnih podatkov, pa je količina teh zanemarljiva.

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Starejši v informacijski družbi

Elderly in the information society

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POVZETEK

Podobno kot druge države Evropske unije se tudi Slovenija sooča s problemom pospešenega staranja prebivalstva na eni strani in procesom digitalizacije družbe na drugi. Uporaba informacijsko-komunikacijske tehnologije (v nadaljevanju: IKT) je v Sloveniji še posebej nizka med osebami, starejšimi od 65 let, kar še poglablja starostno diskriminacijo in socialno izključenost starejših, hkrati pa izkazuje potrebo po uvedbi ukrepov za dvig digitalne pismenosti tretje generacije.

Teoretični izsledki pričajo, da uporaba IKT pomembno vpliva na kakovost življenja tretje generacije, spodbuja socialno vključenost starejših in zmanjšuje starostno diskriminacijo, kar potrjujejo tudi izsledki empiričnega dela. V raziskavi sem se osredotočila na osebne pripovedi treh proaktivnih uporabnikov IKT, starejših od 65 let, in s kvalitativno metodo polstrukturiranega poglobljenega intervjuja ugotovila, da uporaba IKT pomembno vpliva na kakovost življenja v tretjem življenjskem obdobju, pa naj bo to z vidika enostavnega iskanja informacij na spletu, ohranjanja stika z bližnjimi sorodniki in prijatelji ali vzpostavljanja občutka varnosti, pri tem pa pomembno vlogo odigra predvsem medgeneracijsko zavezništvo.

Ključne besede

Demografsko staranje, informacijska družba, informacijsko-komunikacijska tehnologija, starejši, vseživljenjsko učenje

ABSTRACT

Slovenia is, similarly to other countries of the European Union, facing on the one hand with the issue of population aging and on the other with the process of digitization of society. As statistic figures show the use of information and communication technology (hereinafter referred to as ICT) is in Slovenia particularly low among people over 65 years old, which aggravates age discrimination and social exclusion of elderly, while also demonstrates the ought for imposing measures for the raise of third-generation's digital literacy. The theoretical findings reveal that the use of ICT has a significant impact on the quality of life of the third generation, it promotes the social inclusion of older people as well as it reduces age discrimination as, additionally, results of empirical research confirmed. In the empirical study I focused on personal narratives of three proactive ICT users aged over 65 years. Through the qualitative method of semi-structured in-depth interviews I concluded that the use of ICT has a significant impact on the quality of life in the third age whether this encompasses a simple online search for information, keeping in touch with close relatives and friends, or establishing a sense of security, wherein intergenerational alliance plays an important role.

Keywords

Demographic aging, information society, information and communication technology, the elderly, lifelong learning

1. UVOD

Slovenija se na poti digitalizacije družbe srečuje s številnimi izzivi, žal pa prepogosto pozablja na svoje najpočasnejše sopotnike – vedno številčnejše starejše prebivalstvo.

Uporaba IKT je v Sloveniji še posebej nizka med osebami starejšimi od 65 let, kar je glede na demografske trende in neustavljiv proces digitalizacije družbe zagotovo podatek, potreben dodatne obravnave. Delež oseb, starejših od 65 let, naj bi se do leta 2080 povzpel na skoraj 29 % (kar je slabih 10 % več od leta 2017), od tega naj bi starejši od 80 let predstavljali 12,2 % [14]. Kljub temu, da uporaba IKT med starostniki v Sloveniji postopoma narašča, je v enaki skupini še vedno zaskrbljujoče visok delež neuporabnikov tovrstnih tehnologij.

V prispevku se osredotočam na proaktivne uporabnike pametnega telefona, računalnika in interneta, starejše od 65 let. Z metodo polstrukturiranega poglobljenega intervjuja z dvema sogovornikoma in sogovornico sem sprva skušala ugotoviti stopnjo njihove digitalne pismenosti, kasneje pa so me zanimali predvsem vplivi digitalne tehnologije na kakovost njihovega življenja, ovire, s katerimi se pri uporabi tovrstne tehnologije srečujejo, in njihova osebna stališča do uporabe IKT, natančneje pametnega telefona, računalnika in interneta. Podatke, pridobljene v intervjujih, sem primerjala s teoretičnimi izsledki in zaključke ustrezno analitično kontekstualizirala.

Za boljše razumevanje preučevane tematike se bomo v teoretičnem delu najprej podrobneje seznanili z različnimi vidiki staranja, aktualnimi demografskimi spremembami in njihovimi posledicami ter položajem starostnikov v današnji informacijski družbi.

2. RAZNOLIKI VIDIKI STARANJA

Staranje je razvoj med spočetjem in smrtjo, obdobje, ko človek dozori, medtem pa mu pojenjajo telesne in duševne moči. Gre za proces, ki ga vsaka oseba doživlja in zaznava drugače. Vlažno-vroče podnebje, urbano okolje, nezdrav način življenja, neustrezna prehrana, premalo gibanja, stres in škodljive razvade so samo nekateri izmed dejavnikov, ki poleg dednosti in kakovosti življenjskih razmer vplivajo na hitrost staranja [13].

Poleg tega, da staranje na eni strani prinaša poslabšanje zdravstvenega stanja in upad telesnih funkcij, kot so denimo pešanje vida (v obliki daljnovidnosti, zmanjševanja jasnosti slike, sive mrene), poslabšanje sluha (to se pogosto odraža z manjšo občutljivostjo na visoke tone in naglušnostjo), upad fizične moči (po 70. letu izgubimo kar 30 % fizične moči), zmanjšanje človekove reaktivnosti (predvsem hitrost reagiranja in reakcijski časi), težave s spominom in pozornostjo ter upad umskih zmožnosti (najhitreje hitrost zaznavanja in številčna sposobnost, počasneje pa besedne sposobnosti) [11], se nekatere sposobnosti z leti izboljšujejo. To na primer velja za sposobnost strateškega razmišljanja, bistroumnost, obzirnost, razumnost, sposobnost presoje in razumskega mišljenja, celovito dojemanje in jezikovne spretnosti [7].

Pri proučevanju socialnega vidika staranja je nujno omeniti problem socialne izločenosti starejših, ki lahko vodi v med starejšimi izjemno pogosto negativno razpoloženje – tj. osamljenost [11]. Pojavi se zaradi nezadovoljene potrebe po osebnem medčloveškem odnosu [12].

Samostojnost starejših se je, zahvaljujoč sodobni znanosti, novim tehnologijam ter družbenemu in kulturnemu razvoju, v zadnjem obdobju podaljšala za več desetletij. V preteklosti je bilo tretje življenjsko obdobje pogosto obravnavano le kot zadnja stopnja človeškega življenja, obdobje odvisnosti od tuje pomoči in umiranja, danes pa je s podaljševanjem trajanja življenjske dobe starost vse daljša, kar izkazuje potrebe po dejavnem staranju, izobraževanju starejših in odgovornem državljanstvu [8].

S svojo modrostjo in bogatimi izkušnjami, vseživljenjskim izobraževanjem in ustreznim medgeneracijskim zavezništvom, lahko starejši ogromno prispevajo, zato je v zdravi družbi nujno odpraviti starostno diskriminacijo (t. i. ageizem) in socialno izključenost starejših. Pomembno vlogo pri odpravljanju tovrstne diskriminacije igra informacijska tehnologija, digitalizacija namreč odpravlja vrzeli med različnimi starostnimi obdobji [8].

Naraščanje števila starejših v družbi in vsesplošna digitalizacija spodbujata razvoj gerontehnologije, interdisciplinarnega akademskega in profesionalnega področja, ki se ukvarja z razvojem in uporabo tehnoloških inovacij za potrebe starejše generacije. Tovrstne inovacije pripomorejo k aktivnemu in zdravemu staranju ter večji samostojnosti posameznikov, s tem pa pomembno vplivajo na kakovost življenja starostnikov. Gerontehnologija poleg pripomočkov za pomoč pri hoji (npr. bergle, hodulje, vozički ipd.) in medicinskih tehničnih pripomočkov (očala, slušni aparati, zobne proteze ipd.) obsega tudi v zadnjem času najhitreje razvijajoče informacijsko-komunikacijske pripomočke in sisteme (npr. rdeči gumb, opozorilni sistemi na prenosnih telefonih, senzorji padcev in gibanja ipd.). Da bi starostniki lahko kar se da dolgo uživali samostojnost v domačem okolju, se gerontehnologija vedno bolj usmerja v razvoj inovacij za prilagoditev okolja, kot so denimo pametni domovi [9].

Prehod v informacijsko družbo je bistveno vplival na potrebe po znanju (to zaradi bliskovitega razvoja nenehno zastareva), zato je za enakopravnost in socialno vključenost starejših ključno prav digitalno izobraževanje. Poleg računalniške pismenosti je pri starejših vedno bolj priljubljeno tudi učenje tujih jezikov, kar močno olajša nadaljnje pridobivanje raznovrstnega znanja (na primer uporabo spletnih brskalnikov)[8]. Naj na tem mestu omenim, da so težave pri računalniškem opismenjevanju starejših najbolj povezane s spominom, pozornostjo, motivacijo in osebnimi stališči, npr. predsodki, strahom ipd. [11].

3. KRATEK PREGLED DEMOGRAFSKIH SPREMEMB V SLOVENIJI

Podobno kot v ostalih državah Evropske unije se tudi v Sloveniji srečujemo s pospešenim procesom staranja prebivalstva, posledice spremembe demografske strukture prebivalstva pa bodo predvidoma na slovenskih tleh še nekoliko intenzivnejše kot v ostalih državah EU-28. Na staranje prebivalstva v Sloveniji sta vplivala predvsem število rojstev, ki se je po letu 1992 močno znižalo ter s tem močno pripomoglo k zmanjšanju naravnega prirasta, in povečanje pričakovane življenjske dobe [20]. Po podatkih EUROSTAT-a [3] je v preteklem desetletju število prebivalcev v Sloveniji postopoma naraščalo in leta 2017 doseglo 2.065.895 prebivalcev, od tega je bilo 14,9 % starih od 0–14 let, 66,2 % starih 15–64 let, delež oseb, starih 65 let ali več, pa je znašal 18,9 % (od tega je bilo 5,1 % oseb starejših od 80 let).

Projekcije prebivalstva 2015 napovedujejo, da naj bi v Sloveniji leta 2080 živelo približno 1.940.000 prebivalcev, kar je 6 % manj od leta 2015. Selitveni prirast naj bi znašal kar 5-krat več od leta 2015, in sicer 2.400 oseb. Enakomerno naj bi se dvigala tudi stopnja rodnosti, ki naj bi leta 2080 dosegla 1,85, in pričakovano trajanje življenja - na več kot 91 let pri deklicah in 87 let pri dečkih. Kljub predvideno višji rodnosti naj bi se prebivalstvo v Sloveniji še naprej staralo, delež oseb, starejših od 65 let, naj bi tako leta 2080 znašal nekoliko manj kot 29 %. V naslednjem obdobju naj bi se močno preoblikovala tudi sama struktura starejšega prebivalstva – za razliko od leta 2017, naj bi se do leta 2080 več kot podvojil delež oseb, starejših od 80 let [14].

Spremembe demografske strukture prebivalstva v Sloveniji bodo pomembno vplivale na povečanje izdatkov za pokojnine, zdravstvo, dolgotrajno oskrbo ter druge izdatke, povezane s prilagoditvijo demografskim spremembam. Zmanjševanja števila delovno sposobnih bo kljub večji delovni aktivnosti mladih in starejših v prihodnjem desetletju negativno vplivalo na gospodarsko rast in rast produktivnosti, ki izkazujeta vedno večje povpraševanje po delovni sili. Kljub trenutni nenaklonjenosti migracijskim politikam se bo v Sloveniji pojavila potreba po pritoku tuje delovne sile. Potrebni bodo ukrepi na številnih področjih, ki jih zadeva proces staranja: pokojninski sistem, sistem zdravstva in dolgotrajne oskrbe, trg dela, izobraževanje, socialno skrbstvo in socialna politika [20].

Pri obravnavanju demografskih sprememb in njihovih posledic je nujno osvetliti problem socialne ogroženosti starejših, čigar delež je v Sloveniji višji od povprečja Evropske unije. Junija 2018 je denimo povprečna neto starostna pokojnina znašala 644,80 EUR [19], kar je sicer 34,80 EUR več kot leta 2015, kljub temu pa še vedno občutno premalo za dostojno življenje oseb po več kot tridesetih letih delovne dobe. O resnosti situacije pričajo tudi zadnjih dostopni podatki Statističnega urada Republike Slovenije [15], ki kažejo, da je bil mesečni dohodek oseb, starejših od 65 let, leta 2015 v povprečju 280 EUR nižji od cene bivanja in najzahtevnejše oskrbe v domovih za ostarele. Najbolj finančno ogrožene so starejše ženske.

4. INFORMACIJSKA DRUŽBA IN POLOŽAJ STAROSTNIKOV V SLOVENIJI

V informacijski družbi gospodarska in kulturna dejavnost temeljita predvsem na ustvarjanju, posredovanju in upravljanju z informacijami. Bogat nabor raznovrstnih aplikacij za zasebno uporabo obsega obdelavo in shranjevanje osebnih podatkov, iskanje informacij preko spletnih iskalnikov, uporabo popularnih družbenih omrežij, internetno nakupovanje, uporabo zabavnih vsebin in podobno [1, 6]. Internet, mobilna tehnologija, družbena omrežja, računalništvo v oblaku, lokacijske storitve, masovni podatki in zbiranje ter obdelava osebnih podatkov zaznamujejo proces digitalizacije družbe, po drugi strani pa predstavljajo grožnjo človekovim pravicam, posebno pravici do komunikacijske in informacijske zasebnost [10]. Države bodo v popolnoma digitalizirani družbi kljub predvidoma milejšemu konceptu zasebnosti postavljene pred zahtevno nalogo – zaščito posameznikovih pravic in zasebnosti [1].

Vzpostavljanje ukrepov za zaščito osebnih podatkov, komunikacijske zasebnosti, varovanje interneta in ohranjanje zaupanja vanj je odločilnega pomena za uspešen razvoj digitalne družbe. Za razvoj vključujoče družbe in s tem izrabo polnega potenciala IKT in interneta pa je treba z različnimi ukrepi omogočiti e-vključenost, digitalno opismenjevanje ter dostop do digitalnih vsebin, s tem pa vključitev v informacijsko družbo vsem skupinam prebivalstva, pri čemer je treba posebno pozornost nameniti manj izobraženim, hendikepiranim ali kakorkoli marginaliziranim posameznikom in skupinam [10]. Med slednje uvrščamo tudi starostnike, o katerih bomo nekoliko več spregovorili v nadaljevanju.

Za razliko od osemdesetih let prejšnjega stoletja, ko je bila Slovenija ena najuspešnejših evropskih držav na področju vzpostavljanja računalniško podprtih državnih evidenc, od začetka finančne in gospodarske krize dalje (leta 2008) na področju IKT razvojno močno zaostaja [1]. Zaradi skromnih vlaganj v razvoj informacijske tehnologije in hkrati premajhne ozaveščenosti javnosti o pomembnosti IKT in interneta za razvoj gospodarstva, države in celotne družbe se razvojno zaostajanje na tem področju iz leta v leto povečuje [4]. Leta 2018 se je Slovenija s splošno oceno 53,0 po indeksu digitalnega gospodarstva in družbe (DESI) uvrstila na nezavidljivo 15. mesto med 28 državami članicami EU [5], leto kasneje pa celo mesto nižje, kar jo uvršča pod evropsko povprečje.

IKT pomembno vpliva na višjo kakovost vsakdanjika starejše generacije, hkrati pa z omogočanjem lažjega dostopa do različnih informacij in razvojem inovativnih storitev pomaga pri reševanju problema socialne izključenosti starejših, spodbuja aktivno staranje in zmanjšuje starostno diskriminacijo. Starejši se pri uporabi IKT srečujejo s številnimi ovirami, ki jih je nujno upoštevati pri razvoju in vpeljavi tovrstnih inovacij. S starostjo se, kot omenjeno, zmanjšujejo določene fizične in umske zmožnosti, zato je starejše nujno treba aktivno vključiti v proces oblikovanja in zasnove rešitev, da bodo te reševale resnične vsakodnevne tegobe starostnikov in bodo uporabnikom prijazne. Glavna ovira tretje generacije pri uporabi IKT je zagotovo digitalna nepismenost, tovrstne tehnologije so namreč v splošno rabo prešle šele mnogo po rojstvu današnje tretje generacije, zato se mnogi z njo nikoli niso podrobno spoznali. Drugi razlogi za neuporabo so tudi neznanje tujega jezika, pomanjkanje osnovnih znanj za uporabo digitalnih naprav, cenovna in geografska nedostopnost tehnologije, odpor, strah in nezaupanje do tehnologije, večanje digitalnega razkoraka zaradi bliskovitega razvoja ipd. Za izrabo polnega potenciala IKT za podporo starejšim in ne nazadnje vključevanje starejših v digitalno družbo je nujno zagotoviti ustrezna formalna in neformalna usposabljanja za dvig digitalne pismenosti in e-znanja, ustanoviti ustrezne službe za pomoč starejšim pri uporabi IKT, omogočiti cenovno in geografsko dostopnost tehnologij ter spodbujati razvoj starejšim prilagojenih inovativnih rešitev in naprav [21].

Z generacijskimi spremembami se bo predvidoma postopoma zmanjševal tudi digitalni razkorak, mlajše generacije so namreč bolj digitalno pismene od starejših [2].

4.1 Uporaba IKT med starostniki v Sloveniji

Po podatkih Statističnega urada Republike Slovenije se uporaba računalnika, interneta, mobilnega in pametnega telefona med osebami, starimi 65–74 let, postopoma povečuje. Kljub temu je bila leta 2017 v enaki skupini skoraj polovica oseb, ki še nikoli niso uporabile računalnika ali interneta [16, 17 in 22]. O uporabi IKT med osebami, starejšimi od 75 let, na portalu SURS ni dostopnih podatkov[1], kar je glede na trend staranja prebivalstva, predviden dvig upokojitvene dobe in vsesplošno digitalizacijo še en nadvse zaskrbljujoč dokaz družbene izključenosti starejših. Za zagotovitev vključujoče digitalne družbe je zato nujno podrobneje proučevati tudi uporabo digitalnih tehnologij med posamezniki, starejšimi od 75 let.

5. ANALIZA INTERVJUJEV Z DIGITALNIMI STAROSTNIKI

V nadaljevanju raziskave sem za pridobivanje podatkov uporabila kvalitativno metodo polstrukturiranega poglobljenega intervjuja. Pogovore sem opravila s tremi starostniki, ki proaktivno uporabljajo IKT, uporabila pa sem predvsem opisna vprašanja, ki sem jih tekom pogovora prilagajala oziroma spontano dopolnjevala. Vsak pogovor je bil posnet in transkribiran, vključno z mašili in pogovornimi oziroma narečnimi besedami, nato pa psevdoanonimiziran. Moji sogovorniki so bili Peter (72 let, univerzitetna izobrazba, po poklicu lektor, urednik, prevajalec), Majda (65 let, višješolska izobrazba, nekdaj zaposlena v državni upravi) in Franc (69 let, zaključena dva letnika fakultete, po poklicu kalkulant, čistilec, spremljevalec gibalno oviranega otroka).

Vsi trije sogovorniki so bili enotni, da jim je pri začetnih izzivih pri uporabi pametnega telefona najbolj pomagala pomoč družinskih članov. Peter se je uporabe naprave priučil sam, kasneje pa mu je z nasveti pomagal predvsem njegov vnuk. *»Čisto sam. No, malce mi je pomagal vnuk, ki je na tem področju bolj šolan, in to je to«.* Majda poleg družinskih članov omenja tudi pomoč zaposlenih na Telekomu Slovenije: *»Naštimali so ga provzaprov nevesta pa ... mislim, da je dol, no, na Mobitelu [Telekom Slovenije] so mi pač te stvari. Pol pa same aplikacije, neki mi je naštimov, provzaprov, Kristina, to je nevesta, snaha bi se reklo, in pa potem sem pa imela določene programe, recimo Viber mi je vnukinja naštimala, ne, ker to ma 14, takrat je imela 13 let, no. 12, 13 let je imela. Tko, da to mi je ona pol naštimala.«.*

O pomembnosti medgeneracijskega zavezništva dodatno priča tudi Francova izjava, kjer pojasni, da je prav vnukinja razlog, da je pričel z uporabo pametnega telefona po tem, ko je pomoč neuspešno iskal pri enem izmed mobilnih operaterjev. *»Ko sem jz tale telefon dubu, sem pršov do operaterja, enga moškega in se je obnašov, kokr da je, pri Telemachu, ne, da je ne vem NASA inženir, ne, češ da je to čist enostavn in me je tko razjezu, da sem ta telefon vrgu v predal in sem reku, da bom tastarga uporablu,*

[1] Po podatkih SURS-a [18] naj bi bilo v drugem polletju leta 2017 v Sloveniji 395.629 oseb, starejših od 65 let. Od tega naj bi bilo 211.160 oseb starih od 65 do 74 let, 184.469 pa starejših od 75 let.

ker se je obnašu tko, kokr da je, nevem, NASA inženir, da bo na Luno letu, češ, use mu je blo jasn … Sej sva se parkrat mal usekala pol, ko sem mel težave, pa sm k njemu hodu, da bi mi pomagal. Sej mal mi je, pol mej meu pa pouhn kufr. Če ne bi meu unukinje, vprašanje, če bi jz telefon iz predala vzel.«

Na podlagi zgornjih izjav sklepam, da medgeneracijsko sožitje ne le odločilno vpliva na kakovost življenja v tretjem življenjskem obdobju, ampak tudi pomembno pripomore k spodbujanju uporabe IKT med starostniki. Tvegam lahko torej ugotovitev, da je digitalnim priseljencem z boljšim socialnim zaledjem, kot je na primer družina, olajšan vstop v svet IKT.

Sogovornika in sogovornica so mi povedali, da imajo svoj pametni telefon vedno s seboj. Vsi trije so se prav tako strinjali, da se v spremstvu pametnega telefona počutijo bolj varno. Peter je koncept varnosti obravnaval z dveh vidikov. Po njegovem mnenju je pametni telefon lahko na eni strani sredstvo za višanje varnosti posameznika, saj ta lahko enostavno pokliče pomoč, po drugi strani pa je zaradi materialne vrednosti slednji lahko predmet kraje. *»Ja, če ga znate pametno uporabljati, potem je to nekaj varnosti več, hitro lahko pokličeš pomoč, tako al drugač. Če pa tega nimaš, pa ne moreš niti poklicati pomoči. Drugo je pa seveda stvar, da ti tisti morebitni napadalci ali pa tisti, ki ti hočejo kaj slabega, bodo najbrž najprej pograbili tvoj telefon. Tako, da je spet vse skupaj vprašanje, ne. […] Da te onemogočijo, karkoli, karkoli ukrepat.«* Tudi Majda slikovito izpostavi prednost enostavnega klica na pomoč: *»Jz tud k grem hodt recimo, zdj, k je, grem sama, ne. In po gozdu in tko js obvezno, bohvari, da nimam telefona, ne. Psa sicer nimam, ne, ampak mam telefon, da mi neko varnost mi da, ja. Pa tudi z avtom, recimo. Zadnjič sm šla sama nekam. Ma, na kratko relacijo. ′Porkaflek,′ sm rekla, ′sm ga pozabla, ne?′ Mislm, da se mi slučajno kej zgodi al na cesti al eno in drugo … Tko, odvisn rataš tudi samo. Ne, ne, ne je sicer večja sigurnost in bl se zaneseš na to, da pol pokličeš nekoga od svojih, če karkoli kej rata, ane.«* Franc se strinja, da pametni telefon vpliva na njegovo varnost. Zaradi slabe baterije njegovega pametnega telefona pa s seboj redno nosi tudi prenosni polnilec (angl. *power bank*): *»Napolnm ga [prenosni polnilec] prej in ga mam sabo.«* Abraham Maslow, utemeljitelj humanistične psihologije, ki se je ukvarjal s hierarhijo potreb, je potrebo po varnosti razvrstil na drugo mesto lestvice, takoj za biološkimi potrebami. Če povzamem Jožeta Ramovša [12], na kakovost človeškega življenja vpliva, v kolikšni meri so zadovoljene njegove potrebe, kar potrjuje, da uporaba IKT med starostniki viša kakovost vsakdanjega življenja.

Moja sogovorca in sogovorka so bili enotnega mnenja, da jim pametni telefon pomaga ohranjati stike z družinskimi člani, prijatelji in znanci, na enostavnost in dostopnost komuniciranja preko mobilnega ali pametnega telefona pa naj bi po mnenju Majde in Franca vplivalo predvsem znižanje cen telekomunikacijskih storitev. Majda takole povzame razvoj ponudbe mobilnih operaterjev: *»Tudi, zdej pa sploh, k maš tudi tak, ne, program, paket. Prej sem imela paket in dostkrat sem, čim sem mal več govorila, recimo sem tm med 20 in 30 evri plačevala mesečno, ne. Zdej mam pa tak paket, da je 10 evrov in so neomejeni klici, neomejeni SMS-i in tko. Tko, da je tud to, ne, ker prej si mogu kar mičkeno gledat, nisi mogu tolko čvekat po mobitelu, ne. […] Še prej pa za nazaj, ko smo imeli pa še kartice, ne. Je blo pa še na kartice sm mela. Nisem imela niti na naročnino. So ble na kartico in je blo pol to tolk impulzov in ti je to takoj požrlo, ne.«*

Da so bile mobilne storitve v preteklosti finančno težje dostopne, poudarja tudi Franc: *»Jz sm z mobilnim telefonom začel od samga začetka. Tko, da ko so mel drugi druge operaterje s Telekomom sem pretiravu pa klicu, da ne bi preveč zapravu, ker so bli pogovori dragi. Torej smo šparal pri pogovorih, pri SMS-ih.«* Danes, ko njegov paket zajema neomejene klice in SMS/MMS sporočila ter 50 GB prenosa podatkov v Sloveniji in znotraj Evropske unije, Franc lahko enostavno in ugodno komunicira s svojci in prijatelji: *»Ja, men se zdi, da sem povezan z vsemi, z minimalnimi stroški«*, kar nedvomno zmanjšuje osamljenost in viša kakovost njegovega vsakdanjika. Upravičeno torej sklepam, da uporaba IKT pri starostnikih zmanjšuje njihovo osamljenost in povečuje socialno interakcijo ter družbeno inkluzivnost.

Ugotovila sem, da Franc za razliko od Majde in Petra, ki uporabljata prenosni računalnik, računalnika še ne uporablja. Ker sta Majda in Peter računalnik uporabljala že na bivšem delovnem mestu, sklepam, da je uporaba računalnika bolj pogosta pri starostnikih, ki so se z IKT srečali že v času zaposlitve.

Začetki Majdine uporabe računalnika segajo v leto 1990, ko se je pričela digitalizacija javne uprave, kjer je bila zaposlena. Pove, da so tudi kasneje prav izobraževanja s področja digitalne pismenosti pomembno pripomogla k njeni samostojni uporabi IKT: *»sm mela tud srečo, da sem bla v taki javni državni službi in smo imeli dosti aplikacij oziroma vse je blo na bazi računalnika. Imeli smo izobraževanja v Ljubljani in tko. In meni je to dost pomagalo, da sem dobila tud nek širši, širši spekter.«*

Peter računalnik uporablja že približno 35 let. Z njim se je prvič srečal pred skoraj 40 leti, vendar takrat o njem ni imel najboljšega mnenja, saj so ga mnogi uporabljali le za zabavo, sam pa tega ni želel: *»Na žalost sem najprej videl slabe stvari, torej pred 30 leti, ko sem videl, da se ljudje, da imajo računalnike in se z njimi predvsem igrajo. Nihče ni kaj poštenega delal, samo so se igrali, igrice, ne. To je pa izguba časa. Sem reku: ′Računalnika nikoli ne bom mel!′«* Pozitivno plat mu je pokazal šele znanec, ki je računalnik tedaj uporabljal za vodenje domačega knjigovodstva. *»Potem se je pa zgodilo, da sem prišel v stik s svojim znancem iz Zagreba in mi je povedal, kako on na računalniku vodi svoje domače knjigovodstvo. Torej prihodke, izdatke in tako naprej.«* Napovedal mu je celo, da bo z njim kmalu mogoče tudi prevajati in lektorirati: *»Kmalu bojo, kmalu se bojo besedila prevajala v računalnik, ne bo treba več pretipkavat, to, kar je lektor popravil, še enkrat in tako dalje.«* Predvidevanja Petrovega znanca so se uresničila in kmalu si je predvsem za namen lekture in prevajanja omislil prvi stacionarni računalnik, približno pet let kasneje pa tudi prvi prenosnik. Od samega začetka vstopa računalnika v splošno rabo ga je uporabljal tudi v tiskarni, kjer je delal kot urednik.

Na podlagi analize intervjujev sklepam, da ima uporaba računalnika pri Majdi in Petru pomemben vpliv na višje človeške razsežnosti, kot sta učenje in ustvarjalnost v znanstvenem (prevajanje in lektura) ali umetniškem smislu (kvačkanje), kar viša kakovost njunega življenja v starosti.

Peter o tem, kako mu računalnik pomaga pri lekturi, pove: *»Predvsem za lekturo, ker računalnik mi omogoča, da imam v tej škatli čisto vse. Čisto vse jezikovne priročnike, dostop do spleta, kjer dobim dodatne, dodatne, podatke za pravilnost ali pa pogostost kakšnega izraza, sploh pa prej smo delali na papirju, je blo treba pisati na papir in nekdo je mogu to ali fizično prepisati s pisalnim strojem, preden se je dalo v tisk, ali pa pozneje je nekdo moral to fizično prenest v računalnik, da se je potem dalo računalniška datoteka v nadaljnjo uporabo in tako naprej. Sedaj* *je pa to prepisovanje ali pa vnašanje, posebno vnašanje odpadlo, ker takoj v računalnik vso zadevo rešim in obenem tudi uredniku ali avtorju ali kdorkoli že ostane vidno, kaj so bili moji posegi v besedilu.«*

Sogovorca in sogovorka izpostavljajo predvsem pozitivne plati interneta, kot na primer dostopnost informacij in enostavnejša socialna interakcija. Peter meni, da pri uporabi interneta prevladujejo dobre plati. V naslednji izjavi pojasni, da zahvaljujoč Skypu lažje komunicira s prijatelji iz tujine. *»Poglejte, dobra stvar je to, ker smo na ta način bliže ljudem. Moji kolegi nekateri so v Avstraliji. Bil sem samo enkrat tam, še takrat sem s šale rekel, da bom v Avstraliji samo trikrat – prvič, zadnjič pa nikoli več, ne. [smeh] Nekateri moji kolegi so v Ameriki, preko računalnika se lahko z njimi ne samo slišim, ampak tudi vidim, preko Skypa na primer. To je, to je odlična stvar.«*

Majda kot pozitiven vidik interneta izpostavlja predvsem dostopnost raznovrstnih informacij, ne glede na čas ali prostor. *»Odkar je internet, ker maš informacijo, ane. Maš hitro informacijo. Karkoli te zanima, dobiš vse takoj. Si na dosegu recimo, to. Informacija je dns važna, informacija je denar. Pustmo te pasti, tle morš bit previden. Ampak ne predstavljam si več, recimo včasih smo kupovali časopise, zdej mi jih ni treba, k maš use gor. Imaš knjige k lahko bereš tudi gor, recimo, ne, so knjige. Imaš razno, karkoli te kej zanima. Ni treba nobenih leksikonov, ne zdravstvenih, ne slovnice, ne slovarjev, nič ni treba. Pogledaš gor, ne, maš SSKJ in daš to in dobiš vse. Ne, to je pa enkratno, ne. To moram reč, da si pač, to je ena taka svetlobna hitrostna informacija, ne. Kadar si jo zaželiš. Karkoli, v katerem momentu, u pounoči. Mislm, ti je vedno na razpolago, ne.«*

Franc prav tako izpostavi pomembnost dostopnosti informacij in poudari, da sta zanj internet in televizija nadomestila branje knjig. Hkrati izrazi tudi ogorčenost nad družbenim razvrednotenjem pomena knjig. *»Torej men, men, kaj pomen internet? Velik mi pomen, kr kaj je bistveno zdele, ti nism povedu. Jz mam tri generacije, mam ljudi, ko so mel radi knjige. Moj dedek, no al pa še štir… Moj pradedek, moj dedek, moj oče. Imam knjižno omaro s petsto knjigam. Meu sem, a, delu sm v tiskarni 30 let in žena tud. Vndar je bla tiskarna, ko je ulagala v stroje, v proizvodno, ne pa v delavce kej posebnga in smo dobival pakete knjig. Torej jz imam knjig neomejeno, mam medicinsko enciklopedijo, k bi jo rd komu podaru, rd bi knjige prodau. Torej cena knjig je minimalna, pomembne so sam tiste z podpisi, z temi… Torej moram povedat… Žena ma Delo naročen, časopis. Nimam časa niti, da Delo berem, kdaj pa kdaj, ne? Torej knjige so na žalo … Kupm kdaj, mogoče na par let eno knjigo, sam more bit res neki posebnga, če ne, je pa internet za moje pojme men uzeu branje. Men je branje uzeu. Jest mam knjig, ko sm si jih dau na stran, d jih bom ponovno prebrau … Ne berem več. Jz grem use novice na… če ne sm pa mogoče mau zasvojen z televizijo.«* Doda še, da je zahvaljujoč internetu lažje *»povezan s svetom«*.

Peter in Majda poudarjata, da previdnost na spletu ni odveč, pa naj bo to zaradi nevarnosti spletnih prevar ali zgolj z vidika kritičnega presojanja informacij. Peter: *»Hočem reči, kako je vse, kar je človeštvo dobrega znašlo, vse to je šlo v neko krivo pot. Tale, ki je iznašel dinamit, ga je iznašel zato, da bi rudarjem omogočil in olajšal delo pri razstreljevanju kamnin oziroma vsega tega ... ali pa v kamnolomih in tako dalje. On je imel to v mislih, ni pa nikoli imel v mislih, da bodo to uporabljali za, za ubijanje ljudi s puškami in takimi stvarmi. Tisti, ki si je zmislil računalnik, ravno tako je imel pred sabo dobro stvar, ampak se je izjalovila tako, da spet smo v strahu in trepetu pred tem, kaj se nam lahko zgodi, ne.«* Kasneje poudari tudi pomembnost kritičnega presojanja informacij na vseh področjih našega življenja: *»Na vseh področjih, na vseh področjih svoje uporabnosti, svojega življenja moramo vse preverjat. Tolko bol, tolko bol.«*

Majda podobno kot Peter poudarja pomembnost kritične distance do informacij dostopnih na spletu. *»To, to je pa tko. Recimo, če včasih gledam kkšno, za kkšno zdravstveno informacijo, ne. Zdj morš pa pol gledat. Če da recimo Univerzitetni klinični center neko dieto, to že veš, da je to kompatibilno, in da je pač to nekako zdrži, ne. Imaš pa vse, moraš učasih, moraš znt razbrt informacije, ne. Pogledaš na več stvari in pol nardiš rezime, ne. Skupek, kaj, kaj, kjere informacije se pojavljajo večkrat, ne, tiste bi skor držale, ne. Moraš znt selekcionirat ubistvu. Ni pa tudi internet zakon, to absolutno ne, ne. Pa tud dostkrat opozarjajo sploh, ne. […] Ker lahko vsak objavi kkšno neumnost. Je pa v večini primerov imaš pa te verodostojne ne, informacije. Sam jih moraš, sej pravm, res mora človk, znt pač tud selekcionirat. Ni vse zlato, kar se sveti.«*

Na podlagi zgornjih izjav sklepam, da internet ob pravilni uporabi pomembno vpliva na kakovost življenja starostnikov, saj omogoča lažje ohranjanje stikov s prijatelji, s tem pa zmanjšuje osamljenost in socialno izključenost.

6. SKLEP

Uporaba IKT med starostniki pomembno vpliva na kakovost njihovega vsakdanjika. Z omogočanjem dostopa do različnih informacij in razvojem inovativnih rešitev za pomoč starejšim in podaljševanje njihove samostojnosti pomaga reševati problem socialne izključenosti tretje generacije, spodbuja dejavno staranje in zmanjšuje starostno diskriminacijo, o čemer nazorno pričajo tako teoretični kot tudi empirični izsledki.

Z dognanji, zbranimi v tem prispevku, želim spodbuditi nadaljnje nacionalne raziskave na doslej slabo zastopanem področju staranja, gerontologije in gerontehnologije, hkrati pa opozoriti, da je za vključujočo digitalno družbo in ne nazadnje izkoristek mnogoterih potencialov starejše generacije nujno z različnimi ukrepi poglobiti digitalno pismenost starejših, spodbuditi uporabo IKT med pripadniki tretje generacije, predvsem pa nemudoma pričeti z zbiranjem in statistično obdelavo podatkov o uporabi IKT tudi med osebami, starejšimi od 75 let.

7. ZAHVALA

Prispevek temelji na diplomskem delu *Odnos starostnikov do informacijsko-komunikacijske tehnologije*, ki sem ga izdelala s pomočjo mentorja dr. Uroša Rajkoviča, kateremu se najlepše zahvaljujem za pomoč in usmeritve. Posebna zahvala gre tudi sogovorcema in sogovorki, za njihov čas, voljo in vse zanimive informacije.

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Webinarji in gradnja skupnosti učiteljev računalništva in informatike NAPOJ

Webinars and building a community for computing teachers NAPOJ

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POVZETEK

NAPOJ (***N**ačrtovanje poučevanja **A**lgoritmov in **P**rogramiranja ter **O**rganizaci**J**a skupnosti* je skupnost učiteljev računalništva in informatike, ustanovljena za izmenjavanje znanja, gradiva in izkušenj pri poučevanju računalniških predmetov v slovenskih šolah.

V šolskem letu 2018/19 smo v okviru skupine pričeli z izvajanjem rednih mesečnih video srečanj. Na teh je predstavljena določena tema, ki ji sledi razgovor o tem, kako lahko vsebine iz teme predstavimo učencem in dijakom. Teme so izbrane glede na želje in potrebe učiteljev ter tako pripomorejo k rasti na strokovnem in pedagoškem področju.

V prispevku je na kratko opisana skupina NAPOJ in predstavljeni webinarji, ki jih izvajamo v sklopu skupine.

Ključne besede

Poučevanje, računalništvo, skupnost učiteljev, webinarji

ABSTRACT

NAPOJ (***N**ačrtovanje poučevanja **A**lgoritmov in **P**rogramiranja ter **O**rganizaci**J**a skupnosti* - Planning of Teaching Algorithms and Programming, and Organization of the Community) is a community of practice for Slovene Computing teachers, established to involve cooperation and sharing of knowledge, study materials and experiences at teaching Computing in Slovenian schools.
During the 2018/19 school year, we began to conduct regular monthly video meetings within the group. In the meeting a specific topic was presented, followed by a discussion about presenting the theme to the students.
This article briefly describes the NAPOJ community and the webinars we provide within the community.

Keywords

Teaching, computer science, teachers community, webinars

1. UČITELJI RAČUNALNIŠTVA IN SKUPINA NAPOJ

Ker nas veliko tistih, ki poučujemo računalništvo in informatiko verjame v navedbo "The quality of an education system cannot exceed the quality of its teachers." (glej [3]) smo leta 2016 ustanovili skupnost NAPOJ.

Slika 1: Logotip skupine NAPOJ

NAPOJ (***N**ačrtovanje poučevanja **A**lgoritmov in **P**rogramiranja ter **O**rganizaci**J**a skupnosti)* je skupnost učiteljev, ustanovljena z namenom, da si vsi, ki poučujemo računalništvo in informatiko, med sabo izmenjujemo znanje, gradiva in izkušnje pri poučevanju računalniških predmetov.

Nastala je na pobudo učiteljev samih, saj se pri poučevanju računalništva in informatike srečujemo z mnogimi izzivi. V teh treh letih smo izvedli že številne dejavnosti. Tako smo sodelovali pri pripravi nalog za spletni storitvi za samodejno preverjanje programov *Projekt TOMO* (https://www.projekt-tomo.si) in *Pišek* (http://pišek.acm.si), na našo pobudo sta nastala spletna e-učbenika *Malina in piton* (https://lusy.fri.uni-lj.si/ucbenik/rpi/index.html) in *Slikovno programiranje* (https://lusy.fri.uni-lj.si/ucbenik/prog/index.html), izvedli smo kar nekaj delavnic s področja fizičnega računalništva, pomagali pri zagonu delavnic in krožkov računalništva na srednjih in osnovnih šolah (v sklopu projekta SKOZ) in še bi lahko naštevali.

Veliko gradiv in idej je nastalo v sklopu večdnevnih delavnic, kjer se osrednja skupina članov skupnosti, t. i. Mojstri Učitelji, zbere v Ljubljani in se skupaj uči, razvija gradiva in predvsem – pogovarja o tem, kako poučevati računalniške predmete.

Pripravili smo tudi spletno stran https://napoj.si/, ki naj bi postala odskočna deska za vse dejavnosti v povezavi skupnosti.

Vsi se zavedamo, da je val razvoja računalništva in informatike izjemno hiter. To pomeni, da moramo učitelji neprestano slediti razvoju. Kljub temu, da nas je veliko takšnih, ki smo rojeni še v prejšnjem stoletju in nam mobilna tehnologija ni bila položena v zibelko, moramo novosti osvojiti, še preden dosežejo večino populacije. Večini učiteljev računalništva in informatike to predstavlja izziv in zato se neprestano izobražujemo, pa nam vseeno včasih zmanjka volje in energije. Na poti naše strokovne rasti nas tako kot druge ovira čas ter za naše potrebe velikokrat neustrezno strokovno izpopolnjevanje. Prav tako je problem tudi službena odsotnost, saj smo vedno pod pritiskom, kako bomo izpolnili učni načrt.

V skupnosti NAPOJ smo ugotovili, da potrebujemo različna znanja, da si želimo izmenjave izkušenj in delitev spretnosti prenosa znanja na naše učeče. Ker pa je izjemno težko zagotoviti srečanja v živo, smo našli rešitev in se domenili za redna mesečna srečanja preko spleta s pomočjo webinarjev.

2. WEBINARJI

Kaj so webinarji? Kljub prevodu imena webinar (web-based seminar), pa le to ni samo posneto predavanje in predvajano preko spleta. Pri webinarjih so udeleženci lahko aktivni, kar pomeni, da lahko postavljajo vprašanja, izmenjujejo mnenja ter tako aktivno pripomorejo k bogatejšim vsebinam. Velika prednost Webinarjev je torej možnost vključitve od doma. Vsem zainteresiranim, ki pa so v času Webinarja zasedeni, lahko omogočimo pasivni ogled s posnetkom tudi kasneje.

Obstajajo različna orodja za izvedbo webinarjev. Mi smo uporabljali ARNESove spletne konference VOX ([8]). ARNES-ova rešitev je zasnovana na Adobovem izdelku Adobe Connect ([1]). Kot navaja spletna stran [8], so spletne konference VOX namenjene preprostemu sodelovanju posameznikov in poučevanju, ker so izjemno enostavne za uporabo. Potreben je le spletni brskalnik, ki ga lahko jih uporabljamo na računalniku in večini mobilnih naprav. Omogočajo uporabo številnih orodij za dodatno komunikacijo: prenos slike z namizja, sodelovanje v klepetalnici, pisanje zapiskov, glasovanje v anketah, izmenjavo datotek, belo tablo …

ARNES jih priporoča za organizacijo sestankov in predavanj na daljavo, kadar udeleženci uporabljajo vsak svoj računalnik ali mobilno napravo.

Za poučevanje na daljavo pride poučevanje z webinarji zelo prav v primeru daljše odsotnosti dijaka (bolezen).

2.1 Nekaj primerov repozitorijev webinarjev

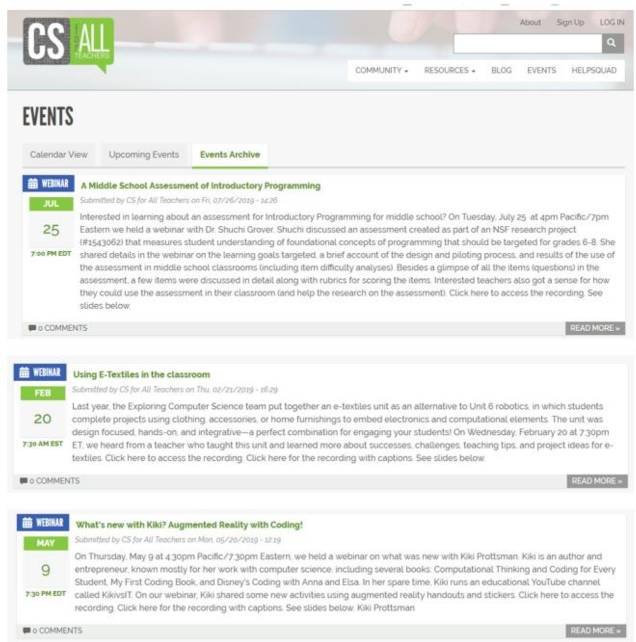
Pri organizaciji in izvedbi webinarjev sledimo določenim zgledom. Na spletu lahko najdemo kar nekaj webinarjev, ki sledijo podobnim ciljem, kot smo si jih zastavili mi. Navedimo nekaj primerov spletnih strani, kjer najdemo webinarje, uporabne za učitelje RIN.

2.1.1 Virtualna skupnost CS for All Teahers

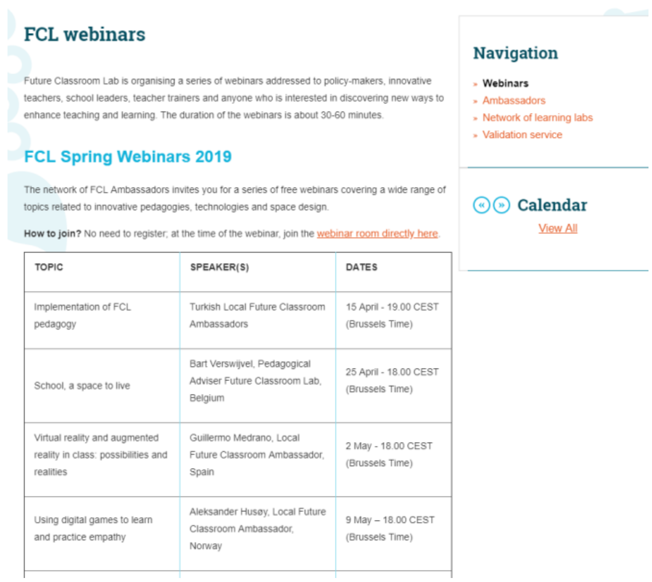
CSforALL je virtualna skupnost ([10]), ki združuje vse učitelje od vrtca do srednje šole, ki jih zanima poučevanje računalništva. V glavnem združuje učitelje iz ZDA, vključitev pa je možna za vse. Njihove spletne strani med gradivi vsebujejo tudi dokaj bogat arhiv posnetkov webinarjev ([2]). Na Slika 2 vidimo primer treh takih webinarjev.

2.1.2 Future Classroom Lab by European Schoolnet

FCL ([6]) je izdelek European Schoolnet, ki se ukvarja z različnimi projekti, ki vzpodbujajo k premisleku o vlogi pedagogike, tehnologije in načrtovanja v učilnicah sedaj in v prihodnosti. Njihove spletne strani (Slika 3) ponujajo vrsto webinarjev ([5]), ki utegnejo zanimati učitelje RIN.



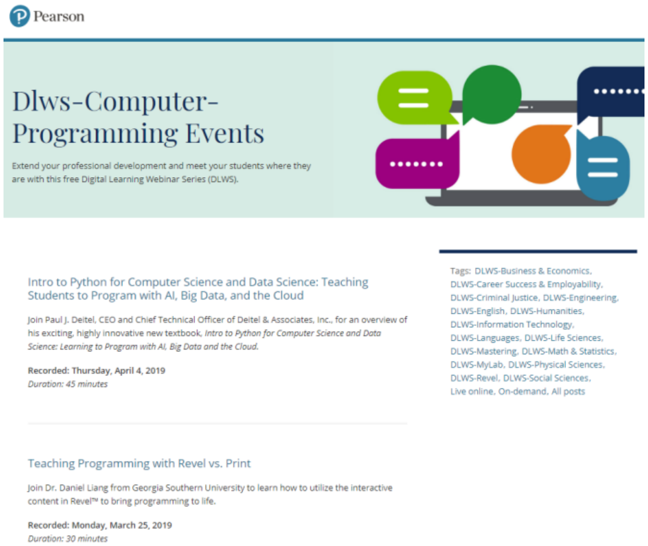
Slika 2: CS for All Teachers webinarji



Slika 3: FCL Webinarji

2.1.3 Pearsons

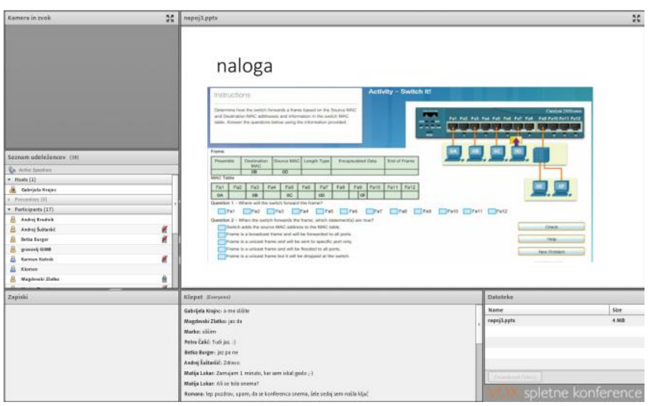
Glede na to, da je Pearsons ena največjih založniških hiš s področja (tudi) digitalnih gradiv, ne preseneča, da na svojih spletnih straneh ([4]) nudi številne webinarje (Slika 4), ki jih lahko s pridom uporabijo učitelji RIN, predvsem za samoizobraževanje. V nasprotju s prej predstavljenimi, ki so povsem prosto dostopni, pa moramo tu v zameno za dostop pustiti določene osebne podatke.



Slika 4: Webinarji založnika Pearson

3. NAPOJ WEBINARJI

V šolskem letu 2019/20 smo začeli z izvajanjem rednih mesečnih video srečanj. Vsako drugo sredo v mesecu smo se ob 20h zbrali v ARNES VOX konferenčni sobi na naslovu https://vox.arnes.si/sckr_si-napoj3/.



Slika 5: primer NAPOJ Webinarja

V skupnosti je lahko vsak, ki si je na določenem področju želel dodatnega znanja, izbral temo, skupaj pa smo pregledali kje in kdo nam lahko pri tem pomaga. Pri takšnem neformalnem izobraževanju smo se vsi zelo veliko naučili. Pridobljeno znanje si seveda želimo prenesti tudi na naše učeče, zato smo veliko pozornosti namenili tudi pedagoškim in didaktičnim vsebinam.

Najprej smo poslušali predavanje o določeni temi in se nato o njej pogovarjali. Razpravljali smo o izkušnjah poučevanja in didaktičnih pristopih. Lani smo izvedli 7 srečanj. Oglejmo si jih:

- Na prvem srečanju je Gabrijela Krajnc s ŠC Kranj predstavila *Računalniška omrežja*. Obnovili smo svoje znanje o omrežnih naslovih (MAC, IPv4, IPv6) ter o omrežnih napravah (stikalih in usmerjevalnikih).
- Na drugem srečanju je uvodno predavanje izvedel Matija Lokar s Fakultete za matematiko in fiziko Univerze v Ljubljani. Govoril je o tem *Kako poučevati rekurzijo*.
- Tretje srečanje je odprl Uroš Sterle s ŠC Kranj, ki je v temi *Formativno spremljanje in uporaba didaktičnih IKT spletnih orodij pri pouku* predstavil izvedbo učne ure, kjer je z dijaki uporabil vrsto spletnih orodij, ki pomagajo pri formativnem spremljanju.
- Po premoru okoli novega leta je Andrej Brodnik s Fakultete za matematiko in fiziko Univerze v Ljubljani pokazal, kako lahko srednješolce seznanimo z določenimi temami s področja kriptografije s temo *Celovitost in zakrivanje sporočil*
- Da bi naše učne programe postavili v mednarodni kontekst, je poskrbel Gregor Anželj z Gimnazije Bežigrad, ki je govoril o *Mednarodni maturi iz Informatike*
- Zadnje redno srečanje s predavanjem smo izvedli v aprilu, kjer je Matija Lokar predstavil še temo *Dinamično programiranje*.
- Imeli smo še zadnje srečanje v maju, na katerem smo se pogovarjali o različnih tekmovanjih s področja računalništva in informatike. Na tem srečanju uvodnega predavanja nismo imeli.

Vse konference s predavanji so posnete in si jih lahko ogledate na https://napoj.si/gradiva/ (glej Slika 6). Tam ([9]) so na voljo tudi določena gradiva, ki so jih udeleženci pripravili za posamezni webinar.

Slika 6: Spletna stran s posnetki webinarjev

Za prvo leto dejavnosti je bila udeležba zelo dobra. Skupaj se je webinarjev udeležilo 82 udeležencev, kar je razvidno iz Slike 7. Večina se je udeležila vsaj treh, v povprečju pa je na posameznem webinarju bilo 23 udeležencev. Največje število hkratnih uporabnikov je bilo 25. Ker si je mogoče posnetke pogledati tudi naknadno, je bilo zabeleženih kar 267 vstopov v konferenco.

Statistika dostopov	
Število vstopov v konferenco	267
Čas in datum zadnjega vstopa v konferenco	23.08. 2019 / 13:54
Število konferenčnih srečanj	62
Največje število hkratnih uporabnikov	25
Število AAI uporabnikov z vnaprej nastavljenimi pravicami	0
Število AAI uporabnikov s prednastavljenimi pravicami, ki so vstopili v konferenco	0
Konferenca javna	Da
Število uporabnikov, ki so se udeležili konference kot gostje	82

Slika 7: Statistika dostopov do webinarjev

4. MNENJA O NAPOJ WEBINARJIH

Po zaključku sezone webinarjev smo med udeleženci naredili krajšo, neformalno anketo. Nanjo se je odzvalo 8 udeležencev. Navajamo nekaj najbolj zanimivih mnenj.

Razlogi za udeležbo:

- "Tako kot verjetno večini učiteljem informatike in računalništva, se mi zdi dobrodošla vsaka možnost razprave, izmenjave izkušenj in učenja. Zato, da sem potem v razredu lahko bolj suverena, dobivam nove ideje in poskušam hoditi s časom v korak."
- "Zanimive in kvalitetne teme"
- " Vedno se rada udeležim dogodkov, kjer lahko pridobim ali obnovim nekaj znanja, sploh, če to lahko storim iz "domačega naslanjača" in mi ni treba porabiti dveh ali treh ur še za pot. Drugi razlog pa je stik in izmenjava izkušenj s kolegi z drugih šol."

Prednost takšnih načinov izobraževanja:

- "Konference so pozitivno prispevale k mojemu strokovnemu in pedagoškemu znanju."
- "Pridobila sem nove ideje, ki jih ne bom nujno vseh uporabila pri pouku, prav gotovo pa so izhodišča za moje naslednje priprave"
- "strokovno izpopolnjevanje, povezovanje z drugimi učitelji, novosti, ideje"
- "znanje in stiki z ostalimi poleg tega pa meni ustrezen čas dogajanja."

V anketi so navedli kar nekaj predlogov glede prihodnjih tem – od baz podatkov, načinov poučevanja določenih tem s področja programiranja (npr. kako predstaviti pojem spremenljivke), nasploh o didaktiki poučevanja računalništva, teme s področja umetne inteligence … Potrudili se bomo, da bomo čimveč tem predstavili v naslednjem šolskem letu.

5. NAČRTI ZA PRIHODNOST

Ker je bila ta oblika izobraževanja dobro sprejeta, bomo z izvajanjem webinarjev nadaljevali. Pripravili smo že okvirni program za šolsko leto 2019/20. Predvidene teme so: praktični primer redovalnice v Excelu, bločne verige, umetna inteligenca, načrtovanje podatkovnih baz, normalizacija podatkovnih baz, podatkovno rudarjenje, sobe pobega.

Tudi v tem letu se bomo srečevali (vsaj) vsako drugo sredo v mesecu ob 20h. Začnemo že 11. 9., potem pa 9. 10., 13. 11. …. Vabimo vas, da se nam pridružite, lahko kar na omenjene datume na naslovu https://vox.arnes.si/sckr_si-napoj3/ ([9]) Ključ za vpis je: napoj3.

Želimo si, da bi ta spletna srečanja postala prostor, kjer bi vsaj občasno srečevali vsi, ki se v Sloveniji ukvarjamo s poučevanjem RIN oziroma nas ta tematika zanima.

6. LITERATURA IN VIRI

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Delavnica poslikave keramike izvedena s pomočjo snemanja predvajanega v živo

Live-stream supported ceramic painting workshop

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POVZETEK

V prispevku je obravnavan problem rabe medijev kot tehnološkega pripomočka pri reševanju likovne naloge na področju kiparstva. Metoda interakcije temelji na uporabi sistema, ki ga sestavljajo računalnik, prenosna spletna kamera, ustrezna programska oprema in projektor. Kamera sledi delu oblikvolke, ki prikazuje unikatno poslikavo keramike ter služi kot vmesnik za interakcijo uporabnikov s sistemom. Računalnik preko povezave s kamero shranjuje in preko projektorja prikazuje posnetek na tabli. Cilj naloge je bil, da sodelujoči učenci in učitelji spoznajo tradicionalni način poslikave kamniške majolke s pomočjo digitalnih medijev. Naloga se je izkazala za uspešno, saj so končni rezultati delavnice pokazatelj, da so lahko vsi učenci sledili poteku poslikave in izdelali svoj izdelek.

Ključne besede

Likovna umetnost, spletna kamera, računalnik, projektor, poslikava keramike, majolka

ABSTRACT

The paper deals with the problem of the use of media as a tech tool in performing a sculpting art task. The method of interaction is based on a system involving a computer, a webcam, applicable software and a projector. The camera follows the artist showing a unique ceramic painting technique and acts as an interaction tool between the users and the system. The computer connected to the webcam saves data and the projector streams the live feed. The aim of the task was to use digital media in the process of students and teachers getting acquainted with the traditional Kamniška majolka ceramic painting. The task proved to be successful as the final results of the workshop were an indication that all students were able to follow the course of the painting and make their own product.

Key words

art, webcam, computer, projector, ceramic painting, majolka

1. UVOD

V okviru mednarodne izmenjave Erazmus+, ki jo je gostila naša šola smo želeli prikazati tudi zgodovina našega kraja Kamnika. Tema izmenjave je bila matematika in umetnost, in tako je bila ena izmed dnevnih delavnic namenjena likovnemu ustvarjanju. Ker pa je bilo veliko gostujočih učencev iz Hrvaške, Poljske in Grčije smo delavnico izvedli kar dvakrat.

Pri urah likovne umetnosti se čedalje bolj spodbuja uporaba pripomočkov IKT in tako smo le te združili s klasičnimi likovnimi tehnikami. Da bi bilo zadano likovno delo zanimivejše učencem smo tradicijo prikazali s pomočjo s IKT pripomočkov. Vključevanje digitalnih kompetenc v vsebine likovne umetnosti sledi smernicam izobraževanja v slovenskih osnovnih šolah.

Kot je zapisano v učnem načrtu za Likovno umetnost: ¨Delo z računalnikom širi možnosti poglabljanja izkušenj in likovnih predstav.¨ Ter da: ¨Informacijska tehnologija omogoča in podpira različne pristope k poučevanje in učenju.¨[1]

2. LIKOVNA DELAVNICA

Med pripomočki za delo z IKT sem na šoli izbrala spletno kamero, računalnik in projektor. Vse to sem vključila v likovno nalogo v kombinaciji s klasičnim ročnim prikazom poslikave keramike.

Ker živimo v sodobni družbi in je uporaba digitalnih medijev učencem že nekaj vsakdanjega je prav, da ne pozabimo na našo tradicijo in zgodovino. S pomočjo ohranjanja le te spoznavajo lepote ročnega in unikatnega ustvarjanja in to tudi znajo ceniti.[2]

¨Učitelj pri likovni vzgoji učence ves čas tudi kulturno vzgaja. Na smiseln način v posamezne korake učnega procesa vključuje primere likovnih del, reprodukcij in originalov likovnih stvaritev.¨ je zapisno tudi v učnem načrtu.[1]

Slika 1. Prikaz poslikave keramike

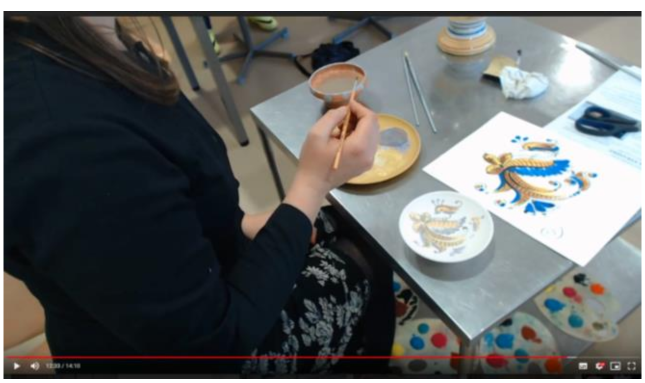
2.1 Kamniška majolka

Prepoznavna umetniška obrt v Kamniku vsaj od konca 19. stoletja dalje je specifična poslikava in izdelava majolik in drugih izdelkov iz keramike. Slika 2. Danes to tradicijo ohranja in nadaljuje nekaj umetnic združenih v KUD Hiša Keramike, zakaj pa ne majolka. Dve izmed njih smo povabil na šola, da sta predstavili poslikavo in vsem prisotnim v živo predstavili t.i. kamniško beloprstno keramiko ter tradicionalne načine njene poslikave.[3] Slika 1.

Slika 2. Kamniška majolka posikana pred končno glazuro in peko [4]

2.2 Potek delavnice

Za izpeljavo likovne delavnice, ki je potekala v angleščini in slovenščini, da so vsi prisotni goste lahko sledili postopku smo si pomagali s prenosno spletno kamero na stojalu, računalnikom in projektorjem. Tako se je na tabli v živo predvajal posnetek ki ga je zajemala kamera. Slika 3.



Slika 3. Izsek posnetka poslkikave

Ker je poslikava tovrstne keramike zelo natančno in podrobno delo, je bilo težko zagotoviti vsem prisotnim, da bi lahko spremljali njeno delo in s te je prišla ideja, da umetnico posedimo in vse njeno delo od blizu snemamo s prenosno spletno kamero. Kamere je bila postavljena na stojalu za umetnico in je snemala ustvarjanje od zgoraj. Tako je bilo najbolj nazorno možno slediti poslikavi in so vsi prisotni na tabli za umetnico spremljali poslikavo. Povezava spletne kamere na stojalu kamere s računalnikom in projektorjem ter prikaz na tabli je omogočal spremljali v živo. Posnetek pa se je tudi shranjeval na računalnik in tako omogočil ponoven ogled.

Slika 4. Delo v rezredu med delavnico

Slika 5. Prikaz postavitve kamere in posnetek projeciran na tabli

Prisotni so sledili postopku poslikave, ki ima točno določeno zaporedje uporabe barv od najsvetlejše rumene do najtemnejše modre barve ter obrobe z črno. Značilno za tovrstno poslikavo je tudi gladka poteza čopiča, ki se je ne popravlja. Slika 4 in 5.

Vsak udeleženec delavnice je namreč tudi sam izdelal svoj likovni izdelek, ki ga je poizkušal čim bolj približati delu umetnice. Tako so udeleženci delavnice bele keramične krožnike poslikali s podglazurnimi barvami v tehniki poslikave majolke in za motiv uporabili prepoznavni kamniškimi vzorec. Vse krožnike smo nato še glazirali in jim tako zaščitil pred umazanijo in vlago. Vsi končni izdelki se lahko uporabljajo kot krožniki ali dekorativni spominki. Slika 6 in 7.

Učenci so si razvijali občutek:

- do likovne kulturne dediščine,
- sposobnosti opazovanja in prostorske predstavljivosti ter likovni spomin,
- razvijajo motorično spretnost in občutljivost.[1]

Slika 6. Izbor končnih izdelkov poslikave učencev

Slika 7. Izbor končnih izdelkov poslikave učencev

3. ZAKLJUČEK

Likovna delavnica se je izkazala za zelo poučno in učinkovito, saj so vsi udeleženci izdelali svojo poslikavo keramičnega krožnika v prikazani tehniki. Tako so si tujci sami izdelali spominek, ki jih bo spominjal na mednarodno izmenjavo v Kamniku.

Uporaba IKT pripomočkov je zelo olajšala delo in omogočila sledenje ustvarjanju vsem prisotnim in se izkazala za zelo uporaben način prikazovanja, ki ga bom še večkrat vključevala tudi k rednim uram likovne umetnosti. Saj se pri podajanju nove likovne naloge učitelj dostikrat znajde v težavi, kako vsem prisotnim učencem v razredu, ki pa jih je pogosto 28. na enkrat prikazati določen način oblikovanja oziroma izdelave likovne naloge. S tovrstnim prikazom vsi učenci sledijo podajanju informacij, ki pa jih kasneje med uro lahko ponovno pogledajo na posnetku, če učitelj oceni, da je to potrebno.

Z vključevanjem IKT pripomočkov k pouku se poveča motivacija za delo in sodelovanje pri uri ter se ob tem ustvarja spodbudno in učinkovito učno okolje. Učenci so motivirani ker imajo na voljo različne načine učenja in različne načine predstavitve njihovega dela.

4. VIRI IN LITERATURA

[1] Učni načrt, Likovna vzgoja. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: Dostopno na naslovu: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_likovna_vzgoja.pdf

[2] Frelih Č., Muhovič J., Tacol, T.: Likovno izražanje 6. Debora, Ljubljana, Slovenija, (2012)

[3] Radej I., Poezija čopiča, Zavod V-oglje, Šenčur, (2013)

[4] https://www.kamnik.si/novice/Kamniska-majolika--ohranitev-in-moznosti-razvoja-13-05-2011, pridobljeno 10.8.2019

Uporaba interaktivnega gradiva pri utrjevanju znanja iz slovenščine

Use of interactive material in consolidating knowledge of Slovenian

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POVZETEK

Pri delu z učenci vse pogosteje opažam, da za delo z učbeniki in delovnimi zvezki niso motivirani. Povsem drugače je pri delu z interaktivnimi nalogami, kjer so učenci motivirani in skoncentrirani na delo. Delo z informacijsko-komunikacijsko tehnologijo je v tem času v razredu praktično nepredstavljivo.

V članku je predstavljeno delo z interaktivnim gradivom za utrjevanje samostalnika in pridevnika. Naloge sem pripravila s programom SMART Notebook. Učenci radi utrjujejo znanje na tak način.

Čeprav od učitelja tako delo zahteva več priprav, pa je potem v razredu le opazovalec in usmerjevalec dela, saj so aktivni učenci. Znaje učencev je po takem utrjevanju zagotovo večje.

Ključne besede

Interaktivno gradivo, interaktivna tabla, SMART Notebook, slovenščina, pridevnik, samostalnik

ABSTRACT

Through several years of my teaching pratice I have found that pupils are less and less motivated to work with textbooks and workbooks. It is completely different when they have a chance to work with interactive assignments, they seem to be more motivated and focused on work. Nowadays, one cannot imagine work in the classroom without using various ICT tools. The article presents work with interactive material for consolidating the grammatical notions of noun and adjective. I created the tasks with the SMART Notebook software. Pupils seem to like to consolidate their knowledge this way.

Although this kind of work requires more preparation from the teacher beforehand, they turn into observers and facilitators of work in the classroom, since pupils become more active by using ICT tools. Knowledge of pupils after such consolidation is certainly greater.

Keywords

Interactive material, interactive whiteboard, SMART Notebook, Slovenian (as a school subject), adjective, noun

1. UVOD

Pri nekajletnem delu s petošolci vsako leto znova opažam, da se le-ti pri delu z učbeniki in delovnimi zvezki dolgočasijo, čeprav je to gradivo veliko atraktivnejše kot pred nekaj leti. Kako tudi ne, saj jih na vsakem koraku spremljajo zanimive in na oko privlačne animacije, ki kar kličejo k temu, da jih gledajo.

Vsakokrat, ko sem prižgala interaktivno tablo sem opazila, da se je njihovo zanimanje za spremljanje pouka povečalo. Pri pouku se trudim, da vključujem različne metode in oblike dela, kar mi uporaba IKT zagotovo omogoča. Kot o pomenu IKT pravi Rebernak [2], je uporaba le-te smiselna, ko z njo dosežemo boljše rezultate pri učenju.

Tudi sama se zanimam za novosti v tehnologiji in se rada izobražujem oz. raziskujem možnosti, ki nam jih nudi. Delo na področju tehnologije mi je v izziv, ki se ga vedno rada lotim.

Že ko sem pred štirimi leti v učilnico dobila interaktivno tablo, sem vedela, da jo bom pri svojem delu pogosto uporabljala. Takoj sem pričela raziskovati program SMART Notebook. Videla sem, da nudi ogromno možnosti za popestritev dela v razredu.

Program uporabljam za žrebanje učencev, za odmerjanje časa pri delu. ki ga želim časovno omejiti, pri učni pomoči učencev, pri dodatnem in dopolnilnem pouku ter za utrjevanje znanja pri vseh predmetih.

Občasno se poslužujem že izdelanih interaktivnih nalog, ki jih najdem na spletu oz. jih nudijo določene založbe, nekatere pa izdelam tudi sama. Slednje so uporabnejše, saj jih prilagajam vsaki generaciji učencev posebej in so narejene za utrjevanje snovi, ki mojim učencem dela težave.

2. INTERAKTIVNO GRADIVO

Predstavila bom nekaj igradiv, ki sem jih izdelala za utrjevanje znanja pri slovenščini, s pomočjo programa SMART Notebook ter ter prednosti. Petošolci imajo precej težav in tudi zmanjšano motivacijo pri usvajanju znanja pridevnika in samostalnika, zato bodo igradiva predstavljena v nadaljevanju namenjena utrjevanju prav teh besednilnih vrst. Predstavila bom, kako take naloge pripomorejo h kvalitetnejšemu pouku.

Učenci s pomočjo teh interaktivnih nalog nadgrajujejo učno snov in dosegajo naslednje cilje [1]:

- ločijo med samostalnikom in pridevnikom,
- vedo, da samostalniki poimenujejo bitja, pojme in stvari,
- pridevniku določijo vrsto, spol in število
- samostalniku določijo spol in število,

- se navajajo na samostojno delo z interaktivnim gradivom,
- se navajajo na to, da sami preverijo pravilnost reševanja nalog.

Take in podobne naloge učenci rešujejo na dopolnilnem pouku, kjer lahko res vsak učenec pride na vrsto, da nalogo opravi na interaktivni tabli. Pri pouku pa take naloge uporabim pri delu po skupinah, kjer skupine krožijo po učilnici in na vsaki postaji rešijo določeno nalogo. Ena od postaj je tudi interaktivna tabla.

Glede na to, da nas strokovnjaki ves čas svarijo pred tem, da učenci med poukom predolgo časa sedijo, je tako delo prednost tudi pri tem, saj učenci pri interaktivni tabli ne morejo sedeti.

Slabost take priprave na pouk vidim v tem, da je tehnologija včasih nezanesljiva, ker lahko zmanjka elektrike, kar na srečo ni pogosto. Zaradi tega imam vedno še drugi plan, kako izpeljati uro, če tehnologija zataji.

Pred ocenjevanjem znanja jim občasno omogočim (odvisno od generacije učencev), da tudi med odmori vadijo naloge na interaktivni table.

S temi nalogami želim učencem pokazati, da je tehnologijo mogoče uporabiti tudi v koristne namene in ne le za zabavo-igranje igric.

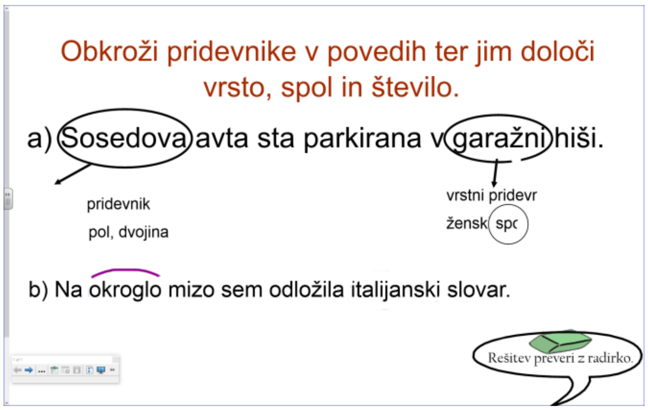
2.1 Preverjanje rešitev

Precej učencev te starosti ima težave pri frontalnem preverjanju pravilnosti rešitev, saj težko sledijo tempu sošolcev, ki berejo rešitve. Prav tako je le nekaj učencev slušni tip, kar pomeni, da večina učencev lažje sledi, če rešitve vidijo tudi napisane. Hkrati pa imajo možnost preveriti tudi pravopisno pravilnost zapisanih besed, kar je ravno pri slovenščini bistvenega pomena. Pri običajnem pouku se pogosto zgodi, da učenci označijo, da je odgovor pravilen, čeprav ni, ker enostavno ne dohajajo tempa.

Pri delu z interaktivnimi nalogami, ki jim jih pripravim, imajo vedno tudi dolžnost, da rešitve preverijo. Ker je preverjanje vedno na drugačen način, se jim tudi to delo zdi zabavno, saj vedno nestrpno čakajo, na kakšen način bodo odkrili rešitve. Pravilnost rešitev preverjajo na različne načine, lahko s pomočjo eradirke, kjer se prikaže rešitev, s klikom na vprašanje se pojavi odgovor, ipd.

Tako preverjanje je vedno individualno in vsak učenec si lahko za pregled opravljene naloge vzame toliko časa kot ga potrebuje. Tako postajajo samostojni tudi pri samokontroli svojega dela.

Ena izmed, za učence, zabavnejših odkrivanj rešitev je delo z nevidnim besedilom, kjer se rešitev pokaže tako, da jo učenci odkrijejo z eradirko.



Slika 1. Eradirka prikaže rešitev (VIR: lasten, zajem zaslonske slike)

2.2 Samostojnost

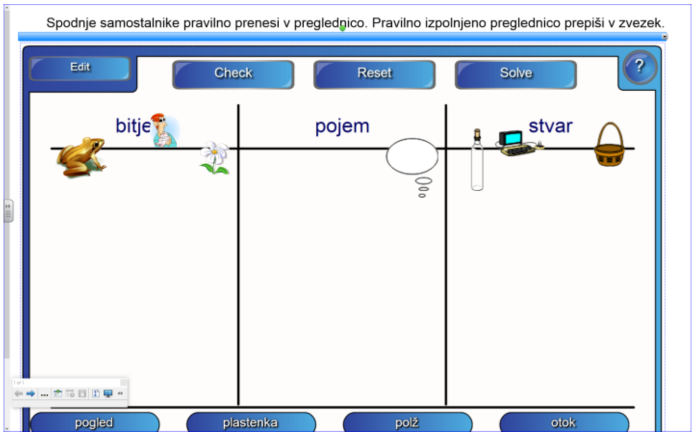
Vsi učitelji si želimo, da bi bili učenci pri delu čim bolj samostojni in da bi znali podatke, ki jih potrebujejo, poiskati sami. Interaktivne naloge, ki jih zanje pripravim, so zasnovane tako, da imajo učenci na voljo skriti zavihek za pomoč, ki ga lahko po potrebi izvlečejo in si z napisanimi namigi pomagajo pri reševanju nalog. Tako se navajajo, da me ne sprašujejo, npr. kaj so že samostalniki, pač pa se poslužujejo pomoči na zavihku.

Slika 2. Zavihek s pomočjo oz. namigom (VIR: lasten, zajem zaslonske slike)

Na začetku dela z zavihki me je skrbelo, da bodo učenci po nepotrebnem koristili pomoč, vendar opažam, da zavihek izvlečejo res le tisti učenci, ki potrebujejo pomoč. Tako niso odvisni od drugih in nalogo lahko rešijo samostojno.

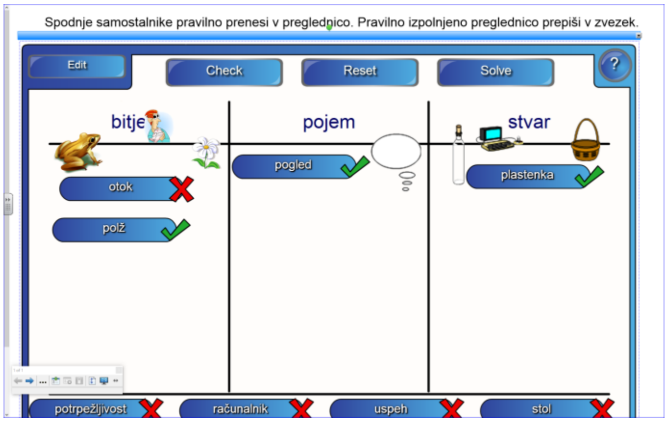
2.3 Primer igradiva: Bitje, pojem ali stvar

Naloga je namenjena temu, da učenci ločijo med besedami, ki poimenujejo bitja, stvari in pojme. Vnaprej določene besede morajo razporediti v ustrezno mesto v preglednici. To nalogo radi rešujejo, saj lahko uporabijo svinčnik za interaktivno tablo in besede prenašajo v ustrezno mesto.



Slika 3. Bitje, pojem ali stvar (VIR: lasten, zajem zaslonske slike)

Učenci ob koncu reševanja z gumbom Chech preverijo, kako uspešni so bili pri reševanju naloge. Pravilno izpolnjeno preglednico nato prepišejo v zvezek.



Slika 4. Povratna informacija o pravilnosti reševanja (VIR: lasten, zajem zaslonske slike)

2.4 Zadovoljstvo učencev

Po večini so učenci zelo zadovoljni, če pouk izvedemo s pomočjo igradiv. Povedo, da si na tak način bolje zapomnijo snov, ker se jim podatki vtisnejo v spomin. Te naloge so na oko privlačne, različnih barv, kar učence še dodatno pritegne k reševanju.

Za učitelje ni večje nagrade kot je zadovoljen učenec, saj tak učenec zagotovo od pouka odnese več.

Slika 5. Pisan čebelnjak s pridevniki (VIR: lasten, zajem zaslonske slike)

Občasno pa se najde tudi kakšen učenec, ki mu klasičen pouk bolj ustreza, saj nima rad sprememb in se pri takem delu ne znajde najbolje.

Posamezne učence pa moti, ker vseh teh nalog nimajo zapisanih v zvezku, saj nekatere vaje opravijo le ustno.

3. ZAKLJUČEK

Po nekaj letih dela z interaktivnim gradivom lahko trdim, da so učenci za tako delo bistveno bolj motivirani in da so tudi dalj časa lahko skoncentrirani na delo. Temu primerno je tudi njihovo znanje večje.

Čeprav taka priprava ure oz. učnega gradiva od učitelja zahteva bistveno več vloženega časa, se vloženi trud izplača, saj je užitek pogledati učence, ki pri učenju uživajo. Kar nekajkrat se je celo zgodilo, da so me učenci prosili, če lahko vadijo tudi med odmorom.

Kljub zahtevnejši pripravi na tako uro, pa je potem pri takih vrstah nalog učitelj pri uri zgolj opazovalec in usmerjevalec dela, saj vse delo opravijo učenci sami, vključno s preverjanjem pravilnosti reševanja.

4. LITERATURA

[1] http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_slovenscina_OS.pdf

[2] Rebernak, B. 2008. Pomen IKT in e-gradiv pri pouku v sodobni šoli, Vzgoja in izobraževanje XXXIX (5): 91–93.

Digitalno opismenjevanje odraslih

Digital literacy for adults

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POVZETEK

Vseživljenjsko učenje postaja vse bolj pomemben del vsakega od nas. Ljudje za delo in prosti čas potrebujemo vedno nova znanja. Evropska unija razpisuje številne projekte za izobraževanje odraslih. Čeprav so brezplačni, pa je potrebno udeležence precej spodbujati k vpisu in jih ves čas motivirati. Predstavljamo, kako starejše od 45 let izobražujemo za uporabo digitalne tehnologije. Udeležence spremljamo po 6 mesecih po zaključku izobraževanj. Rezultati so pokazali: večina udeležencev pridobljeno znanje uporablja. Še več, ga nadgrajuje, saj so premagali začetni strah pred tehnologijo. A po drugi strani opravljene ankete še vedno kažejo, da se ljudje tečajev ne bi udeležili, če bi morali zanje plačati.

Ključne besede

Tečaji, odrasli, računalništvo, učenje

ABSTRACT

Lifelong learning is becoming more and more important in our lifes. We need new skills and knowledge for work and pri- ate. European Union has a lot of different educational projects for adults. Although they are free, institutions have to encourage and motivate people all the time. In this paper, we describe how we educate adults over 45 with computer science. We monitored them after 6 months after they are complete the training. The majority of participants use the acquired knowledge. They overcome their initial fear of technology. But on the other hand, polls show that people would not attend the courses if they had to pay for them.

Keywords

Class, adults, computer science, learning

1. UVOD

Že zelo dolgo ni bilo toliko možnosti za izobraževanje odraslih kot ta hip. Evropska unija prepoznava potrebo in potencial v starejših zaposlenih, ki so zakladnica znanj, izkušenj, a pogosto občutijo stisko zaradi uvajanja novih tehnologij, za katere menijo, da jim ne bodo kos.

2. IZOBRAŽEVANJE STAREJŠIH

Definicija pojma »odrasel« v izobraževanju opisuje osebo, ki je prekinila redno šolanje in prevzela nove družbene vloge, poleg tega pa se od časa do časa ali neprekinjeno izobražuje [2].

Krovna organizacija, ki bdi nad izobraževanjem odraslih v Sloveniji, je Andragoški center Republike Slovenije. Njegov cilj je razvijati področje izobraževanja odraslih skladno z Resolucijo o Nacionalnem programu izobraževanja v Republiki Sloveniji (ReNPIO 2013–2020) na podlagi Zakona o izobraževanju odraslih. Ukvarja se z različnimi področji dela, vezanimi na izobraževanje odraslih in vseživljenjsko učenje. Med drugim nudi tudi podporo projektom za spodbujanje neformalnega izobraževanja odraslih.

ReNPIO 2013–2020 [5] je za aktualno obdobje med drugim opredelil naslednji ciljni skupini, ki sta podlaga za veliko razpisov:

– brezposelni: prednostna skupina so starejši od 50 let, ki nimajo poklicne ali strokovne izobrazbe ali imajo manj ključnih ali poklicnih zmožnosti;

– zaposleni: prednostna skupina so starejši od 45 let z dokončano manj kot štiriletno srednjo šolo ali pomanjkanjem ključnih ali poklicnih zmožnosti.

En odgovor na ciljne skupine, potrebne izobraževanj in usposabljanj, je leta 2016 objavljen razpis za Pridobivanje temeljnih in poklicnih kompetenc, ki ga sofinancirata Evropski socialni sklad in Ministrstvo za izobraževanje, znanost in šport.

Spomnimo: takrat je bilo v formalno ali neformalno izobraževanje odraslih vključenih 47 % ljudi, delež vključenih pa se s starostjo zmanjšuje. Tako se jih je l. 2016 med 35–49 letniki izobraževalo 53 %, med 50–64-letniki jih je bilo 33 % oseb, med 65–69-letniki pa 16 % [4].

Na drugi strani je bila Evropa še vedno pod vtisom gospodarske krize, ki je posledično med drugim vplivala na zmanjševanje delovnih mest in odpuščanje delavcev.

Da bi bili starejši zaposleni kar najbolj zaposljivi in konkurenčni na trgu delovne sile, je projekt ponudil možnost udeležbe v številnih neformalnih izobraževanjih za pridobivanje temeljnih in poklicnih kompetenc zaposlenih. Javni razpis izvajamo v okviru Operativnega programa za izvajanje Evropske kohezijske politike 2014-2020 za doseganje specifičnega cilja Izboljšanje kompetenc manj vključenih v vseživljenjsko učenje. [6]

Projekt konzorcijskim partnerjem po državi omogoča izvedbo brezplačnih programov tujih jezikov, komunikacije, različnih računalniških tečajev, ipd. v celotni Sloveniji za ciljno skupino nižje izobraženih zaposlenih (in od l. 2019 tudi brezposelnih), prednostno za starejše od 45 let.

2.1 Proces do vključitve

Čeprav bi na prvo oko lahko sodili, da se skupine zainteresiranih udeležencev zaradi možnosti brezplačne vključitve polnijo kar same, je resnica malenkost drugačna.

Projekti Evropskega socialnega sklada so izjemno ciljno usmerjeni. To pomeni, da zasledujejo določeno rdečo nit in nagovarjajo specifično publiko, skladno z resolucijami in stanjem na trgu dela.

Glede na situacijo »na terenu« so to ljudje, ki iz različnih razlogov niso končali šolanja ali pa so ga zgodaj zaključili in do šole ne kažejo posebnih simpatij. Misel na vrnitev v šolske klopi jim je tuja, večkrat slišimo njihove komentarje, da se na starost res ne nameravajo učiti, pa čeprav zanje to pomeni nekonkurenčnost v primerjavi z mlajšimi sodelavci, ki so suvereni npr. na računalniškem področju.

To pomeni, da potrebujejo veliko spodbude in motivacije za vključevanje, prave pristope, ko v proces že vstopijo in spremljanje na njihovi poti izobraževanja.

Na učinkovitost učenja vplivajo številni dejavniki, med njimi izpostavljam pomembnejša: fiziološki, kadar smo npr. utrujeni, žejni, bolni,… in psihološki, kadar gre za naše umske sposobnosti, predznanje, učne navade, motivacijo, čustvenost,…

Pred, med in po vključitvi udeležence spremljamo tudi skozi projekt Svetovanje zaposlenim 2016-2022. Gre za proces spoznavanja krepkih in šibkih točk posameznika, iskanje primerne poti za npr. dokončanje formalne izobrazbe, informiranje posameznika o možnostih, ki jih ima na področju izobraževanja odraslih.

Del posameznikov se v programe uspešno vključi s pomočjo napotitve pristojnega Zavoda za zaposlovanje. Že v začetku projekta smo namreč z območno službo vzpostavili dobro sodelovanje, ki je obrodilo sadove. Svetovalke poznajo projekt, razpolagajo s promocijskim materialom in kandidate usmerjajo v izobraževanja, ki jih potrebujejo za osebno rast ali iskanje dela.

Del udeležencev se priključi na podlagi usmeritev kadrovskih služb. Le-te z zaposlenimi običajno izdelajo osebni načrt s cilji, katere kompetence naj bi posameznik usvojil v naslednjem obdobju. Ker so posamezniki napoteni preko svojega zaposlovalca, jemljejo izobraževanja resno in jih tudi redno obiskujejo.

Velik del udeležencev pa se vključuje izključno na podlagi notranje motivacije. Strokovnjaki so si zelo podobni v miselnosti, da ima motivacija odločilno vlogo pri vključevanju v izobraževanje, pri vztrajanju na poti do ciljev in pri sami učni storilnosti [3].

Temu pritrjujemo tudi na podlagi izkušenj z delom z odraslimi. Vsi, ki na izobraževanja pridejo sami, izkazujejo visoko mero motiviranosti, izobraževanj se udeležujejo redno, so vestni pri opravljanju nalog in učenju, poleg tega pa pogosto s seboj pripeljejo soseda, partnerja ali prijatelja. To se je izkazalo zelo pozitivno tudi tekom izobraževanja, saj nekdo, ki ga poznamo, deluje na nas pozitivno, pomirjujoče in motivacijsko, občuti enako stisko in se z njim lažje soočamo s svojimi težavami.

2.2 Izvajanje programov

Kljub začetnemu strahu in nelagodju, ko udeleženci po 20, 30 letih spet sedejo v šolske klopi, izobraževanja lepo tečejo. Razlogov za to je veliko, redki so samoumevni:

1. Ustrezni prostorski pogoji

Izobraževanja potekajo v velikih, prostornih učilnicah. Kadar je to potrebno, so opremljene s sodobno IKT, najpogosteje projektorji, računalniki in pametnimi tablami. Če narava poučevanja to omogoča, jim omogočimo menjavo okolja, učilnic, delo zunaj šolskih prostorov.

2. Strokovnost kadra sama po sebi ni dovolj

Izbor predavateljev se je v nekaj letih po začetku programov izkazal kot zelo pomemben dejavnik. V evalvacijah so namreč udeleženci večkrat izpostavili, da bi se nadaljevalnega tečaja udeležili, če ga bo izvajal isti predavatelj. Izbiramo predavatelje, ki imajo izkušnje z andragoškim delom, so empatični in potrpežljivi.

3. Kreiranje skupine

Skupine kreiramo glede na:

- Predznanje udeležencev: v kolikor udeleženci sami ne zmorejo oceniti svojega znanja, ga uvodoma preverijo profesorji in na podlagi tega svetujejo glede skupine.
- Lokacijo: v kolikor je mogoče, radi izobražujemo na dislokacijah. Udeležencem so bližje domačemu kraju, zato je več možnosti, da se priključijo še drugi domačini, poleg tega posamezniki poznajo več udeležencev in se bolje počutijo v njihovi družbi.
- Če imamo več možnosti, kandidate razporejamo glede na njihov status (brezposelnim je včasih nelagodno tečaje obiskovati z zaposlenimi, nižje izobraženim je neprijetno ob višje izobraženim,…).

V procesu izobraževanja svetovalec spremlja udeležence po potrebi. Pogosto so pri odraslih v pomoč pripomočki, ki prepoznavajo učne stile odraslih ali načine, kako se učiti.

3. DIGITALNO OPISMENJEVANJE STAREJŠIH

Starejši odrasli so bili ob začetku množične uporabe računalnikov večinoma redno zaposleni ali na pragu upokojitve. V takšni situaciji so se le redki odločali za samostojno učenje ali vključevanje v razne načine izobraževanj na področju IKT [1]. Danes je seveda povsem drugače.

Mnogim starejšim so računalniki, uporaba pametnih telefonov in tablic še vedno velika ovira, neznanka.

Projekt Pridobivanje kompetenc omogoča izpeljavo javnoveljavnega programa Računalniška pismenost za odrasle v dolžini 60 ur ter programe Računalniško digitalnega opismenjevanja, ki so dolgi 40 ur in so specifični glede na slušatelje. Gre za usposabljanja za delo s preglednicami, urejevalniki besedil, Google orodji, fotoaparatom, telefoni,… Skladno z usmeritvami in cilji Evropskega socialnega sklada mora vsak partner projekta za udeležence izvesti več kot 50% programov z računalniškimi vsebinami.

Udeleženci najpogosteje prihajajo, ker računalnik potrebujejo za delo. Velikokrat prihajajo s stiskami. V podjetjih prehajajo na brezpapirno poslovanje, uvajajo službene elektronske naslove in nanje prejemajo plačilno listo, elektronsko beležijo prisotnost na delovnem mestu, ipd. Vse to jih spravlja v zagato, na drugi strani pa nimajo poguma to povedati na glas.

V nadaljevanju predstavljamo primer dobre prakse, za katerega si želimo, da bi ga ponovili.

V krajevni skupnosti v regiji smo razposlali več 100 vabil k udeležbi osnovnega tečaja računalništva. Do roka smo zbrali približno 30 prijav. Kot prikazuje slika 1, smo izvedli informativni sestanek na sedežu skupnosti, saj je predsednik izkazal velik interes za izvedbo pri njih.

Na sestanku smo preverili ustreznost vstopnih pogojev posameznikov in se dogovorili za termine izvedb. Vključili smo 15 odraslih iz lokalnega okolja. Med njimi gospoda, ki je prišel izključno na željo svoje žene in ni kazal nobenega interesa po izobraževanju. Kot je povedal, računalništva za svoje delo ne potrebuje in ne vidi potrebe po računalniku doma.

Med udeleženci je bil kmet, ki se je sicer prijavil sam, izključno zaradi upanja, da bi elektronsko prijavo subvencij in računalniško vodenje kmetije lahko prevzel na svoja pleča. Kot je povedal, njegov sin nima potrpljenja in časa za razlago ob računalniku, on pa potrebuje počasno delo in večkratne poskuse.

Na izobraževanja je hodila gospa, zaposlena v zdravstvu. Njeni nadrejeni so od nje pričakovali, da se bo sama priučila dela v določenih programih, ki jih potrebuje za službo, čeprav sama sploh nima računalnika doma. Vodstvo njene službe je izobraževanja plačalo le za višje usposobljene kadre, čeprav znanje programov potrebujejo vsi sodelavci. Izrazila je strah pred rokovanjem s tehnologijo, a ji je uporaba le-te nujna za delo.

Slika 1: Vpis na osnovno računalništvo v krajevni skupnosti.

60 ur programa so izpeljali sredi zime, ko so imeli kmetje največ časa. Program so obiskovali vestno, nekateri so prinašali celo svoje računalnike, čeprav razpolagamo z mobilno učilnico (na sliki 2). S predavateljem so vzpostavili zaupljiv odnos in mu začeli prinašati svoje telefone, fotoaparate in druge elektronske naprave. Vzpostavili so povezave, prenesli fotografije,… Prepričani smo, da je k udeležbi pripomoglo dejstvo, da se je predavatelj odprl, jih obravnaval kot enake in njihovega (ne)znanja ni zasmehoval, pač pa se jim je skozi njihove težave še bolj približal.

K redni udeležbi je pripomogla tudi mobilna učilnica, ki nam omogoča, da prenosnike odpeljemo na lokacijo izobraževanja. Ta je udeležencem "znana", domača in pri roki, kar zagotovo šteje.

Slika 2: Primer mobilne učilnice.

In rezultati? Vsi udeleženci so uspešno zaključili izobraževanje. Gospod iz uvodnega dela zapisa je bil navdušen nad predavateljem in vsem, kar se je naučil. Njegov prvi stavek je bil:

"Veste, zdaj sem si pa na telefon namestil aplikacijo z zemljevidi. Kako je to "fajn"! Zdaj po teh naših "hribih" takoj najdem domačijo, ki jo iščem in ne izgubljam časa z obračanjem. Prej sem prevozil več kilometrov, če sem zgrešil pravo pot." Isti gospod, ki je prišel izključno na željo žene.

Tudi kmet je bil zadovoljen. Kreiral si je elektronski naslov, se prijavil v elektronsko aplikacijo za subvencije, preko spleta uspešno plačuje prispevke in dajatve za svojo kmetijo. Na računalnik si je uspešno prenesel tudi fotografije s telefona in jih poslal v razvijanje. Oba udeleženca sta torej, čeprav morda bolj zaradi osebnega namena, pridobila uporabna znanja za poklic.

3.1 Evalvacija

Poleg svetovanja z vsakim udeležencem opravimo evalvacijo – pisno v obliki vprašalnika ter ustno, saj se organizatorji izobraževanja odraslih udeležimo uvodnega in zaključnega srečanja določenega programa in se z udeleženci pogovorimo o njihovih morebitnih težavah na področju izobraževanja. Njihovi odzivi so zelo pozitivni. In kaj jim pomeni največ? Povzemam najpogostejše komentarje skoraj 300 udeležencev, ki so programe obiskovali med letoma 2016 in 2018.

Največkrat poudarjajo smisel za andragoško delo predavateljev. Potrdilo se nam je naše predvidevanje, da je pomen izbora predavateljev ključen. Predavatelji morajo imeti sposobnost se vživeti v situacije posameznikov, ki niso navdušeni, da se morajo izobraževati, se poistovetiti z njihovimi življenjskimi situacijami, v katerih so se znašli, ipd.

Udeležencem je za dobro počutje na izobraževanjih pomembna tudi bližina lokacije izvajanja in brezplačnost tečajev. Pozitivno je, da se je med pomembnejšimi razlogi, zakaj so zadovoljni z usposabljanji, znašlo tudi Svetovanje za znanje. Odrasli udeleženci namreč pogosto ne vedo, kako bi se lotili učenja. Pripomočki jim pokažejo, kakšen stil in tip učenja bi jim ustrezal in to običajno podkrepimo še z nekaj praktičnimi vajami ali napotki. Tudi predavatelji spodbujajo k temu in rezultati so zavidljivi. Ljudje namreč izgubijo strah pred uporabo tehnologije.

4. ZAKLJUČEK

Znanja računalništva so danes nujna. A kot pravijo naši predavatelji, se računalnika nikomur ni treba bati. Ko uspemo s starejšimi odraslimi to prepreko odpraviti, se začne prijetno delo, rezultati usposabljanj pa so takrat najboljši.

Zadovoljni smo, da udeleženci razširijo dober glas o programih in se ponovno vračajo, s čimer zagotovimo trajne rezultate, znanja pa gredo "v prave roke". Tistim, katerim so namenjena s ciljem lažjega prehajanja med delovnimi mesti oz. iskanja nove zaposlitve. Krog je sklenjen, ko ugotovijo, da so bila usposabljanja koristna, se vrnejo ter postanejo člani velike družine Vseživljenjskega učenja.

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Z IKT premagujemo težave pri učenki z več motnjami

With ICT, we are overcoming problems in learners with multiple

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POVZETEK

Pomoč v razredu je zelo pomembna za dobro počutje in pozitivno klimo v oddelku. V primeru prešolanja učenke tekom šolskega leta je medsebojna pomoč zelo pomemben dejavnik. Sošolci lahko na nesebičen način pomagajo novinki, jo usmerjajo, opogumljajo, ji dajejo občutek pripadnosti z majhnimi koraki. Velik vpliv lahko imajo ti majhni koraki pri učencih z več motnjami, ki se poleg vseh čustvenih stanj ob prešolanju srečujejo še s številnimi težavami, ki izhajajo iz njihovih posebnih potreb. Pomembno vlogo pri vključitvi odigra empatičen učitelj, ki vso to dogajanje vodi in usmerja. Preko različnih dejavnosti, aktivnosti smo učenki ob prehodu v naš zavod nudili pomoč in podporo, tako je lažje prešla skozi težko obdobje aklimatizacije. V začetku je prav, da šolsko delo pustimo malo v ozadju, se osredotočimo na dobro počutje, pozitivna doživetja, čustva, da pridobimo zaupanje otroka. Deklica je bila zelo vešča uporabe IKT, tako je lahko na ta način izražala čustva, jih zapisala v obliki pisma. Zapis z roko ji je delal preglavice. Lahko je ohranjala stike s sošolci, si dopisovala z novimi sošolci v popoldanskem času. IKT smo vključevali na več nivojev, izkoristili smo visoko motiviranost učenke pri delu z njo ter dosegli majhne, vendar pozitivne rezultate.

Ključne besede

Pomoč, učenci z več motnjami, prilagoditve, IKT

ABSTRACT

Willingness to help others in the classroom is very important for the overall energy in the division, especially then a student changes the whole environment in the middle of the academic year. Classmates are encouraged to welcome all newcomer, giving them a sense of belonging thus contributing to the well being of the newcomer. These simple gestures have a special impact on pupil with multiple disorders who are challenged not only with the emotional impact of the change itself but also with the new restrictions arousing from their special needs. An important role in this transition period is played by the teacher, who need to control and oversee what is happening with the student, how the student is accepted etc. For optimal acclimatization it is best to put the actual school work on the side for a short period in order to boost confidence and positive emotions in order to gain trust. The student was very familiar with the usage of ICT enabling her to express her emotions by forming a letter, as she had trouble with manual writing. Through this she could stay in contact with past classmates and started forming relationships with the new ones in the afternoon hours. ICT was implemented on different levels which resulted in small but crucial positive results.

Keywords

Help, pupils with multiple disabilities, adaptations, ICT

1. UVOD

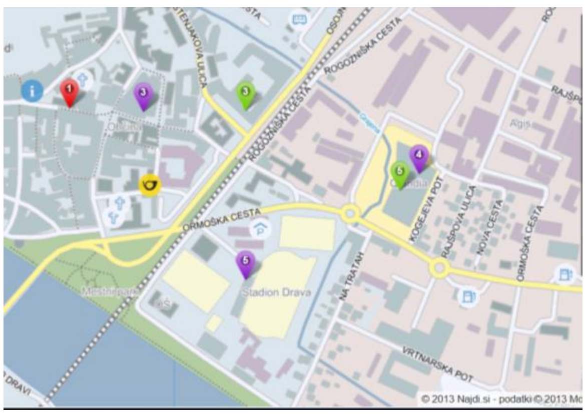
Prešolanje je za otroka precej stresno, če pri tem upoštevamo, da gre za prešolanjem med šolskim letom, za selitev na drug konec Slovenije ter učenko s posebnimi potrebami je situacija še toliko bolj zahtevna in kompleksna. Deklica je bila na podlagi Odločbe o usmeritvi opredeljena kot: dolgotrajno bolan otrok, otrok z lažjo motnjo v duševnem razvoju, otrok z zmerno govorno-jezikovno motnjo in otrok z lažjo gibalno oviranostjo. Sošolce smo seznanili o prihodu nove učenke, si ogledali slike njenega mesta, od koder prihaja ter se osredotočili na občutke, čustva ob selitvi in se poskusili vživeti v njeno situacijo. Čustvena varnost je pomemben temelj samopodobe in samospoštovanja. V kolikor otroku sporočamo, da ni pomemben lahko to trajno vpliva na njegovo samospoštovanje in samopodobo [7]. Samopodoba je kompleksen proces, ki vpliva na številne procese pri otroku in je pomembna za nadaljnji razvoj in uspešnost otroka. Jurišičeva [1] opredeljuje tri vidike, ki vplivajo na samopodobo otroka: kognitivni, telesni in edukativni dejavniki. Kognitivni posegajo v oblikovanje otrokove samopodobe ter vplivajo na razvoj vseh ostalih sposobnosti. Telesni dejavniki vplivajo na razvoj telesnih zmožnosti in videza. Edukativni trajajo vse od vstopa v šolo in tja do konca osnovne šole. Torej je izredno pomembno, kako bomo učenko sprejeli. Pogosto je v ospredju le šolsko delo, ostala področja so malo zanemarjena.

2. METODE DELA

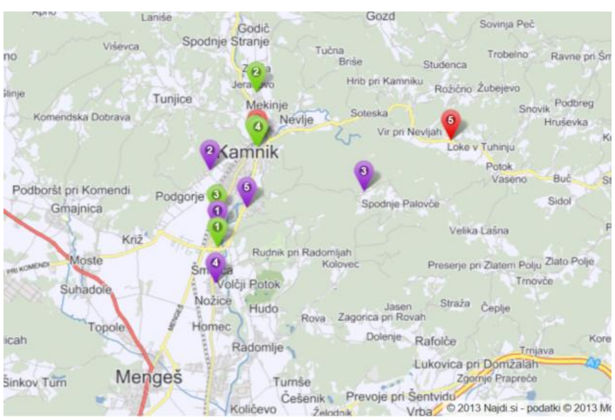
Na podlagi znane opredelitve diagnoze deklice smo predvidevali, da ima kar precej težav na področju komunikacije, samopodobe, čustvovanja in navezovanja stikov. Učenka je bila ob prešolanju stara 12 let in je obiskovala izobraževalni program z nižjim izobrazbenim standardom. Najprej smo vsi skupaj spoznali novo učenko. V prvem mesecu smo vsak dan prvo uro namenili pogovoru o tem, kako se počutimo, kaj smo delali včeraj, kaj se je novega zgodilo. Naredili smo analizo prejšnjega dne in pregledali kaj vse nas čaka tekom šolskega dne. Za boljšo orientacijo smo urnik in vse terapije vsak dan sproti zapisali na tablo. Ob sprotnem opazovanju, zapisih razredničarke smo kmalu ugotovili na katerih področjih deklica potrebuje več pomoči. Glede na to, da so vsi njeni sošolci gibalno ovirani, nekateri celo težje in težko, smo ji vsi priskočili na pomoč, glede na svoje sposobnosti. Pri delu z računalnikom je samostojna in zelo motivirana. Tako smo na več načinov vključevali IKT v pouk, kar je nanjo delovalo zelo motivacijsko, krepila je samopodobo, posredno je spletala nove prijateljske vezi, raziskovala nova področja in nenazadnje tudi sama pomagala sošolcem.

3. REZULTATI

Želeli smo, da bi se deklica pri nas počutila varno, da bi pridobila občutek varnost. Učitelji lahko s svojimi ravnanji, dejanji pomagajo zagotoviti varno šolsko okolje z razvijanjem občutka enkratnosti, pomembnosti. Izpolnjujejo lahko potrebo po pripadnosti, večajo učenčeve kompetence in nenazadnje s tem vpliva na izboljšanje fizične in čustvene varnosti [1]. Deklici smo skušali zagotoviti ta občutek varnosti s spoznanjem učencev, šole, z igranje različnih igre vživljanja, selitve, iskanja novih prijateljev, sošolcev. Večina teh iger je potekala po sistemu igre vlog in analize ob koncu igre ter vključitvijo IKT. Deklica je bila precej spretna pri delu z računalnikom, sama je iskala informacije po spletu o Kamniku, o Ptuju, o prijateljih. Poleg občutku varnosti smo velik poudarek namenili tudi čustveni plati, kako se počutiš, če nimaš prijateljev, če nimaš nikogar, ki bi ti pomagal, če ne poznaš šole. Z izražanjem čustev ljudje pokažemo kaj doživljamo [7]. Na podlagi vseh zgoraj opisanih aktivnosti in pogovorov smo ugotovili, da je selitev v nov kraj in prihod v novo šolo med šolskim letom lahko zelo naporna ter da moramo novi sošolki pomagati na vse področjih. IKT nam je služila kot izredno motivacijsko sredstvo. Ogledali smo si zemljevide obeh mest, jih med sabo primerjali (slika 1 in 2), kaj je drugačno, kaj podobno. Deklica je povsem spontano začela z opisom svojega mesta, ob tem nam je povedala številne zgodbe, ki so vezani na njeno življenje pred selitvijo. Pridobili smo pomembne informacije o njenem življenju, delovanju in funkcioniranju.



Slika 1: Ptuj



Slika 2: Kamnik

Iskali smo značilnosti mest, posebnosti, lego, položaj v Sloveniji (slika 3). Deklica je pri ročnem zapisu imela težave, pri zapisu z računalnikom pa ne. Zaradi predznanja je lahko pomagala tudi sošolcem, kar je okrepilo njeno samozavest, ker je bila zadržana je na ta način brez prisile pristopala do sošolcev, jim pomagala. Tako so se vse pogosteje obračali na njo in se z njo dopisovali tudi v popoldanskem času.

Slika 3: Ptuj in Kamnik

Zelo veliko ji pomeni uspeh na šolskem področju, da je pohvaljena, kar nanjo deluje izredno motivacijsko. V kolikor se učenci dobro počutijo, lažje opravljajo šolsko, miselno delo in se učinkoviteje učijo. Pri tem dobro počutje pri učnem procesu utemeljujemo na pomenu učnih izkušenj, znanja, čustvene angažiranosti, dobri socialni klimi in kakovostnih odnosih med učenci, učitelji ter vse ostalo kar podpira dobro počutje [1]. Njena motivacija za delo niha, se pa močno poveča ob uporabi računalnika (npr. zapis, iskanje informacij). Pri zapisu z računalnikom je spretnejša, hitrejša, pri zapisu z roko potrebuje spodbudo za začetek dela in pohvalo. Njena pisava je okorna in slabo čitljiva, deklica težko bere svoje zapiske. Spodbujanje in poudarjanje uspeha, pohvala ji veliko pomenijo in dobro vplivajo na njeno samopodobo. Tako deklica sedi z učencem, ki se zelo trudi, redno piše domače naloge in jo celo spodbuja. To ima za deklico zelo motivacijsko noto, zato je prisotnega manj upiranja. Deklica potrebuje večje število ponovitev, da snov osvoji (npr. poštevanka). Nekaj aplikacij smo ji naložili na tablični računalnik in z veseljem utrjuje učno snov tudi po pouku. Snov lažje razume ob slikovni ali praktični razlagi oz. delom s praktičnim materialom, podkrepljeni z besedno razlago in video vsebinami, ki jih ob usmeritvi učitelja sama poišče. Ostali sošolci so manj spretni pri delo z IKT. Pri posploševanju in izločanju bistva ima težave, potrebuje jasno usmeritev in navodila. Transfer znanja iz enega področja na drugega je relativno dober.

Deklica je zjutraj pogosto zelo zaspana in nezainteresirana za pogovor. Potrebuje nekaj časa, da začne funkcionirati. Tako ji je sošolka, ki uporablja le nadomestno komunikacijo priskočila na pomoč v času pred poukom. Skupaj sta odšli v razred, se pripravili na pouk, druga drugi sta pri tem pomagali, pregledali sta urnik pouka in terapij na tabli, ki smo ga zapisovali zaradi slabe časovne orientacije. Komunikacija med sošolkama je bila le nebesedna z uporabo komunikatorja, vendar dovolj za ohranjanje jutranjega miru in miren začetek dneva. Deklica se je s komunikatorjem prvič srečala v našem zavodu in ga je ob pomoči sošolke hitro osvojila. Tako je povsem spontano začela komunicirati tudi v času pred poukom. Oblikovali smo tudi tedenski in mesečni plan, saj jo zelo zanimalo kdaj bodo na vrsti »njene« dejavnosti (jahanje, delovna terapija, obisk ZOO…). S pomočjo učitelja je oblikovala tabelo in vpisovala aktivnosti.

Deklica tekom dneva veliko govori, sprašuje, opisuje, govor je glasen, želi prevzemati glavno vlogo v komunikaciji v skupini, odvisno od aktivnosti in dejavnosti, ki se izvajajo. Njena komunikacija je pogosto neustrezna. Ob pomoči učitelja je izdelala semafor s pomočjo računalnika, kasneje so ga ponotranjili vsi učenci in smo ga vsi uporabljali ter korigirali neustrezno izražanje, ki ga je sicer pri deklici bilo bistveno več kot pri ostalih, vendar to ni bilo ključnega pomena. Semafor ji je bil v velik ponos, saj je to bilo njeno delo.

Njeno močno področje je govorno izražanje, ima bogat besedni zaklad, je pa zelo nespretna v medosebni komunikaciji in funkcioniranje v medosebnih odnosih. V navezovanju stikov je zadržana, v začetni fazi izraža odklanjanje in odpor. Prisotno je odklonilno vedenje, posebej do novih ljudi, ki jo nagovarjajo. Želi si novih prijateljev, vendar je pri vzpostavljanju vezi nespretna, saj velikokrat nevede užali sovrstnika (imaš zobe kot konj, za vikend se moram spočiti od učiteljev, itd.). Veliko smo opazovali deklico in njeno vstopanje v družbo vrstnikov. Tako smo po dobrih dveh tednih organizirali pogovorno uro, ki jo je vodil psiholog. Povabili smo sosednji razred, kjer so bila dekleta s katerimi se je deklica rada družila. Pogovarjali smo se o komunikaciji, naših čustvih, kako pristopamo do prijateljev, kaj je primerno izražanje, kdaj nekoga tudi užalimo. Srečanja smo izvajali enkrat tedensko ves mesec. Zaradi zgoraj opisanih težav smo se odločili, da semafor ponesemo še izven našega razreda, ker je semafor oblikovala sama je bila ponosna, da smo ga predstavili tudi drugim in ni bilo odklonilnega vedenja pri korekciji komunikacije. Razložila jih je kako semafor deluje, ob kletvicah zasveti rdeča luč. Poskusimo poiskati novo, ustreznejšo besedo.

Zelo rada ima živali, ki ji zelo veliko pomenijo, zato je vključena na delovno terapijo s konji. Dobro opazuje in zaznava dogajanje v njeni okolici. Rada prebira knjige o živalih, o njih veliko ve, o tem tudi rada pripoveduje sošolcem, učiteljem in drugim. Skrbi za domačega dihurja, na kar je zelo ponosna. O tem nam je pripravila govorni nastop, skupaj z učiteljico je oblikovala predstavitev v Power pointu in posnela kratek film.

4. DISKUSIJA

Uporaba IKT pri različnih dejavnostih je pripomogla k lažjemu prehodu učenke v novo okolje. Delovala je kot nek vezni člen v začetni fazi, ko je bilo učenki težko navezati stike s sošolci. Zaradi možnosti uporabe računalnika v samem učnem procesu je bilo dosti manj upiranja pri zapisu besedil. Posledično je bilo njeno funkcioniranje boljše, ustreznejše, manj je bilo neprimernega vedenja, upiranja agresivnih izbruhov. Posledično se je izboljšalo njeno počutje, kar je tudi sama zaznala (Njeno opažanje: sedaj ne znorim več tako pogosto…) IKT je povezala sošolce, jih spodbudila, da so si pomagali, saj so se morali povezovati pri uporabi računalnika. V razredu sta bila dva računalnika in 5 učencev, tako je bilo sodelovanje ter povezovanje nujno in lažje saj je novinka bila opremljena z znanjem o uporabi IKT.

5. ZAKLJUČKI

Ob prihodu učenke v naš zavod smo delovali na področju dobrega počutja, da pri učenki razvijemo občutek varnosti, sprejetosti, da bo deklica lahko funkcionirala v skladu s svojimi zmožnostmi. Dolgoročnejši cilj, ki mu bomo sledili skozi celotno osnovnošolsko obdobje bo izboljšanje komunikacije, medosebnih odnosov, razvijanje socialnih veščin, spretnosti uporabe IKT. Vsi strokovni in nestrokovni delavci bomo morali delovati dosledno, tako bomo dosegli željene rezultate, kar pa je za deklico zelo pomembno. Potrebuje še korekcijo omenjenih področij, kjer pa kot vemo ni instant napredka in ni hitrih rešitev.

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Uporaba IKT pri učenki s težko motnjo v gibalnem razvoju

Use of ICT in schoolgirls with difficult disturbance in motion development

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POVZETEK

Pri učencih s posebnimi potrebami je potrebno ob pomoči učitelja najti ustrezno prilagojeno izobraževalno tehnologijo, ki bo učencu v pomoč pri doseganju vsebin v vzgojno-izobraževalnem procesu. To od učitelja zahteva nenehen razvoj in raziskovanje tega področja, da lahko, glede na otrokove posebne potrebe najde ustrezne programe ali aplikacije. Pri delu z učenko z težko gibalno oviranostjo je to precej zahtevno delo, saj je potrebno poiskati takšne programa, ki ji bodo olajšali delo in hkrati omogočili njen napredek. Preko različnih vsebin smo izvajali samostojno delo in učenje s pomočjo Power pointa, Powtoona, Skypa in Geogebro. Uporabljene metode učenki omogočajo, da je aktivna v skladu z zmožnostmi, razvija svoje sposobnosti, je izredno motivirana za delo, lažje nadomesti snov v času daljše šolske odsotnosti in pridobiva nova znanja.

Ključne besede

Prilagoditve, IKT, gibalno ovirani učenci, napredek

ABSTRACT

When talking about students with special needs, it is crucial to work with the pupil`s teachers in order to find the optimal technology that will enable them to achieve the goals set forth in the educational plan. This requires the teacher to constantly explore this area in order to find the best possible tool adapted to the child`s specific needs. When working with a physically impaired pupil, this is particularly challenging as it is hard to find the best balance between a program that eases the process for the student in all fields while still challenging and allowing them to evolve in all aspects. We have performed independent work with the student through a variety of platforms such as PowerPoint, Powtoona, Skype and Geogebro. The methods allow the student to stay active within her capabilities while stimulating the development which motivated further growth, enabling her to make up for any deficit that were to arise due to a longer period of absence.

Keywords

Adaptation, ICT, mobility-impaired pupils, progress

1. UVOD

Delo z otroci z gibalno oviranostjo zahteva od učitelja številne prilagoditve za dosego ciljev. Deklica je težko gibalno ovirana učenka, ki je povsem odvisna od pomoči odrasle osebe. Gibalno ovirani otroci imajo prirojene ali tekom življenja pridobljene okvare gibalnega aparata, perifernega ali centralnega živčevja. Razlikujemo otroke z: lažjo, zmerno, težjo, težko gibalno oviranostjo [4]. Otroci s težko gibalno oviranostjo so funkcionalno popolno odvisna od druge osebe oseba, zaradi hude motnje, ne zmorejo samostojnega gibanja. Le-to je mogoče z električnim vozičkom, koliko je le-to samostojno, je odvisno še od funkcij rok, ki so pogosto slabe. Delno ali malo lahko pomaga pri osnovnih dnevnih opravilih, deklica ima tudi dihalno podporo. Pri dnevnih opravilih je povsem odvisen od pomoči druge osebe, tudi zaradi motnje kontrole sfinktrov [3]. Hude motnje so prisotne pri orientaciji, senzomotorični integraciji, zaznavanju in občutenju dražljajev. Pri šolskem delu potrebuje stalno pomoč druge osebe, prilagoditve pri sami izvedbi naloge, okolja in pripomočkov (individualno prilagojen in izdelan sedež, miza, IK tehnologija) [4].

Učenka, ki je težko gibalno ovirana je kljub vsem težavam zelo motivirana za delo z IKT. Želi si pridobivati vedno nova znanja, biti v stiku s sošolci,kjub daljši odsotnosti. Vse učne obveznosti opravi kot ostali, v kolikor je le mogoče se udeleži še dodatnih matematičnih in drugih tekmovanj.

2. METODE DELA

Delo je potekalo v šolskem in domačem okolju. Zaradi narave dela je deklica veliko odsotna, ravno IKT nam omogoča povezavo tudi v tem času.

Na podlagi njenega predznanja in izkušenj smo uvajali IKT na večjih področjih. Nadaljevala je z uporabo učbenikov in delovnih zvezkov na spletu in zapisov s pomočjo PDF readerja, kar ji omogoča samostojno delo.

Pri matematiki, pri učnem poglavju deljenje z ostankom smo naleteli na težavo, da so starši deklico učili deliti na en način, v šoli smo delali na drug način. Deklica je bila zmedena in se je slabo počutila. Želela je osvojiti način deljenja, ki ga je podala učiteljica. Težavo smo rešili tako, da smo posneli kratek videoposnetek o deljenju z ostankom, tako je lahko sledila poteku in ga kar precej hitro osvojila.

Pri geometrijskih likih in telesih smo uporabljali aplikacijo na pametni tablici Geogebra.

Power point je deklica uporabila za samostojno delo in samostojno raziskovanje zgodovine Slovenije in pomoč pri govornem nastopu preko Skypa.

Svojo najljubšo knjige nam je predstavila s pomočjo Powtoona.

Zaradi dolgotrajne odsotnosti smo za učenje, poučevanje, komunikacijo in stik z zunanji svetom, ker ga zaradi težkega zdravstvenega stanja deklica nima, koristili preko Skype. Podajanje učnih vsebin, opazovanje in izvedbo poskusov smo izvedli med samim poukom. Deklica nas je spremljala preko Skypa. Med oddelčno skupnostjo smo koristili čas za sproščen pogovor o dogajanju v času pouka, po pouku.

3. REZULTATI

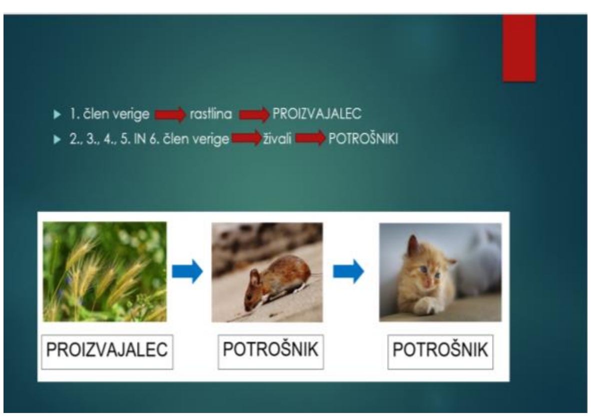
Učenka je v svoje delo vložila veliko truda in energije. Trikrat tedensko ima po uro ali dve učno pomoč na domu. kjer navadno rešujejo naloge matematike, slovenščine in angleščine. Ostale dni stik vzdržujemo preko Skypa. Učna snov je prilagojena. Učitelj vedno poskrbi, da je to učna snov, kjer je več razlage, poskusov, da deklica ni prikrajšane za praktične, vidne izkušnje, ker sicer si učno snov lahko sama prebere iz knjig. Pomembna je izkušnja, videti, spoznati učno snov preko različnih poti.

Deklica je zelo motivirana ze delo, želi si sodelovati pri vseh aktivnostih, delati zapise, poročati, vendar ji njeno zdravstveno stanje tega ne dopušča. Vsakih 45 minut mora menjati položaj iz električnega voza na ležeči voz. Po malici so aktivnosti lahko samo še pol urne. Ta dejstva so še posebej pomembna, ko pregledujemo rezultate njenega dela.

Za oblikovanje in predstavitev takšne predstavitve deklica prebere snov v učbeniku. Po spletu poišče ustrezne informacije, jih zbere in šele nato začne z oblikovanjem strani. Pri tem si dela zapiske, kaj bo povedala ob sami predstavitvi. Na sliki 1, 2 in 3 so prikazani povsem avtentični zapisi učenke.

Slika 1: razlaga.

Opazimo lahko (slika 1), da je poleg teksta uporabila tudi prikaz verižnega spleta.



Slika 2: primeri

Druga slika prikazuje primere, ki jih je lepo podkrepila s slikami.

Na zadnji sliki (slika 3) je uporabila zabavne slike, ki so zelo pritegnile ostale učence, ki so poslušali predstavitev. Opazimo nekaj slovničnih napak, vendar so zapisi avtentični. Slovnične napake smo popravili na koncu po predstavitvi.

Slika 3: zabavne vsebine.

Zardai gibalne oviranosti, zdravstvenega stanja je deklica veliko manjkal apri športni vzgoji. Izvajanje, preverjanje in ocenjavanje le-te ima prilagojeno. Zaradi tega smo skupaj določili temo, ki nam jo je predstavila deklica. Predstavila je umetnostno drsanje s pomočjo Power pointa, kamor je vključila kratke videoposnetke, fotografije in vse podkrepila s samostojnim govorom. Pri tem je potrebno opozoriti, da mora deklica po takem govornem nastopu počivati vsaj pol ure, ker to zanjo predstavlja velik fizični napor (dihanje, položaj na vozičku).

Pri matematiki smo posneli film o pisnem deljenju. Deklici je zelo pomembno, da delo opravi tako kot njeni sošolci, saj tako lažje sodeluje pri urah, ko je prisotna v šoli. Zelo pogosto nam pove, da bo delala kot ostali. Pri oblikovanju geometrijskih likov je bila zelo navdušena nad aplikacijo Geogebro, saj je sama lahko like večala, manjšala in opazovala kaj se z njimi dogaja, kako se spreminjajo.

Deklica zelo rada prebira knjige o Harryju Potterju. Za govorni nastop je pripravila njegovo predstavitev v Powtoonu. S tem programom se je šele spoznala. Pri pouku sva pregledali kaj ponuja, se malo poigrali, nato se je lotila samostojnega dela. Učence je ta predstavitev zelo priutegnila, bila je drugačna, malo teksta, kar ji je omogočalo dokaj hiter napredek, kar je zanjo pomembno, saj je zaradi same diagnoze hitro utrujena in mora počivati. Takrat pa bere in bere. V njeni glavi je polno idej in preko teh različnih delajvnosti, aktivnosti smo jih uresničevali.

Pri naravoslovju in gospodinjstvu smo opravili številne poskuse: barvanje tkanine, tehtanje, guganje, prenašanje teže. Delo je bilo načrtovano tako, da je deklica lahko spremljala te poskuse v živo, prekjo Skypa, lahko je sodelovala v predvidevanjih, diskusiji in analizi poskusa. S tem je slišala razlago učne snovi, kaj se zgodi v danem trenutku, kaj se spremeni. Omenjen pristop je bistveno drugačen in bolj zanimiv kot samo branje učnih vsebin iz učbenika.

Deklico zelo zanima zgodovina. Sama je izrazila željo po oblikovanju predstavitve o Slovencih v Jugoslaviji (Slika 4).

Slika 4: Kraljevina SHS

Ob koncu vsake predstavitve se nam zahvali za pozornost (slika 5). Tako skrbi za ohranjanje vljudnosti do poslušalcev.

Slika 5: Republika Jugoslavija

Ob koncu šolskega leta smo se lotili priprave delavnice za sošolce o uporabi Power pointa. Vendar je žel nismo uspeli izvesti v celoti do konca šolskega leta.

Pogor preko Skypa je omogočal stik s sošolci. V času prehladnih obolenj je deklica več mesecev doma. Takrat tudi ustna ocenjevanja izvedemo preko Skypa. Pred tem se vse dogovorimo o poteku ocenjevanja, tudi ponavljamo preko videoklica. Po potrebi učno snov dodatno utrjujo pri urah dodatne strokovne pomoči, ki v tem času potekajo na domu.

Kot smo že omenili so tudi njeni socialni stiki zelo okornjeni v času večmesečne odsotnosti. Deklici zelo veliko pomeni pogovor s sošolci, drug drugega vidijo, se pogovorijo kaj je novega na šoli. Učenka je stara dvanajst let in ima veliko željo po druženju s sošolci kot ostali njeni vrstniki.

4. DISKUSIJA

Uporaba omenjenih programov, aplikacij omogoča, da učenki razvijamo digitalno pismenosti, ki ji omogoča lažje doseganje željenih ciljev med poukom in v času daljše odsotnosti za pouk ter lažje doseganje cilje , ko je zaradi počitka ali preventive odsotna tudi po več mesecev. Deklica zmore le nekaj preprostih gibov s prsti, ravno toliko, da premika miško in uporablja prste.

Zelo je motivirana za nove oblike dela, da se kaj novega nauči. Hitro osvoji nove aplikacije in programe.

Pri tem je pomembno, da učitelj sam skrbi za razvijanje digitalnih kompetenc. Zakaj je to tako pomembno? Učitelj mora raziskovati in iskati različne aplikacije in poznati posebnosti učenka, da jo lahko uporabi v praksi. Mora zelo dobro poznati prednosti in slabosti programa, aplikacije, da lahko uvidi kaj bo učenec s težko gibalno oviranostjo lahko uporabil, presodil kaj ni primerno za uporabo za učence s tako motnjo, ter da raziskuje vse te aplikacije in programe na spletu.

5. ZAKLJUČKI

Znanje je njeno »orožje«. Na ta način se dokazuje, z znanjem in premikanjem meja nemogočega glede na njeno zdravstveno stanje. Uporabljene aplikacije in programe bo lahko uporabljala in nadgrajevala tudi v prihodnje ter se še dodatno izpopolnjevala na tem področju.

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Arnesovo orodje za učitelje MOST-VO

Arnes˙s tool for teachers MOST-VO

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POVZETEK

Arnes v sklopu svojih aktivnosti učiteljem ponuja možnost uporabe spletne učilnice MOST-VO. Ta je namenjena izobraževanju otrok druge in tretje triade OŠ na področju varne rabe spleta in sodobnih komunikacijskih tehnologij. S tem so učiteljem ponujena gradiva in okolje, v katerem bodo otroke izobraževali o nevarnostih na spletu, katerih se otroci ne zavedajo in jim tako ponuditi znanje za bolj varno vključevanje v digitalni svet.

Ključne besede

MOST-VO, MOOC, internet, varnost, otroci, učitelji, spletna učilnica, ARNES

ABSTRACT

ARNES offers its users the use of online classroom MOST-VO. The purpose of the classroom is to provide teachers with a tool for educating children of the first and second triad in the field of safe use of internet and modern communication technologies. Teachers gain access to study materials and environment in which they are able to provide knowledge of the dangers of internet of which children are mostly oblivious. With the digital classroom, they are able to provide them with information, which will equip them to stay safe in the digital world.

Keywords

MOST-VO, MOOC, internet, safety, children, teachers, online classroom, ARNES

1. UVOD

Pomemben del Arnesove vloge v raziskovalno-izobraževalni skupnosti je izobraževanje uporabnikov in prenos znanja. Arnes tako izvaja predavanja, organizira konferenco Mreža znanja, pripravlja strokovne delavnice, strokovne pripomočke in množične odprte spletne tečaje – MOST (angl. MOOC) (Izobraževanje Arnes, b.d.). Z namenom priskrbeti učiteljem kvalitetno in sodobno orodje, ki bi jim pomagalo pri informiranju otrok o varni rabi spleta in naprav, se je Arnes odločil pripraviti tudi spletno učilnico oziroma spletni tečaj z vsebinami, ki so namenjene otrokom) (Arnes, b.d.).

2. KAJ JE MOST?

Kratica MOST, množični odprti spletni tečaj, je slovenska različica kratice MOOC, Massive Open Online Course (Izobraževanje Arnes, b.d.) .

Arnesovi spletni tečaji so na voljo vsakomur, ki ga obravnavana tematika zanima. Tečaji potekajo na daljavo, udeleženci pa prek spletne učilnice, ki pripada posameznemu tečaju, prejmejo gradiva in naloge, ki jih morajo za uspešno končanje predelati in opraviti. Udeleženci za sodelovanje na tečaju potrebujejo zgolj dostop do spleta (Izobraževanje Arnes, b.d.).

3. POSEBNOSTI MOST-VO

MOST-VO nekoliko odstopa od klasične oblike množičnih odprtih spletnih tečajev. Standardna oblika participacije na običajnem tečaju MOST poteka tako, da se v prvi fazi udeleženci prijavijo na tečaj, ki se nato začne na določen datum. Tečaj vodi ena ali več oseb, ki moderirajo spletno učilnico. Po uspešno zaključenem tečaju udeleženci v svoj profil prejmejo digitalno značko na portalu skupnost.sio.si, kjer so zbrane spletne učilnice, pridobijo pa tudi potrdilo, ki si ga lahko natisnejo (SIO, b.d.).

Tečaj MOST-VO je zastavljen nekoliko drugače. V primerjavi s klasičnim MOST, je veliko bolj decentraliziran, saj ga Arnes želi ponuditi učiteljem kot orodje za pomoč pri pouku in drugih izobraževalnih aktivnostih. Pri tem tečaju dobi učitelj dostop do spletne učilnice, v kateri prejme vlogo izvajalca (non-editing teacher) ter svojo skupino, vključno z geslom, ki omogoča, da se učenci vpišejo v skupino, ki jim je dodeljena. (Moodle.si, b.d.). Tako je učitelj pri vodenju tečaja avtonomen, sam odloča kdaj začeti s tečajem, o časovnem poteku tečaja in koga želi vključiti vanj. MOST-VO postavi v vlogo izvajalca učitelja, Arnes pa skrbi za vsebine v tečaju. za spletno učilnico in za tehnično pomoč.

4. ZASNOVA IN RAZVOJ MOST-VO

Velik del Arnesovih aktivnosti je usmerjen v izobraževanje in osveščanje javnosti o spletni varnosti (Varni na internetu, b.d.). Pri tem so bili mlajši otroci prepoznani kot kritična skupina, ki ima na eni strani omogočen preprost dostop do spleta in komunikacijskih tehnologij, na drugi pa so v večini primerov premalo opremljeni z znanji, s katerimi bi se lahko uspešno soočali z nevarnostmi, ki jih uporaba te tehnologije prinaša s seboj (LSE 1, b.d.). Predvsem jim primanjkuje izkušenj, zato podcenjujejo težave in so pretirano samozavestni pri uporabi tehnologij, kar jih lahko privede v težavne situacije, katere težko rešijo sami (LSE 2, b.d.).

Tečaj MOST-VO je zasnovan na osnovi Tečaja o varni rabi interneta in naprav za odrasle (MOST-V), ki pa je namenjen v prvi vrsti učiteljem in redno dvakrat letno poteka že pet let, vanj se je do sedaj vključilo že 7.800 udeležencev. Tečaj za otroke MOST-VO pokriva isti nabor vsebin, ki so v celoti prilagojene otrokom.

Arnes prepoznava ključno vlogo učiteljev na področju osveščanja, saj so oni tisti, ki imajo možnost otrokom podati informacije, ki jim bodo omogočale varno rabo interneta in komunikacijskih naprav. Da bi učitelje opremili s potrebnimi znanji, smo pripravili tečaj MOST-V za odrasle. Ker pa za svoje delo z učenci potrebujejo tudi kvalitetno orodje za izobraževanje o tej tematiki, smo pripravili MOST-VO za otroke. Pri pripravi in evalvaciji te spletne učilnice je Arnes k sodelovanju povabil strokovnjake iz Pedagoške fakultete Univerze v Ljubljani in z Zavoda za šolstvo RS.

Spletna učilnica je postavljena na platformi skupnost.sio.si, ki je del spletnega mesta SIO. Ta povezuje in integrira projekte, dejavnosti in storitve slovenskega izobraževalnega sistema. Na portalu skupnost SIO se nahajajo različne spletne učilnice, med drugim vsi Arnesovi MOST, spletne učilnice Ministrstva za izobraževanje, znanost in šport, Ministrstva za pravosodje, Zavoda RS za šolstvo, Centra RS za poklicno izobraževanje, Šole za ravnatelje, Andragoškega centra Slovenije in drugih ustanov.

4.1 Testno obdobje in odprtje tečaja

Po dogovoru o obliki in vsebinah tečaja se je Arnes lotil priprave gradiv in urejanja spletne učilnice.

Po osnovni postavitvi spletne učilnice je sledilo testno obdobje, v katerem so učilnico preizkušale nekatere šole ter strokovnjaki iz Pedagoške fakultete Univerze v Ljubljani in Zavoda za šolstvo RS. V skladu s pridobljenimi povratnimi informacija iz tega obdobja so bile narejene določene prilagoditve učilnice.

Tečaj je bil predstavljen in dan v uporabo učiteljem v sklopu širšega nabora aktivnosti ob mednarodnem Dnevu varne rabe internet 14.2.2019.

5. VSEBINE TEČAJA

Vsebine tečaja so razdeljene na tri sklope (oziroma tri "tedne"), ki zajemajo vse ključne informacije za varnost otrok na spletu in pri uporabi komunikacijskih tehnologij. Gradiva so podana v različnih oblikah:

- Vsa osnovna gradiva so podana v obliki interaktivnih videoposnetkov, ki učence spodbujajo h aktivnosti, z zanimivimi vprašanji, ki omogočajo takojšnji razmislek in pogovor o tematiki
- Kvizi
- Forumi
- Dodatne aktivnosti. Tu najdemo povezave na članke, videe, tematske igre ali druge zanimive vsebine, ki se nahajajo izven učilnice in se ukvarjajo z obravnavano tematiko.
- Napotki za telesne aktivnosti. Ob koncu vsakega sklopa so dodana tudi navodila za preproste gibalne vaje, ki otroke spodbujajo k bolj aktivnemu življenskemu slogu, saj se vse ostale aktivnosti v tečaju izvaja sede.

5.1 Prvi sklop

V prvem sklopu gradiv so razdelane spletne laži in prevare. Tu učenci pridobijo informacije, kako prepoznati lažne trgovine in profile na spletu, kako preveriti resničnost najdenih informacij in kako vzpostaviti kritično distanco do prebranega. Namen gradiv v tem sklopu je otroka ozavestiti, da ni vse resnično, kar najdemo na spletu ter da je potrebno nekritičnosti in naivnost zamenjati s kritičnim razmislekom o objavljenem. (LSE 3, b.d.).

5.2 Drugi sklop

V drugem sklopu je glavni poudarek na družbenih omrežij in različnih aplikacijah. Otrokom so na voljo nasveti, kaj je primerno deliti na spletu in kaj ne, poleg tega pa so podane tudi smernice internetnega bontona. Učence tečaj ozavesča o daljnoročnih posledicah svojih objav na družbenih omrežjih in aplikacijah za komuniciranje ter o drugih načinih deljenja informacij o naših navadah, željah in strahovih, saj se otroci v večini primerov ne zavedajo, kakšno sled puščajo na internetu ter kako je možno deljene informacije zlorabiti. Prav tako je poudarek na oblikah "virtualnega nasilja", ki se ga pogosto marginalizira v primerjavi s fizičnim.

5.3 Tretji sklop

V zadnjem sklopu vsebin so glavne obravnavane tematike vezane na gesla, navidezno resničnost, ki jo ustvarja splet ter ekološki vidik uporabe spleta in komunikacijskih tehnologij (Milek 2019). Pri geslih se učencem predstavi, kako izgleda močno geslo in čemu se morajo izogibati, ko izbirajo gesla za različne storitve. Pri navidezni resničnosti spleta poskušamo predstaviti iluzijo, ki jo pogosto ustvarjajo družbena omrežja. Le-ta namreč dajejo popačeno sliko posameznikovega življenja, ki je pogosto predstavljena v skrajnostih. Ekološki vidik se navezuje na posledice naše uporabe spleta in sodobnih tehnologij na okolje. Učencem poskušamo prikazati nesmisel neprestane menjave naprav z novejšimi, ter jih pirpraviti do tega, da pri uporabi pomislijo tudi na to, kako s tem vplivajo na okolje.

6. UPORABA V ŠOLAH

Po odprtju tečaja javnosti se je vanj do poletja 2019 vključilo 18 učiteljev iz 17 različnih šol. Nekateri izmed teh učitelji so skozi tečaj vodili več skupin učencev, večina učiteljev je tečaj uporabljala le pri pouku, tako da se v splošnem učenci niso vpisovali direktno v učilnico, zaradi tega nimamo natančnega števila udeleženih. Po naših informacijah se število učencev, ki so se v tem času seznanili z vsebinami v učilnici, giblje nekje med 500 in 600 učenci

Pridobitev dostopa do skupine v spletni učilnici poteka bo sledečem postopku:

- Učitelj, ki želi uporabljati spletno učilnico kontaktira Arnes prek elektronskega naslova most.vo@arnes.si.
- Skupaj s strokovnjakom na Arnesu ugotovita kakšno je njegovo znanje uporabe portala skupnost SIO, Arnes učilnic oz. platforme Moodle. Na podlagi tega se nato predvideva, koliko pomoči s strani Arnesa bo učitelj potreboval pri uporabi spletne učilnice. Priporoča se vsaj osnovno poznavanje okolja portala skupnosti SIO.
- Učitelj in Arnes se dogovorita za ime skupine in geslo za vpis. Arnes v spletni učilnici ustvari skupino z izbranim imenom, v večini primerov je ime skupine enako imenu šole iz katere prihaja učitelj. Geslo dsotopa omogoča, da se učenci v učilnico vpišejo sami. Za vpis potrebujejo profil na portalu skupnosti SIO, ki pa se jim avtomatsko ustvari, ko se prijavijo s svojim šolskim AAI profilom. (Celo udeleženci, ki še nimajo AAI dostopa, si lahko osebni profil na portalu skupnosti SIO sami ustvarijo.)
- Učitelju se dodeli status non-edititng teacher v spletni učilnici. S tem pridobi možnost odpiranja vsebin po sklopih za učence. Tako si lahko sam zastavi časovni okvir dela, v katerem bo predelal vsebine.

- Vsa nadaljnja uporaba spletne učilnice je nato v rokah učitelja.

6.1 Povratne informacije o uporabi spletne učilnice

V anketi, ki je bila sestavljena s strani Arnesa in poslana učiteljem, ki so uporabljali spletno učilnico, smo pridobili zanimive povratne informacije, ki govorijo o tem, kako so dejansko učitelji uporabljali spletno učilnico, potem ko jim je bi omogočen dostop do le-te.

Medtem, ko je bilo mišljeno, da se poleg učiteljev v spletno učilnico vpišejo tudi njihovi učenci, ki bi bili uvrščeni v pripadajočo skupino, je velika večina učiteljev ta korak izpustila in spletno učilnico uporabila kot orodje pri pouku, za neposredno obdelavo gradiv med šolskimi urami. Poleg tega so učitelji koristili spletno učilnico tudi med podaljšanim bivanjem in nadomestnimi urami. Uporabnost spletne učilnice v različnih situacijah potrjuje Arnesovo predvidevanje, da se bodo učitelji znašli in orodje prilagodili svojim potrebam in zamislim.

Vsa gradiva, s katerimi je spletno učilnico opremil Arnes, so bila v anketi ocenjena zelo pozitivno. Tako smo z učilnico dosegli svoj namen, saj imajo z njo učitelji na voljo kvalitetno storitev, ki jo uporabljajo po svojih željah, s tem pa otrokom podajo informacije, ki jim bodo pomagale ori ohranjanju varnosti in zasebnosti na spletu ter pri pametni uporabi komunikacijskih tehnologij.

7. ZAKLJUČEK

S tečajem MOST-VO je Arnes uspel ponuditi učiteljem sodobno, strokovno in prilagojeno orodje, ki bo pomagalo pri ozaveščanju otrok o na spletnih izzivih in jih usmeriti v varno uporabo naprav.

V spletno učilnico bodo sproti dodajane aktualne vsebine in spremenjene vse vsebine, ki ne bodo več relevantne. Tako bodo uporabnikom vedno na voljo ažurne informacije in gradiva. Proces ustvarjanja in dograjevanja spletne učilnice namreč poteka neprekinjeno Upamo tudi, da nam bodo pri tem pomagali tudi učitelji s svojimi povratnimi informacijami. Naša želja je, da oblikujemo in vzdržujemo orodje ki vsebuje vse tisto, kar potrebujejo učitelji. Učilnica ni ustvarjena v vakumu in ne želimo, da je sama sebi namen. Upamo, da se bo za uporabo učilnice odločilo še veliko več učiteljev in da bodo na ta način pripomogli k osveščanju otrok o tem, kako uporabljati nove tehnologije in skrbeti za lastno varnost na spletu.

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PiDigits – distribuirani sistem za računanje števila PI

PiDigits - distributed system for calculation of number PI

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POVZETEK

Letos je 265. obletnica rojstva barona Jurija Vege, ki je med ostalimi dosežki, nekaj časa držal tudi svetovni rekord v številu izračunanih decimalk števila π. Naša šola je povezana z imenom Jurija Vege in zato smo se s skupino dijakov odločili, da bi zagnali projekt s katerim bi poskusili doseči rekord v izračunu decimalk števila π.

Sistem PiDigits, ki smo ga začeli razvijati, uporablja t.i. BBP algoritem, ki omogoča direktni izračun poljubne decimalke števila PI v šestnajstiškem ali binarnem sistemu. To omogoča distribuirani izračun na velikem številu nezahtevnih računalnikov. S sistemom bomo poskusili seznaniti čim večje število uporabnikov ter na ta način popularizirati Vego in njegovo delo ter matematiko in tehniko.

Ključne besede

Število PI, distribuirano računanje, BPP algoritem

ABSTRACT

This year is the 265th anniversary of the birth of Baron Jurij Vega, who among other achievements, also held for some time the world record in the number of calculated decimal places of the number π. Our school is affiliated with the name Jurij Vega, so we decided to start a project with a group of students to try to reach a record in calculating decimal places of π.

The PiDigits system we started developing uses BBP algorithm that allows the direct calculation of any decimal PI number in a hexadecimal or binary system. This enables distributed computation on a large number of non-sophisticated computers. We will try to introduce the system to as many users as possible, thus popularizing Vega and its work, as well as mathematics and technology in general.

Keywords

Number PI, distributed computing, BPP algorithm

1. UVOD

Fascinantna zgodovina konstante, ki jo danes poznamo kot število π, obsega več tisočletij, skoraj od začetka pisane zgodovine pa do danes. V marsičem je ta zgodovina vzporedna z napredkom znanosti in tehnologije na splošno ter posebaj matematike in računalniške tehnologije.

Letos je 265. obletnica rojstva barona Jurija Vege, ki je med ostalimi dosežki, nekaj časa držal tudi svetovni rekord v številu izračunanih decimalk števila π. Naša šola je, vsaj po popularnem imenu, povezana z Jurijem Vego in ker se ukvarjamo z računalništvom, smo se s skupino dijakov odločili, da bi zagnali projekt s katerim bi poskusili doseči rekord v izračunu decimalk števila π.

To bi naredili s pomočjo t.i. BBP (Bailey–Borwein–Plouffe) algoritma, ki nam bo omogočil vzporedni izračun velikega števila decimalk.

2. ZGODOVINA ŠTEVILA π

V eni najstarejših omembah števila π so Babilonci uporabljali približek 3 1/8 = 3.125. V približno istem času so Egipčani predvidevali, da krog s polmerom devet ima isto površino, kot kvadrat s stranico velikosti osem, kar da π = 256/81 = 3.1604 ... Ostali so se v tem času zadovoljili z vrednostjo 3.

Prvo resnejše matematično računanje vrednosti števila π je izvedel Arhimed iz Sirakuze (približno 250 pr.n.št), ki je uporabil geometrično vrsto na podlagi vpisanih in opisanih poligonov ter dobil meji 3 10/71 < π < 3 1/7 oz. 3.1408... < π < 3.1428... Arhimedovo metodo niso izboljšali več stoletij.

Na vzhodu je Al-Kashi iz Samarakanda okrog leta 1430 izračunal π na 14 decimalk

V 17 stoletju sta Newton in Leibniz iznajdla infinitezimalni račun, ki je omogočil premik tudi na področju računanja števila π. Tako so nastale nove formule za izračun števila π, npr Gregory-Leibnizova formula, ki jo dobimo če v spodnji formuli:

$$\begin{aligned}\tan^{-1} x &= \int_0^x \frac{dt}{1+t^2} = \int_0^x (1 - t^2 + t^4 - t^6 + \cdots)\, dt \\ &= x - \frac{x^3}{3} + \frac{x^5}{5} - \frac{x^7}{7} + \frac{x^9}{9} - \cdots\end{aligned}$$

damo vrednost x = 1, nakar dobimo:

$$\pi/4 = 1 - 1/3 + 1/5 - 1/7 + 1/9 - 1/11 + \cdots$$

Nažalost, ta vrsta konvergira zelo počasi in je potrebno na stotine členov, da bi izračunali π na komaj dve decimalki natančno.

Formulo je izboljšal Machin:

$$\pi/4 = 4\tan^{-1}(1/5) - \tan^{-1}(1/239)$$

Okrog leta 1910 je indijski matematik Ramanujan najdel novo neskončno vrsto:

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9801}\sum_{k=0}^{\infty}\frac{(4k)!(1103+26390k)}{(k!)^4 396^{4k}}$$

Vsak element te vrste ustvari dodatnih osem pravilnih decimalk. Leta 1985 je Gosper po tej formuli izračunal 17 milijonov decimalk števila π. Ramajunova formula je bistveno bolj učinkovita od dotedanjih vendar deli z njimi linearno kompleksnost – če želimo izračunati dvakrat več decimalk, moramo izračunati dvakrat več členov vrste. Prav tako je značilnost teh algotimov, da je za izračun *d*-te decimlke potreben izračun vseh predhodnih *d-1* decimalk.

Kratek povzetek zgodovine je strukturiran v tabeli 1.

Tabela 1: kratek zgodovinski pregled izračunov števila π [1].

Babilonci	cca 2000 pr.n.št.	1	3.125
Egipčani	cca 2000. pr. n. št.	1	3.16045
Kitajci	cca 1200 pr. n. št.	1	3
Arhimed	cca 250 pr. n. št.	3	3.1418
Tsu Ch'ung Chi	cca 480	7	3.1415926
Viete	1593	9	3.1415926536
Machin	1706	100	
Vega	1794	140	
Shanks	1874	707	(527 pravilnih)
Genuys	1958	10.000	
Guilloud and Bouyer	1973	1.001.250	
Kanada in ostali	1982	16.777.206	
Kanada in ostali	1989	1.073.741.799	
Haruka Iwao	2019	31.415.926.535.897	

3. BBP FORMULA

Formula Bailey – Borwein – Plouffe (BBP formula) je formula, ki omogoča izračun posamezne decimalke števila π v šestnajstiškem sistemu neodvisno od ostalih decimalk. Formulo so odkril leta 1995 Simon Plouffe in jo poimenoval po avtorjih članka v katerem je bila objavljena: Davidu H. Baileyju, Peter Borwein-u in Plouffeu [2]. Pred tem jo je Plouffe objavil na svojem spletnem mestu [3]. Formula je naslednja:

$$\pi = \sum_{k=0}^{\infty}\left[\frac{1}{16^k}\left(\frac{4}{8k+1}-\frac{2}{8k+4}-\frac{1}{8k+5}-\frac{1}{8k+6}\right)\right].$$

Dokazano je, da formula omogoča izračun n-te šestnajstiške ali binarne decimalke, brez potrebe po izračunu predhodnih n-1 decimalk. Prav tako algoritem ne zahteva uporabo visoke natančnosti.

Časovna kompleksnost kljub temu ostaja linearna, kar pomeni, da s tem algoritmom sicer lahko direktno izračunamo n-to decimalko vendar je za 'bolj oddaljene' decimalke potrebno bistveno več časa.

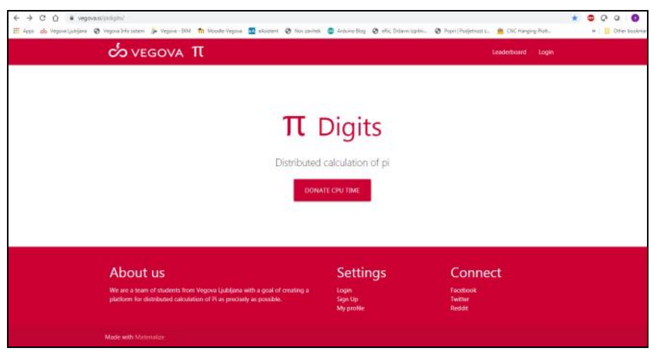
4. PIDIGITS

PiDigits je večnivojski sistem za distribuirano računanje decimalk števila π s pomočjo BBP algoritma. Projekt je zastavljen v naslednji obliki:

- uporabniki se registrirajo/prijavijo v sistem in od strežnika dobijo 'paket' v obdelavo.
- 'paket' je določeno število decimalk, ki se na njihovem računalniku izračunajo z BBP algoritmom. Le ta nam omogoča, da je izračun decimalk neodvisen od uporabnika do uporabnika (za razliko od ostalih, kjer je za izračun ene decimalke potrebno poznati vse predhodne).
- po končanem izračunu se decimalke pošljejo nazaj na strežnik, kjer se shranijo.
- sistem tako beleži izračunane decimalke ter koliko je decimalk izračunal posamezni uporabnik.
- sistem omogoča prikaz seznama uporabnikov, ki so najbolj prispevali k računanju decimalk.

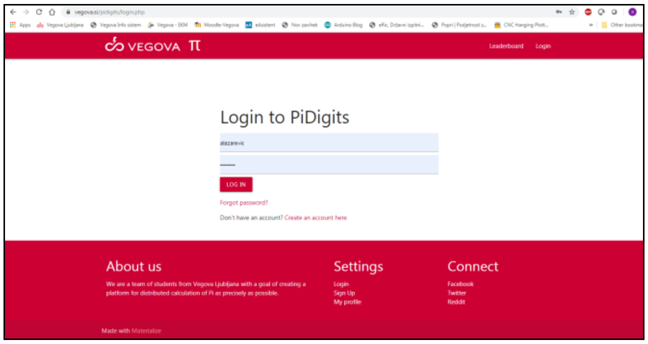
Uspešnost projekta (izračun čim večjega števila decimalk) je tako odvisna od (velikega) števila uporabnikov, ki sodelujejo.

Sistem je trenutno v pilotski fazi: spletna stran je dostopna na naslovu http://vegova.si/pigidits (slika 1).



Slika 1: Naslovna stran projekta PiDigits.

Sistem omogoča registracijo novih in prijavo obstoječih uporabnikov (slika 2). Po prijavi odjemalec pridobi informacijo o paketu decimalk, ki jih mora izračunati. Decimalke se izračunajo na odjemalcu in po koncu izračuna rezultati pošljejo na strežnik. Strežnik beleži uporabnika, pakete, ki jih je posamezni uporabnik rešil ter, seveda, izračunane decimalke.



Slika 2: Prijavna stran projekta PiDigits.

Trenutno je uporabljena podatkovna baza MySQL, strežniške skripte so napisane v PHP-je, izračun decimalk se izvaja v JavaScript-u.

5. ZAKLJUČEK

Trenutna verzija sistema je namenjena testiranju arhitekture in ni še optimizirana za izračun ter shranjevanje večjega števila decimalk.

Potrebne so še nadgradnje na različnih nivojih:

- na baznem nivoju bo potrebno dodati kapacitete za shranjevanje velikega števila decimal (nakup diskov, postavitev v RAID; namestitev SUPB).
- testiranje samega izračuna decimalk je pokazalo, da je računanje v JavaScriptu preveč počasno (za računanje ‘oddaljenih’ decimalk) in zato bo treba narediti posebno aplikacijo, ki bo znala bolj učinkovito izkoristiti procesorsko moč odjemalca. Tako bi naredili za različna okolja (Windows, Android, iOS) ter tako omogočili sodelovanje večjega števila uporabnikov.

Za uspeh projekta je potrebno veliko število uporabnikov, ki bodo 'darovali' del procesorskega časa svojih računalnikov/tablic/mobilnih telefonov. Zato načrtujemo tudi niz promocijskih aktivnosti, s katerimi bi pridobili čim večje število uporabnikov ter posredno v njih spodbudili zanimanje za matematiko in tehniko.

6. VIRI IN LITERATURA

[1] https://en.wikipedia.org/wiki/Chronology_of_computation_of_π#cite_note-34

[2] D. H. Bailey, P. B. Borwein and S. Plouffe, “On The Rapid Computation of Various Polylogarithmic Constants”, 1996. http://www.cecm.sfu/personal/pborwein/

[3] David H. Bailey, »A Compedium of BBP-Type Formulas for Mathematical Constatns«, 2017

Oblak 365 in domače branje pri slovenščini

Cloud 365 and home reading at slovene language

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POVZETEK

V prispevku predstavljamo, kako se lahko samostojno in skupinsko delo ob domačem branju pri slovenščini prepleta z uporabo različnih računalniških orodij. V različnih skupinah smo uporabljali *Oblak 365*, v katerem so se učenci naučili delovati in sodelovati v spletnem okolju, v katerem lahko nalagajo svoje dokumente v skupne mape ali urejajo dokument skupaj z drugimi sošolci. Učenci so ob spodbudi in usmerjanju mentorja izdelali glasilo – skupen dokument, v katerem so upoštevali osnovna pravila oblikovanja besedil v *Microsoft Wordu* od naslovnice do navajanja referenc. Svoje znanje računalniškega oblikovanja in zapisa besedil, ki so ga nadgrajevali od šestega do devetega razreda, so uporabili v tvorjenju različnih besedil in oblikovanju skupnega dokumenta. Delo jih je navduševalo in hkrati so ugotavljali, kako odgovorno je sodelovanje z drugimi avtorji v skupnem dokumentu in koliko časa porabijo za takšno delo. Pri usmerjanju dela učencev smo se stalno povezovali tudi s šolsko računalničarko, ki je učence usmerjala in jim pomagala ob zahtevnejših problemih, s katerimi so se srečevali pri pisanju. Končni rezultat je bilo glasilo ob domačem branju.

Ključne besede

Oblak 365, urejanje besedil, domače branje, skupni dokument.

ABSTRACT

This article shows how teamwork at required reading in Slovene language can interleave with different software tools. Different teams load documents to shared folders inside Cloud 365 and edit shared documents. Pupils create together school newspaper using shared editing. They have to follow basic editing rules in Microsoft Word (Header styles, referencing …). Computer knowledge that pupils got from sixth to ninth class they use for creating different texts and shared document. Pupils were impressed with their results, they realised how responsible is collaboration with different authors and they learn to estimate time for such work. Computer science teacher help pupils resolving more demanding computer problems. Result of common work was school newspaper.

Keywords

Cloud 365, word processing, required reading, shared document.

1. UČENJE DIGITALNIH KOMPETENC OB DOMAČEM BRANJU

Pri pouku slovenščine lahko digitalne kompetence razvijamo pri različnih dejavnostih. Vuorikari [5] v svojem prispevku o digitalnih kompetencah pravi, da vsak, ki je spreten na tem področju, nima težav z obdelavo podatkov, komunikacijo, ustvarjanjem vsebin, varnostjo in reševanjem problemov. Osnovna šola je poleg domačega okolja pomembna pri uvajanju in poučevanju digitalnih kompetenc, kjer se učenci srečujejo z iskanjem ustreznih podatkov in njihovo uporabo, z varnostjo na spletu in seveda s samostojnim zapisom besedil, pri katerih upoštevajo pravila zapisa besedil in navajanja po ISO-standardih [3].

Učence pri slovenščini vsako leto seznanjamo z različnimi veščinami pisanja besedil s pomočjo računalniškega programa *Microsoft Word*. V šestem razredu jih seznanimo s pravilnim oblikovanjem naslovnice in zapisom besedila z uporabo ustrezne poravnave, oznakami naslovov in navajanjem virov. Znanje vsako leto nadgrajujemo tako, da se v sedmem razredu naučijo številčenja strani in vstavljanja slikovnega gradiva z označevanjem naslovov le-tega. Hkrati učence pri obravnavi basni seznanimo tudi z osnovo uporabe PPT-predstavitve. V osmem razredu utrjujemo znanje s pripravo besedil za govorne nastope in domače branje s pomočjo programov *Microsoft Word* in *Microsoft Power Point*. V devetem razredu smo k zapisu besedil v urejevalniku besedil *Microsoft Word* uvedli urejanje v *Oblaku 365*, v katerem učenci ponovijo osvojeno znanje preteklih let in se naučijo pisanja in oblikovanja vsebin v spletnem okolju. Odločili smo se, da bomo v prispevku predstavili, kako uporabljamo spletna orodja za pripravo nalog ob domačem branju.

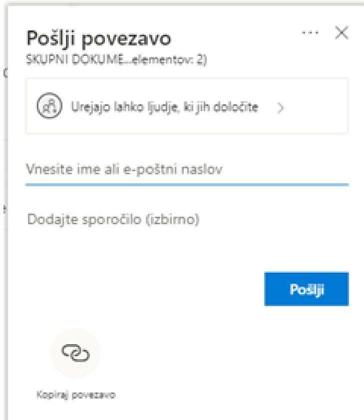
2. OBLAK 365

Na spletni strani https://o365.arnes.si je zapisano, da je *Office 365 paket storitev, ki vključuje elektronsko pošto, digitalno shrambo, orodja za avdio in video komunikacijo, deljenje dokumentov in hkratno delo na njih. Vsa ta orodja so med seboj tesno povezana s tvojo šolsko e-identiteto*. [1] Pri pouku slovenščine smo v sodelovanju z računalničarko na naši šoli uporabljali elektronsko pošto, deljenje dokumentov in hkratno delo v njih. V nadaljevanju bomo predstavili, kako je potekalo seznanjanje učencev z digitalno shrambo, kako je nastajal skupni dokument, katere prednosti in pomanjkljivosti smo opazili pri delu in zakaj se nam zdi taka oblika dela dobra.

3. PISANJE IN UREJANJE BESEDILA SKUPAJ Z DRUGIMI AVTORJI

3.1 Elektronski naslovi in povabilo

Ker *Oblak 365* povezuje *Office365* in *Arnes AAI*, so morali tudi učenci pridobiti elektronski naslov v federaciji *AAI Arnes*. V sodelovanju z računalničarko na naši osnovni šoli, ki je najprej pripravila vso potrebno dokumentacijo za pridružitev organizacije in v nadaljevanju smo pridobili elektronske naslove vsi učitelji in kasneje tudi učenci. Učenci so dobili posebne obrazce, ki so jih izpolnili skupaj s starši in na podlagi katerih so pridobili nov elektronski naslov. Elektronski naslov v *AAI Arnes* je tudi učiteljem, ki smo se odločili za delo v *Oblaku 365*, omogočil, da smo v posamezne skupine ali k posameznim nalogam povabili učence. Učencem smo poslali povabilo v skupino in v okencu *Dovoli dostop* izbrali *Lahko ureja*, saj so bile naloge povezane z aktivnim sodelovanjem pri nastajanju skupnega dokumenta ob domačem branju.



Slika 1: Okno za povabilo k urejanju dokumenta

3.2 Navodila za delo

Z učenci smo se najprej pogovorili o tem, da bodo ob domačem branju pripravili posebno glasilo v elektronski obliki, v katerem bodo predstavili samostojno delo in delo v dvojici ter se preizkusili pri postavitvi, pregledovanju in urejanju dokumenta v *Oblaku 365*. Učenci so bili navdušeni, da bodo lahko delali s pomočjo računalnika in spletnega okolja. Hkrati jih je navduševalo tudi, da bodo po prebrani knjigi lahko delali tudi skupaj s sošolci in ne le samostojno. Eno šolsko uro smo namenili prijavi in vajam, s pomočjo katerih so se učenci seznanili z *Oblakom 365* – kako se prijavim, kako najdem mapo, ki je v skupni rabi z mano, kako nalagam svoj dokument v izbrano mapo in kako urejam skupni dokument s sošolci. Za vajo so urejali dokument, ki so ga našli v mapi *Vaje*. S pomočjo učnega lista z navodili za urejanje dokumenta v *Microsoft* Wordu so učenci ponovili značilnosti urejenega dokumenta z ustrezno pisavo, oblikovanjem odstavkov, naslovov in podnaslovov ipd. Že na začetku smo opazili, da nekateri učenci zelo dobro poznajo pravila pri urejanju dokumentov, hitro razumejo in povezujejo računalniška znanja ter delo v spletnih okoljih. Na drugi strani so bili učenci, ki manj pogosto uporabljajo različna računalniška in spletna orodja in so imeli tudi z osnovnimi aktivnostmi v *Oblaku 365* kar precej težav.

Učenci so dobili navodilo za izdelavo šolskega glasila na učnem listu. Delo in urejanje je potekalo več mesecev (od januarja do aprila). Najprej so si učenci prebrali knjigo, določeno za domače branje – ena generacija *Visoško kroniko* Ivana Tavčarja in druga generacija *Zgodbe po Shakespearu* Charlesa in Mary Lamb, tretja generacija knjigo po izbiri. V nadaljevanju bomo vse korake pri nastajanju časopisa povezali z *Zgodbami po Shakespearu.*

Vsak učenec je samostojno zapisal osnovne informacije o zgodbi, tako da je oblikoval miselni vzorec ali zapis s ključnimi besedami. Svoje gradivo je prinesel k pouku v februarju. Skupaj z učencem, s katerim je nadaljeval delo v dvojici, sta pripravila predstavitev notranje zgradbe, ki je vsebovala strnjeno obnovo ter predstavitev književnih oseb, kraja in časa dogajanja. Delo je potekalo med poukom slovenščine v računalniški učilnici naše šole. Učenci so besedilo zapisali v *Microsoft Wordu*, tako da so uporabljali program na računalniku in so dokument potem naložili v mapo v *Oblaku 365* ali pa so svoje besedilo zapisovali v programu *Word*, ki ga omogoča *Office 365*.

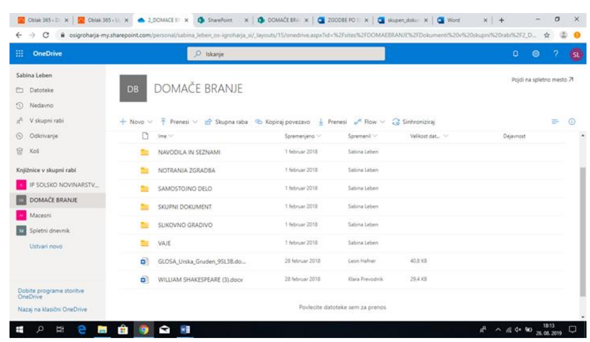
Do marca so učenci samostojno pripravili razmišljanje ali poustvarjalno besedilo, za katerega so izbrali naslov s pomočjo žrebanja in izbire zaporedne številke. V urejevalnikih besedil so lahko pisali razmišljanja, dramska besedila, nadaljevanje pripovedi, raperske pesmi, pesem lepljenko, strip, dopisovanje po elektronski pošti ali na Skypu, križanke … [2] Učenci so lahko izbrali tisto besedilo, ki jim je blizu ali pa besedilo v povezavi z najljubšo zgodbo, ki so jo prebrali. Besedilo so oblikovali doma in ga do dogovorjenega datuma naložili v skupni dokument, oblikovan v *Oblaku 365*.

Zadnji del nalog je bil zopet povezan z delom v dvojici, saj so učenci prevzeli različne vloge pri urejanju skupnega dokumenta, v katerem so bila zbrana vsa besedila, ki so jih pripravljali od januarja do aprila. Skupni dokument so uredili od naslovnice, postavitve podpoglavij do virov in literature na koncu. Končna oblika glasila z upoštevanjem popravkov in sprememb je nastala v začetku maja.

3.3 Organizacija map in nalaganje dokumentov

V skupini, ki smo jo ustvarili za domače branje *Zgodbe po Shakespe0ru*, so učenci ob prijavi v *Oblak 365*, izbiri spletnega mesta *DOMAČE BRANJE* in dokumentih v skupni rabi z njimi najprej videli mapo *2_DOMACE BRANJE_9sl3B*. Glavno mapo smo razdelili na več podmap, v katere so nalagali posamezne dokumente in na koncu v posebni mapi skupaj oblikovali skupni dokument.

Mape so bile organizirane glede na aktivnosti, ki smo jih predvideli za domače branje. V prvi mapi so bili shranjeni seznami učencev po dvojicah in izbranih besedilih ter navodila za delo. V drugo mapo so učenci oddajali besedila in naloge, povezane z njihovim samostojnim delom, v tretji mapi so bila besedila v povezavi z notranjo zgradbo zgodb in na koncu slikovno gradivo ter skupni dokument.



Slika 2: Postavitev map

Preden so učenci postavili in uredili skupni dokument, smo jim besedila pregledali oblikovno ter pravopisno in slovnično. Popravke smo vnašali v njihov dokument in ko so se naslednjič prijavili ter pregledali svoj dokument, so sprejeli popravke, dopolnili manjkajoče podatke in oblikovno uredili besedilo, če prvič niso upoštevali vseh navodil in priporočil. Med pripravo in urejanjem posameznih besedil, ki so jih pripravljali samostojno ali v dvojici, je med nami potekala spletna komunikacija v okolju *Oblaka 365*. Učenci so poleg pošiljanja sporočil učitelju, spoznali tudi uporabo pripomb in sprememb, ki nam v *Microsoft Wordu* omogočajo, da vsak vidi spremembe in zapis pripomb ob dokumentu in ne le na koncu besedila. Na začetku so se pojavile težave, da niso vsi videli vnesenih dopolnil in popravkov, zato smo naredili še nekaj vaj v računalniški učilnici in potem je delo steklo. S posameznimi učenci smo še večkrat pogledali njihovo delo tudi v šoli, drugi so bili pri uporabi popolnoma samostojni.

3.4 Postavitev in urejanje skupnega dokumenta

Potem ko so bila posamezna besedila urejena, sta učenca, zadolžena za urejanje skupnega dokumenta, odprla in naložila dokument za skupino. Dokument sta razdelila na posamezne dele od naslovnice prek podnaslovov posameznih sklopov do navajanja virov in literature na koncu. Dokument smo pregledali v skupini in se pogovorili o ustreznosti posameznih vsebinskih enot.

Vsaka dvojica je opravila svojo nalogo pri oblikovanju in urejanju končne podobe dokumenta. Učenci so izbirali med oblikovanjem naslovnice, zapisom uvodnika, pripravo kazala vsebine in slik, kolofonom, oblikovnim pregledom in po potrebi urejanjem obojestranske poravnave, vstavljanjem številke strani, izbiro ustrezne pisave, prelomom strani, urejanjem slikovnega gradiva in dodajanjem le-tega, kjer strani oblikovno niso bile ustrezno zapolnjene, pregledom in popravki pri navajanju virov in literature.

Učenca, ki sta izbrala zapis naslovov in podnaslovov, sta natančno pregledala mapo vseh prispevkov in v pogovoru z učiteljem, določila naslove in podnaslove posameznih sklopov, znotraj katerih je bilo jasno, vsebine katerih zgodb spadajo v posamezni razdelek. Potem so vsi učenci vstavljali svoja besedila v skupni dokument in jih po potrebi še popravljali. Besedilo so lahko dodajali in urejali v spletnem okolju, saj *Oblak 365* omogoča uporabo urejevalnika besedil ali pa so izbrali možnost *Odpri v namizni aplikaciji*, *Odpri datoteko Word* in v nadaljevanju so v okencu dobili varnostno vprašanje o odpiranju datoteke, pri katerem so izbrali odgovor *DA*. Običajno so morali potem še enkrat vpisati svoj elektronski naslov za uporabniško ime in geslo. Potem se je odprl dokument v *Wordu*, ki so ga lahko shranjevali in osvežili s posodobitvami drugih avtorjev. Paziti so morali, da so vse spremembe shranjevali v skupni dokument in niso ustvarjali samostojnega dokumenta ter ga na novo nalagali v mapo. Večini učencev je to uspelo brez težav, nekateri učenci pa zaradi pomanjkljivega znanja ali drugih težav s programsko opremo niso uspeli urediti svojega dela brez pomoči sošolcev ali učitelja.

Potem ko so bila vsa besedila na ustreznem mestu v skupnem dokumentu glasila ob domačem branju, so učenci še enkrat pregledali besedila in jih popravljali v skladu z učnim listom ***Navodila za urejanje besedila v programu Microsoft Word.*** Navodila so vsebovala ustrezno poimenovanje dokumenta, ustrezne robove dokumenta, izbor pisave in njeno velikost, oblikovanje naslovnice, postavitev strani in oblikovanje naslovov, obojestransko poravnavo besedila, ustrezno oblikovane odstavke v besedilu, slike in fotografije, označene z naslovi ter navajanje virov in literature po ISO-standardih [3]. Ko so učenci v začetku aprila pripravili skupen dokument, smo ga še enkrat pregledali in podali povratno informacijo. Tokrat je bilo potrebno še zelo malo popravkov, saj so učenci v procesu nastajanja posameznih besedil povratne informacije sproti prejemali in so večino neustreznih zapisov ali oblikovnih nastavitev že popravili. Nekatere napake so se ponovno pojavile pri prenašanju besedila v skupni dokument. Ko so sprejeli in popravili vse predlagane spremembe, je dokument dobil končno podobo v pdf-obliki in tiskani obliki.

3.5 Urejen in dokončan dokument

Končni rezultat ali skupen dokument je nastajal več mesecev v šolskem in domačem okolju. Učenci so prek vaje in navodil spoznali osnove dela pri urejanju in oblikovanju skupnega dokumenta, se učili dogovarjanja in prevzemanja odgovornosti, sodelovanja v skupini in pomoči učencem, ki so na področju digitalnih kompetenc šibkejši. Spoznali so, da je potrebno veliko znanja, potrpežljivosti in truda, da lahko oblikujemo skupen dokument, ki ima rdečo nit, je ustrezno oblikovan ter vsebinsko zanimiv in privlačen. Potrebovali so veliko spodbude in zaupanja ter tudi pomoči, da so uspeli dokončati zastavljeno nalogo. Pri delu so bili deležni pomoči učiteljice slovenščine kot tudi računalničarke, saj so se včasih pojavile težave, ki so zahtevale reševanje zahtevnejših problemov.

Ko so učenci pri pouku predstavljali svoje delo v okviru skupnega dokumenta, razmišljali o prednostih in pomanjkljivostih predstavitve domačega branja v obliki skupnega dokumenta, so najprej navajali, da je delo z računalniškimi programi in spletnimi orodji privlačno. Hkrati so pripovedovali, da si niso predstavljali, da je potrebno toliko časa in različnih veščin za nastanek končnega izdelka. Ugotavljali so, da so se naučili veliko stvari, kot na primer pravila ustreznega oblikovanja besedila v *Microsoft Wordu*, oblikovanje in zapis kazala, vstavljanje preloma strani in preloma odseka, uporabo pripomb in komentarjev ob besedilu, ustrezno označevanje slikovnega gradiva … Kot glavno pomanjkljivost so navajali veliko časa za pisanje besedil na računalniku in ustrezno oblikovanje zapisov ter občasno blokiranje programa, ko niso uspeli dostopati v skupni dokument ali pa shraniti sprememb, ki so jih vnesli.

4. PREDNOSTI IN POMANJKLJIVOSTI DELA V *OBLAKU 365*

Ugotavljamo, da metode dela z različnimi računalniškimi programi privlačijo učence. Zgoraj opisano samostojno delo in delo v skupini lahko poteka s skupino učencev, ki so vešči oblikovanja in pisanja raznovrstnih besedil, medtem ko je za učence, ki na teh področjih niso tako vešči, bolje izbrati krajše zapise, ki jih ob vodenju učitelja oblikujejo, zapisujejo in urejajo.

Učenci so za delo motivirani, hkrati potrebujejo zelo jasna in natančna navodila, ki jih usmerjajo pri uporabi različnih računalniških programov ali spletnih okolij, v katerih ustvarjajo ustvarjalna in poustvarjalna besedila. Kadar naletijo na težave, je pomembno, da si vzamemo čas, se z njimi pogovorimo in iščemo skupne rešitve. Večinoma je dovolj ponovitev zaporedja korakov in možnost, da učenec ponovno preizkusi postopek, za katerega meni, da mu ne gre. Včasih smo za pomoč zaprosili učiteljico računalništva, ki je pomagala pri različnih *sporih,* ki so nastali zaradi sočasnega urejanja dokumenta dveh učencev na isti strani. Dokler *spor* ni bil rešen, besedila ni bilo mogoče urejati ali shranjevati. Včasih je program prekinil povezavo in se spremembe niso shranile, kar je pomenilo, da je moral učenec ponovno opraviti del naloge ipd.

Prednost takega načina dela je hitra komunikacija in usklajevanje mnenj s pomočjo sporočil ali pripomb ob besedilu, tako da se lahko urejanje in popravki vnašajo kar sproti. Hkrati predstavlja takšno delo veliko odgovornost in sodelovanje, da spoštujemo delo drug drugega, ga ne spreminjamo in brišemo brez dogovora z drugim avtorjem. Tako se tudi učimo, da osvežujemo podatke v skupnem dokumentu s sprotnim shranjevanjem in glede na občasne težave programa je dobro na koncu shraniti kopijo tudi na svoj računalnik. Poleg tega je zelo pomembno, da vsak v skupini odgovorno opravi svojo nalogo in upošteva časovnico. Če nekdo v skupini ne pripravi besedila do dogovorjenega datuma, pomeni, da tudi drugi učenci z delom ne morejo nadaljevati in dokončati svoje naloge. Tako se je nekajkrat zgodilo, da so tudi sošolci spodbujali *zamudnika* naj pohiti in upošteva dogovore, da bodo lahko v skupini dokončali nalogo.

Učenci so pri delu pokazali tudi veliko samoiniciativnosti in ustvarjalnosti, saj so ustvarjali raznovrstna besedila, jih oblikovali v *Microsoft Wordu* ali pa skenirali svoje lepljenke, oblikovali križanko ali strip, iskali raznovrstne rešitve pri dodajanju slikovnega gradiva ipd.

Ob nastajanju skupnega besedila se je vedno dobro zavedati, da gre za proces, ki prinaša nova znanja in veščine, hkrati ga lahko vedno izpopolnjujemo in oblikujemo, saj imajo učenci zelo različno razvite digitalne kompetence. Nekateri so zelo vešči pisanja besedil, saj se pogosto lotevajo zapisa in ustvarjanja s pomočjo IKT-tehnologije, tako da se njihovo znanje stalno izpopolnjuje pri različnih predmetih. Druga skupina učencev rada brska po spletnih straneh ali rešuje kvize s pomočjo različnih računalniških orodij, razvijanje drugih digitalnih kompetenc se jim zdi naporno in menijo, da jim vzame veliko časa, pogosteje so površni pri smernicah za pisanje in oblikovanje besedil z računalniškimi programi. Zdi se jim, da v osnovni šoli tako znanje še ni zelo pomembno. Tudi za drugo skupino učencev je pomembna spodbuda, da začnejo počasi prepoznavati in razmišljati o možnostih, ki jih nudi razvijanje različnih digitalnih kompetenc.

5. ZAKLJUČEK

V prispevku smo poskušali pokazati, kako lahko učenci razvijajo digitalne kompetence pri branju in razmišljanju ob besedilih za domače branje. Po branju zapisujejo besedila, s katerimi predstavljajo vsebino in svoje poglede na prebrano, poskušajo aktualizirati dogajanje, uporabljajo elektronsko pošto, spletno okolje in druge računalniške programe, ki jim omogočajo predstavitev ustvarjalnih idej. Pri literarni vsebini tako razvijajo tudi digitalne kompetence, ki nas danes spremljajo praktično na vsakem koraku: urejanje in obdelava podatkov, elektronska komunikacija, ustvarjanje novih vsebin, skrb za varnost in reševanje problemov. Nekatere digitalne kompetence so bile pri nastajanju skupnega dokumenta v *Oblaku 365* bolj v ospredju, drugih smo se le dotaknili. Na osnovnošolski ravni začenjamo pot, ki jo bodo učenci v nadaljnjih letih izpopolnjevali in nadgrajevali osnovno znanje. Ugotovili smo, da je ena izmed večjih prednosti urejanja skupnega dokumenta sočasno delo. Na drugi strani ima urejanje dokumenta v spletnem okolju tudi pomanjkljivost, ki jo predstavljajo predvsem blokade v programu ali pa prekinjanje povezave s skupnim dokumentom, ko se nam pojavi zapis *Urejanje v realnem času*, zato je pomembo, da skrbno in sproti shranjujemo spremembe.

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Izdelava načrta šolskih poti po poti digitalizacije

School routes plan development; following the path of digitalization

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POVZETEK

Razvoj prometa je na eni strani prinesel napredek, na drugi strani pa spremenil tudi svet, v katerega stopajo otroci. Vsaka šola naj bi imela izdelan načrt šolskih poti, ta pa zahteva stalno posodabljanje, kar dosežemo na podlagi celostnega pristopa, v sodelovanju s ključnimi deležniki zagotavljanja varnosti v cestnem prometu. V prispevku je razbrati razvoj priprave načrta šolskih poti v času desetih let vse do danes, ko živimo v dobi digitalizacije. Izpostavljene so pomanjkljivosti in prednosti načrtov, ki so nastajali na različne načine in preko različnih računalniških programov v sodobnem času, ko je načrt varnih in nevarnih šolskih poti objavljen in dosegljiv tako za šolarje in njihove starše, kot tudi za vso zainteresirano javnost na spletu.

Ključne besede

Načrt šolskih poti, digitalizacija, promet

ABSTRACT

The development of traffic has brought about improvements but has also changed the world that children enter. Every school should have a detailed plan of school routes, which requires constant updates; these can be accomplished by using a wholesome approach and by collaborating with key participants that ensure road traffic safety. This article investigates the development of plans of school routes over the span of the last ten years; a time of rapid digitalization. Highlighted are the advantages and disadvantages of plans that have been made using various approaches and through various software programmes, in contemporary time, when the plans of safe and unsafe school routes are available online and accessible to students and their parents, as well as to a wider public.

Keywords

School routes plan, digitalization, traffic

1. UVOD

Otroci spadajo med ranljivejše skupine v cestnem prometu in so največkrat žrtve v prometnih nesrečah v vlogi pešcev in kolesarjev, zato je področje šolskih poti (in s tem povezano učinkovito načrtovanje varnejših šolskih poti) izrednega pomena za varnost otrok v prometnem vsakdanu. [4]

Kako zbrati podatke o poteh, ki so za učence do šole in domov najbolj varne? Kje so kriteriji, ki določajo, da je neka pot varna ali nevarna (to namreč spremeni dejstvo, ali bo učenec v šolo pešačil ali ga pripada prevoz)? Kdo je kompetenten, da o tem odloča? Na kakšen način se lotiti dokumentacije omenjenih poti? Na kakšen način objaviti narejen načrt? Ta in mnoga vprašanja so se mi porajala po glavi, preden je načrt začel sploh nastajati.

2. ANALIZA STANJA

Na Osnovni šoli Komandanta Staneta Dragatuš so bila okoli leta 2009 postajališča stalna, potreb po spremembah ni bilo. Načrt varnih in nevarnih poti je bil narejen na listu v velikosti A3 formata, na njem pa je bilo razbrati karto Dragatuša z glavno ulico do šole in še kakšno manj prometno cesto, po kateri učenci pešačijo do šole. Opaziti je bilo še šolo, ki je bila posebej označena, in prehod za pešce. List je bil plastificiran in prilepljen na steno ob vhodu. Ta se z leti ni spreminjal oz. posodabljal.

Dejstvo pa je, da pešci niso le tisti učenci, ki hodijo peš od svoje hiše do šole. V promet so namreč vključeni in izpostavljeni tudi vsi tisti učenci, ki morajo pešačiti/kolesariti/kotalkati … od doma do postajališča oz. isto pot nazaj, to pa pomeni, da so tako rekoč pešci vsi učenci, z redko izjemo tistih, ki do šole pridejo s starši in v prometu v vlogi pešcev/kolesarjev/kotalkarjev … niso izpostavljeni.

Na tej točki sem prišla do ugotovitve, da bo potrebno karto razširiti iz naselja Dragatuš na celotni šolski okoliš. Poleg tega nekatera postajališča za otroke niso bila varna, zato smo jih prestavili znotraj vasi. Spremembe so nastale kot posledica sodelovanja z SPV Črnomelj, Policijo Črnomelj in prevoznikom, ključni dejavnik in povod za to pa so bili seveda starši s svojimi pripombami in argumenti o morebitnih nevarnostih.

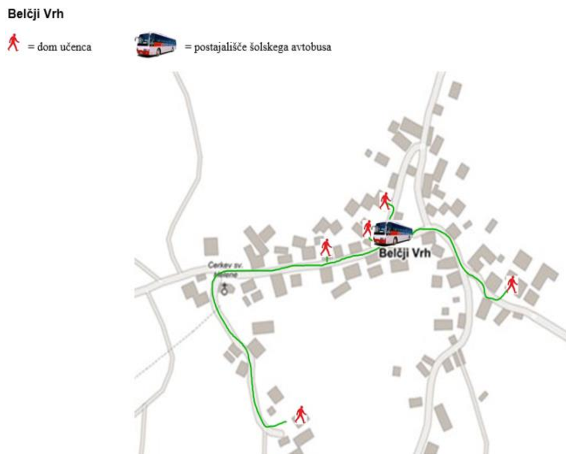
2.1 NAČRT NA PAPIRJU

Da bi bil celotni šolski okoliš na listu v takšni velikosti, da bi bilo poleg tega razbrati še ulice in po možnosti narisane poti, ki jih naši učenci prehodijo, se je sprva zdelo nemogoče. Kljub temu je v obliki nekaj okrog 20 listov formata A4, ki sem jih natisnila in jih lepila enega zraven drugega, nastala prva verzija oz. načrt, ki sem ga predstavila takrat na Usposabljanju za kolesarske izpite in prometno vzgojo v organizaciji Zavoda za šolstvo v Kopru. Načrt je bil sicer dobro zastavljen, zajemal je vse zahteve in bil dostopen javnosti, vendar je bil risan na roke, ni imel pravega videza zaradi neustrezne oblike listov, ki so bili zlepljeni, težave sem imela tudi s posodabljanjem, saj sem z vsem morala z novim šolskim letom začeti znova… Skratka, potrebno je bilo iskati novo rešitev.

2.2 OD PAPIRJA DO RAČUNALNIKA

Ugotavljala sem, kako spraviti narisano iz lista v elektronsko različico, poleg tega pa sem želela označiti zgolj tiste varne/nevarne poti, ki so tisto šolsko leto dejansko prehojene, tiste, od koder učencev v šoli več ni, pa odstraniti.

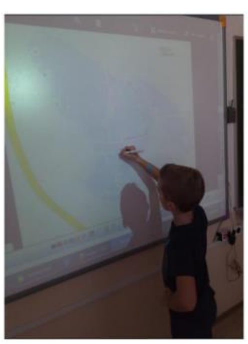
Potrebovala sem vse naslove naših učencev. Po hišnih številkah sem preko programa *Piso* (Prostorski informativni sistem občin) ugotavljala, iz katere hiše (na karti) prihajajo naši učenci. Ker nisem živela v isti občini, kot otroci šolskega okoliša, njihovih naslovov tega nisem poznala. S pomočjo programa *slikar* sem se tokrat lotila vsake vasi posebej. Hišo, od koder prihaja posamezen učenec (ali več učencev), sem označila z ikono pešca, prav tako sem označila ikono na mesto postajališča (oz. šolo), do (od) koder učenec pešači. S pomočjo možnosti zajema zaslonske sike (tipka Print Screen na tipkovnici) in programa *Slikar* sem s spletne strani *Najdi.si.zemljevid* ali pa *Google Maps* dobila karto posameznih vasi, nato pa so učenci predmetne stopnje vrisovali poti, po katerih hodijo v šolo oz. do postajališča (slika 1).



Slika 1. Karta šolskih poti učencev na Belčjem Vrhu

Ta način dela je zahteval ogromno časa. Sicer je bilo vse lično, vsaka vas je bila prikazana na svojem listu, vendar cilj še vedno ni bil izpolnjen. Načrt šolskih poti naj bi namreč visel na steni na vhodnih vratih šole in bil tako dostopen javnosti. Najverjetneje bi bilo potrebno spravit vse na eno skupno karto/zemljevid in ne karte vsake vasi posebej. Druga težava se je pojavila pri posodabljanju, saj sem zemljevid shranila kot sliko, da je lahko postal javen. Popravki torej niso bili kasneje mogoči. Poleg tega sem spoznala, da risanje z miško ni enostavno in ni natančno.

Ker sem v razred dobila interaktivno tablo (*Interwrite Dualboard*), spoznavala funkcije in možnosti, ki jih ta ponuja, sem ugotovila, da bi način vrisovanja poti z miško lahko zamenjala in bi risala na interaktivno tablo s svinčnikom. Seveda je bilo to lažje. Učenci so sami vrisovali pot, po kateri hodijo do šole (slika 2). V ozadje programa *WorkSpace* sem pripravila podlage – karte, po njih risala poti in shranila dokument v istem programu.



Slika 2. Vrisovanje šolskih poti preko interaktivne table

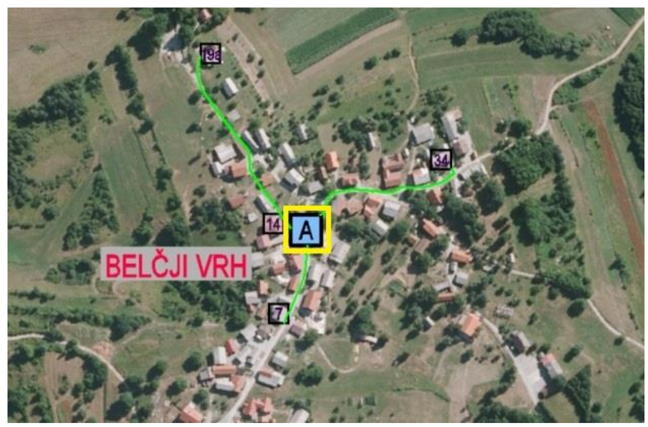
Tako je ostal živ in ponujal možnost dopolnjevanja, brisanja ipd. Posodabljanje sem s tem že izboljšala.

Še vedno pa ni šlo za načrt šolskih poti v enem kosu, ki bi visel v šoli na steni in bi zahteval minimalne posodobitve za naslednje šolsko leto.

2.3 AUTOCAD

Na bližnjem gradbenem podjetju sem predstavila, kaj želimo izdelati in kako smo cilj dosegli do sedaj. Predstavila sem pomanjkljivosti pri delu in prosila za nasvet. Predlagali so mi, delo s pomočjo programa *AutoCAD*. Na karto šolskega okoliša, ki bi mi jo naložili, bi le z nekaj naučenimi funkcijami, ki jih ponuja program, hitreje narisala omenjene poti (slika 3).

Program namreč ponuja možnost povečevanja oz. približevanja izbranega dela, tako se da pot narisati natančno. Po drugi strani pa so mi ponudili možnost tiska na tiskalnik velikega formata, kjer je bilo možno v vsaki vasi razbrati narisane poti, načrt pa je bil končno v enem kosu.



Slika 3. Prikaz varnih poti s pomočjo programa AutoCAD

Nekaj let sem bila s tem zadovoljna, po drugi strani pa sem ponovno iskala boljši način. Zaradi zgoščenosti vseh podatkov na karti namreč ni bilo moč natančno razbrati posameznih hiš. Po drugi strani je tiskanje s tiskalnikom velikega formata za šolo predstavljalo strošek. Ponovno sem veliko časa izgubljala s posodabljanjem podatkov, saj sem znova iskala s pomočjo spleta, iz katere hiše učenci niso več naši šolarji in iz katerih hiš prihajajo prvošolci.

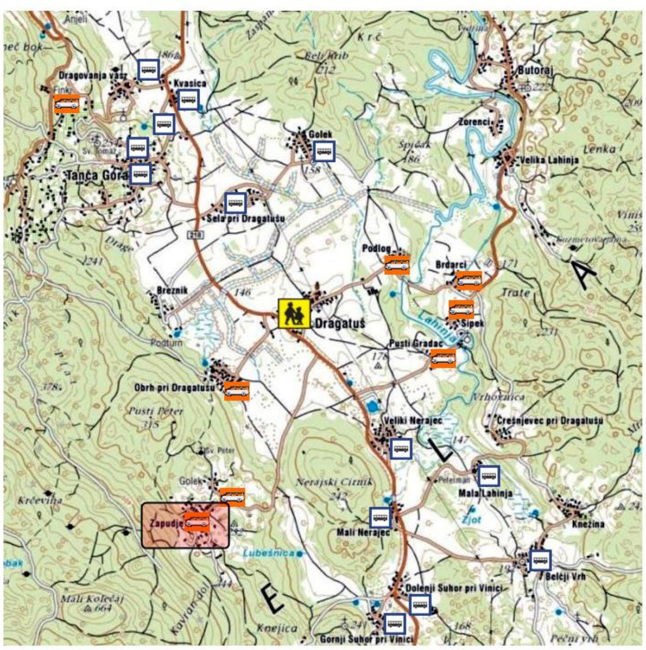
Zadala sem si cilj, da bi s posodabljanjem podatkov izgubila kar se da manj časa. Prav tako pa je bilo aktualno zdaj tudi to, da načrt, dostopen za javnost, ni nujno nahajajoč se na vhodu šolskih vrat. Gre predvsem za dostopnost staršem, učencem, in širši javnosti, ki jo tematika zanima; torej (tudi ali le) preko spleta.

2.4 GIMP

Učitelj računalništva na naši šoli je bil tisti, ki je podatke postavil v javnost na spletno stran šole. Ker pa je takoj prepoznal pomanjkljivosti oz. težave, s katerimi se vsako leto pri posodabljanju soočam, je predlagal pot, kjer bi moje delo potekalo hitreje in bi postalo bolj sistematično, pregledno. Program *Gimp* namreč omogoča delo po plasteh, zato sem se načrta lotila znova, tokrat s pomočjo tega programa. Naslove vseh naših učencev sem razvrstila po vaseh. Nato sem se lotila vsake vasi pod svojim dokumentom. Znotraj vasi sem naredila toliko plasti, kolikor je razredov, iz katerih prihajajo učenci. Plasti sem poimenovala kar po razredih. Tokrat sem v ozadju uporabila karte s spletne strani Agencije za promet (šolske poti), kjer se da približati do te mere, da so vidne hiše in njihove hišne številke, s tem pa je bilo delo hitrejše. Potrebno je bilo le postaviti se v določeno plast (npr. 1. r.) in pregledati, kdo prihaja iz tega razreda, poiskati njegovo hišo (po hišni št. naslova) in narisati pot do postajališča. Na ta način sem v ostalih plasteh le dopolnila pot, ki je bila že v prejšnji plasti označena in zemljevid je bil hitreje končan. Seveda so učenci pri tem sodelovali, saj sami najbolje poznajo poti, po katerih hodijo do postajališč, me usmerjali in popravljali. Nekatere poti so vrisovali kar sami preko interaktivne table, sama pa sem nato samo shranila podatke.

Ugotovila sem, da posodabljanje poteka hitreje, saj je moja naloga le ta, da vsako leto zbrišem plast 9. r. (devetošolci), dodam plast 1. r. (prvošolci) in vse ostale plasti le preimenujem (npr. 1. r. v 2. r. ipd.). Ko je vsaka karta (vas) narejena na ta način, končno verzijo shranim v *pdf* obliko zapisa in jo pošljem računalničarju. On pa posamezne karte preko spletnih povezav spravi na zemljevid šolskega okoliša (slika 4).

Trenutno narejene karte s pomočjo učitelja računalničarja še izboljšujemo, saj želimo, da bi se s klikom na ikono postajališča (modra oz. oranžna ikona na sliki 4) prikazala fotografija tamkajšnjih poti (slika 5), s klikom na postajališče te karte (oranžna ikona na sliki 5) pa fotografija postajališča (slika 6). Dodali bi lahko še kakšno dodatno ikono (npr. klicaj), ob kliku nanjo pa bi bila opisana nevarnost oz. opozorilo za večjo varnost pešca (npr. nevaren, nepregledni ovinek/mesto, kjer učenci cesto prečkajo brez prehoda za pešce/hoja po cesti brez pločnika …). Na ta način bi se najlažje približali zahtevam Agencije za promet, ki ureja in dopolnjuje spletni portal: Načrti šolskih poti. Preko slednjega je možno pregledovati načrte šolskih poti posameznih šol, stanje v občinah in na nacionalni ravni.



Slika 4. Načrt šolskih poti OŠ Dragatuš

Slika 5. Načrt šolskih poti v vasi Zapudje

Slika 6. Postajališče na Zapudju

3. KAKO NAPREJ?

Portal Načrti šolskih poti je namenjen tako otrokom in staršem, da lahko pridobijo informacije za njihovo šolo, kot tudi nam, učiteljem ter drugim, ki so aktivni na področju urejanja in informiranja glede šolskih poti. Priprava preglednega spletnega portala z zbranimi dokumenti Načrti šolskih poti je eden izmed pomembnih korakov pri nadgradnji tega področja in spodbujanju sistematičnega urejanja šolskih poti. [2]

Javna agencija za varnost v prometu nekaterim šolam v okviru sodelovanja v nacionalnih preventivnih akcijah zagotovi oz. sofinancira digitaliziran načrt šolskih poti na podlagi izdanih Smernic za šolske poti. [1]

Če bi bila naša šola na razpisu v maju 2020 izbrana, bi digitalizacija na ravni šole oz. šolske spletne strani poenotena ostalim digitaliziranim načrtom na spletnem portalu Agencije za promet.

4. SKLEP

Smernice za šolske poti so prvenstveno namenjene varnejšim šolskim potem za šolarje – pešce. Posredno se na ta način promovira tudi zdrav in varen način mobilnosti. Ukrepi za varnejšo prometno infrastrukturo in večjo varnost otrok na šolskih poteh prinašajo dolgoročno tudi znatne prihranke lokalnih skupnosti na področju organiziranih šolskih prevozov, hkrati pa pripomorejo k učinkovitem in aktivnem vključevanju otroka oziroma šolarja v svet prometa. [4]

V današnjem času je digitalizacija prisotna na vseh področjih življenja in je v skokovitem porastu. Z digitalizacijo načrtov lahko preko mobilnih aplikacij poveča uporabnost zemljevida šolskih poti, predvsem pri otrocih in starših. Zato je Agencija za varnost prometa podprla digitalizacijo šolskih poti in jo bo še spodbujala tudi v prihodnje. Na ta način je omogočen celosten pregled pomanjkljivosti in nevarnosti na šolskih poteh na sodoben in otrokom privlačen način.

Nekatere ugotovitve raziskav so pokazale, da klasični papirnati zemljevidi v današnjem času ne dosežejo tistih, ki so jim namenjeni – predvsem otrok in njihovih staršev. Če pa so podatki o šolskih poteh in nevarnih točkah zbrani na spletnem portalu, bo to zagotovo večja spodbuda za otroke, da se učijo o prometu, prometni varnosti in samozaščitnem ravnanju v prometu.

Podatki, ki se preprosto prikazujejo na računalniku ali pametnem telefonu, služijo kot učinkovit didaktični pripomoček pri temah s področja varnosti v prometu: starši lahko s svojim otrokom pregledajo najbolj varno pot do šole, preden jo dejansko prehodijo v praksi, otroci pa so aktivno vključeni v proces izboljšanja prometne varnosti na šolskih poteh. Ne nazadnje pa je digitalni načrt tudi odlično orodje za javne službe, ki lahko sistematično načrtujejo odpravljanje nevarnih točk in odsekov šolskih poti. [3]

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Prepoznavanje in etimologija angleškega računalniškega besedišča

Recognition and etymology of English computer vocabulary

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POVZETEK

Obvladovanje besedišča je za tuje govorcev angleščine nujno, saj zagotavlja učinkovito komunikacijo ter sprejemanje in posredovanje informacij na vseh področjih našega delovanja in ustvarjanja. Usvajanje in pomnjenje angleškega strokovnega besedišča je lahko še toliko bolj zahteven proces. Pomnjenje je lahko uspešnejše, če razvijemo zmožnost prepoznavanja strokovnega besedišča v tekstih ter če dobro razumemo in poznamo etimologijo strokovnih izrazov. V prispevku so opisane zanimivosti o izvoru angleškega računalniškega besedišča in besedotvorni postopki.

Ključne besede

Angleško računalniško besedišče, prepoznavanje strokovnih izrazov, etimologija, besedotvorje

ABSTRACT

Knowing a second language vocabulary is essential for effective communication as well as for the transfer of information in every field of people's professional or creative work. Second language technical vocabulary acquisition may be a challenge, but we can make it easier and more successful by being able to recognize technical vocabulary in texts as well as by understanding and knowing the etymology of technical words. Some interesting facts on the etymology of English computer vocabulary and its word-formation are presented in this paper.

Keywords

English computer vocabulary, recognition of technical vocabulary, etymology, word-formation

1. UVOD

Angleščina je mednarodno sredstvo komunikacije na praktično vseh področjih človekovega delovanja in ustvarjanja, v gospodarstvu, izobraževanju, obveščanju, kulturi, turizmu, kot tudi v vseh vejah znanosti in tehnologije. Večini svetovnega prebivalstva predstavlja tuji jezik oz. drugi jezik. Za učinkovito sporazumevanje v katerem koli tujem jeziku je, še bolj kot poznati jezikovna pravila, pomembno razviti svoj besedni zaklad. Izgradnja besedišča je dolgotrajen proces, ki zahteva veliko truda in potrpežljivosti, pri čemer so lahko v pomoč določene strategije oz. modeli za usvajanje in pomnjenje besedišča. V teoretičnih virih in raziskavah (npr. [2], [3] in [8]) najdemo tehtno podporo trditvi, da sta poznavanje in raba učnih strategij izredno pomembna za uspeh pri učenju. Uporaba učne strategije za učenje zagotavlja boljše rezultate, večjo učinkovitost in lažje usvajanje jezika [5].

Zmožnost prepoznavanja strokovnih izrazov ter poznavanje in razumevanje izvora angleških strokovnih izrazov (etimologija) sta možni strategiji za lažje pomnjenje angleškega strokovnega besedišča.

Narava natančnega dela v stroki zahteva natančno in enopomensko komunikacijo, v kateri ima pomembno vlogo strokovno besedišče. Tradicionalna terminološka teorija razume strokovne izraze ali termine kot poimenovanja za znanstvene ugotovitve, strokovna odkritja in koncepte [1]. V okviru angleškega strokovnega jezika so torej izrazi, ki jih najdemo v strokovnih besedilih in se neposredno nanašajo na strokovno vsebino posameznih področij.

Jezik znanosti in tehnologije lahko tako v angleškem kot slovenskem jeziku delimo na t.i. znanstveni jezik in na strokovni jezik. Znanstveni jezik vključuje natančne in nedvoumne znanstvene in akademske izraze. Pri strokovnem jeziku gre za termine posameznih strok, ki pa imajo lahko v različnih strokah različen pomen [7]. Računalniški jezik pripada v glavnem tej drugi skupini, torej strokovnim jezikom.

2. PREPOZNAVANJE STROKOVNEGA BESEDIŠČA

2.1 Pristopi prepoznavanja strokovnega besedišča

Za prepoznavanje strokovnega besedišča imamo lahko različne pristope: intuicijo poznavalca strokovne teme, uporabo strokovnih slovarjev in uporabo določenih vodil, ki nam pomagajo poiskati strokovno besedišče v tekstu [2].

Najbolj očitne strokovne in akademske besede večine znanosti in strok so grškega in latinskega izvora in se ne pojavljajo pogosto izven njihovih specialnih področij [2]. Vendar bomo v nadaljevanju (podpoglavje 3.1) videli, da to v veliki meri ne velja za računalniško besedišče, saj je veliko izrazov vzetih prav iz splošnega besedišča in se (sicer v drugem pomenu) pojavljajo tudi v vsakdanjem življenju.

Pozoren iskalec strokovnih besed v tekstih lahko opazi, da so si nekateri strokovni izrazi podobni ali celo enaki v različnih jezikih. Nekateri avtorji v besedilu nakažejo, da gre za strokovno besedo, in jo npr. definirajo, zapišejo v debelem ali poševnem tisku, kar kaže na njeno pomembnost in močno povezavo med besedo in temo v tekstu. Strokovni izrazi se v besedilu ponavljajo, pogosto pa so zapisani v okviru diagramov ali slik.

2.2 Nivoji besed v strokovnih besedilih

Eden možnih pristopov za prepoznavanje strokovnega besedišča v tekstu je, da uporabimo dognanja teoretikov [2], ki ugotavljajo, da v strokovnih besedilih načeloma ločimo štiri nivoje besed: zelo pogoste besede; znanstveno oz. akademsko besedišče; tehnično oz. strokovno besedišče in manj pogoste besede. Če se naučimo razlikovati med temi nivoji, bomo lahko prepoznali strokovne izraze.

Zelo pogoste besede so del najpogostejših 2000 angleških besed splošnega pomena, ki se pojavljajo v vsakem besedilu, ne glede na to, ali gre za splošno, strokovno, leposlovno ali katero drugo besedilo. To besedišče navadno predstavlja okrog 80 % besed v znanstvenih knjigah in časopisih ter okrog 90 % v pogovorih in umetnostnih besedilih. Vključuje praktično vse funkcionalne angleške besede [4].

Za akademske bralce je skupina 570 akademskih besed. Gre za besedišče, ki je poznano znanstvenikom z najrazličnejših področij, se ne nanaša le na posamezno stroko in bo na primer v romanih predstavljalo manj kot 2 % besed [2].

Tretji nivo besed predstavlja strokovno besedišče, ki predstavlja okrog 5 % tekočih besed v specializiranih besedilih. Gre za besede, ki se v specializiranih besedilih s posameznih področij pojavljajo pogosto, redko pa jih bomo zasledili v besedilih izven teh področij [4]. Tehnično besedišče je v središču zanimanja ljudi, ki delajo na specializiranih strokovnih področjih.

Četrti nivo besed sestoji iz vseh preostalih angleških besed, to so manj pogoste besede. Takih besed je na tisoče, vendar bodo predstavljale le 5 % tekočih besed v tekstih [2].

Chun in Nation [2] sta oblikovala štiristopenjsko lestvico, s katero sta razvrščala besede nekega strokovnega besedila o anatomiji človeka, da sta lažje izluščila strokovno besedišče. Na tem mestu prikazujemo poslovenjeno tabelo 1 z njunimi primeri v upanju, da bo morda v pomoč bralcu članka pri razvrščanju besed in prepoznavanju strokovnih izrazov v angleških besedilih, s katerimi se bo srečal v prihodnje.

Tabela 1. Ocenjevalna lestvica za iskanje strokovnega besedišča (velja za besedilo o anatomiji)

1. korak Besede s pomenom, ki ni neposredno povezan s področjem anatomije. Besede, ki se ne nanašajo na temo besedila. Primeri: člen *the*, je, med, to, za, 12, soseden, vsote, splošen, neposredno, konstantno, zgodaj, zlasti.
2. korak Besede s pomenom, ki je minimalno povezan s področjem anatomije. Opisujejo pozicije, gibe ali značilnosti telesa. Primeri: gornji, del, oblikuje, pari, strukture, obdaja, oblikuje, povezan, koče, ščiti.
3. korak Besede s pomenom, ki je tesno povezan s področjem anatomije. Nanašajo se na dele, strukture ali funkcije telesa, kot na primer predeli telesa in sistemi telesa. Takšne besede so rabljene tudi v splošnem jeziku. Lahko imajo določene omejitve glede rabe, odvisno od predmetnega področja. Primeri: prsni koš, deblo, vrat, trebuh, rebra, prsi, votlina, rama, pas, koža, mišice, stena, srce, pljuča, organi, jetra, koščen, trebušni, dihanje. Besede te kategorije so lahko strokovni termini na določenem področju, kot je anatomija, a se lahko pojavijo z enakim pomenom na drugih področjih, kjer pa ne veljajo za strokovne termine.
4. korak Besede s pomenom, ki je specifičen za področje anatomije in ni verjetno, da bi jih poznali v splošnem jeziku. Nanašajo se na strukture in funkcije telesa. Imajo jasne omejitve glede rabe, odvisno od predmetnega področja. Primeri: toraks (prsni koš), sternum (grodnica), kostni, vertebrae (hrbtenica), pektoral (prsi), mišična ovojnica, trahea (sapnik), viscera (notranji organi), stržen.

3. IZVOR ANGLEŠKEGA RAČUNALNIŠKEGA BESEDIŠČA

3.1 Splošne besede z novim pomenom

Angleški računalniški strokovni izrazi so pogosto vzeti iz vsakdanjega življenja, le da dobijo v računalništvu drugačen pomen. Sun [7] ugotavlja, da je semantična sprememba jasna in preprosta, zaradi česar jih je laže usvojiti, to pa zagotavlja učinkovito komunikacijo in posredovanje informacij. Avtor navaja med drugim primer angleške besede *programme* (slo. program), katere splošni pomen je »skupek nalog oz. del, ki se določijo za uresničitev, ali zapis takšnih nalog (po SSKJ)«, v računalništvu pa je to »skupek ukazov, danih računalniku, da izvede operacijo«. Beseda *bus* je v vsakdanjem življenju »vozilo«, v računalništvu pa »tokokrog«. Splošni pomen besede *keyboard* je »klaviatura«, računalniški pa »tipkovnica«. Angleško *chip* je v splošnem pomenu »tanek, rezina«, v računalništvu pa »silikonski delček z zapletenim sistemom električnih povezav, namenjen shranjevanju in procesiranju informacij v računalniku«. Podobno bi lahko ugotovili za angleške računalniške termine *crack, firewall, virus, traffic, clouds, cookies, port* itd.

Vir: hum3d.com

Vir: farbtoner.com

Slika 1. Splošni in računalniški pomen angl. besede *chip*

Izvor nekaterih angleških računalniških besed je v starih izrazih, ki v skladu z zahtevami družbenega razvoja dobijo v računalništvu nov pomen. Sun [7] navaja med drugim primer angleške besede *menu*, katere prvotni pomen je bil »seznam jedi«, v računalniški angleščini pa gre za »seznam ukazov oz. program«. Izvorni pomen angleške besede *bug* je »hrošč, insekt«, v računalništvu pa je to »napaka v programski kodi«, ki je ta pomen dobila, ko se je vešča znašla v tradicionalnem računalniku in povzročila motnjo. Pomen angleških računalniških terminov *memory*, *read* in *write* je metaforičen, saj gre za poimenovanja po človeških sposobnostih, ki jih računalnik v resnici nima [7]. Podobni izrazi so še *authorization*, *mouse*, *host* itd.

Vir: webmd.com Vir: sdjewishjournal.com

Slika 2. Prvotni in računalniški pomen angl. besede *bug*

3.2 Tvorjenje besed

Precejšen delež strokovnega, tudi računalniškega, besedišča ni vključen v terminološke slovarje [7], zato je za uporabnika težje odkriti njihov pomen. Gre za preoblikovane oz. tvorjene besede, kot so npr. *uninstall*, *undo*, *reset* ipd. Ko se naučimo prepoznati določene postopke besedotvorja, opazovati in razumeti pomenske podstave tvorjenih besed in iz njih razumeti pomen, je učenje besedišča bistveno lažje, znanje pa tudi bolj trajno.

Za lažje razumevanje in primerjavo bomo v podpoglavjih v nadaljevanju na kratko predstavili besedotvorje v splošni slovenščini, splošni angleščini, strokovni/tehnični angleščini ter računalniški angleščini.

3.2.1 Besedotvorje v splošni slovenščini

V slovenščini gre pri besedotvorju za proces združevanja besedotvornih podstav in obrazil v novo besedo. V grobem imamo štiri besedotvorne načine:

- izpeljevanje: dodajanje pripone (npr. sin-ko, šol-ar-ček);
- sestavljanje: dodajanje predpone (npr. pre-lep, pra-ded);
- zlaganje: povezovanje podstav z medpono (npr. tok-o-krog) in
- sklapljanje: združevanje podstav brez obrazil (npr. za-tem).

V tem kontekstu lahko omenimo še krnitev, to je postopek, ko besedo okrnimo, da nastane nova (npr. mobi). Pogosto pa tvorimo nove besede s kombiniranjem besedotvornih načinov zlaganja in izpeljevanja (npr. prv-o-šol-ka) ali s kombiniranjem krnitve in izpeljave (npr. Mir~~oslav~~-ko → Mirko), s kombiniranjem krnitve prav do prvih črk in sklapljanja pa dobimo kratice (npr. TOSAMA) in krajšave (npr. t.i.).

3.2.2 Besedotvorje v splošni angleščini

V splošni angleščini so glavni besedotvorni načini:

- *compounding*: sklapljanje dveh ali več korenov (npr. *e-ticket*, *mailman*, *pick-pocket*);
- *derivation*: modifikacija korena brez dodajanja drugih korenov, z dodajanjem pripone ali/in predpone. Primerljivo z našim izpeljevanjem in sestavljanjem ali njuno kombinacijo, kar se v angleščini imenuje *affixation* (npr. *injection*, *subtitle*, *renovation*);
- *blending*: združevanje dveh besed na ravni glasov, ne na ravni morfemov (npr. *brunch*, *motel*, *smog*, *carjacking*);
- *clipping*: kot naša krnitev, krajšanje dela besede, preostanek obdrži pomen prvotne besede (npr. *burger* namesto *hamburger*);
- *acronyms*: okrajšave oz. kratice, ki skupaj tvorijo novo besedo, ki se tudi zapiše in izgovarja kot beseda (npr. *scuba* (iz *self-contained underwater breathing apparatus*, *radar*, *UN*, *UNICEF*, *LOL*, *BRB* …).

3.2.3 Besedotvorje v strokovni/tehnični angleščini

Poimenovanje strokovnih pojavov, ugotovitev in konceptov dovoljuje tudi nekoliko drugačen pristop k besedotvorju od splošnega. Zato opazimo v strokovnih besedilih in v teoretičnih virih nekoliko drugačno klasifikacijo besedotvorja v tehničnem besedišču.

Yedla [9] na primer razvršča besedotvorne postopke v strokovnem (*technical*) besedišču enako kot v splošnem:

- *compounding* (npr. *airbus*, *back-up*, *firewall*);
- *affixation* (npr. *multimedia*, *automation*, *misapply*, *mulfunction*, *accuracy*, *terminate*);
- *clipping* (npr. *aeroplane*, *cabriolet*, *typographical*);
- *portmanteau* (blending (op.a.), npr. *bionics*, *mechatron*, *modem*);
- *acronyms* (*ARM* - ***a**dvanced **r**isk **m**achine*, *BIT* - ***b**inary **d**igit*).

V kategorijo besedotvorja pa uvršča tudi:

- *onomatopoeia* (posnemanje glasov, npr. *bomb*, *click*, *splat*) in
- *eponyms* (imena ljudi, krajev, stvari, ki postanejo del splošnega besedišča, npr. *Diesel engine*, *denim* (iz fr. Serge de Nimes, balgo iz Nimesa, Francija), *Celsius thermometer*), čeprav bi tu lahko s stališča etimologije govorili bolj o sposojanju besed.

3.2.4 Besedotvorje v računalniški angleščini

Splošno rabljeni besedotvorne načine v angleškem računalniškem besedišču v glavnem metoda transformacije, metoda kratic in okrajšav, sinteza in tako dalje [7]. Po avtorju povzemamo razvrstitev, utemeljitve in nekatere primere.

- *Synthesis* (slo. sinteza): v angleškem računalniškem besedišču večino tvorjenih izrazov predstavljajo sestavljene besede. Pojavljajo se v ustaljenih oblikah, ne zapisujejo se pogosto z vezajem in imajo poseben pomen. Pogosto se povezujejo pridevnik + glagol, pridevnik + prislov ter prislov + samostalnik (npr. *upload*, *download*, *login*). Precej sestavljenk je tudi iz dveh samostalnikov (npr. *diskcopy*, *webmaster*, *filename*). Nekatere sestavljenke se tvorjene z dodanimi obrazili in tako dobijo nov pomen in novo besednovrstno lastnost (npr. *phase advancer* (odstranitev elektronske faze), *pilot oscillator* (oscilator kanala)).
- *Affixation*: dodajanje obrazil (predpon in pripon) korenskim morfemom. V angleškem računalniškem besedišču imajo nekatere predpone močno besedotvorno sposobnost, npr. re- (*retry*, *refresh*, *replay*), pre- (*prescan*, *preview*), inter- (*internet*, *interface*, *interactive*), tel- (*telenet*). Med močnimi priponami so -er (*explorer*, *server*), -or (*accelator*, *monitor*) in -ize (*minimize*).
- *Conversion*: konverzija ali pretvorba ene vrste v drugo, npr. *reject* postane samostalnik v pomenu »proizvod, ki je bil zavrnjen zaradi napake« ali *time* postane glagol (*to time*).
- *Abbreviation*: okrajšave se nanašajo na krnitev besed in združitev začetnih črk v novo besedo npr. WWW, PC, http, MS-DOS, CPU).

V pregledani literaturi nismo zasledili izrazov *phishing* in *pharming*. To sta primera besedotvornega načina, ki ga angleško imenujemo *blending*, se pravi združevanja dveh besed na ravni glasov, ne na ravni morfemov. Gre za novejša izraza, ki se ju tudi v slovenščini uporablja kar v izvorni (torej angleški) obliki.

Angleško *phishing* v stroki poimenuje vrsto napada na varnost osebnih podatkov v računalniku. Beseda je sestavljena iz besed *password* (slo. geslo) in *fishing*. Izraz *pharming* pomeni v stroki »preusmeritev na škodljivo spletno stran« in je tvorjen iz besed *farming* (spl. »kmetijstvo«) in *pharmacy* (spl. »lekarništvo«). Zanimivo je, da se tak termin pojavlja tudi v genetiki in farmaciji, in sicer predstavlja eno izmed tehnik genskega inženiringa [6]. Podobno je v preteklosti nastala tudi beseda *phreaking*, ki je poimenovanje za vdore v telefonska omrežja, in sicer iz besed *phone* in *freaking*.

4. ZAKLJUČEK

V računalništvu je angleščina pravzaprav poklicni jezik. Obvladovanje strokovnega besedišča je zato nujno, a je za številne govorce angleščine kot drugega jezika vseeno lahko zahtevna naloga. Pomnjenje je po našem mnenju in tudi mnenju številnih strokovnjakov uspešnejše, če si za to izdelamo strategije.

V članku predlagamo strategijo prepoznavanja strokovnih izrazov v besedilih ter poznavanje in razumevanje izvora angleških strokovnih izrazov (etimologija). Med pristopi prepoznavanja strokovnih izrazov je zanimiv pristop deljenja besedišča na štiri nivoje, in sicer: zelo pogoste besede; znanstveno oz. akademsko besedišče; tehnično oz. strokovno besedišče in manj pogoste besede. S pomočjo teh nivojev lažje razlikujemo in izluščimo strokovne izraze.

V pomoč nam je lahko tudi poznavanje izvora računalniškega besedišča. Zanimivo je, da so angleški računalniški strokovni izrazi pogosto vzeti iz vsakdanjega življenja, le da dobijo v računalništvu drugačen pomen (npr. *menu*, *bus*). Pomenska sprememba je pogosto jasna in preprosta, zaradi česar jih je laže usvojiti.

Še bolj pogoste so tvorjene besede. Koristno je poznavanje slovenskega besedotvorja, saj so besedotvorni postopki v slovenščini in angleščini zelo primerljivi. Opazimo lahko tudi, da so angleški računalniški strokovni izrazi večinoma tvorjeni po ustaljenih besedotvornih postopkih: s pomočjo dodajanja obrazil (npr. *preview*, *minimize*), sestavljanja (npr. *upload*, *login*), krnjenja in sklapljanja (npr. *DRAM*, *http*) in tako dalje.

Dobro poznavanje besedišča zagotavlja učinkovito komunikacijo ter sprejemanje in posredovanje informacij v tujem jeziku, ne le na področju računalništva, temveč na vseh področjih našega delovanja in ustvarjanja.

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Uporaba IKT za spodbujanje fizične aktivnosti učencev

The use of ICT to encourage students' physical activity

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POVZETEK

Informacijsko komunikacijska tehnologije (IKT) je danes nujen element podpore izobraževanja in napredka učencev, hkrati pa prekomerna uporaba ali celo zloraba različnih tehnologij predstavlja skupni problem vzgojno izobraževalnih institucij in staršev. Da bi povečali znanje o IKT, hkrati pa poskrbeli za gibanje učencev, smo štiri partnerske osnovne šole prijavile Erasmus+ projekt z naslovom *I'm collaborating with ICT for my school*. V okviru projekta smo učence vključili v tečaje računalniških orodij Microsoft Word, Microsoft PowerPoint, Prezi in Windows Movie Maker. Učenci so z različnimi računalniškimi programi predstavili tradicionalne nacionalne igre, ki so jih tudi aktivno igrali v šolskem okolju, ter svoje predstavitve izmenjali z vrstniki iz ostalih sodelujočih držav. Sodelovanje v mednarodnem projektu je pripomoglo k primerjavi učnih metod in rezultatov uporabe IKT ob izmenjavi primerov dobrih praks.

Ključne besede

Informacijsko komunikacijska tehnologija, Učenci, Fizična aktivnost, Igre

ABSTRACT

Information communication technology (ICT) has become an essential element of education and progress of students, whereas excessive usage or even misuse of diverse technologies forms a collective issue of educational institutions and parents. To extend the knowledge on ICT and at the same time ensure the physical activity of students, four partner primary schools have outset the Erasmus+ project entitled *I'm collaborating with ICT for my school*. In the scope of the project, students were involved in courses of ICT tools Microsoft Word, Microsoft PowerPoint, Prezi and Windows Movie Maker. Pupils used ICT tools to present traditional national games. In addition to playing the games in their educational environment, they presented the games to peers from other countries. Being a part of an international project enabled the partners to compare teaching approaches and results of ICT usage along with the exchange of best practices.

Keywords

Information communication technology, Students, Physical activity, Games

1. UVOD

Tako v domačem okolju, kot tudi v šolskem uporabljamo informacijsko komunikacijsko tehnologijo (IKT) kot pripomoček, s katerim lahko obogatimo proces učenja [1]. Hkrati ima IKT tudi negativne učinke na različne nivoje mentalnega in fizičnega zdravja [2]. Kot navaja že Stidder [3], se IKT lahko uspešno uporabi tudi za poučevanje telesne vzgoje. V literaturi zasledimo tudi več primerov, ki prikazujejo uspešno uporabo IKT za izboljšanje ali povečanje fizične aktivnosti učencev [4]–[6]. Mobilne igre na prostem za skupine otrok so v zadnjih letih postale neke vrste hit na področju razvoja mobilnih aplikacij [7].

V prispevku predstavljamo izvedbo mednarodnega projekta Erasmus+, v katerem je sodelovala tudi Osnovna šola Škofja Loka – Mesto [8]. Na začetku predstavljamo glavne cilje projekta, kratko opišemo metodologijo, nato pa se posvetimo rezultatom projekta. V zaključku so kratko povzeti pozitivni učinki izvedbe projekta na učence, učitelje in deležnike iz lokalne skupnosti.

2. PROJEKT *I'M COLLABORATING WITH ICT FOR MY SCHOOL*

V šolskih letih 2016/17 in 2017/18 se je na Osnovni šoli Škofja Loka - Mesto izvajal mednarodni projekt Erasmus+ z nazivom *I'm collaborating with ICT for my school*. V projektu so sodelovale partnerske institucije iz 4 držav: Portugalske (Agrupamento de Escolas Dr. Flávio Gonçalves, Póvoa de Varzim), Italije (Stituto Comprensivo San Pellegrino Terme), Turčije (Himmet Çondur Cumhuriyet Ortackulu) in Slovenije (Osnovna šola Škofja Loka – Mesto).

Partnerji projekta so kot enega ključnih problemov v osnovnošolskem izobraževanju zaznali informacijsko pismenost učencev. Glede na razgovore s starši (predvsem učencev s slabšim učnim uspehom), učitelji ugotavljajo, da učenci preživijo preveč prostega časa na elektronskih napravah. Kljub temu, da na različnih napravah igrajo zelo kompleksne računalniške igre, pa se pogosto izkaže, da jim že enostavno iskanje po spletu lahko predstavlja težavo. Večini učencev ne uspe pripraviti niti enostavne naloge v urejevalniku besedil. V slovenskih osnovnih šolah je vsekakor problem, saj med obveznimi vsebinami ni predmetov s področja računalništva. S podobnimi problemi pa se srečujejo tudi v partnerskih šolah. Za večino učencev pomanjkanje izkušenj pri delu s tehnologijo predstavlja dodaten izziv. Da bi IKT uporabljali čim bolj učinkovito tudi v učnem procesu, jih je potrebno primerno spodbuditi. Vsekakor bodo ta znanja potrebovali tudi kasneje, saj danes praktično vsako delovno mesto zahteva tudi določene kompetence s področja IKT.

Sodelovanje projektnih partnerjev s ciljem povečanja informacijske pismenosti učencev je omogočilo primerjavo različnih metod poučevanja IKT v osnovnih šolah in ocenjevanje uspešnosti uporabe le-teh. Partnerji projekta so predstavili primere dobrih praks, s katerimi se učenci lahko bolj hitreje in bolj učinkovito seznanijo s funkcionalnostmi novih IKT orodij.

Eden od pomembnih vidikov izvedbe projekta je tudi integracija IKT v izobraževalni proces. Sodoben način poučevanja zahteva vključevanje IKT na vseh ravneh. Pozorni moramo biti na to, da je IKT učencem predstavljena na zanimiv način, saj s tem pridobimo njihov interes in sprejetje novega načina dela. Partnerji projekta smo kot enega od zanimivih načinov predstavitve novih IKT orodij identificirali predstavitev tradicionalnih otroških iger.

Da bi učenci lahko uspešno predstavili tradicionalne igre iz svoje države, pa se morajo najprej seznaniti z ustreznimi orodji, ki omogočajo predstavitev. V okviru projekta smo se tako odločili izvesti dodatno izobraževanje za vključene učence, ki so na koncu izobraževanja predstavili svoj izdelek – predstavitev ene tradicionalne igre v izbranem orodju. Igre so nato predstavili svojim vrstnikom iz drugih držav, kar je pripomoglo tudi k večji fizični aktivnosti učencev ter druženju.

V prispevku je predstavljen projekt, metodologija ter najpomembnejši rezultati projekta. V zaključku podajam glavne ugotovitve in predloge za nadaljevanje podobnih iniciativ v osnovni šoli.

3. METODOLOGIJA

Za večjo prepoznavnost aktivnosti projekta Erasmus+ v lokalnem okolju, so učenci vseh sodelujočih partnerskih šol pripravili predloge logotipov projekta, med katerimi je bil izbran najboljši logotip, ki so ga izdelali učenci iz Turčije (Slika 1).

Slika 1: Logotip projekta *I'm collaborating with ICT for my school*.

Na začetku projekta smo pripravili vprašalnik, s katerim smo želeli ugotoviti, v kolikšni meri učenci uporabljajo IKT v domačem okolju. Vprašalnik je za vse 4 sodelujoče države pripravil slovenski partner v okolju Google.

Po zaključku izobraževanja smo z drugim vprašalnikom ugotavljali, koliko so učenci napredovali v poznavanju posameznih IKT orodij.

V skladu z glavnimi cilji projekta, so bile organizirani tečaji, v okviru katerih so se učenci seznanili z orodji, ki so jih kasneje lahko uporabili za predstavitev različnih tradicionalnih iger (Tabela 1).

Tabela 1: Pregled izvajanja tečajev za posamezno orodje.

Naziv tečaja	Termin	Razred
Microsoft Word	Januar 2017	5., 6.
Microsoft PowerPoint	April 2017	7.
Prezi	Oktober 2017	8.
Windows Movie Maker	Marec 2018	9.

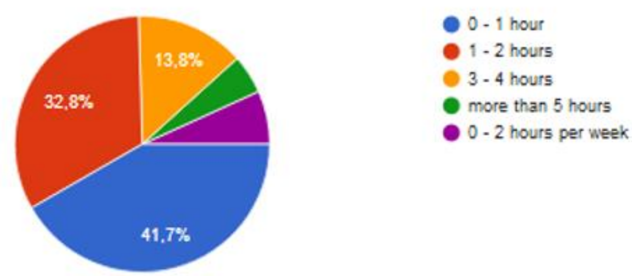
Skupina učencev, ki je bila izbrana za mednarodno izmenjavo, je bila zadolžena, da poleg osnovne predstavitve igre pripravi tudi predstavitev sebe, šole, Škofje Loke in Slovenije. Ker je projekt mednaroden, so bile vse predstavitve pripravljene v angleškem jeziku.

4 skupine učencev (skupaj 28 učencev), udeležencev tečajev navedenih v Tabeli 1, je sodelovalo pri pripravi predstavitev tradicionalnih iger v različnih okoljih.

4. REZULTATI PROJEKTA

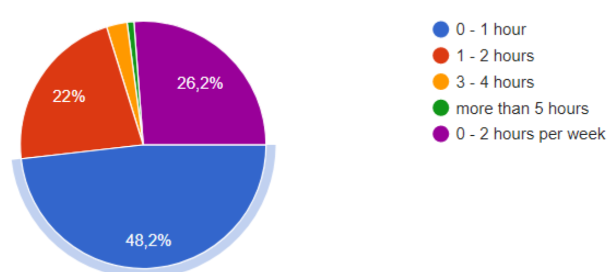
4.1 Uporaba IKT

Prvi rezultat projekta so predstavljale analize uporabe IKT. Na vprašalnik je v OŠ Škofja Loka – Mesto odgovorilo 344 učencev, 50,4 % deklic in 49,6 % dečkov. Starost anketirancev je bila med 10 in 14 let. Največ učencev, kar 86,1 % ima v lasti pametni telefon, 35,4 % pa (tudi) tablični računalnik. 46,6 % učencev ima tudi računalnik s povezavo v splet. Slika 2 prikazuje, v kolikšni meri učenci uporabljajo IKT opremo za igranje iger in uporabo družbenih omrežij.



Slika 2: Koliko časa dnevno porabiš za igranje iger in uporabo družbenih omrežij?

Slika 3 prikazuje, koliko časa dnevno učenci uporabljajo IKT za iskanje informacij na spletu ali za šolsko delo.



Slika 3: Koliko časa dnevno porabiš za iskanje informacij in delo za šolo?

Med spletnimi stranmi, ki jih učenci najpogosteje obiskujejo izstopa Youtube.com (92,2%), sledi pa Facebook.com (42,9%), ki mu uspešno sledi šolska spletna stran (41%).

Med programi, ki jih najpogosteje uporabljajo, učenci izpostavijo Microsoft Word (62,8%) in Microsoft PowerPoint (61,4%).

4.2 Predstavitev rezultatov projekta

Rezultati aktivnosti projektne skupine so bili prikazani v Erasmus kotičku v šoli, na šolski spletni strani, e-twinning računu, igralnemu kotičku, ter v šolski knjižnici. Po končanem projektu so bile v igralnem kotičku zbrane vse igre sodelujočih držav. Vsaka država je v svojem jeziku in angleškem jeziku predstavila svoje tradicionalne igre, ki smo jih skupaj združili v e-knjigi z naslovom *Tradicionalne otroške igre v Evropi*. Preko družbenih omrežij Facebook in WhatsApp smo skozi celotno obdobje izvajanja projekta objavljali slike in video posnetke mobilnosti. Kot zanimivost so učenci pripravili tudi slovarček najpogostejših izrazov v slovenščini, kot prikazuje slika 4.


SOME SLOVENIAN DAILY EXPRESSIONS

Hello: Živjo!
Good morning: Dobro jutro.
Good afternoon: Dober dan.
Good night: Lahko noč.
How are you: Kako si?
I: Jaz.
I'm fine, and you: V redu sem, kaj pa ti?
Goodbye: Na svidenje/ adijo.
See you: Se vidiva.
Thank you: Hvala.
Yes: Da. No: Ne.
You: Ti.

SOME SLOVENIAN WORDS IN GAMES

Game: Igra.
Let's run: Tecimo.
Let's start: Začnimo.
Let's catch: Ujemimo.
Stop: Končaj.
Throw the ball: Vrzi žogo.
Say a color: Povej barvo.
Say a name: Povej ime.
Game over: Konec igre.
Play: Igrajmo.
Jump: Skoči.
Take: Vzemi.
It is your turn now: Zdaj si ti na vrsti.
It is my turn: Jaz sem na vrsti.
Touch: Dotakni se.
You won: Zmagal si.
You lost: Izgubil si.
You get one point: Dobiš eno točko.
Come: Pridi.
Give: Dati.
Form a circle: Naredite krog.
Judge: Sodnik.
Go: Pojdi.

NUMBERS

1. Ena
2. Dva
3. Tri
4. Štiri
5. Pet
6. Šest
7. Sedem
8. Osem
9. Devet
10. Deset
11. Enajst
12. Dvanajst
13. Trinajst
14. Štirinajst
15. Petnajst
16. Šestnajst
17. Sedemnajst
18. Osemnajst
19. Devetnajst
20. Dvajset
30. Trideset
40. Štirideset
50. Petdeset
60. Šestdeset
70. Sedemdeset
80. Osemdeset
90. Devetdeset
100. Sto

Slika 4: Slovarček najpogostejših izrazov.

Navodila za igranje tradicionalnih iger so učenci izdelali v izbranem orodju, ki so se ga naučili uporabljati na tečaju. Tako so nastali izdelki v Microsoft Word (Slika 5), Microsoft PowerPoint (Slika 6), Prezi (Slika 7), ter Windows Movie Maker (Slika 8).


KOZA KLAMF

YOU NEED:

- A base (table, chair…)
- A goat (bottle, ball, rock, can…)
- Rocks or balls (something to throw that isn't bouncy. Tennis balls not recommended)

Before you start, you choose the herder. You mark the Herder's territory and decide from where you will throw. You put the Goat on the base and you may begin the game.

RULES:

Everyone gets only one ball/rock. Players try to knock the Goat off its base. If they throw and miss, they can enter the Herder's territory and collect it without the Herder trying to catch them. However, if they throw and hit the goat, the Herder will put the goat back and try to catch the player that knocked it down while he/she tries to collect his/her ball/rock. The Herder can catch the player only while he/she is in the Herder's territory, so that player must run. The only way to be safe is to touch your rock that is on the ground. If the Herder catches him/her, they switch roles. If the Herder doesn't catch the player, the players start throwing again.

RULES FOR THE HERDER:

Your job is to stand by the Goat while others try to knock it down. You can't block their hits. If they don't hit the Goat, you leave them alone while they collect their ball/rock. Whoever manages to knock it down, you have to put the goat back on its base. Once that is done, you have to catch the one that hit it. You can't catch him/her if they are touching their ball/rock on the ground. Once they pick it up, you can continue the chase. If you catch him/her, you switch roles.

Slika 5: Navodila za igranje tradicionalnih iger v Microsoft Word.

Slika 6: Predstavitev v okolju Microsoft PowerPoint.

Slika 7: Predstavitev v okolju Prezi.

V okviru 5 urne delavnice so se učenci naučili urejati svoje video posnetke z orodjem Windows Movie Maker. Učenci so za telo, ki so ga sestavili iz kock Lego, naredili ročno in računalniško risbo izometrične projekcije. Na delavnici so uporabili svoje mobilne telefone za fotografiranje in snemanje, ter uporabili program za snemanje zaslona, ko so risali izometrično projekcijo s programom Qcad (Slika 8) [9].

Slika 8: Predstavitev izdelana z orodjem Windows Movie Maker [9].

Ob vsakem mednarodnem srečanju so učenci pripravili tudi *blog* oziroma spletni dnevnik, preko katerega so svoje vrstnike in širšo javnost obveščali o aktivnostih, ki so potekale na posamezen dan (Slika 9).

Slika 9: Spletni dnevnik učencev.

V tednu varne rabe interneta 6. - 10. 2. 2017 in 5. - 9. 2. 2018 smo za učence v času razrednih ur in ur računalniških predmetov izvajali aktivnosti, ki so obravnavale problematiko varne in odgovorne rabe interneta in mobilnih naprav.

4.3 Mnenja učencev o izobraževanju

Učenci, ki so bili udeleženi v projektu, so odgovorili tudi na anketni vprašalnik o tem, koliko so se na dodatnih izobraževanjih naučili.. Učenci so se tako na primer v urejevalniku besedila naučili povečati in pobarvati črke, nastaviti poravnavo besedila, vstaviti sliko. Na tipkovnici jih večina zna najti posebne znake (npr. @, {, % …). 87,4 % zna uporabiti ukaz za prelom besedila, več kot 90 % zna v urejevalniku besedil narediti miselni vzorec, obrobo strani, tabelo.

Na osnovi dobljenih rezultatov vidimo, da je poznavanje in uporabnost programov pri vsakdanjem in šolskem delu vsekakor večja.

4.4 Analiza učinka projekta

Po zaključenem projektu ugotavljamo, da so bili učinki na udeležence projekta sledeči:

- izboljšala se je samostojna raba IKT med učenci: učenci znajo uporabljati enega od orodij Microsoft Word, Microsoft Power Point, Prezi in Windows Movie Maker. Znanje so učenci uporabili tudi pri ostalih predmetih v izobraževalnem procesu (npr. seminarske naloge, video posnetki, oblikovanje naslovnic, pisanje pisma, …),
- učenci, ki so se udeležili izmenjave, so ugotovili pomen izobrazbe tako s področja IKT kot tujih jezikov, saj je bilo znanje tujega jezika pomembno za sporazumevanje, poznavanje IKT pa za pripravo predstavitev ter navezovanje stikov z učenci partnerskih šol,
- učenci so pridobili pomembne izkušnje, ki vodijo do večje samozavesti pri javnem nastopanju ter bolj učinkovitega timskega dela,
- učenci so v večji meri seznanjeni s pomenom uravnoteženosti uporabe IKT v vsakdanjem življenju,
- zaradi pridobljenih dodatnih znanj in veščin s področja IKT, tujih jezikov, širšega pogleda na skupnost, reševanja izzivov in sodelovanja v skupini so učenci pridobili veliko izkušenj, ki jim bodo lahko kasneje koristile na trgu dela,
- komunikacija z učenci med partnerskimi šolami je potekala v angleškem jeziku, še posebej intenzivna je bila v času pred in med izmenjavami, učenci so se naučili enostavnih osnovnih izrazov v jezikih vseh štirih sodelujočih šol,
- z izmenjavami so učenci pridobili širši pogled na različnost narodov, njihovih navad, razmišljanj, vedenj, s poročanjem pa sovrstnike in širšo okolico seznanili s svojimi izkušnjami in pripomogli k širjenju strpnosti med nami,
- spletene prijateljske vezi med sodelujočimi učenci so se ohranile, nekaj je načrtovanih družinskih obiskov,
- z izvedbo predavanj o varni uporabi spleta se bolj zavedajo pravilne in primerne uporabe IKT tehnologij,
- z raziskovanjem tradicionalnih iger so razvili več socialnih in športnih kompetenc, ter večjo ozaveščenost o zdravem načinu življenja,
- v novem šolskem letu se je več otrok vpisalo v pouk in interesno dejavnost računalniških orodij,
- povečalo se je zanimanje za vključitev v mednarodne projekte in vključenost učencev v neobvezni predmet tuji jezik,
- s spletanjem prijateljskih vezi zunaj svoje domovine so širili evropsko dimenzijo medsebojnega bivanja v sozvočju različnih narodov,

- učenci, ki so se udeležili izmenjave in s tem povezanih pridobljenih znanj in spretnosti, so pridobili certifikat Europass mobilnost.

Po končanem projektu smo izvedli tudi vprašalnik med naključno izbranimi oddelki posameznega razreda, ker nas je zanimalo, kakšna je pripravljenost naših učencev za sodelovanje v mobilnostih in aktivnostih v okviru Erasmus+ projektov v prihodnosti. Rezultat je pokazal visoko stopnjo želje in pripravljenosti za delo.

5. ZAKLJUČEK

Sodelovanje v mednarodnem projektu je pripomoglo k primerjavi učnih metod in rezultatov IKT ob izmenjavi primerov dobrih praks med sodelujočimi šolami, učitelji in učenci. Še posebej so se v pozitivni luči izkazale delavnice IKT na mednarodnih projektnih sestankih (izmenjava teoretičnih znanj z delavnicami) ter projektnih izmenjavah učencev z aktivnimi delavnicami in njihovimi predstavitvami izdelkov po zaključku.

Učenci, ki so bili deležni obiska tujih učencev ali so sami obiskali drugo državo so ugotovili pomen izobrazbe tako s področja IKT kot jezikov, saj je bilo znanje jezika pomembno za zmožnost sporazumevanja, uporaba IKT pa za predstavitev sebe in navezovanje stikov z učenci partnerskih šol.

Prav tako je bil izveden vprašalnik med učitelji, ki v projektu niso neposredno sodelovali, a je rezultat pokazal na njihovo veliko pripravljenost za sodelovanje v prihodnjih letih. Na roditeljskih sestankih za 4. razred so učiteljice izvedle vprašalnik o smiselnosti vključevanja šole v projekte za njihove otroke. Analiza je pokazala, da so starši pripravljeni svoje otroke podpreti pri projektnih aktivnostih in da šolo v teh prizadevanjih podpirajo. Tudi to je kazalnik, da smo dobro delali, bili slišani, videni in dovolj odmevni, da se je o nas govorilo tudi v lokalni skupnosti.

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Nekateri vidiki uporabe IKT pri pouku matematike

Some aspects of using IKT in mathematics class

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POVZETEK

Uporaba sodobne informacijske tehnologije zavzema velik del prostega časa naših otrok, naših učencev. Pri uporabi le-te nas pogosto prekašajo. IKT je lahko pripomoček ali podpora pri poučevanju, vendar pa ni neke enotne poti. Vsak učitelj se znajde po svoje, odvisno od sredstev, ki so na voljo, okolja v katerem živi in dela, predznanja in tehnične opremljenosti šole, učencev in njihovih družin. Na Zavodu za šolstvo so z anketo med učitelji ugotovili, da je uporaba IKT med učitelji matematike še vedno sorazmerno majhna. V prispevku predstavim elemente IKT, ki so prisotni pri mojem delu, torej poučevanju matematike in poučevanju učencev nasploh. Opozarjam na nekatere pomanjkljivosti IKT, s katerimi se srečujem ter poskušam najti nekaj smernic za nadaljnje delo.

Ključne besede

IKT tehnologija, poučevanje, matematika, osnovna šola

ABSTRACT

The use of modern information technology occupies a large part of the free time of our children, our pupils. They often outperform us when using it. ICT can be a gadget or support in teaching, but there is no single path. Every teacher finds himself, depending on the resources available, the environment in which he lives and works, the knowledge and technical equipment of schools, pupils and their families. At the Educational institute, the study of teachers found that the use of ICT among math teachers remains relatively small. In the paper, I introduce the elements of ICT present in my work, i.e. teaching mathematics and teaching pupils in general. I am warning some of the shortcomings of the ICT that I am meeting and trying to make some guidance for further work.

Keywords

ICT technology, teaching, mathematics, primary school

1. UVOD

Poučevanje in učenje matematike lahko poteka povsem klasično, s kredo in tablo, lahko pa vključuje uporabo sodobne IKT tehnologije, ki nam je na razpolago. Kaj sploh razumemo pod izrazom IKT? Informacijsko-komunikacijske tehnologije (IKT) je skupen izraz za nabor najrazličnejših računalniških, informacijskih in komunikacijskih naprav (strojna oprema), aplikacij (programska oprema), omrežij (Internet) in storitev. [1]

Informacijsko komunikacijske tehnologije so prisotne na vseh področjih življenja in obsegajo področji računalništva in telekomunikacij, ki se zaradi izjemno hitrega napredka vedno bolj zlivata. IKT tako obsegajo shranjevanje in obdelavo podatkov ter prenos informacij preko brezvrvičnih in vrvičnih zvez. Obsegajoč bakreno in optično infrastrukturo, navidezno in nadgrajeno resničnost, kognitivni radio, internet stvari, komunikacijo stroj-stroj in mobilna omrežja 5. generacije, so IKT v osrčju sodobnega tehnološkega sveta. [2]

Če poenostavim, bi lahko rekli da sem sodi vse, kar ni klasično: tabla, kreda in papir (zvezek, učbenik, delovni zvezek). Zdi se, da se IKT spreminja celo hitreje od lastne definicije. Trenutno se govori že o mobilnih omrežjih 6. generacije. Pred več kot tremi stoletji je avstrijska cesarica Marija Terezija uvedla splošno šolsko obveznost za vse otroke med šestim in dvanajstim letom. Z reformo se je dvignila splošna izobrazba, znanje je postalo vrednota, kar velja še danes, nabor znanja pa se spreminja. Pa tudi učbenike, tablo in kredo počasi izpodriva IKT. Bodo slednji tudi dokončno potonili v pozabo, kot so npr. logaritemske tablice? V učnem načrtu za matematiko je zapisano: Kvadratne korene števil, ki niso (očitni) kvadrati racionalnih števil, računamo z žepnimi računali (torej ne uporabljamo tablic ali pisnih algoritmov). [3]

Dejstvo je, da razvoj poteka hitreje kot kadarkoli prej. Skoraj tri stoletja so učenci uporabljali le tablice in krede. Zvezki in učbeniki očitno ne bodo imeli tako dolge življenjske dobe. Vendar pa znanje, ki ga pridobimo z digitalnim učenjem, naj ne bi bilo enakovredno tistemu, ki ga pridobimo na podlagi lastnih izkušenj v resničnem svetu. S hitrim razvojem tehnologije otroci preživljajo več časa v digitalnem svetu in manj v naravi, kar lahko slabše vpliva na njihov miselni proces, Naši možgani si stvari bolje zapomnijo, če jih izkusijo, kot pa če jih zgolj vidijo na napravi. S številnimi študijami (npr. poskus zlaganja kock) so ugotovili, da se otroško dojemanje spremeni, če te kocke zlagajo fizično ali prek zaslona digitalne naprave. Otroci za boljše razumevanje pojavov torej potrebujejo resnično, ne zgolj navidezno izkušnjo. [4]

Raziskave kažejo, da papir sicer ostaja najbolj priljubljen in učinkovit medij za branje daljših in zahtevnejših besedil, s čimer ljudje razvijamo in pridobivamo kognitivne sposobnosti, kot so koncentracija, širjenje besedišča, ter spomin. V dobi digitalne tehnologije pa ljudje vse več beremo z zaslona. Branje z zaslonov naj bi bilo manj poglobljeno kot branje s papirja, razumevanje daljših besedil pa je pri branju s papirja bistveno boljše.

Več kot 100 raziskovalcev s področja branja, učenja, založniških študij in pismenosti iz vse Evrope, se je oktobra 2018 zbralo na Norveškem. Pri tem so prišli do nekaj ključnih ugotovitev:

- Digitalno okolje prinaša številne izzive, bralci pa precenjujejo svojo sposobnost razumevanja besedila, kadar berejo z zaslona. To je posebej izrazito, kadar berejo pod časovnim pritiskom, ko se še slabše osredotočajo in ko preskakujejo besedilo.
- Razumevanje predvsem daljših neumetnostnih besedil je boljše, če jih beremo s papirja.
- Utelešena kognicija (to pomeni dejstvo, da na to, kako se učimo, kaj vemo in znamo, vpliva vse naše telo, ne le na možgane), vpliva tudi na razlike med branjem s papirja in zaslona, ki se najbolj pokažejo pri pomnjenju, razumevanju in poglabljanju v besedilo.

Ker je predvsem pri mladih zelo razširjeno branje z zaslonov, so pripravili nekaj priporočil, ki bi jih morali upoštevati v procesu šolanja, pa tudi industrija. Vse ugotovitve, priporočila in vprašanja, na katera bi morali v prihodnosti odgovoriti, so zapisali v t. i. deklaraciji iz Stavangerja o prihodnosti branja. [5]

2. UPORABA IKT PRI MATEMATIKI

2.1 Strateške usmeritve

Januarja 2016 so na Ministrstvu za izobraževanje, znanost in šport pripravili dokument Strateške usmeritve nadaljnjega uvajanja IKT v slovenske vzgojno-izobraževalne zavode do leta 2020. Vizija nadaljnjega uvajanja IKT v slovenske vzgojno-izobraževalne zavode je zagotoviti posameznikom možnost izobraževanja v odprtem, ustvarjalnem in trajnostno vzdržnem učnem okolju, podprtem z inovativno uporabo informacijsko-komunikacijske tehnologije, kar bo na učinkovit in kakovosten način omogočilo pridobitev znanja in spretnosti, ključnih kompetenc in spretnosti 21. stoletja, potrebnih za uspešno vključevanje v družbo. S tem bo zagotovljen tudi dvig konkurenčnosti znanja in kompetenc naših učencev, dijakov in študentov, da bodo lahko prispevali k inovativnosti in konkurenčnosti domačega trga in bodo bolj opolnomočeni za uspešen vstop na trg dela (vključno z EU) ter za aktivno participacijo v družbi.

Za doseganje vizije bodo pri umeščanju IKT v izobraževanje spodbujali razvoj:

- didaktike in e-gradiv,
- izgradnje platforme in spodbujanja sodelovanja,
- krepitve e-kompetenc pri učečih se in učiteljih,

informatizacije ustanov … [6]

2.2 Učni načrt za matematiko

V učnem načrtu za matematiko je v zvezi z IKT med drugim zapisano: Z razvojem informacijsko-komunikacijske družbe je prisotnost matematike na drugih predmetnih področjih vedno manj vidna, saj se skriva v tehnologiji. Za upravljanje določenih dejavnosti je zato manj pomembno zgolj rutinsko obvladovanje računskih postopkov, vedno pomembnejši pa so razumevanje, medpredmetno povezovanje in uporaba matematičnega znanja ter zmožnost reševanja problemov. [3]

Pri **splošnih ciljih** je navedeno, da naj bi med osnovnošolskim izobraževanjem učenci razvili tiste **kompetence**, ki vodijo k sposobnostim za stalno učenje. V povezavi z IKT je v učnem načrtu navedeno, da v osnovni šoli v okviru matematične kompetence v skladu z naštetimi splošnimi cilji razvijamo: zbiranje, urejanje, strukturiranje, analiziranje, predstavljanje podatkov ter interpretiranje in vrednotenje podatkov oziroma rezultatov; uporabo informacijsko-komunikacijske tehnologije.

V povezavi z naravoslovnimi predmeti spodbujamo naravoslovno-matematično kompetenco za razvoj kompleksnega mišljenja: Iskanje, obdelava in vrednotenje podatkov iz različnih virov: zmožnost presoje, kdaj je informacija potrebna; načrtno spoznavanje načinov iskanja, obdelave in vrednotenja podatkov; načrtno opazovanje, zapisovanje in uporaba opažanj/meritev kot vira podatkov; razvijanje razumevanja in uporabe simbolnih/grafičnih zapisov; uporaba IKT za zbiranje, shranjevanje, iskanje in predstavljanje informacij …

Operativni cilji vodijo v usvajanje bistvenih matematičnih pojmov in vsebin. Učitelji razporejajo zaporedje operativnih ciljev in vsebin, v smiselnem obsegu, kot to dopušča pouk matematike, vključujejo tudi kompetence, cilje medpredmetnih področij in cilje kroskurikularnih tem: cilje informacijsko-komunikacijske tehnologije … in sicer v skladu s sodobnimi trendi znanja in smernicami, zapisanimi v evropskih dokumentih.

V didaktičnih priporočilih je v 6. razredu pri obdelavi podatkov predvidena uporabo računalniških preglednic. »Učenci zberejo in uredijo podatke ter jih vnesejo v primerno računalniško preglednico. Ob tem spoznavajo delovanje in uporabnost računalniških preglednic: npr. s spreminjanjem podatkov v preglednicah se spreminjajo prikazi. Obdelavo podatkov z računalniškimi preglednicami povežemo tudi z reševanjem problemov in raziskavami. Dejavnosti, če je le mogoče, izvajamo v računalniški učilnici. Za učenec bo vsebina bolj nazorna, razumljiva in zagotovo bolj smiselna, če bodo zbirali podatke iz svojega okolja.« Dejavnosti izbiramo iz vsakdanjih situacij (preglednice, prikazi v časopisih, podatki na svetovnem spletu ipd.). Uporaba računalniških preglednic naj postane potreba in običajno orodje urejanja in prikazovanja podatkov, s katerimi lahko simuliramo različne situacije (npr. kaj se zgodi, če posamezni podatki pomembno odstopajo ali jih spreminjamo).

Med **standardi znanja** za tretje vzgojno-izobraževalno obdobje je navedeno, da učenec: uporablja računalniške preglednice, uporablja informacijsko-komunikacijsko tehnologijo pri reševanju problemov, kritično vrednoti informacije na spletu in drugje.

Med didaktičnimi priporočili preberemo še, da naj začetni pouk matematike izhaja iz izkustvene ravni učencev, ki se postopoma v višjih razredih ob različnih dejavnostih nadgrajuje v formalno matematiko. Holistični pristop učenja in poučevanja uresničujemo z raziskovalno dejavnostjo, reševanjem problemov iz vsakdanjega življenja, vključevanjem aktualnih vsebin in sodobnih tehnologij. Dodatno motivacijo in boljše razumevanje lahko dosežemo s konkretnimi ponazorili, različnimi didaktičnimi pripomočki, izzivi, s primeri, ki osmišljajo matematične vsebine, sodobnimi gradivi, z informacijsko-komunikacijsko tehnologijo idr. **Učencem s posebnimi potrebami** je treba prilagoditi učenje matematike, uporabiti drugačen didaktični pristop in tudi drugačen dostop do tehnologije kot drugim učencem. V takih primerih naj se učitelj matematike o didaktičnih pristopih in o uporabi tehnologije odloča v sodelovanju z ustreznimi strokovnimi službami.

Medpredmetno povezovanje uresničujemo pri pouku matematike in tudi v okviru naravoslovnih, kulturnih, projektnih, tehniških dni ter pri drugih šolskih dejavnostih, ki potekajo na šoli. V okviru medpredmetnega povezovanja naj učenci uporabljajo informacijsko-komunikacijsko tehnologijo (npr. različne računalniške programe), izdelajo statistično raziskavo (družboslovni in naravoslovni predmeti) ali npr. v povezavi z likovno vzgojo izrazno preiskavo (npr. simetrija v naravi, zlati rez).

O informacijski tehnologiji v učnem načrtu piše: V današnjem svetu se uporaba tehnologije zahteva in pričakuje pri nadaljnjem študiju, v vseh poklicnih dejavnostih, na vseh delovnih mestih in je tudi sestavni del vsakdanjega življenja. Pouk matematike naj učence usposobi za uporabo tehnologije predvsem pri srečevanju z matematičnimi problemi, ob tem pa se posredno usposabljajo tudi za uporabo tehnologije v vsakdanjem življenju. Informacijsko-komunikacijska tehnologija omogoča in podpira različne pristope k poučevanju in učenju, npr. raziskovanje in reševanje matematičnih ter avtentičnih problemov. Tehnologija omogoča hitro povratno informacijo, ki je nepristranska in neosebna. To lahko opogumlja učence, da sami predvidevajo in razvijajo svoje ideje, jih testirajo in spreminjajo ter popravljajo oziroma izboljšujejo. Tehnologija lahko pomaga učencem premostiti primanjkljaje v znanju, učne težave ali specifične težave na področju grafomotorike ter ponuja dodatne možnosti učenja v ustreznem spoznavnem stilu posameznika. Informacijsko-komunikacijska tehnologija (IKT) je lahko sredstvo za razvoj matematičnih pojmov, sredstvo za ustvarjanje, simuliranje in modeliranje realnih ali učnih situacij, lahko je učni pripomoček ali komunikacijsko sredstvo. Učni načrt pri nekaterih vsebinah predvideva uporabo tehnologije, pri drugih pa je odločitev prepuščena učitelju. Na voljo imamo različne vrste tehnologij: numerična in grafična računala, računalniške programe (dinamična geometrija, programi za delo s funkcijami, računalniške preglednice, programi za statistiko, programi za učenje ali utrjevanje določenih matematičnih vsebin ipd.), internet (informacije, elektronska učna gradiva, elektronska pošta, spletne učilnice, video konference ipd.), orodja in programe za zapis in predstavitev podatkov ali rezultatov dela (interaktivna tabla, programi za predstavitve ipd.). Pri pouku matematike v osnovni šoli jo lahko uporabljamo z naslednjim namenom: razvijamo matematične pojme, raziskujemo in modeliramo, avtomatiziramo določene postopke, predstavljamo rezultate dela, preverjamo znanje. **Numerično računalo** naj se uporablja kot pomoč pri učenju drugih vsebin (npr. pri stereometrijskih izračunih ali drugih učnih situacijah, kjer učencem in učenkam omogoča osredotočenje na cilje višjih taksonomskih stopenj). Po presoji se računalo lahko uporablja tudi kot kognitivno sredstvo (npr. izračunati/določati kvadratne korene števil brez tipke za kvadratni koren; preiskovati pravilo za množenje/deljenje s potenco števila 10). Računalo se smiselno uporablja glede na cilje pouka itn.

Programi dinamične geometrije lahko dopolnijo razumevanje geometrije in predvsem geometrijske konstrukcije. Dinamičnost geometrijske slike odpira učencem vpogled v povezave med matematičnimi pojmi.

Programi za delo s funkcijami omogočajo delo s tremi reprezentacijami: tabelo vrednosti, grafom in s predpisom (formulo). Če je program dinamičen, pa zlahka odkrivamo povezave med pojmi. Računalniške preglednice in dinamični programi za delo s podatki Računalniške preglednice omogočajo učinkovito delo s podatki. Obdelujemo lahko več podatkov in realne podatke, saj so postopki urejanja, razvrščanja, računanja in prikazovanja avtomatizirani. Zato se lahko osredotočimo na interpretacije in razlago pojavov, ki jih podatki opisujejo.

Svetovni splet: Učenci lahko uporabijo splet za iskanje raznih podatkov in informacij pri pripravi projektov, zbiranju podatkov in podobno. Elektronska učna gradiva (e-gradiva) se lahko uporabijo v različnih fazah učnega procesa ali za samostojno delo učencev izven pouka. Lahko so v pomoč ob morebitni daljši odsotnosti učenca, sploh če vključimo še e-komunikacijo med učencem in učiteljem. **Spletne učilnice** so lahko mesto za sistematično zbiranje učnih gradiv ali gradiv za preverjanje znanja, za izmenjavo izdelkov ali za e-komunikacijo med udeleženci učnega procesa. **Uporaba drugih programov in orodij**: Pri pripravi in predstavitvi projektnih nalog ali preiskav učenci uporabljajo programe za zapis in prikazovanje podatkov in rezultatov svojega dela.

Predlagana didaktična sredstva tretjem vzgojno-izobraževalnem obdobju: Matematična učilnica naj bo opremljena: s kompletom geometrijskega orodja za učitelja (ravnilo s šablono, geotrikotnik, šestilo), s kompleti žepnih računal, s predstavitveno opremo (grafoskop, LCD-projektor, interaktivna tabla ipd.), s primerno tablo s čim večjo površino, z modeli geometrijskih teles, z računalnikom z ustrezno programsko opremo za doseganje ciljev po učnem načrtu za matematiko in z dostopom do spleta. Učenci naj imajo pri pouku matematike dostop do računalniške učilnice z ustreznim številom delovnih mest.

3. DEJANSKA UPORABA IKT

Poročilo strokovne delovne skupine za analizo prisotnosti vsebin računalništva in informatike v programih osnovnih in srednjih šol ter za pripravo študije o možnih spremembah (RINOS): če opazujemo učne načrte v osnovni šoli, vidimo, da tudi razvoj splošnih digitalnih kompetenc (digitalno opismenjevanje) ni načrtovan usklajeno med predmeti in ne po vertikali ter je prepuščen učiteljem. Posledično je prevelik odstotek učencev, ki zapusti osnovno šolo tudi brez razvitih kompetenc za rabo digitalnih tehnologij.

Glede na zapisano v učnih načrtih bi pričakovali, da imajo učenci dobro razvite digitalne kompetence in da znajo digitalno opremo smiselno uporabljati. Žal raziskave kažejo, da večina učencev teh znanj, veščin in kompetenc ne pridobi (npr mednarodna raziskava računalniške in informacijske pismenosti ICILS 201319). Ugotovljeno je tudi, da se zaznava učitelja o pomembnosti IKT pri poučevanju statistično značilno povezuje z njegovo uporabo IKT pri poučevanju. To pomeni, da je kljub temu, da učitelji sledijo istim učnim načrtom, dejanska uporaba IKT v razredu povezana z usposobljenostjo učitelja in njegovim odnosom do IKT v šoli. V isti raziskavi je bilo ugotovljeno, da učitelji in učenci večinoma uporabljajo IKT le za najosnovnejša opravila, ki so: urejanje besedil, priprava predstavite v in iskanje podatkov na spletu. To pa je le nekaj kompetenc od enaindvajsetih iz modela DigiComp, pa še te so glede na raziskavo ICILS razvite na najnižjem nivoju, kar je presenetljivo malo glede na vključenost digitalnih kompetenc v vse učne načrte.

Iz raziskav je moč sklepati, da vsi učenci osnovnih šol v Sloveniji ne pridobijo temeljnih digitalnih kompetenc. Šola v tem primeru ne zmanjšuje razlik med učenci, ki nastanejo zaradi najrazličnejših vplivov (socialno ekonomski status, izobrazba staršev, dostop do novih tehnologij doma, ipd.) in še poglablja prepad in veča digitalno ločnico… [9] Tudi po podatkih Zavoda RS za šolstvo IKT uporablja malo učiteljev matematike. Vsaj tako so pokazali delni rezultati analize vprašalnika na to temo za prvih 99 odgovorov, ki so jih prejeli do 3. 4. 2019. Delni rezultati (Tabela 1) so bili predstavljeni na Študijski skupina za matematiko, 16.4.2019 , OŠ Trebnje. [7]

Tabela 1. Navedbe učiteljev o uporabi IKT pri pripravi na pouk

Posamezne navedbe	Število
različni učbeniki (tiskani, e-učbeniki, i-učbeniki)	55
učni načrt	47
letna učna priprava, LDN	10
delovni zvezek, samostojni delovni zvezek	14
internetne strani, splet	17
IKT (računalnik, pametni telefon, interaktivna tabla, tablice)	6
zbirke vaj, zbirke nalog	5
priročnik	4
predlog priprav	1
odgovori izhajajoč iz anketirancev *(svoje znanje, ideje iz resničnega življenja, lastne ideje, "zdrava kmečka pamet", svoje stare priprave, lastne didaktične pripomočke)*	10

4. RAČUNALNIŠKO MIŠLJENJE

Pri tem ne gre neposredno za uporabo IKT, je pa z njim tesno povezano. Računalniško mišljenje (ang. computational thinking) nekateri avtorji in strokovna združenja pojmujejo kot eno izmed ključnih spretnosti učencev 21. stoletja in jo povsem eksplicitno postavljajo ob bok osnovnim učnim spretnostim branja, pisanja in računanja. Čeprav naj bi bilo računalniško mišljenje kognitivna spretnost, ki se tesno povezuje z računalniškim programiranjem, pa programiranje še zdaleč ni edina dejavnost, ki zahteva uporabo procesov računalniškega mišljenja. Opredelitev računalniškega mišljenja je zaradi pomanjkljive teoretične podlage danes še vedno nejasna. Analiza raziskav na področju računalniškega mišljenja, v kateri so avtorji pregledali več kot 500 raziskav, izvedenih v zadnjem desetletju, je namreč pokazala, da se konstrukt računalniškega mišljenja najpogosteje raziskuje v odnosu do učenja prek iger (game based learning), do konstruktivizma, pozitivnega tehnološkega razvoja (positive techological development), MINT (t.j. področje matematike, informatike, naravoslovja in tehnike, angleška sopomenka je STEM) ali s teoretskim konceptom območja bližnjega razvoja Vigotskega. Avtorji se v opredelitvah in značilnostih računalniškega mišljenja osredotočajo na abstrakcijo, reševanje konfliktov, algoritmično mišljenje, prepoznavanje vzorcev, dizajnersko mišljenje (design-based thinking), konceptualizacijo, dekompozicijo, avtomatizacijo, analiziranje, preverjanje in razhroščevanje, generalizacijo, matematično presojanje, implementacijo rešitev in modeliranje. Računalniško mišljenje naj bi torej pomenilo način mišljenja, ki lahko predstavlja pomembno orodje ustvarjalnega mišljenja, kritičnega mišljenja, odločanja in reševanja problemov. Predpostavlja namreč razvijanje rešitev odprtih problemov na način sledenja vrsti dobro opredeljenih korakov. Učenci, ki spretnosti računalniškega mišljenja ne razvijejo, so, oziroma postajajo v svojih sposobnostih reševanja problemov zelo omejeni. Način spoprijemanja s problemi, kot ga predpostavlja računalniško mišljenje, je namreč ključni pristop k reševanju problemov na vseh strokovnih področjih. Takšen pristop reševanja problemov velja za ključnega v naravoslovju, v zadnjem času pa avtorji opozarjajo tudi na pomen zmožnosti takšnega pristopa k reševanju problemov na področju družboslovja (na primer pri formuliranju raziskovalnih vprašanj na področju psihologije). [8]

5. SODELOVANJE MED UČITELJI

Na naši šoli poučuje matematiko na predmetni stopnji sedem učiteljic in učiteljev na matični in dveh podružničnih devetletnih šolah. Ker poskušamo v okviru šole in s tem tudi matematičnega aktiva delovati enotno, predstavlja sodelovanje velik izziv, saj se vsi skupaj dobimo le na pedagoških konferencah in sestankih aktiva nekajkrat letno. Tudi slednje je zaradi različnih urnikov kar težko uskladiti. Nekaj več časa za pogovor je le na uvodni konferenci, na ostalih gre več ali manj za podajanje navodil, predstavljanje raznih poročil. Za komunikacijo tako uporabljamo predvsem elektronsko pošto. V preteklih šolskih letih je vsak učitelj uporabljal poljuben elektronski naslov, v minulem šolskem letu smo prešli na enotno spletno pošto (Arnes). To nam je v primeru raznih projektov, ko je potrebno sodelovati s številnimi učitelji, ki jih osebno morda sploh ne poznaš, ker poučujejo na drugi lokaciji, sporočanje zelo poenostavilo. Vsi zaposleni imamo enoten naslov z imenom in priimkom, tako odpade tudi ugibanje kdo od zaposlenih se skriva npr. za »pikanogavicka@gmail.com« …Pomembno pa je tudi z vidika varnosti sporočil ter zaradi ločenosti zasebnih in službenih vsebin.

V okviru matematičnega aktiva se preko e-pošte dogovarjamo predvsem o obravnavi učne snovi, dogovarjamo se za sestanke, se usklajujemo v primeru da pride pri kakšni skupini ali razredu do zaostankov, nadomeščanj. Dogovarjamo se glede nalog, učnih listov in dodatnih vaj, izmenjujemo si preverjanja in ocenjevanja znanja. Ocenjevanja znanja navadno sestavi en ali dva učitelja, ki jih nato pošlje v ogled še ostalim, ti zapišejo svoja opažanja, komentarje in morebitne popravke, avtor pa nato glede na to prvotno verzijo izboljša ter ponovno pošlje v pregled ostalim, kar zna biti precej zamudno, glede na to da nas pri tem sodeluje sedem učiteljev. Omenjeno delo poteka navadno v popoldanskem in večernem času, kar je potrebno usklajevati z družinskimi obveznosti, zato pogosto ni možen takojšen odgovor, čemur pa elektronska pošta v končni fazi tudi ni namenjena. Končno verzijo preizkusa nato pripnemo v našo skupno spletno učilnico. Tudi, ko je že oddana, se najde še kakšna napaka, tako da poteka sodelovanje tudi v spletni učilnici. Tudi tukaj smo pričeli uporabljati Arnesovo storitev, vendar se je izkazalo, da je postopek prijave nekoliko daljši, zato se raje poslužujemo elektronskih sporočil, šele ko je preizkus že dodelan pa še spletne učilnice. V spletno učilnico na začetku šolskega leta oddamo tudi vse letne priprave za matematiko ter za morebitne izbirne predmete, dodatni in dopolnilni pouk ter interesne dejavnosti.

6. UČITELJ - UČENEC

6.1 Dnevnik in redovalnica

Zadnji dve leti ne uporabljamo več klasičnih dnevnikov in redovalnic, temveč Lopolis. Zaradi velikosti šole je delo zdaj mnogo učinkoviteje, saj ima na primer razrednik takojšen vpogled v dogajanje v svojem razredu (npr. izostanki, ocene, graje) Prihaja pa tudi do težav (npr. vpisovanje vsebin v času ko so učenci v šoli v naravi, del učencev pa ostane na šoli ali pa npr. med nadomeščanji, ko se oddelek prerazporedi, ipd.), ki jih vodstvo šole s ponudnikom storitve rešuje bolj ali manj sproti.

6.2 Projektor in i – tabla

Uporaba interaktivne table je omejena na določene učilnice, kar predstavlja težavo za učitelje, ki nimamo svoje učilnice in smo vsako uro v drugi učilnici. To zahteva veliko načrtovanja, včasih tudi menjavo zaporedja ur. Uporabljamo jo predvsem popestritev učne snovi s slikovnim gradivom, animacijami (predvsem v vlogi projekcijskega platna), pa tudi za reševanje interaktivnih nalog. Tudi projektorjev ni v vseh učilnicah, kjer pa so jih s pridom uporabljamo, da učenci prepišejo učno snov. Učitelj ima tako boljši pregled nad celotnim razredom ter delom posameznih učencev, kot če bi pisal na tablo, učenci pa prepisovali. Tukaj bi poudarila, da je izbor e-gradiv po mojem mnenju zelo skromen, nepregleden, celo kaotičen. V šoli kot učno gradivo uporabljamo le učbenik, zato imamo dostop do elektronske različice učbenika (nekoliko olajša delo, ker učencem ni potrebno nositi učbenikov, vendar je po drugi strani ugodno, da ima učenec pregled nad celotno stranjo v učbeniku, medtem ko je na tabli le del, ki ga takrat rešujemo).

V učnem načrtu za matematiko preberemo še: Tudi pri pouku matematike učenci razvijajo slušno razumevanje, govorno sporočanje, bralno razumevanje in pisno sporočanje. **Ob uporabi učbenika in obravnavi besedilnih nalog razvijajo bralno pismenost** in se spopolnjujejo v rabi že pridobljenih bralnih strategij, ki jim omogočajo razumevanje matematičnega besedila.

6.3 Programska oprema in aplikacije

Program Word uporabljam predvsem za priprave na pouk, učne liste in preverjanja ter preizkuse znanja. GeoGebro uporabljam za pripravo geometrijskih slik bodisi za projekcijo na tablo (slednjemu dobro služi PowerPoint), za učne liste, preverjanja, preizkuse znanja ali kar sprotno nastajanje geometrijskih slik. Aplikacijo NoteBloc uporabljam na pametnem telefonu, rezultat je podoben skeniranju; dokument (npr. rešitve nalog) je tako dovolj kakovosten za projekcijo na tablo.
Učni načrt med IKT uvršča (morda za koga presenetljivo) tudi numerična računala. Na šoli imamo več kompletov enakih računal, tako da ima med učno uro vsak učenec svoje računalo. V 6.razredu se učijo predvsem zapisovanja izrazov, v 7. zapisovanje ulomkov,

v 8. razredu se predhodnemu znanju pridruži računanje kvadratnih korenov, v 9. razredu pa jih uporabljajo predvsem pri geometriji, ko bi pri obilici računanja (npr. neznane stranice, površina, prostornina geometrijskih teles) »izgubili rdečo nit«. Učenci uporabljajo računala tudi pri fiziki, kemiji, tako da lahko tudi tukaj govorimo o medpredmetnem sodelovanju. Ugotavljamo pa, da učni načrti med predmeti niso najbolj usklajeni, saj bi pri naravoslovnih predmetih kakšno izmed matematičnih znanj potrebovali že prej. Pri matematiki pa je predstavljena tako, kot da za to še niso slišali pri drugih predmetih ali obratno.

6.4 Splet

Učencem občasno pokažem kak posnetek, še pogosteje pa jih najdejo kar sami doma. Težava videoposnetkov, kjer nekdo razlaga snov, je pogosto uporaba neustreznih postopkov ali drugačna terminologija, kar učenca lahko še bolj zmede. Pri uporabi pri pouku pa lahko učitelji opozorimo na morebitne razlike v primerjavi s tem, kako delamo v šoli. V primeru, da gre za posnetke v tujem jeziku, lahko učitelj sproti prevede oziroma razloži videno. Občasno igramo tudi matematične igre, npr. za utrjevanje poštevanke (uporabne so predvsem v podaljšanem bivanju, med urami nadomeščanj, uvodno in zaključne ure matematike …). Opozorila bi še na pomembnost sprotnega nastajanja slike na tabli, »pred očmi« učencev, samo pokazati sliko ni dovolj, saj morajo usvojiti ustrezne postopke.

6.5 Spletna učilnica

Učencem je namenjena njihova spletna učilnica. Zaenkrat jo uporabljamo kot mesto, kjer lahko najdejo naloge za vaje pred posameznimi preizkusi znanja ter tudi rešitve zanje. Ta medij uporabljamo predvsem z željo, da bi zmanjšali število kopij, drugi cilj pa je navajanje učencev na tovrstno delo. Kljub temu, da to rešitev uporabljamo že nekaj let, učencem po potrebi vaje še vedno natisnemo. Še vedno se najde kdo, ki potoži, da doma nimajo bodisi računalnika, tiskalnika ali internetne povezave. Pogosto se nočejo izpostaviti pred celotnim razredom, tako da smo dogovorjeni, da pridejo pred zbornico in dobijo natisnjene izvode vaj. Druga težava pa se pojavi pri vstopu s spletno učilnico, saj se pogosto zgodi, da se učenci poskušajo prijaviti v spletni učilnico za učitelje ali pa se prijavljajo z drugi gesli, čeprav jim damo v šoli jasna navodila in jim pokažemo, kako pridejo do spletne učilnice (prijaviti se je potrebno kot »gost«). Zaenkrat je komunikacija zgolj enosmerna. Če imajo učenci vprašanja, vprašajo učitelja osebno pri pouku ali dopolnilnem pouku in ne preko klepetalnic ali e-pošte.

6.6 Računalniška učilnica

Na matični šoli imamo dobro opremljeno računalniško učilnico z dovolj računalniki za celoten razred učencev. Na podružničnih šolah sta učilnici nekoliko manjši, z manjšim številom računalnikov, kar pomeni, da ne more vsak učenec delati za svojim računalnikom. Računalniško učilnico obiščemo v 6. in 9. razredu, ko pregledujemo rezultate nacionalnega preverjanja znanja ter v 8. razredu, ko v okviru aktiva učiteljev matematike učencem pripravimo tehniški dan z naslovom "Podatki". Učencem pokažemo delovanje osnovnih funkcij v programu Excel ter oblikovanje table in grafov, nato še zapisovanje obrazcev in formul v programu Word. Drugače kot v obliki tehniškega ali naravoslovnega dne je organizacija pouka v računalniški učilnici precej otežena (številni oddelki, urnik, prisotnost računalničarja), vendar pa tudi razpoložljivih dni dejavnosti ni ravno na pretek.

6.7 Mobilni telefoni, tablični računalniki

Pametni telefoni so postali zelo močno orodje, ki ga ima praktično vsak učenec predmetne stopnje. Na šolah jih ne uporabljamo zaradi različnih vzrokov, najpogosteje zato, ker so prepovedani s šolskimi pravili. Takole je med drugim zapisano v šolskih pravilih naše šole: »V času šolskih in obšolskih dejavnosti ter med odmori je uporaba mobilnih telefonov in drugih elektronskih naprav prepovedana, razen če je potrebna za zagotavljanje varnosti ali zdravja učenca. Učenci prinašajo elektronske naprave v šolo na lastno odgovornost. V nujnih primerih lahko učenci uporabijo telefon v pisarni svetovalne službe, pomočnikov ravnatelja ali v tajništvu šole, na podružničnih šolah pa v pisarni vodje šole ali v zbornici. Zvočno in slikovno snemanje in fotografiranje učencev in delavcev šole brez njihovega soglasja ni dovoljeno.« [10]

Uporaba pametnega telefona doma se ne razlikuje kaj dosti od uporabe računalnika ali tablice: predvsem za igranje igric, socialna omrežja in ogledovanje posnetkov. Resnici na ljubo so računalnike in televizorje v naših domovih v veliki meri zamenjali kar pametni telefoni. V šoli bi bili zelo uporabni npr. za reševanje kvizov. Tudi preverjanja znanja (formativno spremljanje) bi bilo zelo enostavno na način, da učencem na projektorju predvajamo naloge za preverjanje, ki jih rešujejo na list, vsako rešitev pa nato vpišejo v aplikacijo (kot npr. v tabelo na matematičnem tekmovanju Kenguru). Učitelj in učenci v trenutku dobijo povratno informacijo. Naj navedem še primer iz neke šole. Učenci so mobilne telefone uporabljali pri pouku, nato pa so se starši zaradi tega pritožili, češ da se učenci primerjajo med sabo, saj nimajo vsi učenci enako zmogljivih (beri: dragih) telefonov in zgodbe je bilo konec.

V šolskem letu 2019/2020 bomo preko razpisa SIO 2020 na šoli pridobili 20 tabličnih računalnikov, ki bodo namenjeni uporabi pri pouku v razredih. Eno izmed možnosti uporabe vidim v že zgoraj omenjenih »spletnih kvizih« za preverjanja znanja učencev.

7. SODELOVANJE S STARŠI

Kljub temu, da imajo starši zdaj možnost vpogleda v elektronsko redovalnico se zdi, da se zaradi tega obisk na govorilnih urah in roditeljskih sestankih ni zelo zmanjšal. Lopolis nam kot razrednikom omogoča tudi pošiljanje elektronskih sporočil staršem, kar uporabljamo po dogovoru na ravni šole predvsem za vabila na roditeljske sestanke ter morebitna obvestila, po dogovoru s starši pa tudi individualno (npr. sporočanje posebnosti o otroku). Težava, ki se tukaj pojavljajo so da učitelj vpiše graje ali pohvale, pa te razredniku so ali pa niso vidne. Težava je tudi pri beleženju domačih nalog, saj ni možno vnašati opomb, npr. da je učenec nalogo delno opravil, da ni znal, ipd., kar zna biti razredniku dobrodošla informacija pri razgovoru s starši. Tudi pri komunikaciji s starši velja načelo, da je elektronska pošta namenjena zgolj obveščanju staršev, za vse morebitne pogovore pa je še vedno na prvem mestu osebni stik ali vsaj telefonski razgovor, saj pri elektronski komunikaciji kaj hitro lahko pride do nesporazumov ali napačne interpretacije zapisanega.

8. ZAKLJUČEK

Kot že omenjeno, sem iz več virov ugotovila, da učitelji zelo malo uporabljamo IKT. Nad tem sem bila izjemno presenečena, saj sama zelo veliko raziskujem in iščem vire po spletu. Bodisi je to literatura s področja izobraževanja na splošno ali pa vsebine, ki jih uporabim pri poučevanju matematike. Učenci pogosto ne vidijo smisla v učenju večine matematičnih vsebin, zato menim, da jim je le-te potrebno osmisliti na njim razumljiv in privlačen način. Primer: pri obravnavi velikih števil v šestem razredu (števila, večja od milijona) so morali učenci za domačo nalogo poiskati, koliko denarja zaslužijo znani nogometaši in drugi slavni športniki,

glasbeniki ali igralci. Števila smo nato naslednjo uro zapisali v tabelo desetiških enot, jih prebrali, primerjali in uredili po velikosti. Učencem se je zdela ura zelo zabavna, novo znanje so pridobili na zabaven, »neboleč« način.
Zakaj majhna uporaba IKT pri učiteljih? Kar se tiče matematike, je težko najti gradivo, ki bi ti povsem ustrezalo, tako da je včasih hitreje, če ga pripravimo sami. Gradiva na spletu so zelo raznolika in razpršena. Samostojni delovni zvezki so v elektronski obliki večinoma dostopni le tistim šolam, kjer imajo učenci delovne zvezke tudi v fizični obliki. Ne smemo pa zanemariti tudi dejstva, da Slovenija še ni v celoti in enakomerno pokrita z dovolj zmogljivim internetnim omrežjem. Le nekaj kilometrov od največjih slovenskih mest se lahko že pojavijo težave. Učitelji pogosto na delovnem mestu nimamo primernih delovnih pogojev, (kabinet ali miren prostor, zadostno število računalnikov) zato veliko delamo doma. Praviloma z lastnimi računalniki, tiskalniki, pametnimi telefoni, kar se mi osebno zdi nesprejemljivo. Vzrok za majhno uporabo IKT bi lahko bil tudi v starostni strukturi učiteljev, saj se starejši praviloma vedno težje privadijo na novotarije (s statističnimi podatki ne razpolagam).
Številne priprave in učni listi na USB-ključkih, v oblakih, v elektronski pošti so postali zelo nepregledni. Rešitev trenutno vidim v programi One Note (o365) (glej npr. zbornik VIVID 2016, str. 52), kar nameravam preizkusiti v tem šolskem letu. One Note (o365) ali OneNote namreč omogoča integracijo vseh možnih virov v dokument in ravno to je tisto, kar potrebujem pri vsakdanjem delu. Lahko bi bil tudi rešitev težave glede sodelovanja znotraj aktiva učiteljev matematike, ki smo razpršeni po različnih šolah. Pozitivna stvar v zvezi z One Note je zagotovo ta, da imamo zdaj vsi zaposleni strokovni delavci kot tudi učenci dostop do programskih orodij o365, kar je osnova za nadgradnjo. Pri izvedbi preverjanj, formativnega spremljanja bi bila dobrodošla uporaba spletnih anket, npr. aplikacija Kahoot (glej npr. zbornik Vivid 2017, str. 8 in str. 166). Kahoot je brezplačna učna platforma, ki omogoča interaktivno učenje. Običajno se za igro uporabljate dve elektronski napravi, eno ima učenec, npr. telefon, tablica, računalnik, na kateri odgovarja na vprašanja preko mobilne aplikacije, druga naprava pa se prikazuje vsem udeležencem, npr. na projektorju, interaktivni tabli… Največkrat se uporablja kviz. Učitelj določi čas za odgovor na posamezna posamezna vprašanja od petih sekund do dveh minut. Sodelujoči išče pravilni odgovor med ponujenimi odgovori, med katerimi mora biti en pravilen. Vprašanja so lahko podprta s slikami, video posnetki. Aplikacija omogoča tudi sledenje osebnemu napredku v znanju vsakega od učenca. Učenci odgovarjajo na vprašanja z glasovanjem na osebnem mobilnem telefonu tablici ali računalniku.

Uporaba IKT pri pouku je v prihodnosti tako rekoč neobhodna. Nepredstavljivo je, da se 21. stoletju v slovenski osnovni šoli še najdejo učenci, ki tudi v 8. razredu ne znajo samostojno uporabljati računalnika za najosnovnejša opravila. Vse to v času, ko je človek v vesolje poslal humanoidnega robota. Morda smo tako starši kot učitelji zavedeni s tem, da otroci izjemno dobro obvladajo uporabo pametnih telefonov z namenom zabave, kar pa med drugim lahko vodi v odvisnost in druge bolezni ter motnje, ne pomeni pa nujno dodane vrednosti v smislu znanja in računalniške ali bolje rečeno IKT pismenosti. Če želimo preusmeriti uporabo IKT zgolj iz zabave na učenje, je najprej potrebno ustrezno ozavestiti, usposobiti in opremiti učitelje (programska in strojna oprema, izobraževanja, kakovostna, prosto dostopna in sistematično urejena e-gradiva). Predvsem države daljnega vzhoda izjemno veliko vlagajo v znanje in kaj lahko se zgodi, da z nadaljevanjem sedanje prakse kaj kmalu postanemo le še cenena delovna sila zanje.

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Pametni mobilni telefon kot pripomoček glasovalnega sistema Kliker

Smartphone as a technical accessory for a classroom response system Kliker

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POVZETEK
Napredek v tehnologiji se odraža v našem vsakdanjem življenju, njegov vpliv pa čutimo tudi v šolah. Na tem področju se pojavljajo novosti skoraj vsak dan. Ponujene so nam nove aplikacije oziroma programi, ki jih lahko uporabljamo. Prav vsi imamo izkušnje s pametnimi mobilnimi telefoni, mlajši pa so z njim še posebej vešči.
V prispevku predstavim pametne mobilne naprave, med drugimi tudi pametni mobilni telefon ter možnosti uporabe le-tega pri pouku. Uporaba pametnega mobilnega telefona ima kar nekaj prednosti, zavedati pa se moramo tudi slabosti.
Ob aktivnostih s pametnimi telefoni sem ugotovila, da so bili učenci pri delu motivirani in zainteresirani za delo. Sam pregled pravilno rešenih nalog je bil hitrejši, saj sem njihove odgovore dobila v dokaj kratkem času. Težave so se pokazale pri začetni uporabi programske opreme, ki pa so skozi uporabo izzvenele. Slabost uporabe, ki sem jo zaznala, pa je bil sam nadzor nad uporabo družbenih omrežji, saj so le-te kljub strogemu nadzoru učenci še vedno uporabljali.

Ključne besede
Pametna mobilna naprava, pametni mobilni telefon, spletna aplikacija Kliker

ABSTRACT
Technological advance is seen in our everyday life and its effect is also felt in school. Almost every day there are innovations in the area and users are offered new applications and programs. Everyone has experience in using a smartphone and the youth is especially skilled at it.
The article introduces smart mobile devices including a smartphone and suggests its usage in class.
Using a smartphone has many advantages but we have to be aware if its disadvantages as well. I have found out that the students were motivated and interested in work when they were using smartphones. Checking the tasks was faster because I got their results in quite a short time. In the beginning, there was difficulty in using software, but some practice solved it. Using smartphones had one disadvantage: controlling the usage of social media. Even with great control, the students still used it.

Keywords
Smart mobile device, smartphone, classroom response system Kliker

1. UVOD
Večina osnovnih šol učencem prepoveduje uporabo mobitelov, vendar je tu potrebno upoštevati čas in namen. Strinjam se, da so prepovedani za uporabo med odmori, saj bi jih učenci uporabljali zgolj za lastne potrebe (družbena omrežja, youtube …). Sama pa se pri pouku srečujem s situacijami, v katerih se mi zdi uporaba mobilnega telefona dobrodošla. Seveda pa je novost vedno potrebno umestiti v pouk premišljeno in ne prepogosto. Kljub prepovedi uporabe telefonov v šoli, smo na naši šoli oblikovali pravilnik, ki določa, da učenci lahko uporabljajo telefone kot učni pripomoček pri pouku [8].
V letošnjem šolskem letu sem se odločila, da telefone preizkusim s pomočjo spletne aplikacije Kliker, ki je prosto dostopna na spletni strani kliker.sio.si.

2. MOBILNO IZOBRAŽEVANJE IN Z NJIM POVEZANE NAPRAVE
Lovrenčič [10] mobilno izobraževanje definira kot vejo elektronskega izobraževanja, pri katerem interakcija poteka preko mobilnih naprav. Interakcija predstavlja komunikacijo med slušateljem in predavateljem.
Mobilno izobraževanje je neke vrste e-izobraževanje, pri katerem se uporabljajo mobilne naprave, ki so manjše in imajo omejene zmožnosti (omejen zaslon, velikost pomnilnika, hitrost procesorja, povezovanje s spletom …). Naprave uporabljamo predvsem za brezžično komunikacijo z drugimi uporabniki, za dostop do spleta in uporabo aplikacij. So majhne, lahke, priročne, enostavne za uporabo in delujejo na baterije. Med mobilne naprave uvrščamo prenosne računalnike, dlančnike, pametne telefone in običajne mobilne telefone.
Če gre pri običajnih mobilnih telefonih zgolj za prenos govora in teksta, se z razvojem novih elektronskih elementov, komponent in tehnologij komunikacija mobilnih naprav razširi še na druge načine komunikacij (slika, video …), vse to pa nam omogočajo tudi pametni mobilni telefoni [10].

2.1 Pametni mobilni telefon
Pametni telefon je mobilni telefon visokih zmogljivosti, ki ima za osnovo platformo mobilnega računalništva [10]. Sodobnejši pametni telefoni imajo možnost opravljanja nalog, za katere je bilo v preteklosti potrebno uporabljati posebne naprave [3]. Vgrajeno imajo večpredstavnostno tehnologijo (digitalna kamera, različni predvajalniki), omogočajo povezovanje prek IR, Bluetooth, WLAN, GPRS in UMTS ter orientacije po prostoru [3, 10]. V osnovnih nastavitvah imajo vgrajen WAP in spletni brskalnik, odjemalec elektronske pošte ter možnost nalaganja

lastnih programov, katerih ponudba pa je na trgu vedno večja. Mobilni telefon postaja čedalje bolj podoben pomanjšanemu prenosnemu računalniku in njegova osnovna funkcija (prenos govora) je zgolj ena izmed možnosti uporabe [10].

2.2 Uporaba telefona v šolah

Uporaba interaktivnih tabel, tabličnih računalnikov in računalnikov je v šolah že dobro preizkušena, medtem ko o uporabi pametnih telefonov še ni zaslediti veliko aktivnosti. V okviru projekta E-šolska torba je Zavod RS za šolstvo šolam nudil podporo in svetovanje pri uporabi različne IKT za poučevanje, kar dokazuje, da je stroka pozitivno naravnana k uporabi IKT-ja pri pouku. Učitelji so se odločali za različne možnosti, od uporabe e-vsebin do e-storitev v vzgojno-izobraževalnih ustanovah. Učitelji so po večini podajali pozitivna mnenja o uporabi IKT-naprav [1].

O uporabi mobilnih telefonov pri pouku še ni veliko zapisov. Trenutno prehaja do nasprotujočih se mnenj, ali v šolah dovoliti mobilne telefone. Glavni razlogi, da starši in učitelji zavračajo uporabo le-teh pri pouku so: zloraba zasebnosti, motenje pouka, nelegalen prenos podatkov, sporne vsebine … Učitelj samo uporabo med poukom težko nadzoruje, zato je mobilnike najlažje prepovedati. Včasih pa ravno prepovedano predstavlja največjo željo po uporabi [6]. Koložvari vidi rešitev v ustrezni vzgoji in izobraževanju za uporabo sodobnih mobilnih naprav z dodajanjem ustreznih izobraževalnih vsebin, ki so za učence zanimive. Na koncu pa dodaja: »Da bi mobilni telefon lahko uporabljali tudi pri pouku, je potreben proces, ki mladega najprej vzgaja za vrednote in nato tehnično izobražuje.« [6] . Mlade je potrebno naučiti, da na rabo mobilnih telefonov gledajo kritično, saj jim predstavlja predmet, s katerim ohranjajo stike s svetom ter izražajo svoje vrednote in položaj v družbi. Pomembno je, da odrasli izobrazimo mlade tudi z manj prijetnimi vidiki uporabe mobilnih telefonov, npr. kako se izogniti prevaram in virusom, ter se z njimi pogovorimo tudi o medvrstniškem in internetnem nasilju ter odvisnosti od komunikacij in iger. Pri sami uporabi pa moramo paziti tudi na socialno diskriminacijo [4].

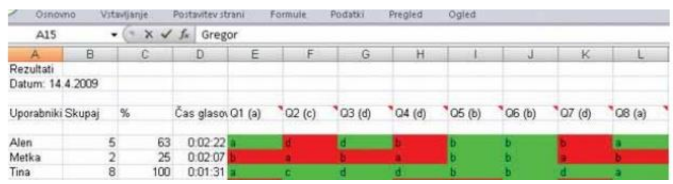
Pametni telefoni imajo več funkcij, ki jih lahko uporabimo pri pouku. Spodaj bom naštela nekaj najbolj uporabnih.

- Iskanje in ogledovanje spletnih virov je ena izmed funkcij, ki je v splošnem zelo v uporabi. V šoli nam lahko služi za: iskanje podatkov o obravnavani učni vsebini, preverjanje informacij, iskanje odgovorov na postavljena vprašanja, ponavljanje obravnavane učne vsebine, dostop do e-učilnice, obravnava vprašanja avtorskih pravic, presoja verodostojnosti različnih virov.
- Fotografiranje in izdelavo avdio- ter videoposnetkov prav tako lahko uporabimo v šoli, in sicer za: snemanje poskusov, fotografiranje na naravoslovnem dnevu, pogovor in razvijanje kritičnega razmišljanja ob slikah, obravnavo vprašanja zasebnosti, snemanje govornega nastopa, izdelavo in poslušanje podcastov, pregledovanje fotografij in videoposnetkov.
- Qr koda je dvodimenzionalna črtna koda v obliki kvadratka. Črtno kodo generiramo s pomočjo ustrezne aplikacije, ob tem pa ji določimo tudi vsebino. Črtno kodo lahko prilepimo na učni list, s čimer učencem ponudimo rešitev naloge ali dodatne vsebine. Na plakatih imamo dodatne povezave na različne vsebine (video, spletne strani …).
- V programskih skladiščih je na voljo več tisoč programov, ki se dnevno obnavljajo in dopolnjujejo. Ti programi so predmetno usmerjeni in pomagajo pri izvedbi pouka. Tukaj je uporaba neomejena, saj nam ti programi pomagajo pri risanju grafov, učenju pisanja, ponujajo interaktivne zemljevide ... [4].

Sama sem pri pouku uporabila pametne mobilne telefone za uporabo spletne aplikacije Kliker [11]. Alternativa tej uporabi bi bila uporaba glasovalne naprave. V nadaljevanju predstavim uporabo glasovalne naprave in spletne aplikacije Kliker [11], kje so prednosti in kje slabosti in kako smo izpeljali uporabo v razredu.

3. GLASOVALNE NAPRAVE

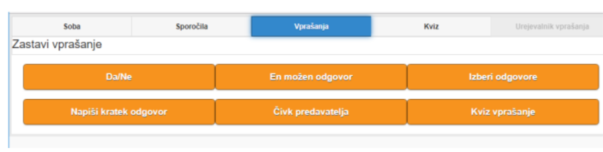
Glasovalne naprave omogočajo nove učne procese pri preverjanju in ocenjevanju znanja, lahko pa jih uporabimo tudi v motivacijske namene pri pogovoru, diskusijah ter pri obravnavi nove učne snovi [2]. S pomočjo glasovalnih naprav lahko na začetku ure preverimo predznanje učencev, na koncu pa njihov napredek (Slika 1) [5]. Vprašanja lahko pripravimo vnaprej ali pa v danem trenutku oblikujemo vprašanja in odgovore [2]. Učenčeva aktivnost je omejena na izbiro pravilne rešitve iz nabora ponujenih odgovorov [7, 9]. Prednost pa je, da sproti pokažejo učenčeva močna in šibka področja [9]. Glasovalne naprave pa mora šola sama kupiti, kar lahko predstavlja velik strošek.



Slika 1. Rezultati glasovanja [13]

4. SPLETNA APLIKACIJA KLIKER

Kliker (Slika 2) je spletna aplikacija, ki sodi med glasovalne sisteme. Predavatelj slušateljem postavlja vprašanja ter spremlja njihove odgovore. Udeleženci pa lahko tudi sami postavljajo vprašanja ali pripombe. Predavatelj ima na voljo več zavihkov (Soba, Sporočila, Vprašanja, Kviz, Urejevalnik vprašanja).



Slika 2. Aplikacija Kliker ter primer zavihka Vprašanja [11]

Predavatelj najprej odpre (virtualno) sobo, preko katere komunicira z udeleženci. Vsak zavihek ima svojo funkcijo:

- Sporočila: lahko sprejema njihova sporočila.
- Vprašanja: izbira med vprašanji, ki si jih sproti izmišljuje. Na voljo imamo možnosti: da / ne / ne vem; en možen odgovor; izberi odgovore; napiši kratek odgovor; čvik predavatelja.
- Kviz: prikazuje seznam vnaprej pripravljenih vprašanj.
- Urejevalnik, kjer pripravimo vprašanja za kviz. Aplikacija ima možnost, da Kviz izvozimo v datoteko na lokalnem računalniku in kasneje spet uvozimo.

Predavatelj se odloči, kateri način dela bo izbral ter sproži glasovanje. Ob poteku glasovanja predavatelj lahko spremlja, koliko slušateljev je že podalo odgovore, oziroma ga po določenem času ustavi. Po zaključku glasovanja v zavihku Vprašanja se nam prikažejo rezultati, ki jih lahko na koncu seje shranimo in obdelamo. Pri uporabi kviza pa nam aplikacija po izvedbi izdela seznam trenutnih udeležencev, urejen glede na njihove točke, dosežene s pravilnimi odgovori v kvizu (Slika 3).

Mesto	Udeleženec	Točke
1.	Janez	27
2.	Veselko	24
3.	Metka	23
4.	Mateja	21
5.	Tone	20
6.	Manca	15

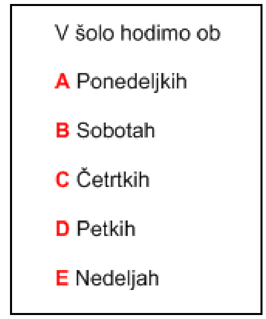
Slika 3. Rezultati kviza [11]

Glede na to, da v šoli nimamo nakupljenih glasovalnih naprav, sem v tem šolskem letu dodobra spoznala aplikacijo Kliker, ki smo jo poskusno uporabili pri pouku matematike z učenci 8. razreda. Aplikacijo smo uporabili pri preverjanju znanja ob koncu obravnavane snovi, čeprav sem kasneje videla, da bi jo lahko uporabili tudi pri preverjanju začetnega znanja.

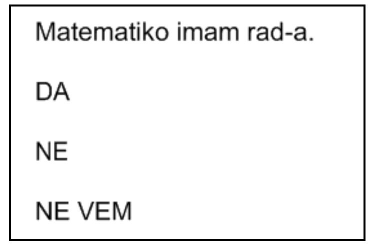
5. PRIMER UPORABE PRI POUKU

Učenci so vedoželjni in pripravljeni na uvajanje novosti pri pouku. Ko smo se v začetku leta pogovarjali, da bi pri pouku poizkusno uvedli uporabo mobilnih telefonov, so bili navdušeni. Dogovorili smo se tudi, da če je kdo brez mobilnega telefona oziroma ga mu starši ne dovolijo prinašati v šolo, uporablja šolski prenosni računalnik ali tablico. Mobilne telefone smo uporabljali pri preverjanju znanja. Uporabila sem ga pri štirih različnih sklopih: Kvadriranje in korenjenje, Računanje z racionalnimi števili, Količine in Pitagorov izrek.
Pred samo uporabo smo se dogovorili o pravilih uporabe. Ker so na šoli med odmori mobilni telefoni prepovedani, je bil dogovor, da ga v učilnico prinesejo izklopljenega v šolski torbi. Nekaj učencev je bilo brez telefona, zato sem jim priskrbela šolske prenosne računalnike.
Učencem sem na začetku predstavila spletno aplikacijo Kliker. Prijavili smo se v našo skupno sobo, ob prijavi so si določili vzdevke. Za začetek sem pripravila vprašanja, pri katerih so spoznali različne tipe nalog. Najprej so odgovarjali na vprašanje, kjer je bila možnost enega odgovora (Slika 4), nato izberi odgovore (Slika 5) in možnost odgovora da / ne / ne vem (Slika 6) ter napiši kratek odgovor (Slika 7).

Slika 4. Možnost enega odgovora



Slika 5. Izberi odgovore



Slika 6. Možnost odgovora da / ne / ne vem

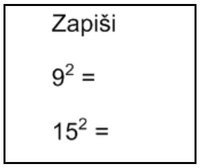
Slika 7. Kratek odgovor

Kako uporabljamo aplikacijo, smo se seznanjali pri vsaki učni uri, kadar so učenci uporabljali mobilne telefone. Ob primerih so učenci spoznali osnove delovanja ter pridobili izkušnjo, kaj se jim prikaže na zaslonu ob posameznem tipu nalog. Pomembno je tudi, da učenec zna zaključiti glasovanje, saj je le-to samodejno zgolj pri nalogah, kjer je možen samo en odgovor oziroma, ko odgovarjajo da / ne / ne vem. V ostalih dveh primerih mora odgovor poslati z dodatnim klikom na zaslon.
Po vsakem odgovoru smo pogledali, kako so odgovarjali in analizirali dobljene rezultate (Slika 8).

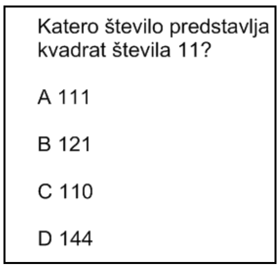
Slika 8. Prikaz odgovorov [11]

Po spoznavanju z osnovami delovanja spletne aplikacije smo z učenci prešli na preverjanje učne snovi. V nadaljevanju bom navedla nekaj primerov pri vsaki obravnavani učni snovi.

Korenjenje in kvadriranje
Naloge za hiter pregled poznavanja korenov in kvadratov števil. Imeli smo dva tipa nalog. Ali so učenci sami zapisovali kvadrate in korene števil (Slika 9) ali pa so izbirali med ponujenimi odgovori (Slika 10).



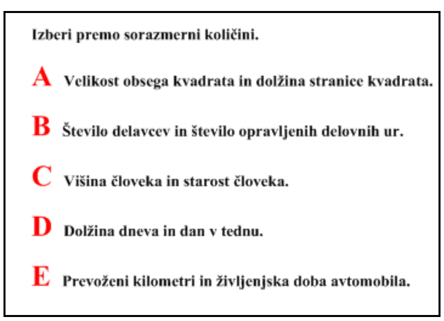
Slika 9. Zapiši kvadrat števila



Slika 10. Izberi kvadrat števila 11

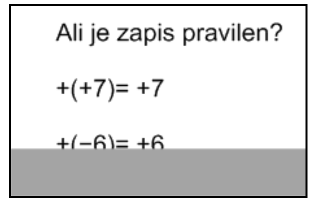
Strinjam se, da bi lahko to isto preverili tudi ustno ali pisno. Vendar pri ustnih odgovorih lahko vprašamo samo enega učenca, pri pisnem preverjanju pa nato potrebujemo čas, da pregledamo pravilnost rešenih nalog in povratna informacija sledi kasneje (naslednjo šolsko uro).

Količine
Pri tem sklopu smo preverili poznavanje koordinatnega sistema in poznavanje premo ter obratno sorazmernih količin, kjer sem uporabila tip naloge, ki ponuja več možnih odgovorov (Slika 11).



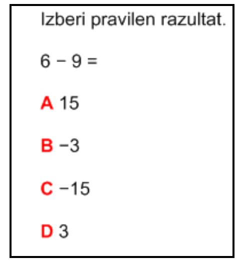
Slika 11. Primer premo sorazmernih količin [12]

Računanje z racionalnimi števili
Zelo pomemben del snovi v osmem razredu je zame poglavje Računanje z racionalnimi števili, saj učenci to znanje potem neprestano potrebujejo v nadaljnjem izobraževanju, tako v osnovni kot v srednji šoli. Sama dam temu poglavju velik pomen in prav nenehno sprotno preverjanje, ali učenci dano snov razumejo, je tu nujno potrebno.
To snov smo preverjali večkrat in imeli tudi največji nabor nalog. Na elektronski tabli sem imela pripravljene primere. Učenci so reševali primer za primerom, vseskozi pa smo preverjali njihove odgovore in pregledovali statistiko odgovorov. Najprej smo preverili znanje iz določanja predznakov (Slika 12).

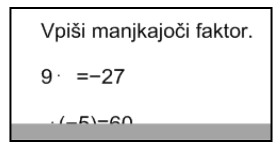


Slika 12. Izbira pravilnega zapisa

Sledili so primeri, kjer so učenci izbrali pravilen rezultat (Slika 13) ali pa vpisovali pravilne rezultate (Slika 14).



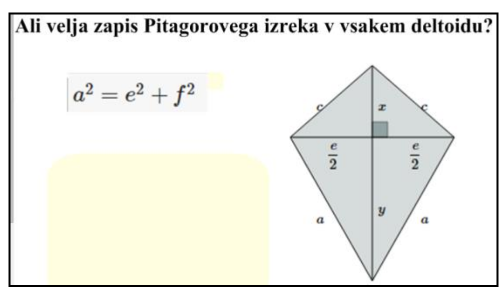
Slika 13. Izbira pravilnega rezultata



Slika 14. Vpiši manjkajoči factor

Na tabli smo imeli več primerov tako tipov nalog, kjer učenci izbirajo pravilen odgovor, kot tudi nalog z vstavljanjem manjkajočih členov oziroma pravilnega rezultata.

Pitagorov izrek
Za zadnjo obravnavano učno snov sem si izbrala še Pitagorov izrek. Učenci so bili aktivni v različnih situacijah. Iz zapisa Pitagorovega izreka so morali razbrati hipotenuzo, določiti velikost dolžine stranice, ugotoviti pravilne zapise Pitagorovega izreka v različnih likih (Slika 15).



Slika 15. Pitagorov izrek [12]

Pri uporabi aplikacije Kliker smo se srečevali s prednostmi in slabostmi. Prav zagotovo je bila ena izmed prednosti dostopnost do programske opreme, saj so skoraj vsi učenci imeli svoje pametne mobilne telefone in sem sama priskrbela le nekaj prenosnih tabličnih računalnikov. Kadar sem v razredu delala s pomočjo tabličnih računalnikov, smo morali delati v parih, saj kljub temu da so jih učenci prinesli od doma, nismo imeli dovolj opreme. Za prednost lahko štejem tudi odzivnost in hitro povratno informacijo. Ko sem učencem postavila vprašanje in odprla glasovanje, sem v minuti dobila njihove odgovore, brez izgube časa, da se sprehodim po razredu in vsakemu posebej preverjam rezultate. Učenci so bili motivirani za delo in bolj aktivni kot v običajnih urah. V nobenem primeru nismo telefonov uporabljali celo šolsko uro, ampak zgolj v začetni fazi.

Kot slabost lahko omenim, da je pri takem načinu dela, kot sem ga izbrala, nekoliko težja analiza dosežkov po učencih. Lahko bi si po poteku seje shranila njihove dosežke in jih analizirala, vendar se mi je zdel to dolgotrajen postopek. Izbrala bi lahko še drugo možnost, in sicer, da bi uporabila Kviz, kjer bi dobila natančno statistiko učenčevih pravilnih odgovorov. Še ena slabost, ki smo jo opazili, je bila, da so učenci imeli nekaj sistemskih težav pri samem vstopu v sobo oziroma so morali vmes sejo zaključiti ter se ponovno prijaviti. Vendar je bilo to v manjšem merilu in jih ni zmotilo pri delu. Mogoče so imeli nekoliko več težav v prvi uri, nato pa so se skozi dolgotrajnejšo uporabo težave zmanjšale, saj so že sami vedeli, kaj je potrebno narediti. Težak pa se mi je zdel tudi sam nadzor nad delom učencev, saj so kljub prepovedi uporabljali še druge družabne aplikacije.

6. ZAKLJUČEK

Menim, da se uporabi mobilnih telefonov pri pouku ne bomo mogli izogniti v celoti. Učenci so željni novih idej in načinov uporabe. Ob uporabi so bolj motivirani za delo in podajajo pozitivne povratne informacije. Kot sem že omenila, bo uporabo potrebno vpeljati premišljeno. Kot slabost sem omenila nadzor nad učenci, saj so, kot so mi kasneje pripovedovali, vseeno uporabljali telefon tudi za dostop do družabnih omrežij, kljub temu da smo strogo postavili pravila. Se je pa skozi sam proces uporabe nedovoljena uporaba zmanjševala. Kot navaja Koložvari [6], učenci morajo pridobiti izkušnje in sodelovati v samem procesu vzgoje uporabe tehnologije. Glede na dosedanje izkušnje, ki so štele v prid uporabi, se bom tega sama v prihodnosti še lotila tudi z drugimi možnimi načini uporabe (iskanje informacij, risanje grafov …).

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[12] https://eucbeniki.sio.si/

[13] http://www.dlib.si/stream/URN:NBN:SI:DOC-OEQ4819F/aa5d7ecc-f7ff-4f4a-961a-8c1cbd0406d5/PDF

Uporaba didaktičnih programov pri poučevanju ulomkov

Using didactic programs at teaching fractions

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POVZETEK

Učenci se z deli celote pri pouku prvič srečajo v 2. razredu, svoje znanje pa nadgrajujejo vse do 7. razreda. V prispevku predstavim različne vidike vpeljave ulomkov ter najpogostejše težave, s katerimi se učenci srečujejo pri pouku. Kot učiteljica matematike na predmetni stopnji dajem velik pomen poučevanju ulomkov v 6. razredu, kjer učenci spoznajo različne zapise ulomkov in predstavo na številski premici, v 7. razredu pa ulomke nadgradijo še z vsemi računskimi operacijami. Menim, da je potrebno dele celote poučevati s pomočjo konkretnih modelov ali diagramov in ne zgolj na simbolni ravni z učenjem pravil na pamet. Znanje, pridobljeno na tak način, je trajnejše in kakovostnejše.

V nadaljevanju prikažem didaktične programe za poučevanje ulomkov in dejavnosti, ki jih lahko izvajamo pri pouku in s katerimi učencem osmislimo dele celote do te mere, da pravil za računanje z ulomki ne morejo »pomešati«, saj jim njihova predstava delov celote tega ne dovoli.

Ključne besede

Ulomki, vizualizacija ulomkov, računanje z ulomki

ABSTRACT

Students first learn about parts of a whole in the second grade and they add up to their knowledge until the seventh grade. This article shows different views of how to introduce fractions and the most common problems the students have in class. As a lower secondary education teacher of Mathematics, I emphasize the meaning of teaching fractions in the sixth grade where the students learn about different types of fractions and their representation on a number line. The fractions are upgraded in the seventh grade with all mathematical operations. I believe that parts of a whole must be taught with the help of concrete models or diagrams and not only on a symbolic level with learning rules by heart. Knowledge that is gained this way is more durable and quality.

In the continuation, I show programs and lesson activities to give meaning to parts of a whole to a level where students cannot mistake the fractions rules because the picture of parts of a whole itself does not allow them to.

Keywords

Fractions, visualization of fractions, computing with fractions

1. UVOD

Z raziskavo, ki smo jo predstavili v prispevku leta 2017 [5], smo ugotovili, da uporaba interaktivne table pozitivno vpliva tako na znanje učencev kot tudi na njihovo motivacijo. V prispevku smo predstavili rezultate raziskave o vplivu učnih stilov pri uporabi interaktivne table pri obravnavi ulomkov v 7. razredu in le bežno omenili dejavnosti, ki jih lahko pripravimo pri pouku. Za načrtovanje učnih ur je pomembno, da učitelj pozna tematiko, težave, ki lahko nastopijo ob obravnavi, in čim bolj pester izbor dejavnosti, ki jih lahko uporabi pri pouku, kar pa bom predstavila v nadaljevanju.

Pri pouku matematike se učenci s pojmom ulomki srečujejo od 2. do 7. razreda. Pri poučevanju si učitelji pomagajo s konkretnimi materiali in modeli, od teh pa prehajajo na diagrame in na koncu na simbolni zapis. Payne [6] meni, da je učenje ulomkov sestavljeno iz petih komponent, ki jih mora učenec znati med seboj prepleteno povezovati. Te komponente so:

- konkretni materiali (delitev pice, čokolade, piškotov …), s katerimi si pridobi praktične izkušnje;
- uvajanje matematičnega jezika, kjer gre za povezavo med deli celote konkretnih modelov in matematično poimenovanje (polovica, tretjina, četrtina …);
- konkretni modeli, kjer realne premete zamenjamo s konkretnimi modeli (kartoni, razdeljeni na enake dele; geoplošča …);
- diagrami, s katerimi učenci usvojijo risanje in branje le-teh, za kar v začetku potrebujejo veliko pomoči. Pri spoznavanju diagramov je tako nujno potrebno povezovanje s konkretnimi materiali;
- simboli, ki je zadnja komponenta uvajanja delov celote in jo vpeljemo, ko so vse ostale komponente že zelo dobro osvojene. Deli celote se z zapisom s simbolom preimenujejo v ulomek.

2. RAZLIČNI VIDIKI VPELJAVE ULOMKOV

Ulomki so v uporabi več kot 3500 let. Poznali so jih že Babilonci, kasneje pa so se resneje z njimi začeli ukvarjati Egipčani. Njihovi zapiski so se ohranili na Rhindovem ali Ahmesovem papirusu iz leta 1650 pr. n. št. [1]. Ulomke lahko definiramo na različne načine, pri vpeljavi moramo biti pozorni predvsem na predznanje in starost otrok.

<u>Ulomek kot del ali več enakih delov celote</u>

Vpeljava ulomkov je lahko izvedena na konkretni grafični in geometrijski predstavi otipljivih predmetov, kot so npr. čokolada, torta, vrvice, kvadrati, krogi, kocke … Predmet delimo na več enakih delov, nato pa sledi samo poimenovanje s polovico celote, tretjino celote, četrtino celote … ter nato še njihov simbolni zapis 1/2, 1/3, 1/4 … 1/b [7].

Ulomke si lahko predstavljamo tudi kot strukturni delež celote, na primer 2/3 ljudi nosi očala. Učitelj skupaj z učenci razmišlja, kaj to pomeni v smislu »dva od treh ljudi, ki nosijo očala« [3].

Ulomek na številski premici

Ulomke lahko ponazorimo tudi s slikami točk na številski premici. Predstavitev na številski premici ima določene prednosti pred modeli, saj jo je lažje razdeliti na enake dele. Razdalja od 0 do 1 nam predstavlja enoto, ki jo razdelimo na ustrezno število enakih delov ter na njej prikažemo dani ulomek [9].

Ulomek kot količnik naravnih števil

Vsak ulomek lahko predstavimo kot količnik dveh naravnih števil. Pri tem nam ulomkova črta pomeni znak za operacijo deljenja [7]. Učenci morajo razumeti, da je ulomek posledica deljenja zgornje števke s spodnjo, da torej zapis a/b pomeni
a : b [3].

Ulomek kot razmerje

Razmerje imenujemo vsak količnik dveh količin ali števil. Pri razmerju gre za nakazano deljenje in ga zapišemo a : b ali a/b. Ko nakazano deljenje v razmerju izračunamo, dobimo količnik ali koeficient razmerja (k = a/b). Z razmerjem računamo tako kot z ulomkom [8].

3. ULOMKI IN UČNI NAČRT

V Učnem načrtu [10] so ulomki razporejeni v temo aritmetika in algebra in nadalje v sklop racionalna števila. V učnem načrtu se od 2. do 7. razreda, ko učenci obravnavajo dele celot, učni cilji vseskozi prepletajo in dopolnjujejo.
V prvem triletju ulomke spoznavajo na konkretnih modelih in slikah. Zapisovati začnejo tudi enostavne ulomke 1/3, 1/4 …
V 4. in 5. razredu na modelih predstavljajo tudi dele celote 3/4, 2/5 in znajo izračunati del celote 1/4 od 20 ter kasneje vrednost več delov celote, npr. 3/4 od 20. Določiti pa znajo tudi celoto, če imajo podan en del.
V 6. razredu učenci pri obravnavi delov celote uporabljajo izraze ulomek, števec, imenovalec, ulomkova črta, ulomke upodobijo na številski premici in usvojijo pojem desetiškega ulomka, ki ga kasneje uporabljajo za zapis decimalnega števila.
V 7. razredu učenci ulomke še krajšajo, razširjajo, poiščejo skupni imenovalec dveh ali več ulomkov, nadaljujejo zaporedje z ulomki, ulomke primerjajo med seboj in s številom 1 ter ulomke, večje od ena, zapišejo kot celi del in ulomek, manjši od ena, ter obratno. V drugem sklopu 7. razreda učenci osvojijo še vse računske operacije z ulomki.
V 7. razredu se v sistemu formalnega izobraževanja obravnava ulomkov zaključi. V višjih razredih in v srednji šoli se učenci z ulomki še vedno srečujejo, s predpostavko, da zakonitosti računanja že poznajo. Zato menim, da sta dobro razumevanje in predstavljanje ulomkov, ki ga jim podamo učitelji do 7. razreda, še bolj pomembna.

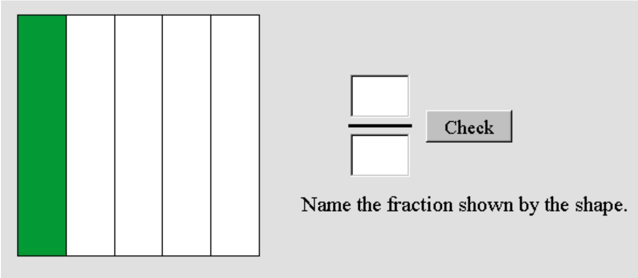
4. TEŽAVE PRI USVAJANJU ULOMKOV

Raziskava, ki so jo izvedle V. Manfreda Kolar, A. Janežič, T. Hodnik Čadež [2], je pokazala presenetljivo slabe rezultate. V raziskavi so sodelovali učenci osmega razreda osnovne šole, študentje tretjega letnika razrednega pouka in študentje četrtega letnika matematike na Pedagoški fakulteti v Ljubljani.

V raziskavi so ugotovile, da kar 59 % učencev 8. razreda, 58 % študentov razrednega pouka in 42 % študentov matematike ne zna primerjati dveh ulomkov z različnima imenovalcema. Izkazalo se je, da učenci in študentje znajo primerjati ulomke, če gre za problem iz vsakodnevnega življenja, takoj ko pa naloga podaja ulomka z različnima imenovalcema, pa nastopijo težave. Avtorice menijo, da moramo iskati razloge za slabše rezultate v tem, kako poučujemo dele celote in ulomke že od začetka uvajanja v osnovnih šolah. Navajajo, da v začetku prevladujejo naloge, ki zahtevajo, da učenci prepoznajo, ali je celota razdeljena na enake dela oziroma da sami razdelijo lik na enake dele. V 6. razredu pa so v zelo kratkem času soočeni z različnimi pomeni ulomkov (spoznajo pojem ulomkova črta, števec, imenovalec; decimalna števila; desetiški ulomek). Od učencev pričakujemo, da imajo ustrezno znanje o ulomkih in da zlahka pretvarjajo različne vidike in zapise ulomkov. Premalo pa imajo časa za raziskovanje in zavedanja pomena različnih zapisov ulomkov.
Na samo razumevanje in delo z ulomki pa vplivajo tudi drugi faktorji, ki jih bom predstavila v nadaljevanju.
Poznavanje in obvladanje računskih operacij je predpogoj za učenje ulomkov oziroma delov celote, saj se vse aktivnosti, povezane s to učno snovjo, izvajajo na osnovi osnovnih računskih operacij. Na primer že sama delitev celote na enake dele zahteva znanje deljenja, pri krajšanju in razširjanju pa tudi množenja. Zato lahko predpostavimo, da bodo učenci, ki imajo težave pri osnovnih računskih operacijah in poštevanki, imeli težave tudi kasneje pri usvajanju ulomkov [4].
K zmanjšanju težav pri poučevanju delov celote in kasneje ulomkov prav gotovo pripomore tudi izbira pravilne strategije učenja. Schmnike [4] navaja, da težave lahko odpravimo tako, da pri poučevanju upoštevamo postopnost usvajanja znanja od konkretnega k abstraktnemu, z izbiro aktivnega pouka ter organizacijo pouka, ki omogoča razumevanje vsem in s tem dvig motivacije in razvoja pozitivnega odnosa do samega predmeta.

5. DIDAKTIČNI ROGRAMI

Poučujem matematiko na predmetni stopnji, kar pomeni, da učence ulomke učim v 6. in 7. razredu. Zavedam se težav, s katerimi se srečujejo učenci pri spoznavanju delov celote, zato poskušam stvari čim bolj konkretizirati in osmisliti. Pri tem si pomagam s konkretnimi modeli in kasneje z diagrami.
V nadaljevanju prispevka bi rada predstavila spletne aplikacije, ki jih uporabljam pri pouku v povezavi z elektronsko tablo, in aplikacije, ki jih lahko uporabljajo doma za samostojno delo oziroma jih uporabljamo pri delu v računalniški učilnici.
Najprej bi predstavila aplikacije, ki jih učenci koristijo med poukom s pomočjo interaktivne table. Aktivnosti izvajamo predvsem frontalno.
Preverimo lahko razumevanje ulomkov, saj nam aplikacija ponudi v kratkem času veliko primerov. Učenec mora ob danem prikazu (Slika 1) zapisati ustrezen del celote. Pri tem lahko učitelj ugotovi, ali učenec razume pravilni zapis, katero število predstavlja celoto (imenovalec) in katero del označene celote (števec).

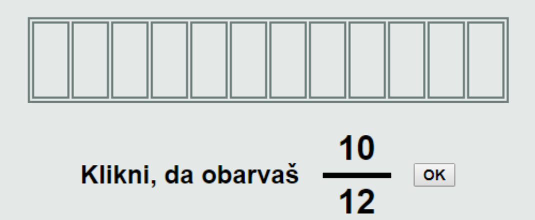


Slika 1. Kolikšen del celote je označen?
Vir:
http://nlvm.usu.edu/en/nav/frames_asid_104_g_1_t_1.html

Da naloge niso enolične in vedno predstavljene z enakimi prikazi, se lahko poslužujemo še nalog z naslednjih spletnih strani, ki enako preverjajo znanje učencev.

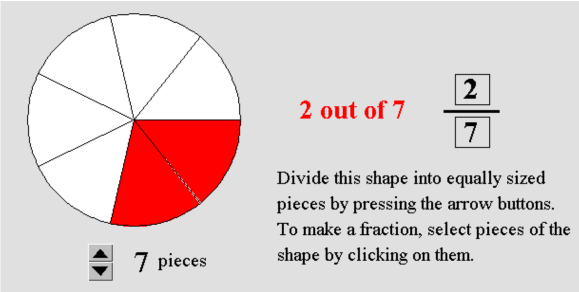
- https://www.visualfractions.com/IdentifyLines/
- https://www.thatquiz.org/sl-6/?-j3-lc-p2kc0
- https://www.mathplayground.com/index_fractions.html

Imamo pa tudi aplikacijo, ki od učencev zahteva, da obarvajo ustrezen del celote (Slika 2).



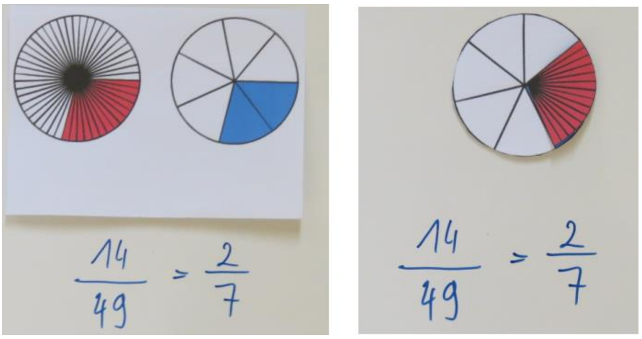
Slika 2. Pobarvaj ustrezen del celote
Vir: https://www.thatquiz.org/sl-6/?-j4-lc-p2kc0

Zanimiva je tudi aplikacija, ki omogoča, da sami barvamo dele celote, ob tem pa se izpisuje obarvani del celote. Sami si tudi izberemo na koliko delov bo celota razdeljena. V primerjavi s prostoročnim risanjem se pri uporabi aplikacije izognemo nepravični delitvi, saj sami like težko razdelimo na povsem enake dele (Slika 3). Pomembno pa je, da učence učimo pravilne terminologije in predstav. Saj če mi narišemo skico »na približno«, bo tudi njemu slika, ki nima pravične delitve, predstavljala pravilno rešitev.



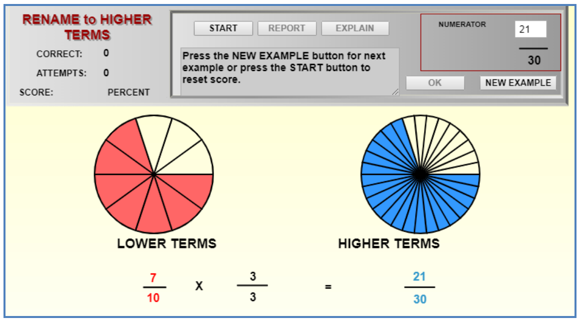
Slika 3. Delitev na enake dele
Vir:
http://nlvm.usu.edu/en/nav/frames_asid_102_g_1_t_1.html

Aplikacije nam omogočajo prikaz z diagrami. Pri pouku v 7. razredu sem uporabila tako modele kot kasneje tudi diagrame. Pri primerjanju ulomkov ter krajšanju in razširjanju le-teh smo uporabljali modele (Slika 4). Papirnate modele smo lahko razstrigli, prekrivali in preko njih ugotavljali zakonitosti, ki veljajo pri enakosti ulomkov.



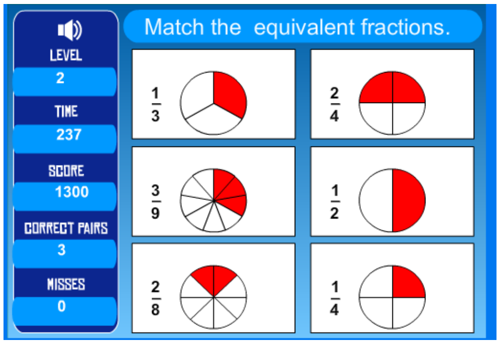
Slika 4. Modeli ulomkov
Vir: http://pefprints.pef.uni-lj.si/3528/

S pomočjo aplikacije pa učenci vizualno spoznajo, kaj dejansko pomeni, da ulomek razširimo (Slika 5) oziroma krajšamo.



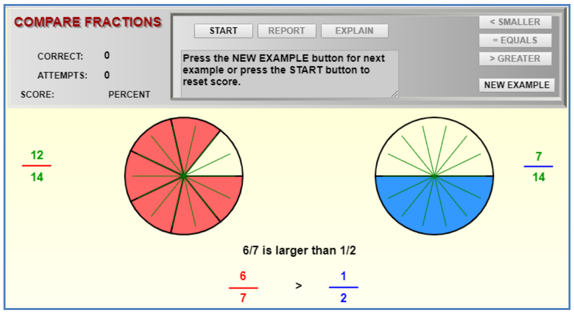
Slika 5. Razširjanje ulomkov
Vir: https://www.visualfractions.com

Na spletu imamo na voljo kar nekaj didaktičnih iger, ki omogočajo razširjanje in krajšanje ulomkov s pomočjo prikazanih diagramov. Večkrat kot učenec vidi povezavo diagrama in ulomka, lažje mu bo v nadaljevanju pri dodajanju novih spoznanj. Didaktična igra (Slika 6) pri učencu vzpodbudi povezavo, da enak pobarvan del celote lahko predstavlja različne ulomke.



Slika 6. Poveži pare
Vir: http://www.sheppardsoftware.com/
mathgames/fractions/memory_equivalent1.htm

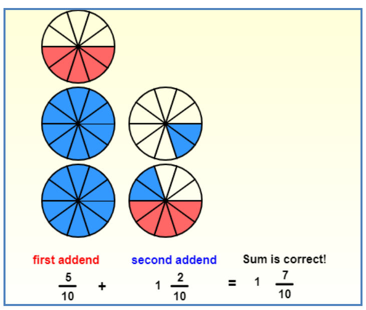
Pri poučevanju sem opazila, da če imajo učenci predstave med zapisi ulomkov in prikazanim delom celote dobro razvite, si pri primerjavi ulomkov ne pomagajo več s samim razširjanjem na skupni imenovalec, ampak le-to zelo uspešno rešujejo zgolj z razmislekom. Še vedno pa jim predstavim tudi, kaj dejansko pomeni primerjanje ulomkov s pomočjo diagramov (Slika 7). Včasih je ulomek, pa čeprav ima tako števec kot tudi imenovalec večji od drugega ulomka, manjši (npr. 4/5 in 7/9).



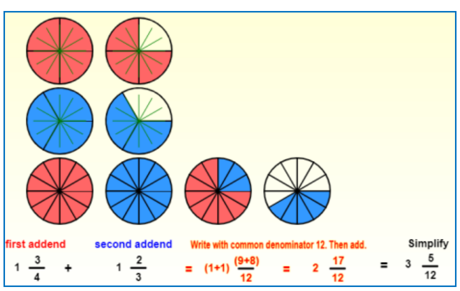
Slika 7. Primerjaje ulomkov
Vir: https://www.visualfractions.com

Že prej sem omenila, da se po spoznavanju ulomkov v 7. razredu učna snov nadaljuje z računskimi operacijami. Če imajo učenci do te faze osmišljen del celote, je računanje z ulomki dokaj nezahtevna snov.

Učencem predstavimo, da lahko seštevamo ulomke z enakimi imenovalci (Slika 8) in vse skupaj tudi grafično podkrepimo. Če učenec ob dejavnosti razume postopek reševanja, potem ve, da mora ulomka z različnima imenovalcema (Slika 9) najprej razširiti na skupni imenovalec.

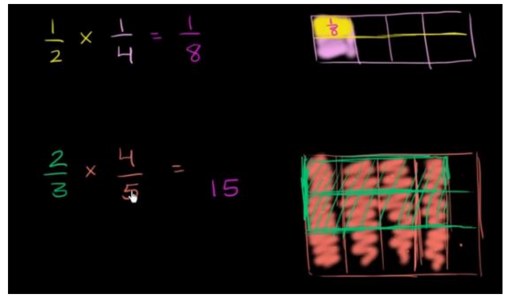


Slika 8. Seštevanje ulomkov z enakimi imenovalci
Vir: https://www.visualfractions.com



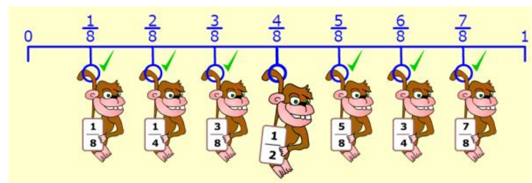
Slika 9. Seštevanje ulomkov z različnimi imenovalci
Vir: https://www.visualfractions.com

Enako si lahko predstavljamo tudi množenje in deljenje (Slika 10).

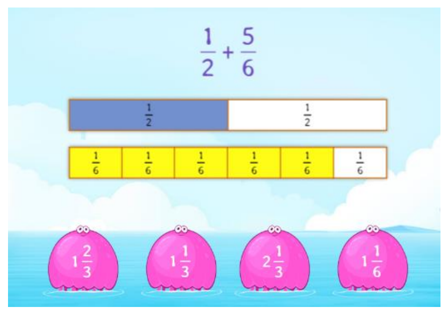


Slika 10. Množenje ulomka z ulomkom
Vir: https://www.khanacademy.org/math/arithmetic/fraction-arithmetic

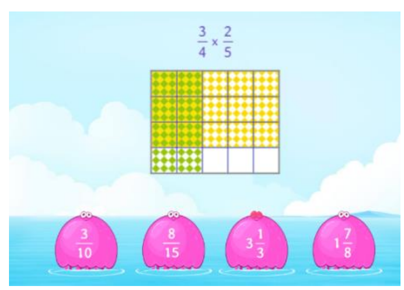
Za kasnejše samostojno delo obstaja kar nekaj spletnih strani, na katerih učenci lahko dobijo vaje za samostojno delo doma ali pa jih peljemo v računalniško učilnico.
Spodaj naštevam le nekaj izmed njih (Slika 11, 12, 13).



Slika 11. Razvrsti ulomke
Vir: http://www.fractionmonkeys.co.uk/activity/



Slika 12. Seštevanje ulomkov
Vir: https://www.splashmath.com/fraction-games



Slika 13. Množenje ulomka z ulomkom
Vir: https://www.splashmath.com/fraction-games

6. ZAKLJUČEK

Ulomki predstavljajo dele celote. Učenci se jih učijo od drugega razreda dalje, še prej pa jih slišijo tudi v pogovornem jeziku (npr. polovica čokolade). Za samo poznavanje ulomkov je pomembno, da se jih učimo sistematično in predvsem postopoma. Bistvo je, da učenci niso takoj deležni samo diagramov, ampak da se najprej srečajo s konkretnim materialom in konkretnimi modeli. Tudi še v

6. in 7. razredu učenci lažje razumejo pravila dela z ulomki, če jim le-te vizualno prikazujemo. Sama vseskozi v obeh razredih in včasih tudi še kasneje, če vidim, da je potrebno, uporabim spletne aplikacije, ki mi omogočajo prikaz ulomkov. Redno pa jih tudi popeljem v računalniško učilnico, kjer v lastnem tempu rešujejo naloge, predvsem pa si primere vizualizirajo.

Po obravnavani snovi smo z učenci pokomentirali pravila, mnogi izmed njih se med reševanjem spomnijo na slike, ki smo si jih ogledovali med poukom. Le redko se tako spomnijo samo pravila.

Glede na to, da smo letos kot učni pripomoček v 8. razredu poizkusili uporabiti pametne mobilne telefone, bi bili prav gotovo tudi pri obravnavi ulomkov lahko koristen pripomoček. Vse te aplikacije so dosegljive preko spleta, so brezplačne, primeri so slikovni. Ob tem pa se izognemo nepotrebnemu tiskanju primerov na učne liste.

Namen mojega prispevka je predvsem spodbuditi učitelje, da pri pouku uporabljajo vizualizacijo ulomkov tudi že v nižjih razredih in se ne zadovoljijo z učenjem pravil na pamet.

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Razvoj e-izobraževanja v Sloveniji

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POVZETEK

E-izobraževanje je v Sloveniji v zadnjih nekaj letih močno preoblikovalo način oz. pristop k poučevanju otrok v šoli. V tem članku smo na kratko povzeli razvoj e-izobraževanja in IKT tehnologije v svetu ter Sloveniji, predstavili značilnosti e-izobraževanja, njegove pozitivne in negativne lastnosti, kakšni so pogoji za uvajanje tovrstnega načina izobraževanja in kakšna je ponudba v Sloveniji. Predstavili smo tudi oblike e-izobraževanja in predebatirali njihovo uporabno vrednost. Razširjenost uporabe v Sloveniji smo na koncu tudi primerjali z Evropo ter predvideli v katero smer se razvoj e-izobraževanja v Sloveniji pomika.

Ključne besede

E-izobraževanje, IKT, razvoj, oblike

ABSTRACT

E-education in Slovenia, has lately drastically changed the way we teach children in schools. In this article we shortly summarize development of e-education and IKT tehnology in the world and in Slovenia. We present characteristics of e-education, his positive and negative traits, conditions for inducting this kind of education and present u what offers for e-education we have in Slovenia. We also present different forms of e-education and discuss their value. At the end we compare the usage of e-education in Slovenia with the usage in Europe and explain in whitch direction e-educatin is headed in the future.

Keywords

E-education, IKT, development, forms

1. UVOD

Razvoj informacijske tehnologije odpira nove priložnosti tudi za učenje. Izobraževanje z obiskovanjem izobraževalne organizacije, učenjem v učni skupini ob navzočnosti učiteljev je bilo nekdaj edina možnost, danes pa je le ena od mnogih. Sodobna tehnologija namreč omogoča številne nove možnosti, med njimi tudi e-izobraževanje: zanj je značilno, da se lahko posameznik uči ob računalniku. Ta mu omogoča dostop do virtualnih učilnic, kjer dobi učno podporo učiteljev in mentorjev, dostopa do različnih učnih virov, preverja svoje znanje, se srečuje z učnimi kolegi ter skupaj z njimi proučuje učno gradivo [1].

E-izobraževanje izhaja iz izobraževanja na daljavo, ki ima danes več sopomenk: študij na daljavo, učenje na daljavo, daljinsko izobraževanje, e-učenje, e-izobraževanje (distance learning, distance education, e-learning, e-education), pri nas pa se je najbolj uveljavil izraz e-izobraževanje. E-izobraževanje temelji na uporabi IKT kot tehnologiji pri podajanju vsebine. Izobraževalni proces je torej podprt z IKT oziroma internetom, ki omogoča drugačno, bolj fleksibilno in predvsem interaktivno zasnovo učnih gradiv ter odpira nove možnosti za komunikacijo med skupinami udeležencev in mentorjem [8]. Velja za obliko izobraževanja, ki je zaradi njene odprtosti še posebej primerna za odrasle, saj je programe e-izobraževanja mogoče učinkovito prilagajati izobraževalnim potrebam odraslih.

Povpraševanju po različnih izobraževalnih programih skušajo s svojo ponudbo slediti različne institucije, ki razvijajo nove oblike izobraževanja podprte z internetom. E-izobraževanje ponujajo tako univerze kot komercialni ponudniki, le to pa je vezano tako na pridobivanje formalne, kot tudi neformalne izobrazbe.

2. 1.ZGODOVINA E-IZOBRAŽEVANJA

2.1 Razvoj informacijsko komunikacijske tehnologije

Informacijsko komunikacijska tehnologija (v nadaljevanju IKT) je bistveni element sodobnih izobraževalnih sistemov in procesov. Obstaja več opredelitev, kaj pomeni pojem IKT, na splošno pa je IKT pojem, ki pokriva tako informacijske tehnologije (računalniško, strojno in programsko opremo), kot telekomunikacijsko opremo/opremljenost in storitve [6]. Skratka gre za skupek strojne (računalniki, monitorji, tiskalniki, vsa ostala oprema, ki jo lahko vklopimo v računalnik in se uporablja pri delu z njim) programske in telekomunikacijske opreme (omogoča medsebojno povezovanje računalnikov).

Informacijsko-komunikacijsko tehnologijo je delovna skupina OECD opredelila že leta 1998 na podlagi naslednjih načel [11]:

-Proizvodi predelovalnih dejavnosti morajo biti namenjeni funkciji obdelave in posredovanja podatkov, s prenosom in prikazom.

-Morajo uporabljati elektronsko obdelavo za odkrivanje, merjenje in snemanje fizičnih pojavov ali za nadzor fizičnih procesov.

-Proizvodi storitvenih dejavnosti morajo biti namenjeni omogočanju obdelave in posredovana podatkov po elektronski pošti.

Da bi razumeli e-izobraževanje je potrebno poznati zgodovino informacijske tehnologije in sistemov, ki se deli na štiri obdobja. Predmehansko obdobje, med leti 3000 pred našim štetjem in 1450 našega štetja, ko so se ljudje začeli sporazumevati, razvijati papir in numerični sistem. Mehansko obdobje, ki se je razvijalo med leti 1450 in 1840. Zanj so značilni razvoj tiska, prvi primeri analognih programov in na koncu obdobja tudi iznajdba binarne logike. Novo mehansko obdobje, med leti 1840 in 1940, v katerem pride do razvoja telekomunikacijske tehnologije (iznajdba telefona in radia). In zadnja elektronsko obdobje, v katerem se od leta 1940 do danes razvijajo računalniki [12].

2.2 Razvoj računalnikov

V petdesetih letih prejšnjega stoletja se o osebnih računalnikih še ni govorilo. Revolucijo v IKT pa je povzročil pojav interneta, ki se je začel uporabljati v potrebe obrambe pod okriljem Agencije ameriškega obrambnega ministrstva za napredne raziskovalne projekte DARPA in Nase. Prva povezava je bila vzpostavljena leta 1969 med štirimi računalniki. [12].

Prva medcelinska povezava je začela obstajati leta 1973 z Londonsko univerzo, med leti 1970 in 1980 pa so bile povezane že vse glavne univerze v ZDA. To omrežje se je sprva imenovalo arpanet, leta 1974 pa ga je zamenjal izraz internet.

Uporabnost interneta za izobraževanje so najprej uvedli v podjetjih in organizacijah, kjer so se ukvarjali s študijem na daljavo, saj jim je internet omogočal rešitev interakcije ob prostorski ločenosti učitelja in učenca. Na eksperimentalni ravni pa so internet prvič začeli uporabljati na New Jersey Institute of Technology, kjer so pouk v razredu dopolnjevali z on-line razpravami med učiteljem in študenti. Vse do 90. let prejšnjega stoletja so v izobraževanju poznali le diskusijske forume in e-pošto, saj je bil internet tehnološko premalo zmogljiv za pošiljanje večjih datotek. Potem pa je sledil pravi razmah interneta z razvojem svetovnega spleta in še posebej orodja HTML (Hyper Text Markup Language), ki je pomenil veliko prelomnico pri uporabi IKT v izobraževanju [3].

Internet nudi bistveno boljše izobraževalne možnosti in omogoča dejansko fizično ločenost med učečim in mentorjem, kar odpravlja potrebo posameznika po potovanju v kraj, kjer se izobraževalni program izvaja. Tudi pri nas je internet ključno prispeval k razmahu izobraževanja na daljavo, saj je postalo bolj opaženo in uporabljeno šele, ko je temeljilo na uporabi interneta in ga že lahko imenujemo e-izobraževanje [8].

2.3 Študij na daljavo kot predhodnik e-izobraževanja

E-izobraževanje razvojno izhaja iz študija na daljavo, zato je potrebno povedati nekaj o razvoju le tega.

Izraz študij na daljavo (v nekaterih virih zasledimo tudi izobraževanje ali učenje na daljavo) označuje izobraževanje, ki poteka preko medija, npr. po pošti (tiskana gradiva), preko radia (avdiokasete, avdio zgoščenke) ali televizije (videokasete, video zgoščenke), časopisov, interneta in kjer je neposreden stik med udeležencem in učiteljem redek ali ga celo ni [12]. Udeleženci se torej učijo sami, srečanja v skupini pa so zelo redka, namenjena predvsem socializaciji, ohranjanju stikov, organizirana pa so lahko tudi iz didaktičnih razlogov [3].

Načeloma naj bi se študij na daljavo začel razvijati z razvojem radia in televizije v 20. stoletju, vendar njegovi začetki segajo v 19. stoletje. Razlog zanj je bil predvsem večja dostopnost do izobraževanja geografsko oddaljenim, zaposlenim in invalidom. Kot začetnika študija na daljavo velja Issac Pitman, ki je leta 1840 organiziral dopisni tečaj iz stenografije v Združenih državah Amerike, takoj za tem pa so se začele razvijati prve dopisne šole v ZDA, Veliki Britaniji in na Švedskem.

V tem času se je uporabljalo predvsem tiskano gradivo in pisna komunikacija, kar je bilo za tedanje čase zelo priročno, predvsem za odročnejše kraje, kjer ni bilo možnega dnevnega neposrednega stika med učiteljem in učencem. V začetku 20. stoletja, pride do razvoja radia, kasneje - po drugi svetovni vojni, pa tudi do razvoja televizije [4]. Izobraževanje na daljavo, kot ga poznamo danes se je torej razvilo iz dopisnega izobraževanja, ki je bila včasih edina oblika izobraževanja na daljavo.

Široka uporabnost internetnih tehnologij je torej povzročila širjenje IKT v izobraževalni sektor. Organizacijam za študij na daljavo so pri opremljanju z IKT kmalu sledile tudi tradicionalne izobraževalne ustanove. Z uporabo IKT v izobraževanju se je vse bolj pogosto začel uporabljati izraz e-izobraževanje, s tem pa so nastajale tudi razne opredelitve tega pojma [3].

3. E-IZOBRAŽEVANJE

Na prve opredelitve e-izobraževanja naletimo leta 2001. Takrat je izšlo delo Marca Rosenberga E-learning Strategies for Delivering Knowledge in the Digital Age, ki ga lahko označimo kot prvo celostno študijo o e-izobraževanju. V tem delu Rosenberg opredeljuje e-izobraževanje kot uporabo spletnih tehnologij v različnih rešitvah za povečanje znanja ali izboljšanje izobraževalnih aktivnosti.

Allison Rosett pa je opredelila e-izobraževanje bolj ohlapno in sicer kot usposabljanje, katerega bistvena značilnost je uporaba spleta in za to uporabila izraz »on-line« izobraževanje oziroma učenje [3]. Po definiciji American Society for Training and Development je sam pojem e-izobraževanje pogosto opredeljen na široko, in sicer kot izobraževanje, pri katerem se uporablja IKT (e-izobraževanje v širšem pomenu). Nanaša se na spletno učilnico, virtualno učilnico ali digitalno sodelovanje. Prav tako lahko gre za podajanje vsebin preko interneta, zvočnih in video posnetkov, izobraževalnih oddaj, interaktivno televizijo, zgoščenke in podobno [4]. Drugi vidik razumevanja e-izobraževanja pa je ožji in izhaja iz funkcionalnosti IKT v izobraževanju. E-izobraževanje obravnava kot smotrno uporabo potencialov IKT oziroma interneta v izobraževanju, usmerjeno k spreminjanju izobraževalne paradigme ter k inoviranju pedagoških pristopov in modelov, kar vodi k večji kakovosti in učinkovitosti izobraževanja. Tako opredeljeno e-izobraževanje imenujemo **celostno e-izobraževanje**. Celostno e-izobraževanje ohranja ključno prvino študija na daljavo, to je prostorsko neodvisno izpeljevanje učnega procesa, nadgrajeno z oblikami tehnološko podprte komunikacije [3].

Glede na stopnjo vključenosti IKT v izobraževanje pa poleg celostnega e-izobraževanja razlikujemo še **tehnološko podprto izobraževanje in kombinirano izobraževanje.** E-izobraževanje je t.i. delno tehnološko podprto izobraževanje zato, ker takšni programi segajo od najpreprostejše uporabe IKT (npr. objava različnih podatkov), pa vse do bolj kompleksnih in zahtevnih oblik uporabe, kot so na primer večji projekti preko spleta. Na takšno pojmovanje pa največkrat naletimo predvsem v tradicionalnem izobraževanju [3]. Glavna razlika med celostnim e-izobraževanjem in delno tehnološko podprtim izobraževanjem je v tem, da pri celostnem e-izobraževanju ne gre le za delno tehnološko podporo, temveč je celostno integrirana v vse prvine izobraževalnega procesa [12].

Pri kombiniranem izobraževanju pa gre za kombinacijo klasičnega izobraževanja z izobraževanjem na spletu. Bistveno za kombinirano izobraževanje je, da dele učenega programa učenci opravijo klasično, druge pa na spletu. S spletom si lahko pomagajo pri učenju, izdelavi seminarskih in projektnih nalog, itd. Gre za uveljavljeno učno obliko, ki prevladuje v šolah in tudi v naprednejših okoljih [9].

3.1 Značilnosti e-izobraževanja

Pri e-izobraževanju so učne vsebine udeležencem dostopne posredno, s pomočjo učnih pripomočkov. Računalniki oziroma splet nam omogoča uporabo najrazličnejših multimedijskih oziroma interaktivnih učnih vsebin, to so npr. html strani, avdio in video posnetki, animacije, simulacije, slike, itd. Za razliko od ostalih načinov izobraževanja na daljavo, je danes stik med učečim in učiteljem poleg posrednega (e-pošta) lahko tudi neposreden, saj računalniška tehnologija omogoča že avdio oziroma video klice, oziroma njun stik lahko poteka preko klepetalnic [5].

E-izobraževanje je povezovalne narave, to pa omogoča takojšnje ažuriranje, shranjevanje, iskanje, distribucijo ali souporabo napotkov ali informacij. Končnemu uporabniku je preneseno po računalniku z uporabo standardnih internetnih tehnologij. E-izobraževanje se osredotoča na najširše razumevanje učenja, t.j. na učne pristope, ki presegajo tradicionalne izobraževalne paradigme.

3.2 Prednosti in slabosti e-izobraževanja

Prednosti

E-izobraževanje ima v izobraževanju veliko pozitivnih lastnosti. Bregar idr. [4]govorijo o prednostih z vidika udeleženca izobraževanja ter prednostih z vidika izobraževanja.

Prednosti z vidika udeleženca so naslednje:

-Večja prožnost v času, kraju, tempu in vsebini izobraževanju.
-Večja interaktivnost in hitrejši dostop do različnih virov
-Večje možnosti prilagajanja učnih pristopov posameznikovim potrebam
-Transparentnost pogojev izobraževanja
-Razvoj novega znanja in kompetenc

Prednosti z vidika izobraževalne organizacije pa so:

-Zmanjševanje stroškov
-Možnost storitev, ki so bolj kakovostne
-Preglednost in dokumentiranost izvedbe programov in konsistentnost izvedbe
-Možnost večje objektivizacije ocenjevanja
-Dostop do kakovostnih virov
-Inovacija pedagoškega procesa in vpeljevanje sodobnih pedagoških modelov
-Boljše možnosti trženja izobraževalnih programov
-Cenejša organizacija in izpeljava izobraževanja

Potenciali, ki se pojavljajo v e-izobraževanju, predvsem v izobraževanju odraslih so: fleksibilnost, interaktivnost, hitrejši dostop do virov, prilagajanje vsebin, itd. [7].

Slabosti

Uvajanje in uporaba e-izobraževanja postaja zaradi svojih prednosti čedalje bolj pogosto, vendar pa ne moremo trditi, da bi lahko e-izobraževanje v celoti nadomestilo klasično izobraževanje in ga tako izrinilo iz predavalnic. Tega ne moremo trditi predvsem zaradi nekaterih negativnih lastnosti e-izobraževanja, kot so na primer neustreznost nekaterih vsebin za podajanje v e-obliki, težavnost uvedbe e-izobraževanja v visokošolske institucije, omejene tehnološke zmožnosti posameznika, potreba po veliki stopnji motiviranosti učečih, potreba po fizičnem kontaktu med študenti, skupnemu študijskem delu, medsebojni pomoči in podobno [8]. Problem lahko predstavlja tudi omrežni dostop, zmogljivost računalnika ter slabša kvaliteta monitorjev, ki vplivajo na oči. Tudi mentorji morajo obvladati uporabo informacijsko komunikacijske tehnologije. Veliko časa mu vzamejo priprave in prenos učnega gradiva na splet, predvsem pa mora obvladovati delovanje portala, kar pa prav tako predstavlja nekaterim mentorjem problem [10].

Slabosti e-izobraževanja se kažejo tudi na strani institucije, ki izobraževanje izvaja. Velik problem so predstavljajo začetni stroški za analizo, izračun sredstev in načrt uresničitve. Prav tako pa je problem neustrezna izbira in akreditacija programov [4]. Na drugi strani pa hitri razvoj e-izobraževanja kaže na čedalje bolj pomembno vlogo e-izobraževanja v obstoječih izobraževalnih programih .

E-izobraževanje se od tradicionalnega najbolj razlikuje po tem, da je udeleženec le redko ali celo nikoli v neposrednem stiku z učiteljem in se uči sam. Učenec ni več potrebno biti prisoten v učilnici ob točno določenem času. Prav tako je tudi potek komunikacije drugačen kot pri tradicionalnem izobraževanju, saj se izvaja preko različnih medijev.

4. POGOJI ZA UVAJANJE E-IZOBRAŽEVANJA

Uvajanje e-izobraževanja na večjih izobraževalnih institucijah ni lahka naloga. Zahteva širok in interdisciplinaren pristop do organizacije, uvajanja, načrtovanja, infrastrukture, administracije, evalvacije, kakovosti in ekonomike izobraževalnih procesov. Alternative uvajanju e-izobraževanja praktično ni, saj globalni trg znanja ustvarja tekmovalno okolje, kjer bodo tisti, ki bodo izkoristili sodobne IKT, imeli prednost pred drugimi [8]. Torej temeljni pogoj za vpeljevanje e-izobraževanja je v prvi vrsti primerna tehnološka infrastruktura s programsko opremo. Razpoložljivost IKT je v Sloveniji zelo dobra, vendar imajo nekatere skupine prebivalstva še vedno problem z dostopnostjo. Še vedno je četrtina gospodinjstev brez osnovne IKT opreme. Problem v razširjenosti IKT pa se kaže tudi z vidika starosti in izobrazbe [3].Velik pogoj za uvajanje e-izobraževanja je prav tako digitalna zmožnost. Ta se danes ne omejuje le na sposobnost uporabe računalniške tipkovnice in pošiljanja elektronskega sporočila, ampak so potrebne digitalne veščine.

To so operativne veščine, ki so potrebne za tehnično funkcioniranje IKT, informacijske veščine za iskanje, vrednotenje in obdelavo informacij ter strateške veščine, ki se kažejo v sposobnosti posameznika, da poišče, analizira in uporabi informacije iz različnih virov kot strateško orodje za izboljšanje lastnega položaja v družbi [6].

Digitalna zmožnost se pri večini uporabnikov v Sloveniji omejuje na raven operativnih veščin in ne dosega niti informacijskih, niti strateških veščin. Prav zato bi bilo potrebno vključiti usposabljanje za obvladovanje digitalne zmožnosti v učne programe rednega izobraževanj na vseh stopnjah in zagotoviti ustrezna usposabljanja za odrasle, ki se vključujejo v programe e-izobraževanja [3].

Za uspešno uvajanje e-izobraževanja je potrebna tudi dobra usposobljenost učitelja, saj je vedno bolj moderator in usmerjevalec pri samostojnem pridobivanju znanja učečega. Učitelj mora znati prilagoditi učne cilje, vsebino programa, učno metodologijo in metode preverjanja znanja. Strategija uvajanja programov e-izobraževanja pa mora upoštevati tudi finančne, kadrovske, organizacijske ter pedagoško-didaktične vidike e-izobraževanja. E-izobraževanje je usmerjeno v povečanje gospodarske rasti, konkurenčnost slovenske družbe in kakovost življenja vsakega državljana Republike Slovenije. Visok pomen e-izobraževanju za uresničevanje strateških ciljev Slovenije zahteva usmerjanje in spodbujanje razvoja e-izobraževanja na najvišji ravni državne oblasti [13].

Vlada Republike Slovenije je leta 2007 sprejela strategijo razvoja informacijske družbe-si 2010. Namen strategije je opredeliti nacionalni okvir spodbujanja razvoja informacijske družbe v Sloveniji ter tako postaviti krovne usmeritve razvoja, ki upoštevajo tehnološki, družbeni in pravno-formalni okvir. Dokument sledi pobudi Evropske unije i2010 – Evropska informacijska družba 2010, kar kaže na jasno povezanost med evropskimi in nacionalnimi prednostnimi nalogami [13].

5. PONUDBA E-IZOBRAŽEVANJA IN RAZVOJ V SLOVENIJI

E-izobraževanje je bilo v Sloveniji v začetku devetdesetih let še razmeroma nepoznano, v zadnjih letih pa se pospešeno uvaja v izobraževalni sistem in sicer kot dopolnitev klasičnemu oziroma tradicionalnemu študiju, kot samostojni študijski programi ter kot posebna izobraževanja za določene ciljne skupine.

V e-izobraževanju so prevladujoča ciljna skupina odrasli udeleženci. V tem primeru je potrebno upoštevati kako se odrasli učijo, kaj potrebujejo in kakšne potrebe imajo. Treba je upoštevati tudi, da se odrasli razlikujejo tudi po tem ali se radi učijo s pomočjo računalnika in koliko so usposobljeni za delo z njim. Pri tem ne gre le za osnovna računalniška znanja, temveč za delo v določenem učnem okolju in za delo s tehnologijami spleta 2.0 [4].

Sredi devetdesetih let je začela delovati Nacionalna projektna enota (NCP) za študij na daljavo na Ekonomski fakulteti v Ljubljani, ki je poskušala v Sloveniji zagotavljati ustrezne razmere na državni ravni za razvijanje e-izobraževanja kot sodobne in učinkovite oblike izobraževanja. Z namenom doseganja večje prilagodljivosti in dostopnosti e-izobraževanja, kakovostnejšega razvoja in izvajanja študijskih programov je poskušala povezati različne akterje pri e-izobraževanju. Enota še danes deluje kot center znanja in informacij [2]. Sočasno in pozneje so potekali tudi drugi projekti in v Sloveniji je tako zaslediti vedno več različnih ponudnikov e-izobraževanja tako za formalne, kot tudi neformalne izobraževalne programe.

Nosilci teh programov so fakultete, nekateri zasebni in javni zavodi (Andragoški center Republike Slovenije, Zavod Republike Slovenije za šolstvo, Center za poklicno izobraževanje RS, Inštitut Jožef Stefan, Zavod MIRK, Zavod Radiotelevizija Slovenije, Doba,…), nekatera podjetja (Netis, Inter-es, IECom, Agora, Komunike,..) ter nekatere regionalne razvojne agencije (RA Sora, RRA severne Primorske, RA Sinergija, RCR Zagorje) [8].

Požar [8] omenja nekaj enot, ki ponujajo storitve izobraževanja na daljavo in sicer so to naslednje enote:

CDED - center za razvoj študija pri Univerzi v Mariboru nudi svetovalne in tehnične storitve s področja odprtega učenja in študija na daljavo vsem pedagoškim delavcem Univerze, po dogovoru pa tudi drugim izobraževalnim ustanovam. Njegova naloga je zagotavljati strokovnost študijskega procesa na daljavo in transformacije učnega gradiva ter skrbeti za kvalitetne tehnične storitve pri izvajanju tovrstnih študijskih programov.

Center za daljinsko izobraževanje na Fakulteti za elektrotehniko razvija lastne aplikacije. V sodelovanju s podjetjem Iskratel je bil v okviru centra razvit integrirani sistem za izobraževanje na daljavo, ki se uporablja v različnih ustanovah in podjetjih (Telekom Slovenije, osnovne šole). **MIRK** (mladi in računalniška kreativnost) - Zavod za projektno in raziskovalno delo na internetu in **Zavod za odprto družbo** sta v sodelovanju z Ministrstvom za šolstvo in šport in Zavodom RS za šolstvo v okviru programa Računalniško opismenjevanje v zadnjih nekaj letih izvajala pilotni projekt učenja na daljavo za osnovnošolce in sicer na osnovi uporabe sodobnih IKT.

DOBA - Visoka poslovna šola Maribor je samostojen visokošolski zavod, ki izvaja kvaliteten, praktično usmerjen visokošolski strokovni študijski program Poslovni asistent na prvi stopnji, ki je prvi akreditiran visokošolski študijski program v severovzhodni Sloveniji na področju poslovnih in upravnih ved, usklajen z Bolonjsko deklaracijo.

V Sloveniji je tudi nekaj organizacij, ki se ukvarjajo s spodbujanjem, promocijo in ponudbo programov e-izobraževanja. Ena takšnih organizacij je Javna agencija za podjetništvo in tuje investicije (JAPTI), ki v sodelovanju z Laboratorijem za telekomunikacije pri Fakulteti za elektrotehniko (LTFE) nudi podporo razvijalcem programov e-izobraževanj. JAPTI zagotavlja tudi usposabljanja za razvijalce, tutorje oziroma mentorje. JAPTI in njihovi partnerji so razvili tudi referenčne centre za e-poslovanje, ti pa so prav tako izdelali nekaj programov e-izobraževanja, ki se v največji meri nanašajo na podjetništvo in vsebine, povezane s podjetništvom [8]. V Sloveniji so do danes e-izobraževanje v različnih oblikah uvedle Filozofska Fakulteta, Fakulteta za elektrotehniko, Fakulteta za računalništvo in informatiko, Ekonomska fakulteta, Fakulteta za matematiko in fiziko Univerze v Ljubljani, Fakulteta za organizacijske vede, Fakulteta elektrotehniko, računalništvo in informatiko, Pedagoška fakulteta in Fakulteta za strojništvo Univerze v Mariboru, Fakulteta za management Univerze na Primorskem ter

Fakulteta za logistiko Celje-Krško (uporablja portal za e-izobraževanje Univerze v Mariboru).

Na Andragoškem centru Slovenije prav tako ponujajo veliko programov e-izobraževanja. V okviru svoje izobraževalne dejavnosti pa ponuja tudi vrsto programov s področja andragoškega usposabljanja. Zanimiv je program Uporaba IKT za strokovne delavce v središčih za samostojno učenje. Ostali programi, ki jih ponujajo so še:

-Motivacija odraslih za učenje in izobraževanje,
-Vodenje in usmerjanje odraslih k učenju,
-Izobraževalne značilnosti odraslih,
-Spletni program o e-izobraževanju,
-Uvodni seminar o postavitvi in vodenju središča za samostojno učenje,
-Svetovanje in mentorstvo pri organiziranem samostojnem učenju,
-Usposabljanje e-mentorjev,
-Temeljni program usposabljanja vodij in mentorjev študijskih krožkov [1].

5.1 Struktura ponudbe e-izobraževanja v Sloveniji

Slovenija je na področju e-izobraževanja v zadnjih letih dosegla precejšen napredek pri ponudbi e-izobraževanja. Najbolj viden napredek je na področju storitev, ki ponujajo pridobitev formalne izobrazbe (Tabela 1). Eden izmed pomembnejših vzrokov za to je, da dejstvo, da se formalno v večji meri izobražujejo mlajši odrasli, ki so bolj dovzetni za sodobno informacijsko in komunikacijsko tehnologijo.

Vedno več je ponudnikov e-tečajev in mentorstva (12), ter ponudnikov najrazličnejših izobraževalnih vsebin (10). Razmerje med posameznimi skupinami je prikazano v Tabeli 1 iz katere je razvidno, da v slovenskem prostoru prevladujejo ponudniki e-tečajev in mentorstva, sledijo ponudniki izobraževalnih vsebin, ponudniki e-tečajev in na koncu ponudniki za pridobitev formalne izobrazbe ter ponudniki najema sistema za upravljanje e-izobraževanja [2].

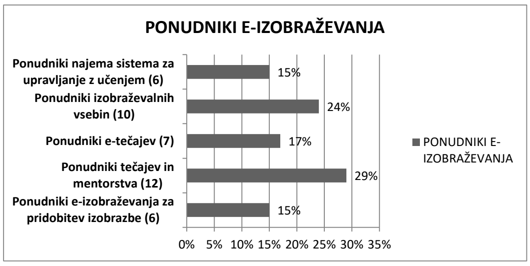

Tabela 1: Struktura ponudbe e-izobraževanja v Sloveniji [2]

Med ponudniki neformalnih oblik izobraževanja pa zasledimo oblike e-izobraževanja, kot so tečaji tujih jezikov, tečaji računalništva, e-izobraževanje za podjetja in ustanove, telekomunikacije, itd.

5.2 Oblike e-izobraževanja v Sloveniji

-Baze znanja. So najbolj osnovna oblika elektronskega učenja. Sem štejemo tudi spletne iskalnike, saj lahko na podlagi ključnih besed pridemo do vsebine.
-Podpora preko spleta. Je oblika e-izobraževanja, ki deluje podobno kot baza znanja. Sem spadajo pogovorne sobe, forumi, oglasne deske, e-pošta, pomoč v živo preko neposrednih sporočil.
-Asinhrono učenje. Uporabniku omogoča prilagojeno časovno uporabo učnega gradiva. Skupnega sodelovanja učencev ni, izobraževalni proces pa se izvaja predvsem z branjem ali s predvajanjem video ali avdio posnetkov.
Zaradi omejene interakcije je pri asinhronem učenju pomembno, da mentor spremlja napredek uporabnika pri učenju. Tipičen primer asinhrone komunikacije je e-pošta, ki omogoča komunikacija z izbranimi prejemniki sporočil v sistemu in je posebej primerna za individualne konzultacije študentov z mentorjem ali tutorjem. Med asinhrono učenje spadajo tudi diskusijski forumi.
Sinhrono učenje. Ker so uporabniki e-izobraževanja na različnih lokacijah, se za neposredno izvajanje učnih gradiv uporabljajo različne tehnologije. Enosmerni video omogoča neposredni prenos ali prenos video posnetka, dvosmerni video pa omogoča tudi interakcijo. Uporaba spletne aplikacije omogoča delo več uporabnikov, predstavitvena in grafična orodja pa omogočajo kakovostne predstavitve. Taka oblika omogoča uporabnikom, da postavljajo vprašanja, dobijo odgovore, prispevajo k razpravam, itd. Tipičen primer so klepetalnice [2].

6. STANJE E-IZOBRAŽEVANJA

E-izobraževanje je skozi zgodovino postalo vse bolj priljubljeno. Danes se v razvitih državah še zmeraj vse bolj uveljavlja in širi, a se uporablja kot smo že omenili, bolj kot dopolnilna sestavina tradicionalnega učnega procesa v predavalnici.

E-izobraževanje se je najbolj razširilo v ZDA, predvsem na odprtih univerzah in v strokovnih usposabljanjih v podjetjih. Posebno mesto je e-izobraževanje dobilo tudi v Evropski uniji in Sloveniji, vendar pri nas še zmeraj ni tako razširjeno. Največ znanja še vedno podajo v predavalnicah, a je prisotna tudi podpora IKT na delno tehnološko podprt način [4].

Začetno navdušenje nad e-izobraževanjem počasi polega. Pravijo, da naj bi termin e-izobraževanje izginil iz političnega besednjaka visoke politike v Evropski uniji, ter da naj bi bili manjši izdatki zanj. V Avstraliji, Novi Zelandiji in ZDA pa je ravno nasprotno, saj vlagajo denar v e-izobraževanje na področju strokovnega usposabljanja v podjetjih.

V Sloveniji se poleg izobraževalnih institucij (šole, univerze, komercialna izobraževalna podjetja), podjetja in javne institucije sicer zavedajo prednosti in pomembnosti e-izobraževanja. Svojim zaposlenim poskušajo to približati in jih spodbuditi k dodatnemu izobraževanju prek lastnih portalov, ki podpirajo izobraževanje na daljavo. Zato so ti portali v veliki meri specializirani za zaposlene v teh podjetjih ali ustanovah, dostopno gradivo pa je prirejeno za notranjo uporabo. Raba e-aplikacij za izobraževanje zaposlenih je v Sloveniji procentualno bolj razširjena kot v povprečju v EU. V Sloveniji uporablja e-aplikacije za izobraževanje 40% podjetij, kar jo uvršča na tretje mesto za Litvo in Ciprom [8].

Kljub potencialnim možnostim je e-izobraževanja v Sloveniji še vedno premalo, saj ni izkoristila priložnosti, ki jih ponuja e-izobraževanje. Pri nas za e-izobraževanje skrbi ministrstvo za šolstvo in šport, ki je leta 2006 sprejelo Akcijski načrt. Spletne strani fakultet, ki naj bi ponujale možnost e-izobraževanja so zelo skope z informacijami o tem načinu študija. Torej lahko sklepamo, da je danes ponudba e-izobraževanja v slovenskih visokošolskih institucijah in programih še vedno premalo zastopana. Možnost e-izobraževanja še vedno ponuja relativno majhen delež višje in visokošolskih zavodov v Sloveniji, kar je precej slabo izhodišče za razvoj e-izobraževanja. Poleg tega pa se moramo zavedati, da do leta 2007 pri nas 31% prebivalstva še ni uporabila računalnika, kar pa je seveda pogoj za razvoj e-izobraževanja. Večina podatkov kaže, da neusposobljenost odraslih za uporabo sodobne tehnologije ogroža dostopnost do e-izobraževanja [7].

Kljub vsemu pa se ponudba e-izobraževanja v Sloveniji bogati, predvsem v sektorju gospodarstva, ki uporablja ta način za razvoj kadrov in posredovanje specifičnih znanj. Obstaja večje število komercialnih ponudnikov programov e-izobraževanja, ki se ukvarjajo s ponudbo e-izobraževanja profesionalno. Dobre prakse pri uvajanju e-izobraževanja v slovenski izobraževalni sistem torej obstajajo, vendar pa je pri tem potreben sistemski in interdisciplinaren pristop, ki bi zagotovil kar se da enoten sistem uvajanja in izvajanja e-izobraževanja ter spodbujal posameznike k uporabi tega načina pridobivanja znanja na vseh ravneh (formalno, neformalno izobraževanje, izpopolnjevanje, usposabljanje itd.) [8].

6.1 Razširjenost e-izobraževanja v Sloveniji

O e-izobraževanju nasploh in še posebej o e-izobraževanju odraslih v Sloveniji danes skoraj da ni na voljo kakovostnih in metodološko primerljivih podatkov. Mednarodne ustanove, kot so OECD, Eurostat in UNESCO, podatkov o e-izobraževanju še niso vključile v svoje statistične baze, temveč v okviru raziskovanj o informacijski družbi pridobivajo posredne indikatorje stanja in razširjenosti e-izobraževanja [3]. O razširjenosti e-izobraževanja v Sloveniji nam lahko največ povesta dve vsebinsko primerni vprašanji in sicer o opravljanju on-line tečajev in o uporabi interneta kot informacijskega vira za učenje (Tabela 2).

STAROSTNE SKUPINE	OPRAVLJANJE ON-LINE TEČAJEV		UPORABA INTERNETA ZA IZOBRAŽEVALNE NAMENE	
	EU-25	SLOVENIJA	EU-25	SLOVENIJA
16-24 let	7%	9%	58%	75%
25-54 let	5%	4%	36%	26%
55-74 let	1%	1%	15%	17%

Tabela 2: Opravljanje on-line tečajev in uporaba interneta za izobraževalne namene [3] [9]

Rezultati kažejo (Tabela 2), da se internet kot orodje pridobivanja informacij za učenje pri velikem deležu mladih v Sloveniji (75%) redno uporablja precej več, kot je povprečje v državah EU-25. Nasprotno sliko pa kažejo podatki za odraslo prebivalstvo od 25 do 54 let, kjer je delež rednih uporabnikov interneta za učenje v Sloveniji majhen (26%) in kar za 10% zaostaja za povprečjem EU (36%). V skupini starejšega prebivalstva se internet za učne potrebe nasploh zelo malo uporablja [3]. Udeležba v on-line tečajih je tako v državah EU-25 kot v Sloveniji za vse starostne skupine na zelo nizki ravni in je največja pri mladih v Sloveniji z 9%. Delež odraslih, ki so se leta 2010 udeležili on-line tečaja, dosega v EU-25 komaj 5% in je v Sloveniji z 4% še malo manjši. Starejše prebivalstvo pa v on-line tečajih praktično ne sodeluje. O razširjenosti e-izobraževanja govorijo tudi podatki o ponudbi izobraževanja in učenja odraslih za formalne in neformalne izobraževalne programe Andragoškega centra Slovenije. Število izvajalcev (Tabela 3) programov e-izobraževanja se je v obdobju od 2005/2006 do 2010/2011 povečalo z 22 na 37 in je v letu 2010/2011 doseglo 13% delež vseh izvajalcev. Prav tako se je v tem obdobju povečala ponudba programov e-izobraževanja, s 110 na 232, kar pomen le 5% vseh programov za odrasle, vključenih v bazo Andragoškega centra Slovenije.

	IZVAJALCI			PROGRAMI		
	VSI	PROGRAMOV EI	V %	VSI	PROGRAMI EI	V %
2005/06	323	22	6,8	5.928	110	1,9
2007/08	319	31	9,7	6.064	152	2,5
2008/09	305	30	9,8	5.326	211	4,0
2010/11	285	37	13,0	4.695	232	5,0

Tabela 3: Pregled izobraževanja odraslih v Sloveniji, podatkovna baza in obdelava ACS [3]

Iz teh podatkov torej lahko sklepamo, da e- izobraževanje v 10 letih ni naredilo posebnega preboja in je le malo napredovalo. Še vedno je pretežno v domeni projektov, kot so programi e-izobraževanja na Andragoškem centru Slovenije v okviru projekta Evropskega socialnega sklada o izobraževanju in usposabljanju odraslih.

7. PRIHODNOST E-IZOBRAŽEVANJA

Sodobna tehnologija torej vedno bolj spreminja izobraževanje in učenje ter narekuje družbene in politične spremembe. Udeleženci izobraževanja prevzemajo vlogo organizatorja učenja, saj učenje ni več osredotočeno na učitelja in ustanovo.

Komuniciranje z uporabo IKT je postal bistveni del človekovega vsakdana in poglavitni vir navezovanja socialnih stikov [4]. Razvoj interneta podpira nov izobraževalni model, ki se naslanja na socialna omrežja. Ta nova stopnja v razvoju spleta se imenuje splet 2.0. Njegova glavna orodja so spletno objavljanje kot so blogi, e-portfoliji, Skype, mobilno učenje, virtualni interaktivni svetovi, integrirane učilnice ali diskusijski forumi. Sem pa spadajo tudi klepetalnice, grafično podprte povezave in orodja za socialno povezovanje (Myspace, Facebook, Twitter) [10].

Moderna družba ne more več delovati brez IKT. Ta vpliva na dvig inovativnosti in konkurenčnosti družbe in njenega gospodarstva, na povečanje števila delovnih mest, dvig kakovosti življenja, enakomeren regionalni razvoj in mednarodno vključenost[12]. Ne moremo predvideti, v kolikšnem obsegu se bo v Sloveniji e-izobraževanje razširilo in dobilo svojo pravo veljavo.

Pričakujemo lahko, da bodo glavne razvojne smernice e-izobraževanja naslednje:

- učno gradivo bo lahko dostopno prek spletnih strani organizacije, ki zaposluje posameznika;

-na voljo bodo bolj izpopolnjena orodja za upravljanje z vsebino; uporaba objektnih tehnologij bo omogočala ponudbo gradiv, ki se prilagajajo uporabnikom;

-sistemi za upravljanje izobraževanja bodo nadzirali in prilagajali učni program vsakemu posamezniku glede na njegovo trenutno znanje, izobrazbo, delovno mesto, željeno učno metodo in podobno. Ti sistemi bodo tudi natančno sledili uporabnikovemu napredku in ga analizirali [8].

8. ZAKLJUČEK

Informacijsko komunikacijska tehnologija je skozi svoj razvoj postala bistveni del človekovega vsakdana in tako moderna družba, skoraj da ne more več delovati brez IKT. E-izobraževanje razvojno izhaja iz študija na daljavo in je nekakšna podzvrst le tega. Zanj je značilno, da temelji na uporabi IKT kot tehnologiji pri podajanju informacij.

V Sloveniji je bilo v začetku devetdesetih let še razmeroma nepoznano, v zadnjih letih pa se pospešeno uvaja v izobraževalni sistem in sicer kot dopolnitev klasičnemu oziroma tradicionalnemu študiju, kot samostojni študijski programi ter kot posebna izobraževanja za določene ciljne skupine. Tako je v slovenskem prostoru moč zaslediti vedno več različnih ponudnikov e-izobraževanja tako za formalne, kot tudi neformalne izobraževalne programe, kot so na primer fakultete, javni in zasebni zavodi, podjetja in razvojne agencije. Od tega je vedno več ponudnikov e-tečajev in mentorstva, ter ponudnikov najrazličnejših izobraževalnih vsebin. Kljub temu pa obstajajo pogoji, ki nas omejujejo pri uvajanju programov e-izobraževanja. Temeljni pogoj za uveljavljanje je primerna tehnološka infrastruktura s programsko opremo. Razpoložljivost IKT je v Sloveniji sicer zelo dobra, vendar imajo nekatere skupine prebivalstva še vedno problem z dostopnostjo. Naj omenim ,da je pri nas še vedno četrtina gospodinjstev brez osnovne IKT opreme. Velik pogoj pa predstavljajo tudi digitalna zmožnost, dobra usposobljenost učitelja, upoštevati pa se mora tudi finančne in kadrovske elemente ter pedagoško-didaktične vidike e-izobraževanja. Ponudba e-izobraževanja se v Sloveniji bogati, predvsem v sektorju gospodarstva, ki uporablja ta način za razvoj kadrov in posredovanje specifičnih znanj. Obstaja tudi večje število komercialnih ponudnikov, ki se ukvarjajo s ponudbo e-izobraževanja profesionalno.

Zaključimo lahko, da je e-izobraževanje v Sloveniji glede na Evropo povprečno razvito. V šolstvu je e-izobraževanje v zadnjih letih uvedlo nekatere korenite spremembe pri načinu izobraževanja učencev, ki so seveda dobrodošle, saj to pomeni da se šolstvo tako kot ostale institucije pomika v koraku s časom. Seveda bi pa lahko na nekaterih področjih temu načinu izobraževanja namenili več sredstev, saj predstavlja ogromen potencial na novo pridobljenega znanja na vseh področjih.

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Potovati okrog sveta z lastnimi posnetki Zemlje z Mednarodne vesoljske postaje

To travel around the world with your own photos of Earth from International Space Station

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POVZETEK

Pri poučevanju geografije in izbirnih predmetov, ki so povezani z razumevanjem Zemlje se nemalokrat znajdemo v zadregi, kako učencem približati in jih navdušiti za raziskovanje zahtevnejših vsebin in celovitega razumevanje planeta, na katerem živimo. Še večji izziv je, kako jim dati občutek, da so lahko tudi oni sami raziskovalci nam že poznanega planeta. Eno od možnosti ponuja Nasin program Sally Ride EarthKAM, ki omogoča snemanje fotografij Zemlje z Mednarodne vesoljske postaje. Dejstvo, da učenci lahko »vstopijo« na Mednarodno vesoljsko postajo in določijo, katero območje Zemlje bi želeli fotografirati, je naravnost vabljivo. Delo s fotografijami in snemanje potovanja v Google Earth programu pa nudi drugačno izkušnjo spoznavanja Zemlje. Delo poteka individualno, učenec si tempo dela določa sam. Poudarek je tudi na odgovornem pristopu posameznika do dela, da pravočasno in natančno ter sistematično opravi naloge, da lahko doseže končni cilj.

Ključne besede

Fotografiranje Zemlje, Sally Ride EarthKAM, površje Zemlje, potovanje, geografija

ABSTRACT

Teaching geography and optional subjects related to understanding Earth, we may often find ourselves ill at ease searching how to interest students for exploration of more demanding contents and comprehensive understanding of the planet we live on. How to give them the sense that they themselves can be explorers of our familiar planet presents an even greater challenge. One of the options is NASA's Sally Ride EarthKAM program, which enables us to request images of Earth form International Space Station. The fact that students can »enter« the International Space Station and select the location on Earth they would like to take image of is straightforward tempting. Working with images and recording tours in Google Earth programme offer a different experience of discovering Earth. Work is done individually and students set their own pace. The focus is also given to the individual's responsible approach to work, to complete the tasks in time, accurately and systematically, in order to achieve the objective.

Keywords

Taking photos of Earth, Sally Ride EarthKAM, Earth's surface, voyage, geography

1. UVOD

Raziskovanje Zemlje je že od nekdaj privlačilo človeka. Potovanja v neznane kraje pa so bila in so še danes povezana s stroški in časom. Doživeti neko pokrajino v polnosti je nemogoče menjati zgolj z opazovanjem posnetkov, so pa ti odlično sredstvo za popestritev in spoznavanje sveta pri geografiji.
Še bolj eksotično in neobičajno je potovanje v vesolje, dano le redkim. Tisti »aha trenutek«, ki so ga doživeli že astronavti, ko so prvič iz vesolja zagledali obris Zemlje, pa se v razredu doživi tudi takrat, ko je učencem omogočeno pokukati skozi kamere Mednarodne vesoljske postaje in posneti lastne fotografije Zemlje. [6]
Ko združimo oboje, lahko s pomočjo programa Google Earth sestavimo lastno potovanje okrog sveta.

2. METODE DELA

Pri pouku geografije učenci razvijajo sposobnosti za uporabo preprostih geografskih raziskovalnih metod, s katerimi pridobivajo informacije o okolju. Usposabljajo se za rabo različnih sredstev in medijev, pri čemer je še posebej pomembna informacijska tehnologija. Učenci z IT tudi samostojno zbirajo in obdelujejo geografske informacije in jih predstavljajo. [10]
V članku je predstavljeno delo z dvema programoma, ki omogočata učencem spoznavanje in raziskovanje območij Zemlje, ki jim sicer ne bi bila dostopna. Kadar ne moremo neposredno opazovati procesov v pokrajini, poskušamo ustvariti njihove predstave s pomočjo projekcije, ki je ena temeljnih metod pri pouku geografije. [2]

2.1 Sally Ride EarthKAM

Sally Ride EarthKAM je Nasin izobraževalni program, ki omogoča učencem, učiteljem in širši javnosti spoznavanje Zemlje iz posebne vesoljske perspektive. [9] Gre za možnost fotografiranja Zemlje z Mednarodne vesoljske postaje, ki svoje kamere za javnost odpre štirikrat letno. V program se prijavi učitelj, ki pridobi uporabniško ime in geslo. Za vsako misijo (snemanje) je potrebno zaprositi za kode, ki jih učitelj razdeli učencem, ti pa z njimi lahko naročajo fotografije. Geslo in kode so kasneje tudi dostop do galerije, kjer so slike shranjene in se jih lahko ureja, analizira, shrani. S posnetimi fotografijami lahko učenci raziskujejo pokrajino in reliefne enote, prepoznavajo delovanje človeka v prostoru, posledice podnebnih sprememb ter spoznavajo matematično geografijo. Podrobneje je dostop in delo s programom predstavil mag. Jure Radišek. [8]

Program je poimenovan po Sally Ride, prvi Američanki v vesolju, ki jo je pogled skozi okno raketoplana tako navdušil, da je svojo izkušnjo želela deliti s študenti s celega sveta. Celo iz vesolja je bilo namreč očitno, da je Zemlja živ planet. [9]

Mednarodna vesoljska postaja (International Space Station ali ISS) je naseljen umeten satelit v nizki Zemljini orbiti, ki jo z Zemlje vidimo kot počasi se gibajočo belo piko. Je najsvetlejši predmet na nebu, ki ga je izdelal človek. [1] Sanje človeka, da bi poletel v vesolje, so velike, zato ne čudi razvoj ideje o vesoljskem turizmu. Astronavt prihodnosti bo lahko postal praktično vsak, ki bo za polet odštel vsaj nekaj deset tisoč evrov. [4]

2.2 Google Earth

Google Earth ali Google Zemlja je program, ki je večini zelo dobro poznan. Uporablja se ga za iskanje in načrtovanje poti, prikazovanje pokrajin, pogled na svet v 3D tehniki. Najbolj zanimiv za učence je ulični (street view) pogled, pogosto se ga uporablja za izdelavo zemljevidov, možno pa je izdelati tudi pravo potovanje in povezati določene točke in slike v nekakšen video posnetek.

Satelitski posnetki, ki jih omogoča program Google Earth, razširjajo paleto geografskih didaktičnih sredstev. Omogočajo pogled na pokrajino, jo povezujejo z zemljevidom, zato jih lahko uporabljamo tudi kot pomoč pri uvajanju v razumevanje kart. [2]

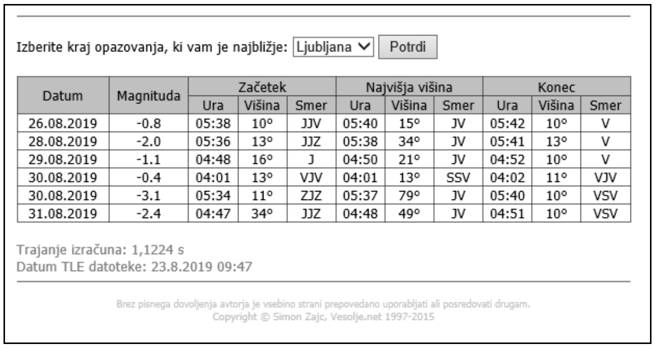
V nadaljevanju je prikazan postopek za izdelavo posnetka potovanja v Google Earth programu.

3. POTEK DELA

3.1 Predstavitev Mednarodne vesoljske postaje in programa Sally Ride EarthKAM

V uvodni uri učence seznanimo s programom Sally Ride EarthKAM in načinom snemanja fotografij. Uro načrtujemo v tednu, ko je odprta misija in lahko snemamo fotografije.

V prvem delu ure naredimo kratko predstavitev Mednarodne vesoljske postaje, kjer navedemo nekaj zanimivih dejstev (velikost, oddaljenost, hitrost potovanja, število posadke). Učence pritegne dejstvo, da prelete MVP lahko opazujemo s prostim očesom, pri čemer si pomagamo s podatki na spletni strani Vesolje.net [7]. Da si lažje predstavljajo pogled na Zemljo in potek dela, predvajamo še kratek video o Zemlji, sestavljen iz fotografij, posnetih na MVP. [3]


Izberite kraj opazovanja, ki vam je najbližje: Ljubljana Potrdi

Datum	Magnituda	Začetek			Najvišja višina			Konec		
		Ura	Višina	Smer	Ura	Višina	Smer	Ura	Višina	Smer
26.08.2019	-0.8	05:38	10°	JJV	05:40	15°	JV	05:42	10°	V
28.08.2019	-2.0	05:36	13°	JJZ	05:38	34°	JV	05:41	13°	V
29.08.2019	-1.1	04:48	16°	J	04:50	21°	JV	04:52	10°	V
30.08.2019	-0.4	04:01	13°	VJV	04:01	13°	SSV	04:02	11°	VJV
30.08.2019	-3.1	05:34	11°	ZJZ	05:37	79°	JV	05:40	10°	VSV
31.08.2019	-2.4	04:47	34°	JJZ	04:48	49°	JV	04:51	10°	VSV

Trajanje izračuna: 1,1224 s
Datum TLE datoteke: 23.8.2019 09:47

Brez pisnega dovoljenja avtorja je vsebino strani prepovedano uporabljati ali posredovati drugam.
Copyright © Simon Zajc, Vesolje.net 1997-2015

Slika 1. Seznam preletov Mednarodne vesoljske postaje [7]

3.2 Samostojno fotografiranje

V nadaljevanju ure učencem razdelimo listke z osnovnimi podatki (naslov spletne strani, uporabniško ime, geslo in kode). Kode razdelimo sistematično, da imajo učence vedno enake kode ter da imamo tudi sami zabeleženo razdelitev, saj lahko kasneje preverimo, kako so učenci opravili naloge in ali so se pojavile morebitne napake pri naročanju fotografij.

Pomembno je, da vsak učenec dela na svojem računalniku (lahko tudi tablici). Če je računalnikov manj in delo poteka v paru, naj vsak učenec naroči svoje fotografije.

Najprej posnamemo eno fotografijo skupaj, da učence počasi vodimo čez celoten postopek dela. Pisanje navodil ni potrebno, saj si največ zapomnijo s tem, ko delajo sami. V programu izberemo orbito. Prvi posnetek naj bo nad območjem, kjer je uspeh slike zagotovljen. Najbolj primerne so puščave, saj nimamo težav z oblačnostjo.

Slika 2. Fotografiranje Zemlje s programom Sally Ride EarthKAM

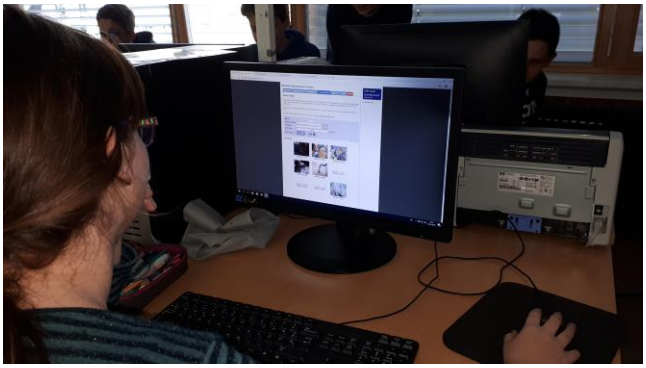
Ko si določimo točko posnetka (oddaljenost od orbite največ 70 km), zaprosimo za sliko (Image Request) in vpišemo potrebne informacije: kodo, orbito, čas snemanja (GMT), geografsko lego (Latitude, Longitude) ter ime lokacije. Pri tem ne uporabljamo šumnikov, izpustimo tudi oznako za kotne stopinje. Učence opozorimo tudi, da preverijo vremensko napoved za območje snemanja, saj je tako uspešnost posnetka večja.

Učencem predstavimo končni cilj: posnetke Zemlje bodo povezali v potovanje, ki ga bodo oblikovali v Google Earth programu. V ta namen je potrebno posneti fotografije Zemlje, pri čemer upoštevamo naslednje zahteve: fotografije naj bodo posnete na različnih poloblah in celinah, območja snemanja naj zajemajo različne tipe površja, različne naravne procese ter območja delovanja človeka. Učenci si pri izbiri območij pomagajo z obravnavano snovjo pri geografiji ali aktualnim dogajanjem (velike poplave, požari, taljenje ledenikov).

Na listke si zabeležijo območje snemanja za vsako kodo. Preostanek ure delajo samostojno, delo pa lahko nadaljujejo doma (pozorni morajo biti na čas odprtosti misije). Med sabo si lahko pomagajo z namigi, spretnejši pa lahko tudi pomagajo tistim učencem, ki jim sprva še ne gre najbolje.

3.3 Analiza fotografij

Po tednu ali dveh, ko so fotografije posnete in opremljene s podatki, naredimo ogled in analizo slik. Učenci vstopijo v galerijo slik v programu Sally Ride EarthKAM, za kar ponovno potrebujejo uporabniško ime, geslo in kode. Vsako sliko poiščejo s svojo kodo, preverijo njeno lokacijo na zemljevidu ali neposredno v Google Earth programu, s katerim je EarthKAM program povezan.



Slika 3. Ogled in izbor fotografij v galeriji programa

Za uspešno in sistematično nadaljnje delu je potrebno, da si uredimo mesto shranjevanja slik na računalniku. Vsak učenec si ustvari svojo mapo, v katero shrani posnete slike najmanjše velikosti, da kasneje ni težav z delovanjem Google Earth programa. V primeru, da slike potrebujemo za razvijanje, shranimo slike v večji resoluciji.
Učenci slike preimenujejo tako, da zapišejo ime območja/celine, misije in svoje ime (obmocje_misija_avtor). S pomočjo zemljevida poskušajo ugotoviti točno lokacijo slike (morebiten zasuk posnetka) in uspešnost posnetka. Za nadaljnje delo uporabijo samo slike, ki so kakovostne.
Vsak učenec izbere po eno sliko, ki jo predstavi sošolcem. Pri tem naj bodo pozorni zlasti na prepoznavanje območij, tipa površja in vplive delovanja človeka. Kratke analize učencev po potrebi dopolnimo. »Uporaba slik iz zraka je v začetku za učence težka. Niso navajeni perspektive, zato je interpretaciji takih slik potrebno posvetiti veliko pozornosti.« [2]

Slika 4. Izbor fotografij za izdelavo potovanja

3.4 Delo v Google Earth programu

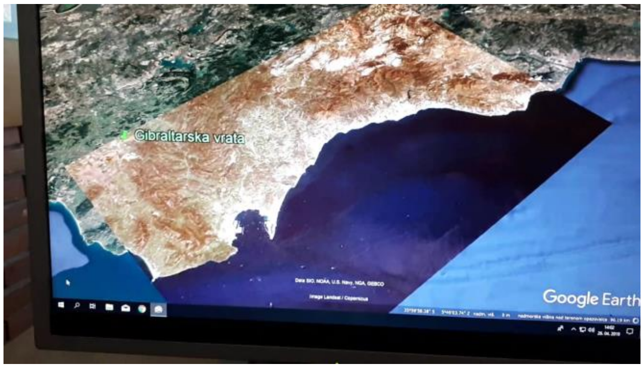
Sledi izdelava potovanja okrog sveta v Google Earth programu. Najprej skupaj z učenci ustvarimo poskusno potovanje, ki vsebuje vse elemente, ki jih je potrebno vključiti v končni izdelek. Ukaze najdemo v orodni vrstici. Učenci običajno že znajo vrisati lokacijo (ukaz »dodaj točko«). Izbrani lokacijo dodamo sliko z ukazom »dodaj prosojnico«. Sliko lahko poiščemo na spletu ali v datoteki in jo vstavimo ter ustrezno pomanjšamo in premikamo. Za pregleden in ličen izdelek je potrebno, da so barve oznak in pisave vidne (običajno svetlejše) ter primerno velike. Oznake in slike shranimo pod istim imenom in v ustreznem zaporedju, kot jih bomo posneli v potovanju. Potovanje posnamemo tako, da izberemo ukaz »posnemi potovanje«, pritisnemo puščico za začetek ter se premikamo od točke do točke po seznamu v »Mojih mestih«. Ko zaključimo snemanje, si potovanje shranimo, pogledamo in ugotovimo, kako izboljšati

Slika 5. Izdelava potovanja v Google Earth programu

Sledi samostojno delo učencev, kjer običajno ne potrebujejo veliko pomoči. Smiselno je, da si sami pomagajo med seboj in tako gradijo tudi skupinski duh. Nekaj časa in potrpežljivosti zahteva ugotavljanje prave velikosti vstavljenih slik ter oznak, odstranjevanje nepotrebnih podatkov ter samo snemanje potovanja. Če želimo doseči kakovosten izdelek, je potrebno snemanje nekajkrat ponoviti.

Učenci za izdelavo svojega potovanja okrog Zemlje dobijo naslednja navodila:

- Slike naj prikazujejo različne celine in naj bodo enakomerno razporejene.
- Slike naj prikazujejo tako naravne kot družbene procese.
- Slike naj prikazujejo različne tipe površja.
- Začetek in konec potovanja naj prikazuje vrtenje Zemlje.
- Potovanje naj prikazuje samo vstavljene slike in napise, nepotrebne oznake, meje, napise in slike, ki jih ponuja program, je potrebno odstraniti.
- Na posnetku naj bo Zemlja orientirana proti severu.
- Dolžina posnetka naj bo od ene do dve minuti. Posamezna slika naj bo prikazana toliko časa, da si jo lahko ogledamo in preberemo napis.
- Vsaka slika naj bo opremljena z zapisom območja.
- Oznake in napisi slik naj bodo ustrezne velikosti in barve, pomembna je preglednost in estetskost.
- Slike naj bodo ustrezno orientirane (naj se ujemajo s podlago v Google Earth).
- Prehodi med slikami v posnetku naj bodo mehki.
- Slikam se po potrebi določi ustrezna prosojnost.



Slika 6. V Google Earth vstavljena fotografija Gibraltarskih vrat, ki je pravilno orientirana

4. REZULTATI

Osnovni namen dela učencev je dosežen že z uspešno posnetimi fotografijami površja Zemlje in izdelanim posnetkom potovanja okrog sveta. Za temi vidnimi rezultati pa se skrivajo še mnogi drugi doseženi cilji, ki pričajo o ključnih kompetencah, ki jih učenci pridobijo z delom.

Učenci lahko svoje kompetence razvijajo le, kadar imajo priložnost biti aktivni. [5] Učijo se samostojnega in odgovornega dela: samostojno uporabljajo programe za izdelavo fotografij in izdelavo potovanja/videa. Učijo se sistematičnosti in organizacije dela: uporaba kod, načrtovanje posnetkov, shranjevanje slik v mapo, urejanje slik, sistematično načrtovanje potovanja. Učijo se odgovornosti: slike lahko snemajo samo v času misije, zato si morajo prilagoditi druge domače in šolske obveznosti. Brez svojih posnetkov ne morejo izdelati lastnega potovanja. Učijo se tudi potrpežljivosti in vztrajnosti, saj vse slike niso uspešne (oblačnost, nedelujoča kamera ali druge tehnične težave) in je potrebno čakati na naslednjo misijo (snemanje). Tako tudi spoznajo, kaj pomeni izpeljati nalogo v daljšem časovnem obdobju.

Slika 7. Povezovanje geografskega znanja pri delu s programom Sally Ride EarthKAM

Za geografijo je ključnega pomena neposredno opazovanje, ki pa ga uspešno nadomestimo z dobrimi posnetki. Analiza slike razvija opazovanje, omogoča predstavo, razvija sposobnost otrokovega mišljenja in ga usposablja, da prostor razume razvojno. [3] Učenci z analizo slik razvijajo orientacijo, opazovanje površja Zemlje in zaznavanje različnih procesov na Zemlji. Prepoznavajo negativne posege človeka, se navdušujejo nad lepotami našega planeta in prevzemajo skrb za varstvo okolja na Zemlji. Znanje o gibanju Zemlje, matematični geografiji, celinah, geografskih procesih povežejo v celoto in razumejo uporabnost posameznih informacij in smiselnost učenja.

5. ZAKLJUČEK

Izbrani način dela zahteva kar nekaj učiteljevih priprav in organizacije pouka, saj je pomemben del vezan na odprtost programa Sally Rde EarthKAM. Tako snemanje fotografij kot izdelavo potovanja je potrebno preizkusiti v šolski računalniški učilnici, da se prepričamo o delovanju programov. Nekoliko laže je tako delo izpeljati z manjšo skupino učencev pri izbirnih predmetih, še zlasti če se odločimo za celoletni projekt. Kljub natrpanemu šolskemu programu si lahko tak pouk privoščimo tudi pri predmetu geografija, saj gre za prepletanje in utrjevanje številnih vsebin iz učnega načrta. Pomembne so tudi digitalne kompetence, ki jih učenec pridobi z uporabo obeh programov in organizacijo dela v računalniški učilnici. Nenazadnje pa je velik poudarek na samostojnem delu učencev, ki si čas za delo razporejajo sami, so izredno aktivni in nenzadnje ponosni na svoje delo. Pogled na naš modri planet je skozi kamere Mednarodne vesoljske postaje omogočen prav vsakemu.

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Organizacija dela učencev v oddelku podaljšanega bivanja

Organization of pupils work in the extended stay unit

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POVZETEK

Učence je potrebno naučiti, kako se organizirajo in kako se naj učijo. V preteklem šolskem letu so se v oddelku podaljšanega bivanja naučili, kako se učiti. S pomočjo Office 365 so izdelali koledarček učenja. Skozi celo leto so sledili zastavljenim ciljem zapisanim v koledarčku. Učenci so se lažje pripravili na pouk in veliko raje utrjevali sprotno snov v oddelku podaljšanega bivanja. Hkrati pa so utrjevali in spoznavali različne digitalne kompetence. Naučili so se uporabljati računalnik kot pripomoček k učenju in naenkrat je učenje v oddelku podaljšanega bivanja postalo stalnica in ne nujno zlo.

Ključne besede

Digitalne kompetence, organizacija, podaljšano bivanje, računalnik, samostojno učenje

ABSTRACT

Pupils need to learn how to organize themselves and how to learn. In the past school year, they learned how to learn in the extended stay section. With the help of Office 365, they created a learning calendar. They followed the goals set in the calendar throughout the year. Pupils made it easier for them to learn and much better consolidate the real-life substance in the extended-stay section. At the same time, they strengthened and realized various digital competencies. They learned to use the computer as a tool for learning, and at the same time learning in the extended-living section became a constant and not necessarily evil.

Keywords

Digital competence, organization, extended stay, computer, independent learning

1. UVOD

Velikokrat se zgodi, da moramo predmetni učitelji zaradi pomanjkanja ur prevzeti delo v oddelku podaljšanega bivanja. Učitelji se znajdemo v zagati, kako pripraviti mlajše učence, da bodo delali po naših navodilih, kako jih motivirati za delo in podobno, saj učenci prihajajo v oddelek v popoldanskem času, utrujeni in nemotivirani. Velikokrat učenci odgovarjajo, da je domača naloga za doma in da je v oddelku podaljšanega bivanja ne bodo naredili, saj je domača naloga. Želela sem motivirati učence za delo in poiskala sem način, ki se je izkazal, da jim je všeč. Uporabila sem Office 365, kjer smo skupaj z učenci organizirali delo po dnevih. Enkrat na teden smo bili v računalniški učilnici, kjer smo naredili načrt za prihajajoč teden. Tega načrta smo se poskušali čim bolj držati. Učencem je bilo spremenjeno delo v oddelku všeč in so si želeli še več takšnih dni.

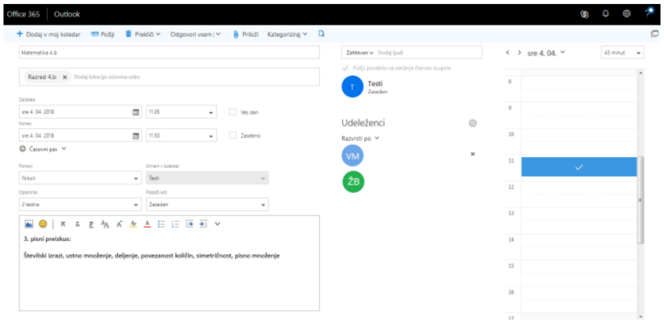
2. POTEK DELA MED ŠOLSKIM LETOM

V oddelku podaljšanega bivanja je učitelj dolžen organizirati delo tako, da lahko vsi učenci naredijo domačo nalogo, se sprostijo, gredo na kosilo in drugače usmerjeno preživljajo prosti čas ([1]). Velikokrat se učitelji sprašujemo, kako učence motivirati, da po napornem dopoldnevu še zberejo moči in naredijo domačo nalogo ali se učijo oziroma pripravijo za naslednji dan.

V preteklem šolskem letu sem organizirala delo tako, da smo enkrat na teden v okviru podaljšanega bivanja obiskali računalniško učilnico. V računalniški učilnici smo raziskovali in spoznavali osnove digitalnih kompetenc ([3]). Na začetku šolskega leta smo spoznali pravi v učilnici, osnove dela z računalnikom. Naučili smo se vklopiti računalnik, ob koncu dela pa pospraviti delovno mesto tako, da smo izklopili računalnik in pospravili mizo. Ko smo usvojili osnovna pravila, smo prešli na načrtovanje delovnega tedna. Učenci so se prijavili v Office 365. V orodju Outlook smo si izdelali koledar. Koledar so učenci delili z učiteljico. V začetku šolskega leta smo v koledar vnesli vso ocenjevanja znanja. Naredili smo si opomnike štirinajst dni pred ocenjevanjem, saj smo takrat v oddelku podaljšanega bivanja začeli z utrjevanje snovi. Zaradi lažjega načrtovanja je učiteljica učencem projicirala seznam pisnih preizkusov (slika 1), le te pa so učenci vnesli v svoje koledarje (slika 2).

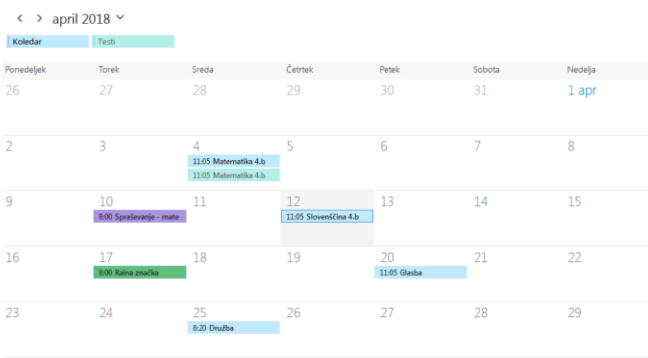
			(8:20-9:05)	
13. 12. 2017	4.c	Družba (DRU)	4. ura (10:15-11:00)	1. pisni preizkus družba
19. 12. 2017	4.c	Angleščina (TJA)	4. ura (10:15-11:00)	1. pisno ocenjevanje znanja
15. 1. 2018	4.c	Slovenščina (SLJ)	3. ura (9:10-9:55)	2. pisni preizkus sovenščina
18. 1. 2018	4.c	Matematika (MAT)	6. ura (11:55-12:40)	2. pisni preizkus matematika
8. 3. 2018	4.c	Naravoslovje in tehnika (NIT)	2. ura (8:20-9:05)	2. pisni preizkus naravoslovje in tehnika
30. 3. 2018 Preverjanje: 23. 3. 2018	4.c	NIP 4c Nemščina (NIP4c N)	6. ura (11:55-12:40)	
4. 4. 2018	4.c	Matematika (MAT)	5. ura (11:05-11:50)	3. pisni preizkus matematika
12. 4. 2018	4.c	Slovenščina (SLJ)	4. ura (10:15-11:00)	3. pisni preizkus slovenščina
18. 4. 2018	4.c	Glasbena umetnost (GUM)	6. ura (11:55-12:40)	1. pisni preizkus glasbena umetnost
25. 4. 2018	4.c	Družba (DRU)	4. ura (10:15-11:00)	2. pisni preizkus družba

Slika 1: Seznam pisnih preizkusov



Slika 2: Vnos podatkov v koledar

Sproti smo enkrat tedensko preverjali ali smo ponovili vse, kar nas čaka v prihodnjih dnevih ([2]). Prav tako pa smo enkrat tedensko vnašali tudi ostala ocenjevanja znanja, ki niso bila naprej napovedana (slika 3).



Slika 3: Primer mesečnega koledarja

V kolikor so učenci čez teden pozabili, katera dejavnost nas čaka v prihajajočem tednu, so hitro lahko pogledali na koledar, ki so ga ustvarili. Tako so se učili tudi ustrezne rabe pametnih telefonov in tablic. Učenci, ki niso imeli telefonov, so svoj koledar kadarkoli lahko preverili na računalniku v učilnici.

3. ZAKAJ OFFICE 365

Uporabila sem program Office 365. Lahko bi tudi kakšen drug program kot so Google Koledar ali Samsung Koledar in podobni. Odločila sem se za Office 365, ker le tukaj lahko šola vsem učencem omogoči uporabniške račune, ki ustrezajo slovenski zakonodaji o varovanju osebnih podatkov. Veliko sem imela pomislekov, saj sem v osnovi želela enako aktivnost izpeljati z Googlovim Koledarjem, vendar me je Office 365 iz varnostnih vidikov bolj prepričal.

Učencem sem pokazala, da lahko svoje koledarje, ki so jih ustvarili v Office 365 enostavno prenesejo tudi na svoj telefon, kjer morajo le dodati Exchange račun in jim se ustvarjen koledar prenese tudi na telefon.

Kakor Google Koledar tudi Office 365 omogoča deljenje koledarja, tako da lahko en koledar ureja več učencev, vendar tega nisem želela, saj sem želela, da vsak učenec sledi svojim zastavljenim ciljem in si izdeluje svoj plan dela.

4. ZAKLJUČEK

Učiteljica oddelka podaljšanega bivanja in razredničarka sva ugotovili, da so učenci začeli svoje delo načrtovati. Dosegali so višje rezultate pri preizkusih znanja, saj so snov veliko prej že v šoli začeli utrjevali. Učenci so postali veliko bolj vodljivi in pripravljeni sodelovati, saj so le tako lahko zapisovali svoje aktivnosti v koledar.

Kot učiteljica v oddelku podaljšanega bivanja bom s takšnim načinom dela zagotovo nadaljevala, saj učenci veliko bolje sodelujejo in jih je lažje motivirati za delo po napornem dopoldanskem urniku. Za tako oblikovano delo je potrebno kar nekaj materialnih sredstev. Na šoli imamo le eno računalniško učilnico, ki je zelo zasedena in lahko z oddelkom podaljšanega bivanja vstopamo le po pouku. Veliko lažje bi bilo, če bi v razredu imeli več računalnikov, ne le učiteljičinega, saj bi tako lahko učenci svoje delo dnevno načrtovali. Upam, da bomo kmalu opremljeni tudi s tablicami, kar bi nam olajšalo delo.

Vsekakor pa se bom še naprej trudila in iskala nove pristope in načine poučevanja, ker le tako je lahko pouk pester in zanimiv današnjim generacijam otrok.

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Metode za dosego višjega nivoja praktičnega znanja pri laboratorijskih vajah

Methods for attaining a higher level of practical knowledge in lab work

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POVZETEK

V prispevku je opisano, kako pri laboratorijskih vajah doseči najvišji možen nivo praktičnega znanja, ki bo dijakom služil kot dobra podlaga za nadaljnje delo v laboratoriju ali delu v podjetju, kjer se bodo po končanem izobraževanju zaposlili.

Problem, ki ga je zaznati, ko dijaki pričnejo z delom v laboratorijih podjetij je, da nimajo nekaterih znanj, predvsem pa izkušenj za delo, problem je nezadostno poznavanje merilne opreme, merilnih tehnik in metod ter poročanja o dobljenih rezultatih v obliki poročil.

Cilj prispevka je podati usmeritve za učitelje, na kakšen način naj se lotijo dela v laboratoriju, kako pripraviti gradivo, kako narediti vaje uporabne in zanimive ter kako naj dijaki napišejo poročila, da bodo poročila pregledna z jasnimi opisi, izračuni in rezultati meritev. Dijaki bodo na tak način usvojili uporabno znanje, ki ga bodo lahko s pridom uporabili tudi po končanem izobraževanju.

K delu v laboratoriju mora dijak pristopiti celostno z narejeno predpripravo, kjer dijak že doma pregleda vsebino vaje, kar mu olajša razumevanje vaje in razlage učitelja. Na vajah sta zahtevani zbranost in koncentracija. Po vaji sledita analiza in vpis rezultatov in dognanj v poročilo.

Rezultat takega načina dela je, da se je dijak sposoben fokusirati na delo, saj ga le tako lahko opravi kvalitetno in v skladu z zahtevami laboratorijske vaje, ki jo dela. V podjetjih bodo dijaki po koncu izobraževanja sposobni lažja dela v laboratoriju opraviti samostojno, zahtevnejša dela pa s pomočjo mentorja, ki jih bo usmerjal in jim dajal navodila za izvajanje meritev.

Ključne besede

Laboratorijske vaje, praktično znanje, pisanje poročil

ABSTRACT

The paper describes methods of how to achieve the highest possible level of practical knowledge in lab work, which will serve as a good basis for students to continue their research or work in the company where they will be employed after completing their education.
A problem that is perceived when students start working in a lab is that they do not have enough practical knowledge how to use work experience. The problem is insufficient knowledge how to use measuring equipment, measuring techniques, methods and writing reports.
The goal of the paper is to show teachers how to perform work in the laboratory, how to prepare materials, how to make the student interesting, teach how students should write the reports transparently with clear descriptions, expressions in measurement results. In this way, students will gain useful knowledge, which they will be able to use after their education.

Students must approach the work in the laboratory in a holistic and pre-prepared manner, where a student studies the content first by himself at home, which makes it easier for him to understand the interpretation of the exercises by the teacher later at school. Exercises require from students to stay in focus. The exercises are followed by an analysis of the results which are also included into the report.

The result of this type of work is that student is able to stay focused on work to justify the quality in accordance with the required laboratory work. After graduation students should be able to work independently in the laboratory and the difficult work will be made possible with the help of a mentor who will advise them the appropriate guidelines for performing the measurements.

Keywords

Laboratory work, practical knowledge, report writing

1.UVOD

V praksi se kaže, da veliko dijakov po srednji šoli ni sposobnih samostojnega dela v podjetju pri laboratorijskem delu na področju meritev. Do neke mere je to razumljivo, saj dijak še nima nobenih praktičnih izkušenj, če še ni imel možnosti dela v podjetju, po drugi strani pa so na srednjih šolah laboratoriji relativno dobro opremljeni za delo. Zato je zelo pomembno, da se dijaki že v času srednje šole naučijo pravilne uporabe laboratorijske opreme, merilnih postopkov in pisanja poročil o opravljenem delu.

Pri izvedbi laboratorijskih vaj je pomembna predpriprava, ki jo dijak naredi pred pričetkom izvajanja vaj, da pristopi k laboratorijskim vajam pripravljen in da čimbolj samostojno in razumsko izvede laboratorijsko vajo, ki se od njega pričakuje. Predpogoj za delo je osnovno znanje s področja meritev, ki naj bi jih dijak dobil že v času rednih ur pri predmetu.

Potrebno je posvetiti dovolj časa predstavitvi delovanja merilne opreme in kako se z njo rokuje, saj nam to prihrani kar nekaj časa pri poznejši razlagi. Merilna oprema v laboratoriju ne sme biti preveč zahtevna v smislu, da omogoča nešteto funkcionalnosti, saj se lahko dijak “izgubi” med vsem možnostmi, ki mu jih le-ta ponuja. Če dijak ne osvoji znanja, kako merilno opremo uporabljati, lahko dobi odpor do nje in z odporom hodi na laboratorijske vaje. Pozornost v času opremljanja laboratorija ni odveč, saj je potrebno izbrati optimalno merilno opremo.

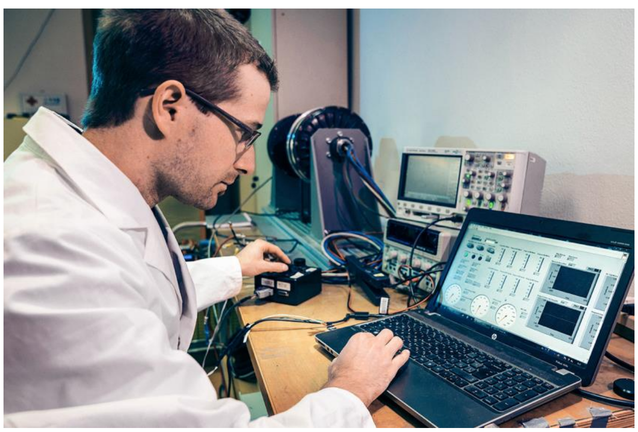
Med izvedbo laboratorijske vaje mora dijak imeti navodila z razumljivimi razlagami, ki ga vodijo skozi izvedbo vaje, postopkov ali morebitnih izračunov. Potrebna so jasna navodila za izvedbo vaje, jasen cilj izvedbe vaje, navodila izdelave poročila in kriteriji ocenjevanja.

1.1.Predpriprava

Predpriprava je zelo pomembna, saj se dijak že doma seznani z vsebino laboratorijske vaje. Na vajo pride pripravljen, ve kaj se bo delalo in učitelju že lahko zastavi morebitna vprašanja, ki jih je dobil med pripravo na vajo. Običajno učitelj priskrbi delovne liste ali skripto z vajami, kjer je opisan potek vaje. To jim služi tudi kot literatura pri izdelavi poročila [1].

1.2.Delo v laboratoriju

Delo v laboratoriju naj poteka v manjših skupinah, da bo vsak dijak imel možnost samostojnega dela, kjer je to mogoče. Če ni mogoče, naj delajo v parih. Učitelj najprej predstavi vsebino in potek laboratorijske vaje in predstavi navodila ter postopke izvedbe vaje. Če je potrebna dodatna razlaga ali demonstracija uporabe merilne opreme, naj učitelj izvede tudi to. Nič ni narobe, če za ta del učitelj porabi več časa kot je sprva predvidel, saj je predpriprava ključnega pomena za kvalitetno izvedbo vaje. Ko so dijaki pripravljeni, naj se lotijo samostojnega dela. Če med delom pride do enakih težav pri več dijakih, naj učitelj za nekaj minut prekine vajo in poda razlago celotni skupini, če pa ima vprašanje samo en dijak, poda razlago samo njemu. Na sliki 1 je prikazano delo v laboratoriju [3].



Slika 1. Delo v laboratoriju, kjer dijak spozna merilno opremo in delo z merilnimi instrumenti [4].

1.3.Pisanje poročil

Poročila naj bodo strnjena v enem dokumentu. Naj si sledijo v zaporedju od prve do zanje vaje. Cilj poročila je opisati izvedbo vaje na način, da lahko nekdo za nami ponovi vajo in primerja dobljene rezultate in postopke meritve z opisom v poročilu. Zaradi poenotenja je predlagana uporaba predloge, ki jo pripravi učitelj. Predloga naj vsebuje kratka navodila za pisanje poročil, razpored poglavij, osnovne oblikovne nastavitve, vrste pisave in velikosti besedila ter poglavij [2].

Iz tako pripravljenih poročil se bodo lažje znašli dijaki in učitelj, poročila pa bodo berljiva in pregledna. Oddaja poročil v tiskani ali elektronski obliki je stvar posameznega učitelja. Vsaka oblika ima prednosti in slabosti. Glede na to, da je trend vedno več stvari spraviti v elektronsko obliko, se preferira ta vrsta oddaje poročila [2].

1.4.Poročilo na eni ali dveh straneh

Kot opcija se dopušča omenjena izdelava poročil na eni ali dveh straneh t. i. "one pager" ali "two pager". Z vsako laboratorijsko vajo napiše dijak poročilo na eni ali dveh straneh. To od dijaka zahteva več razsodnosti, kaj je pomembno pri vaji in kaj lahko izpusti, da bo poročilo zajelo vse bistvene podatke in rezultate laboratorijske vaje. Za uporabo tovrstnega poročila je pomembno, da dijak zna napisati poročilo na več straneh, šele potem se lahko loti tovrstnega poročila. Predlaga se uporaba predloge, ki jo izdela učitelj in jo posreduje dijakom.

Pri poročilu na eni strani mora dijak izpostaviti bistvene rezultate meritev za posamezno vajo. Rezultati morajo biti podani jasno in razumljivo. Na koncu vsake vaje naj dijak poda svoj komentar o izvedeni vaji.

1.5.Ocenjevanje

Če je potrebno iz dela pri laboratorijskih vajah podati oceno dela in izvedbe, se predlaga ocena na podlagi izdelanega poročila in dobljenih merilnih rezultatov ter komentarjev meritev. Slogovna ustreznost ne sme biti pod vprašajem v primeru, ko dijaki dobijo predlogo. Poleg poročila naj dijaki oddajo tudi rezultate meritev na delovnih listih, ki so jih izpolnili med laboratorijsko vajo. Oddaja poročil naj bo časovno omejena s postavljenim rokom, do katerega morajo dijaki oddati poročila [5].

1.6.Delo v laboratoriju podjetja

Delo v laboratoriju podjetja je odvisno od načina dela posameznega podjetja. Na tem mestu bodo podane splošne ugotovitve. V manjših podjetjih običajno en zaposleni dela na več področjih dela, ki so med seboj sorodna. V večjih podjetjih običajno več ljudi dela na istem področju, kar omogoča, da so do neke mere zaposleni nadomestljivi in hkrati kompatibilni med seboj. S tem je tudi omogočen prenos znanja na mlajše sodelavce, kar je zelo dragocena prednost.

V novem okolju – laboratoriju običajno traja nekaj časa, da novozaposleni osvoji znanje za delo z instrumenti in napravami, ki se pri delu uporabljajo. Najboljši vir informacij so sodelavci z daljšim stažem in bogatimi izkušnjami. Novozaposleni si pridobi znanje od sodelavcev, z izkustvenim učenjem in eksperimentiranjem, za reševanje novih izzivov pa je potrebno dodatno znanje iz knjig, priročnikov ali spletnih strani. Dandanes se pogosto dobi najhitreje iskano informacijo na svetovnem spletu kot v knjigi ali priročniku, vendar je potrebno biti pri tem previden, saj nas splet lahko zavede, če se išče pod napačnim iskalnim nizem, ker bo splet ponudil vedno več rešitev, ki med katerimi so tudi napačne stvari.

2.PRIMERJAVA IZDELAVE POROČIL V PODJETJU IN SREDNJI ŠOLI

V podjetju služijo poročila za dokumentiranje izvedbe meritev ali drugih stvari z namenom dokumentiranja izvedenega dela. Poročila se razlikujejo glede na področje dela, sektor, nivo dela, delovno mesto … Na tem mestu bomo podali splošno primerjavo pri delu zaposlenega na tehničnem področju dela v laboratoriju.

2.2.Motiviranost

V srednjih šolah je običajno problem pisanja poročil v motiviranosti dijakov, saj ne vidijo smisla, saj bodo ta poročila ocenjena s strani učitelja, potem pa se jih bo založilo ali pa bodo romala v smeti.

V podjetju je stvar običajno drugačna. Poročila so ključen del dokumentacije, na podlagi katere se primerja druge meritve ali na kateri temelji dosedanji razvoj izdelka ali procesa dela v podjetju. Poročila prebirajo sodelavci, novozaposleni, vodje in tudi management podjetja (odvisno od velikosti in strokovnosti podjetja ali kolektiva). V podjetjih motiviranost ni problem, sta pa potrebni strokovnost in predstavitev pravih rezultatov, ki so ključni pri nadaljnjem razvoju ali dokumentiranju.

Tudi v proizvodnji so poročila, ki služijo beleženju ustreznosti izdelanih kosov. Poročila reklamacij, kjer delavec popiše odstopanja in diagnosticira, zakaj je prišlo do slabega kosa, poročila logistike, managementa in še bi lahko naštevali.

2.2.Prenos znanja v podjetje

Zaradi naštetega je pomembno, da se že v srednješolskem izobraževanju dijaki naučijo čimbolj samostojnega dela v laboratoriju, rokovanja z merilno opremo in izdelavo poročil. V podjetjih so pomembne tudi mehke veščine, ki pa se jim v srednjih šolah ne daje poudarka, saj je potrebno razumeti zahteve in želje nadrejenega, da lahko zaposleni izvede delo v skladu z njegovimi pričakovanji in da so meritve ustrezne, verodostojne in ponovljive pod enakimi pogoji izvedbe. Na poročilo se podpiše odgovorna oseba, ki je meritve izvedla ali njegov nadrejeni, da se lahko v primeru nejasnosti zaposleni obrnejo na dotično osebo.

4.ZAKLJUČEK

Pri laboratorijskem delu v srednjih šolah je zainteresiranost dijakov v veliki meri odvisna od angažiranosti in načina dela učitelja. Kljub temu, da bodo nekateri dijaki nadaljevali šolanje, pa mora biti laboratorijsko delo usmerjeno v pridobivanje praktičnega znanja, da se dijaki naučijo rokovanja z laboratorijsko opremo. V Sloveniji nekateri dijaki že tekom srednješolskega izobraževanja delajo preko študentskega servisa, kar jim omogoča pridobivanje praktičnih izkušenj s področja dela, ki ga želijo opravljati ter pridobijo delovne navade.

Po drugi strani pa jih delo jemlje čas in energijo ter čas, ki je potreben za učenje v srednji šoli. Učitelj naj ne bi zniževal nivoja zahtevnosti na račun odsotnosti dijakov od pouka, saj bodo le na tak način pridobili dovolj strokovnega znanja in bodo usposobljeni za čim lažji začetek dela v podjetju, kjer se bodo po zaključku izobraževanja zaposlili.

Pri laboratorijskih vajah je tudi možnost nadgraditve vaje s seminarsko ali raziskovalno nalogo, če dijaka tematika zanima, kar je še dodaten motiv za delo. Bolj ambiciozni lahko pripravijo prispevek o svojem delu in ga objavijo na kateri od strokovnih konferenc.

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Scrum metoda pri poučevanju v srednjih šolah

Scrum method in high school teaching

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POVZETEK

V prispevku je opisan predlog uporabe metodologije SCRUM pri poučevanju v srednjih šolah in drugih izobraževalnih ustanovah. Potrebe po temi so se pojavile, ker vedno več podjetij stremi k agilnosti in delu po tej metodologiji. Zakaj ne bi tako delali tudi v šolah? Kaj to pomeni za učitelja in kako bi to sprejeli dijaki? Zastavlja se več vprašanj o možnostih uporabe SCRUM metodologije v izobraževalnem procesu. Kaj lahko pričakujemo od takega načina dela in kaj se dijaki pri tem naučijo, pa je opisano v prispevku.

Ključne besede

Scrum, agilne metode, agilnost

ABSTRACT

This article describes how to use the SCRUM methodology in high school teaching and teaching in other educational institutions. The need for this topic has emerged as more and more companies are striving for agility and working according to this methodology. Why not work in schools using this methodology? What does this mean for the teacher and how would students accept it? Several questions arise about the possibilities of using the SCRUM methodology in the educational process. What can be expected from this type of work and what students learn in doing so is described in this article.

Keywords

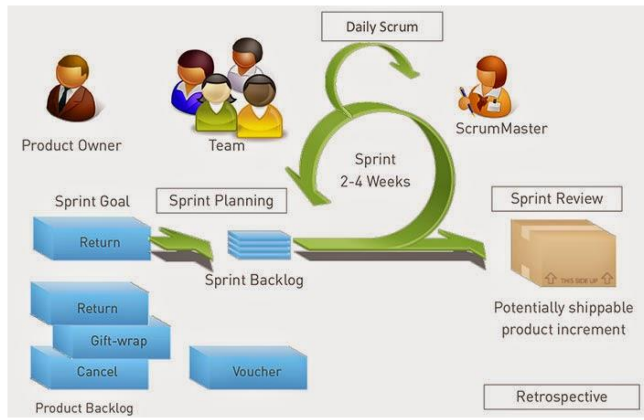
Scrum, agile methods, agility

1. UVOD

1.1 Opis metodologije SCRUM

Prvi uradni zapis pravil SCRUM je nastal leta 1995 izpod peresa J. Sutherland-a in K. Schwaber-ja, čeprav korenine nastanka metodologije segajo dlje. Že leta 1983 sta H. Takeuchi in I. Nonaka opisala postopek razvoja izdelka, pri katerem se faze procesa prekrivajo in razvojna skupina sodeluje pri celotnem procesu. Kot »SCRUM« je tehniko poimenoval J. Sutherland leta 1993, in sicer je metodologijo primerjal z istoimensko formacijo igralcev pri igranju rugbija. Za prvo resno publikacijo na to temo se šteje knjiga, ki je izšla leta 2001 – Agile software developement with Scrum, katere avtorja sta K. Schwaber in M. Beedle [1].

Projekti SCRUM so običajno razdeljeni v serije 30-dnevnih iteracij, imenovanih »sprint« ali cikel (Slika 1). Na začetku cikla razvojna ekipa določi količino dela, ki ga bo opravila v danem intervalu. Naloge se določajo po prioritetnem spisku, imenovanem »Product backlog« ali seznam zahtev. Izbrane naloge se prenesejo na seznam nalog posameznega cikla ali »Sprint backloga«. Sprotno spremljanje dela pa se opravi s kratkimi jutranjimi sestanki ali dnevnimi cikli (ang. Daily Scrum) [1].



Slika 1: Grafični prikaz SCRUM razvojnega procesa [2].

Pregled SCRUM-a je razdeljen v pregled Scrum vlog, časovnih okvirjev ter Scrum izdelkov. Vsi, ki so vpleteni v delovanje Scrum, so Scrum skupina, kljub temu, da znotraj nje obstajajo različne vloge.

Scrum skupina je oblikovana tako, da doseže kar največjo fleksibilnost in produktivnost. Za to je potrebno, da se skupina organizira sama, da se člani ne porazdelijo po funkcionalnih področjih in da delo poteka v iteracijah. Pri Scrum skupini ločimo vloge glede na odgovornost in naloge, ki jih posamezniki opravljajo [1]. To so:

- Skrbnik metodologije (ang. Scrum Master) – skrbi, da vsi Scrum procesi tečejo gladko.
- Skrbnik izdelka (ang. Product Owner) – zadolžen, da ima opravljeno delo čim večjo vrednost za naročnika.
- Razvojna skupina (ang. Team) – Zadolžena za implementacijo naloge [3, 4].

1.1 Karakteristike agilnih metodologij

Glavne karakteristike agilnih metod, ki so značilne za delovno okolje, ki uporablja SCRUM metodologijo so:

Usmerjenost k ljudem – pri agilnih metodologijah v projekt vključimo tudi stranke, končne uporabnike in druge zainteresirane ljudi. Ljudje so najpomembnejši dejavniki, katerim se daje velik pomen. Pomembne lastnosti so družabnost, talent, spretnost in komunikativnost. Če so ljudje na projektu dovolj dobri, jih lahko uporabimo pri kateremkoli postopku in bodo izpolnili vse naloge.

Prilagodljivost – udeleženci se ne bojijo sprememb. Nasprotno, spremembe so dobrodošle v katerikoli fazi projekta. Le-te predstavljajo dobro stvar, saj razvojna ekipa tako spozna zahteve projekta.

Skladno z dejanskim – agilni projekti niso nadzorovani s skladnostjo z načrtom, ampak so nadzorovani s skladnostjo s poslovno vrednostjo.

Uravnoteženje prilagodljivosti in načrtovanja – načrti so pomembni, vendar obstaja problem, da včasih razvoja izdelka ni mogoče napovedati daleč v prihodnost, ker obstaja veliko spremenljivk, zato je najboljša strategija načrtovanja takšna, da se pripravi podrobne načrte za naslednjih nekaj tednov, grobe načrte pa za na naslednjih nekaj mesecev in zelo surove načrte za daljše časovno obdobje.

Empirični procesi – agilni razvoj je empiričen – nelinearen. Empirični pristop predstavlja, da je razvoj nepredvidljiv in kaotičen. Za upravljanje nepredvidljivosti in kontrolo tveganja se uporablja kontrole, kar zagotavlja fleksibilnost, odzivnost in zanesljivost.

Decentralizirani ukrepi – vključitev decentraliziranega stila vodenja lahko vpliva na razvoj projekta, saj lahko prihrani precej časa kot avtokratsko obvladanje procesov. Naloga odločanja se tako razprostira tudi na razvijalce, kar pa ne pomeni, da razvijalci prevzemajo vloge upravljanja, temveč, da o tehničnih odločitvah lahko odločajo razvijalci brez dovoljenja vodje.

Preprostost – agilne metode ubirajo najpreprostejše poti, ki so v skladu z njihovimi cilji. Agilne metode ne pričakujejo jutrišnjih problemov, ampak se pred njimi skušajo ubraniti že danes. Nikoli ne izdelaj več, kot je potrebno in nikoli ne poskušaj pripraviti dokumentov za napovedovanje prihodnosti, saj bodo hitro zastareli.

Dodelovanje – redno vključevanje mnenj in povratnih informacij stranke. Stranka naj tesno sodeluje z razvojno ekipo, saj zagotavlja povratne informacije o svojih prizadevanjih. Bistvenega pomena je tudi stalno sodelovanje med člani ekipe in vodstvom projekta [5].

2. PRAKTIČNA UPORABA V SREDNJI ŠOLI

V srednji šoli bi se metodologija SCRUM lahko aplicirala pri izdelave projektne ali seminarske naloge. Načinov, kako določiti vloge, je več in so odvisni od zastavljenih ciljev, časovnega okvira, ki ga ima učitelj na razpolago in predvidenega načina dela. Potrebne so določene poenostavitve in prilagoditve klasičnega Scrum modela, vendar osnovni koncept dela ostaja enak. V srednji šoli se lahko učitelj odloči med individualnim in skupinskim delom. Pri individualnem delu Scrum metodologija ne pride do izraza, saj je pri metodologiji pomembna ekipa, ki se medsebojno spodbuja in dopolnjuje.

2.1 Individualno delo

Učitelj na začetku predstavi Scrum metodologijo in način dela pri predmetu. Učitelj je skrbnik metodologije, dijak pa deluje kot ekipa, ki je zadolžena za realizacijo zastavljene naloge, ki jo v začetku definira skupaj z učiteljem. Po začetnem uvajalnem in spoznavnem obdobju naj bo delo razdeljeno na t. i. sprinte, ki so dolgi od dveh do štirih tednov. V tem času dijak samostojno preštudira literaturo in izvede nalogo, ki je planirana za čas sprinta. Sledi sestanek z učiteljem, kjer se pogovorita o rezultatih in morebitnih težavah ter definirata akcije za naslednji sprint. Sestanki naj bodo kratki in efektivni brez zamujanja, dijak pa pride na sestanek pripravljen. Vmesne rezultate projekta lahko dijak predstavi kolegom na skupnem srečanju, ki naj bo v časovnem obdobju nekaj sprintov oziroma na koncu leta ali polletja.

Delo poteka individualno med učiteljem in dijakom. Dijak od učitelja dobi komentarje o opravljenem delu ter usmeritev za nadaljnje delo.

Tak način dela spodbudi dijaka za samostojno in odgovorno delo brez možnosti za prepisovanje ali goljufanje, saj ga učitelj redno spremlja skozi čas izvajanja projekta oziroma naloge. Delo od učitelja zahteva fleksibilnost, prilagodljivost, doslednost, organiziranost, osvojitev novih znanj ter drugačen pristop do dela dijakov. Priporočljiva je uporaba Scrum programa za enostavnejše analiziranje in spremljanje dela dijaka, saj z njim spremlja napredek izvedbe dijakove naloge.

Taka oblika dela je s primerno programsko opremo možna tudi za dijake, ki so na daljši bolniški ali športni odsotnosti, saj jim omogoča delo na daljavo, učitelj pa lahko spremlja njihov napredek in osvojeno znanje.

2.2 Skupinsko delo

Pri skupinskem delu se oblikujejo skupine od 3 do 5 dijakov. Dijaki skupaj z učiteljem definirajo projektno nalogo in si razdelijo področja dela, ki jih bodo posamezni dijaki izvedeli v določenih časovnih intervalih. Skupina dijakov izvaja 2 do 4 tedenske sprinte, ob zaključku sprinta se sestane z učiteljem, da se pogovorijo o stanju projekta in morebitnih težavah. Pri tovrstnem delu običajno nekdo prevzame pobudo in poskuša organizirati in oblikovati skupino tako, da skupaj pridejo do zastavljenih ciljev.

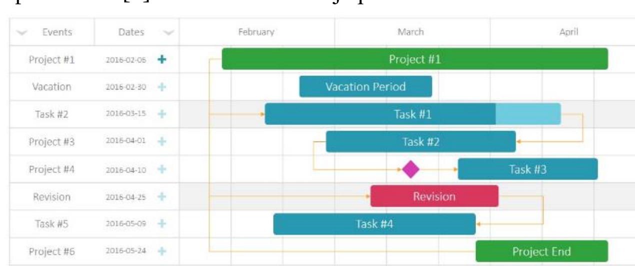
Tak način dela zahteva od dijakov poleg strokovnega znanja tudi organizacijske in komunikacijske sposobnosti in veščine, ki pri klasičnem načinu dela ne pridejo do izraza.

Znotraj skupine lahko pride do nesorazmerne delitve dela, kar lahko privede do trenj znotraj skupine. Sodelovanje je zelo pomembno pri poznejši zaposlitvi v kateremkoli podjetju s Scrum metodologijo dela. Z delom v skupini se dijaki naučijo sodelovanja in pričnejo razmišljati o pomenu sodelovanja in skupinskem delu.

Scrum metodologija s sprinti na nek način sili dijaka k sprotnemu in odgovornemu delu, saj v nasprotnem primeru ne bo zadovoljen le učitelj ampak tudi ostali člani ekipe.

Intenzivnost dela se lahko določa z daljšanjem ali krajšanjem časovnih intervalov, ki jih učitelj prilagodi glede na število tedenskih ur in na število skupin. Tempo dela se tudi lahko zmanjša ali poveča s povečanjem ali zmanjšanjem količine dela za naslednji sprint.

Priporočljiva je uporaba časovnega planiranja projekta – gantograma (Gantt chart), ki vsebuje mejnike in glavna opravila, ki jih je potrebno narediti za zaključek naloge. Delo na projektu je smiselno razdeliti na posamezna opravila, ki se jim določi osebo oziroma osebe, ki bodo v določeni časovni enoti opravila zastavljeno delo. Časovnico dela dijaki predlagajo sami ter se o njej posvetujejo z učiteljem, ki časovnico potrdi ali pa predlaga spremembe [6]. Primer časovnice je prikazan na sliki Slika 2.



Slika 2: Primer časovnice projekta v programu za agilno vodenje projektov [7].

2.3 Ocenjevanje

Pri ocenjevanju se lahko učitelj opira na sledeče stvari: delo opravljeno v predvidenem času, delo opravljeno kvalitetno, zavzetost in pristop do dela, predstavitev sprotnega dela in končna predstavitev. Če je predmet naloge izdelek, se oceni tudi izdelek. Če predstavlja izdelek delo celotne skupine, nagradimo zavzetost celotne skupine.

2.4 Viharjenje možganov

Na dva do štiri tedenskih sestankih dijaki sami predstavijo ideje in predloge, ki so jih dobili tekom reševanja nalog v času sprinta. Če so naloge, ki jih morajo opraviti, preveč zahtevne za posameznika, ali če posamezen dijak ne dobi rešitve, je potreben angažma celotne skupine, ki mu priskoči na pomoč z idejami in predlogi za rešitev problema, kateremu ni bil kos. Tu se pokaže prava moč skupine, ki deluje složno pri reševanju izzivov proti cilju oziroma dokončanju zastavljenih nalog v okviru projekta. Učitelj lahko spodbudi dijake k skupinskim sestankom, kjer sami poiščejo najboljše rešitve v sklopu naloge.

3. PREDNOSTI SCRUM METODOLOGIJE PRED KLASIČNIM POUČEVANJEM

Načina se kar precej razlikujeta. Pri Scrum metodologiji je zavzetost za delo v skupini večja, saj se mora vsak član ekipe potruditi, da je delo ob koncu sprinta narejeno, saj se v nasprotnem primeru določene aktivnosti ne morejo nadaljevati. Na koncu sprinta se izkažejo težave ali pomanjkljivosti, ki jih lahko ostali člani skupine pomagajo odpraviti, da se projekt nadaljuje po začrtani časovnici. Če se izkaže, da skupina ni dovolj hitra ali da si je zadala preveč dela za dosego ciljev, se na skupnem sestanku korigira število ali zahtevnost opravil za naslednji sprint. Sprint je za dijake neke vrste domača naloga, ki jo morajo izvesti v dogovorjenem roku.

Spodbujanje kreativnega in samostojnega dela na način, da dijaki sami predlagajo naloge in usmeritve, česa se bodo lotili in česa ne. Učitelj ima funkcijo mentorja, ki jih usmerja in z nasveti spodbuja pri delu.

3.1 Spodbuda za drugačen način razmišljanja

Scrum metodologija obrne na glavo način razmišljanja, saj ne gre za tekmovanje med dijaki, kdo bo dobil najvišjo oceno pri testu, ampak ravno nasprotno. Glavni cilj je sodelovanje med člani skupine, pomoč, ko nekdo iz skupine ne najde ustrezne rešitve in doseganje skupnega cilja ekipe namesto posameznika.

4. ZAKLJUČEK

Ker se v razvojnih oddelki vedno več uporabljajo agilne metode vodenja projektov, je pomembno, da dijaki že v času izobraževanja spoznajo, da obstajajo tudi drugi alternativni načini dela oziroma sistemi vodenja kot so klasični, kjer nadrejeni enostransko odreja delo posameznikom. Pri agilnih metodah se pokaže moč skupine pri reševanju problemov.

Pri pedagoškem delu se mora najprej izobraziti učitelj, ki je zgled, vodja in mentor dijakom. V začetku ima učitelj veliko dela in prilagajanja, da vzpostavi sistem dela s pomočjo programa za vodenje in spremljanje dela po agilni metodologiji. Ko je sistem oziroma struktura vzpostavljena, pa lahko dijaki sami vnašajo podatke o delu in jih učitelj le spremlja in usmerja k čim boljši realizaciji zastavljenih ciljev.

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Krepitev digitalnih kompetenc pri pouku angleškega jezika

Enhancing digital competences in English language teaching

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POVZETEK

V članku so predstavljeni programi in aplikacije, ki jih uporabljamo pri pouku angleščine na naši osnovni šoli. Z uporabo IKT sredstev in kvalitetnim medkulturnim sodelovanjem nam je uspelo dvigniti motivacijo učencev za učenje tujega jezika, posledično pa se je dvignil tudi nivo znanja angleškega jezika.

Ključne besede

Aplikacije, programi, IKT, angleščina, osnovna šola

ABSTRACT

In this article are presented different computer programs and applications that we're using for English language teaching in our primary school. With the use of ICT and quality international cooperation, we succeeded in raising the levels of motivation of our pupils for learning English language. As a result, the levels of English language knowledge, has also risen.

Keywords

Applications, computer programs, ICT, English language, primary school

1. UVOD

Živimo v 21. stoletju in da današnje generacije uspejo v družbi, ki je polna znanja in informacij, je pomembno, da znajo mladi učinkovito uporabljati sodobno tehnologijo. Učenje angleške slovnice učencem ni zanimivo, zdi se jim dolgočasno in nepotrebno, zato je še toliko pomembnejša predstavljivost specifičnih situacij ter praktična uporabnost z vsakdanjim življenjem. Sodobna tehnologija, posebej internet, izboljšuje dostopnost izobraževanja, spreminja procese poučevanja/učenja ter procese upravljanja in vodenja izobraževalnih institucij (Sulčič, 2007). Gerlič (2009) ugotavlja, da je dandanes veliko novosti v tehniki in tehnologiji pouka, ki jih učitelji bolj ali manj poznajo in jih glede na to tudi dokaj sramežljivo in nedosledno uporabljajo. Scheffknecht (v Gerlič, 2009) trdi, da veliko učiteljev ne pozna dovolj razsežnosti, ki jih ponuja sodobna tehnologija, in imajo zaradi tega do njih odklonilen odnos ali pa jih uporabljajo didaktično neustrezno in neprimerno.

Če si po teoriji Edgarda Dala učenci zapomnijo 10 % tistega, kar preberejo, in 90 % tistega, kar doživijo, potem lahko delo z digitalnimi mediji pomeni nov mejnik učenja s pomočjo IKT-ja (Dale, 1969). S pomočjo računalnika, tablice ali pametnega telefona lahko učenci obiščejo kraje, ki jih praktično sami ne bi mogli videti ali pa doživeti. Predstavljajte si raziskovati ulice Londona, strukturo nevrona, slemena najvišjih gorstev na svetu ali pa površje Marsa. S pomočjo pametnih tehnologij lahko učenci obiščejo vse te kraje. Si predstavljate, da učence postavite na fronto v prvi svetovni vojni? S pomočjo modernih tehnologij lahko učencem varno predstavimo globine morskega dna, ki bi lahko bilo za njih sicer nevarno. Izkušnja, ki jo učenci pridobijo z uporabo IKT sredstev v primerjavi z listanjem po učbeniku, je v tem primeru neprimerno bolj pristna.

1.1 Osnovna šola Senovo

Osnovna šola Senovo je manjša podeželska šola, ki jo trenutno obiskuje okoli 300 učencev. Učenci, ki obiskujejo našo šolo so večinoma slovenske narodnosti, imamo pa tudi kar nekaj učencev migrantov, ki prihajajo večinoma iz držav bivše Jugoslavije in Albanije. Njihove družine so se na Senovo preselile že pred nekaj leti, ko je na Senovem še deloval rudnik. Danes, ko je rudnik in veliko senovskih industrijskih obratov zaprtih, je Senovo postalo mesto z nižjim socialnim standardom. Osnovna šola XIV. divizije je tehnološko zelo dobro opremljena z IKT tehnologijo. Naši učenci imajo na voljo multimedijsko zelo dobro opremljene učilnice. Vsaka učilnica na šoli že ima interaktivno tablo s projektorjem, računalnik ter televizijo, vsem učencem pa je na voljo tudi 26 tabličnih računalnikov, ki jih po potrebi prinese učitelj v razred. Na voljo je tudi brezžično internetno omrežje, da lahko nemoteno uporabljamo tablice ali pametne telefone v izobraževalne namene. Pouk računalništva, multimedije in občasno tudi drugih predmetov poteka v računalniški učilnici, kjer je učencem na voljo 16 zmogljivih računalnikov.

Učitelji naše šole se redno izobražujemo in skrbimo za krepitev naših digitalnih kompetenc, kajti pomembno se nam zdi to znanje prenašati na naše učence. Zavedamo se, da je nova tehnologija naša zaveznica, učence motivira, nam pa pogosto olajša naše delo. Trudimo se tudi, da bi v naše delo (še posebej na oddelku tujih jezikov) vpletli čim več dela z vrstniki s celega sveta. Zdi se nam pomembno, da se učenci zavedajo, da je prvotna funkcija jezika komunikacija in da je le-ta koristno orodje za doseganje mnogih ciljev. To dosegamo tako, da se vključujemo v mednarodne projekte, naši učenci sodelujejo tudi v mednarodnih taborih itd.

2. PROGRAMI IN APLIKACIJE PRIMERNI ZA UPORABO PRI POUKU ANGLEŠČINE

V nadaljevanju bom opisala le nekaj računalniških programov in aplikacij, ki jih uporabljamo pri našem neposrednem delu z učenci. Uporabljamo jih pri »navadnih« urah, ko učencem predstavljamo novo učno snov, pa tudi pri delu na mednarodnih projektih. IKT ne uporabljamo pri vseh naših urah, ampak le ob potrebi ali ko vidimo dobro priložnost, da bi z uporabo IKT svoje učence motivirali, preverili njihovo znanje ali se povezali z razredom iz tujine.

2.1 Mystery Skype

Mystery Skype je bil prvi program, ki smo ga začeli uporabljati, še preden je naša šola kupila tablice in še preden smo učencem dovolili uporabo brezžičnega omrežja. Za njegovo uporabo smo imeli računalnik povezan z interaktivno tablo, kamero in mikrofonom. Mystery Skype je igra, ki jo igrata dva razreda z različnih delov sveta. Povežeta se preko Skype-a in cilj igre je, da samo z zastavljanjem »da« ali »ne« vprašanj ugotovita, iz katere države je drugi razred. Za vsem tem seveda stojita oba učitelja (slovenskega razreda in razreda iz druge države), ki se prej dogovorita o točnem datumu in uri skupnega »druženja«. Učitelje za igro Mystery Skype najdemo na portalu Microsoft in Education. Preden dejansko izvedemo prvo uro Mystery Skype-a, učencem najprej razložimo pravila med samim Skype klicem (kdaj govorijo ter kdaj so tiho in poslušajo), kakšna vprašanja naj sprašujejo in kako naj uporabljajo geografski atlas, ki ga mora imeti vsak učenec pred seboj. Kasneje smo namesto atlasa začeli uporabljati tudi tablice, kar je močno skrajšalo čas, ki so ga učenci porabili, da so ugotovili, iz katere države je nasprotni razred učencev. Nikoli pa ni bila to samo ena igra. Z vsako tujo učiteljico ali učiteljem smo se dogovorili za vsaj še eno ali dve uri, ki smo jih nato izvedli skupaj. Ali smo združili učence v majhne skupinice, ki so imele specifično nalogo ali pa jim dali nalogo, da naj od učenca iz tuje države izvedo določene informacije in jih kasneje predstavijo v razredu.

Med samo igro so učenci aktivni. Aktivno poslušajo, iščejo podatke po spletu, atlasu in govorijo. S tem izgubijo strah pred govorjenjem v tujem jeziku in dojamejo njegovo praktično sporazumevalno funkcijo. Delujejo samostojno in tudi kot del ekipe. Pogosto se zgodi, da je to le začetek prijateljstva med našimi učenci in učenci tujih držav in da se ta vez, ki se je začela pri Mystery Skype-u, nadaljuje še dolga leta. Na fotografiji 1 so naši učenci in učenci iz Vietnama med igro Mystery Skypa.

Fotografija 1: Mystery Skype v 7. razredu (Foto: Lea O. Opravž)

2.2 Kahoot in Formative

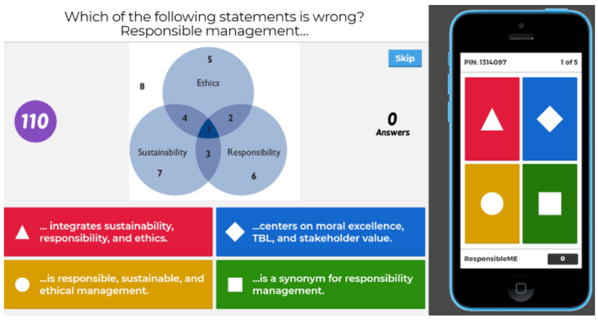
Naslednji aplikaciji, ki tudi krepita digitalne kompetence učencev, sta Kahoot in Formative. Obe sta si dosti podobni, zato je njun opis oz. primerjava združena v tem poglavju.

Kahoot in Formative sta brezplačni aplikaciji, kjer se učenci na zabaven način učijo in utrjujejo novo naučeno snov. Kahoot je dostopen brez registracije uporabnika, pri aplikaciji Formative, pa se je potrebno prej še registrirati. Učitelji sestavimo kvize, v katere ne vključimo le besedilo, ampak tudi fotografije, posnetke z Youtube-a in ponudimo dva, tri ali štiri možne odgovore. Orodje Formative učitelju ponuja prav vse tradicionalne vrste vprašanj in odgovorov, ki smo jih navajeni iz šole – esejska vprašanja, kratka vprašanja in odgovori, prav-narobe, risanje po listu, izbira odgovora, izbira več pravilnih odgovorov … skratka brez omejitev. Za obe aplikaciji potrebujemo računalnik, priklopljen na interaktivno tablo in zvočnike. Učenci potrebujejo pametni telefon ali tablico, igri bi se lahko pridružili tudi preko prenosnega ali stacionarnega računalnika. Aplikacijo Kahoot lahko učenci brezplačno prenesejo na svoje naprave, lahko jo igrajo preko spletne strani Kahoot. Učenci se pridružijo igri s pomočjo PIN-a. Za Formative kviz se učenci pridružijo kvizu na spletni strani https://goformative.com s pomočjo posebnega gesla, ki je za vsak kviz drugačen. Pri Kahoot-u je čas, ki ga imajo učenci, da pritisnejo svoj odgovor, lahko omejen ali neomejen. Učenci poslušajo oz. vidijo vprašanje na interaktivni tabli, na svoji napravi izberejo le odgovor. Kot razliko smo opazili, da Formative nima časovne omejitve, medtem ko je pri Kahootu to vključeno. Na to lahko gledamo kot prednost, saj lahko s časovno omejitvijo učence spodbudimo k hitremu razmišljanju, ali pa kot slabost, ker lahko ta časovna stiska na učence deluje zaviralno. Oba kviza smo že poskusili igrati meddržavno, z oddaljenim razredom, istočasno, in lahko potrdimo, da deluje odlično. Edina težava, na katero smo tu naleteli, je da če na šoli nimate širokopasovne brezžične povezave, vsake toliko časa katerega učenca sistem odstrani iz igre. Tako da sedaj to težavo rešujemo tako, da se za uro Kahoot-a ali Formative-a selimo v učilnico, za katero vemo, da ima odlično brezžično povezavo.

Ob koncu kviza učitelji dobimo povratno informacijo za vsakega učenca, pri katerih odgovorih je bil uspešen in pri katerih ne, tako da lahko to uporabimo tudi za načrtovanje svojega nadaljnjega dela. Povratne informacije učenci pri reševanju Kahoot-a dobijo takoj po odgovoru, medtem ko v Formative učenci povratne informacije ne dobijo takoj, ampak jim jo lahko naknadno sporoči učitelj.

Obe orodji se nam zdita enostavni za uporabo, tako za učitelja kot tudi učenca. Kahoot je bolj primeren za hitro preverjanje znanja, Formative je namenjen temeljitejšemu pregledu nad znanjem učencev.

Aplikacijo Kahoot uporabljamo na naši šoli od 2. do 9. razreda in zaradi njene enostavnosti jo zelo priporočamo tudi za mlajše učence. Na sliki 1 je na levi strani vidna slika z vprašanjem in vsemi možnimi odgovori, ki jo učenci vidijo na interaktivni tabli, na desni stani pa štiri polja na njihovi mobilni napravi, med katerimi izbirajo pravilen odgovor.

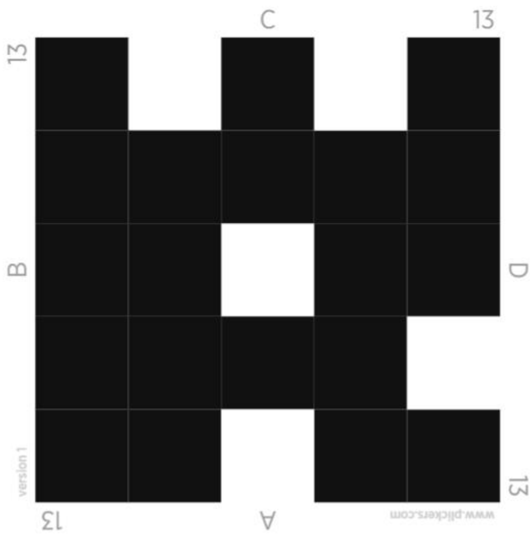


Slika 1: Kahoot **(vir: http://responsiblemanagement.net/kahoot-quizzes-textbook-principles-of-responsible-management/)**

Slika 2: Formative **(vir: https://www.commonsense.org/education/website/formative)**

2.3 Plickers

Plickers je brezplačna aplikacija, ki jo uporabljamo za utrjevanje znanja ali za različna tekmovanja. Sodelujejo lahko učenci le enega razreda, lahko pa vključimo tudi posameznike ali razrede iz drugih držav. Za Plickers potrebujemo računalnik, na katerem je naložena aplikacija in ki je povezan z interaktivno tablo in zvočnik. Učenci ne potrebujejo pametnih telefonov ali tablic. Vsak učenec dobi le kartico s QR kodo, ki jih pridobimo, ko si naložimo aplikacijo na računalnik. Primer QR kode je viden na sliki 3. Plickers je kviz, kjer učitelj postavi vprašanje in pove dva, tri ali štiri možne odgovore. Učenci se odločijo, kateri je pravilni odgovor ter obrnejo svojo QR kartico tako, da je črka pravilnega odgovora na vrhu njihove kartice. Učitelj nato uporabi svojo tablico ali pametni telefon in preko aplikacije Plickers in kamere poskenira vse dvignjene QR kode učencev. Na fotografiji 2 so četrtošolci z dvignjenimi karticami, ki čakajo, da jih učitelj poskenira. Učitelj v trenutku dobi vse njihove odgovore na svojo tablico. Po končanem kvizu lahko vidi poimenski seznam učencev in vse njihove pravilne ali napačne odgovore. Iz tega dobi povratno informacijo, kakšen je napredek posameznega učenca in katera so njegova/njena šibka področja.



Slika 3: Plickers kartica s QR kodo (vir: http://physiquechimiecollege.eklablog.com/plickers-a122933458)

Kviz se lahko izvaja tudi med različnimi državami. Oba učitelja se vpišeta pod istim uporabniškim imenom in istočasno izvajata kviz. Po naših izkušnjah je najboljša kombinacija kar v povezavi s Skype-om. Paziti je potrebno le, da se ista QR kartica ne dodeli dvema učencema. Na koncu spet dobimo poimenske rezultate za vse učence iz obeh držav. Verjetno bi lahko v kviz vključili tudi več držav, a zaenkrat tega še nismo poskusili.

Fotografija 2: Plickers kviz v 6. razredu (Foto: Lea O. Opravž)

2.4 Adobe Spark Video

Adobe Spark Video je brezplačen program, ki ga najlaže uporabljamo na računalniku. Namenjen je obdelavi videa in ustvarjanju različnih predstavitev. Je dokaj preprost za uporabo, saj ima na voljo različne prednastavljene predloge, kamor z lahkoto vstavite svoje fotografije, dodate priljubljeno glasbo in zraven posnamete tudi svoje komentarje ali razlage. Pri urah angleščine učenci uporabljajo Adobe Spark Video za izdelavo različnih projektov ali predstavitev. Za nekatere učence je to malo težje, ker niso toliko vajeni tovrstnega dela. Učenec ima vedno možnost, da naredi klasično predstavitev z zapiski v roki ali plakat, ampak če nekdo vseeno želi narediti digitalno, interaktivno predstavitev, mu je pri tem nudena vsa pomoč. V prvi vrsti imamo v razredih urejeno pomoč znotraj razreda. To pomeni, da se po pouku dobita učenec, ki potrebuje pomoč, in učenec, ki to zna narediti, v knjižnici, kjer so učencem na voljo računalniki in skupaj sestavita predstavitev. Če jima ne gre, se lahko vedno obrneta na nas učitelje ali na šolskega računalničarja. Učencem so predstavitve, narejene preko Adobe Spark Videa, še posebej všeč, saj jih lahko delijo/objavijo tudi na svojih socialnih omrežjih.

Slika 4: Adobe Spark Video (vir: https://teachingforward.net/social-stories-videos/)

2.5. Virtual Field Trips

Navidezni izleti preko Skype-a so predavanja in predstavitve strokovnjakov z določenega področja. Na portalu Mycrosoft in Education se nahaja seznam strokovnjakov iz različnih držav, ki so pripravljeni učencem predstaviti določeno tematiko ali celo kraj oziroma razstavo. Ta predavanja so vedno v angleščini in so brezplačna. Potekajo tako, da se pred predavanjem učitelji dogovorimo z izbranim strokovnjakom, kaj točno oziroma o čem bo predaval vašemu razredu in ga nujno opozorimo tudi na nivo znanja angleščine svojih učencev. Doživeli smo že, da nekateri predavatelji govorijo prestrokovno in prehitro, da bi jih lahko razumeli naši učenci. Učenci običajno pred in po virtualnem izletu dobijo delovni list, s katerim preverijo svoje znanje in poznavanje dane tematike pred in po virtualnem izletu. Izberemo si lahko različne tematike. Našim učencem je bil najbolj všeč gospod Ranjitsinh Disale iz Indije (fotografija

3), ki je našim petošolcem predstavljal svoj tematski park z dinozavri. Gospod Dizale nas je poklical preko Skype-a in ko je bil v parku, smo si preko njegove kamere vsi skupaj ogledali njegov tematski park, izvedeli veliko novega o dinozavrih, slišali njihovo oglašanje in preko prstov gospoda Dizala pritiskali na gumbke na informacijskih tablah in kričali, ko smo se skupaj z gospodom Dizalom peljali z vlakcem po prazgodovinski Indiji. S šestošolci smo na podoben način spoznavali piramide v Egiptu in se naučili veliko o tradicionalni kulinariki Argentine. V naslednjem šolskem letu se odpravljamo še na odkrivanje Amazonke v Brazilijo.

Učenci sami razmišljajo, kam bi lahko na podoben način popeljali učence iz tujih držav in jim na ta način predstavili lepote naše dežele.

Fotografija 3: Gospod Dizale iz Indije (Vir: Facebook)

3. ZAKLJUČEK

Menim, da lahko mi, učitelji, učencem ponudimo dosti več, kot smo dobili sami v času našega šolanja. Živimo v 21. stoletju, tehnologija je napredovala in s tem smo dobili možnost, da učencem podajamo snov na več načinov. Škoda bi bila, da ne bi uporabili tehnologije, ki je tudi našim učencem tako blizu. Seveda mora biti ta uporabna, ne prepogosta in strogo nadzorovana.

Pozitivnih učinkov vključevanja IKT v pouk je veliko. Učenci na ta način veliko pridobijo, še posebej pri tujem jeziku. Sam pouk postane bolj zanimiv, učenci so bolj motivirani. Veliko se naučijo, ne da bi se sploh zavedali, da se učijo. Že ko stopim v razred s škatlo tablic, se jim zasvetijo oči v pričakovanju, kaj zanimivega se bo dogajalo danes. Učenci na tak način dobijo večjo možnost komuniciranja v angleščini. Res je, da najprej potrebujejo nekaj časa, da se opogumijo in da spregovorijo, a ko ugotovijo, da jih oseba na drugi strani dejansko razume, se jim odpre cel nov svet. Veseli so tudi, ko začnejo odkrivati, da tudi učenci iz Brazilije in Bangladeša delajo slovnične napake, predvsem so ponosni nase, da so se že toliko naučili, da oni več ne delajo teh napak.

Preko modernih tehnologij v razredu dostopajo do ljudi in krajev na drugih koncih sveta, pogovarjajo se z njimi, jih spoznavajo in razumejo in s tem se zmanjša tudi njihova nestrpnost do drugih kultur.

Pa zaključimo z izjavo Alberta Einsteina: »Edini vir znanja so izkušnje« (Class VR, 2017). Vprašanje, ki se ob tem poraja nam učiteljem, je, kako prenesti nove izkušnje na učence znotraj fizičnih omejitev same učilnice? Odgovor na to lahko ponudijo moderni mediji in tehnologije skozi zanimive vsebine, ki pri učencih, ob pravilni uporabi, povečajo motiviranost, raven sodelovanja pri pouku, spodbujajo njihovo predstavo in razvijajo kreativnost. Ker je pri uporabi take tehnologije vključenih več čutil, je tudi raven pomnjenja učne snovi veliko večja kot pri klasičnemu pouku.

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Igrifikacija – motiviranje k učenju v modernem času

Gamification – motivating to learn in modern times

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POVZETEK

Izzivi poučevanja v dobi, ko so otroci vsakodnevno obkroženi s prenosnimi tehnologijami, družbenimi omrežji in so vpeti v digitalni svet, od učitelja zahtevajo nenehno sledenje novostim pri uporabi informacijsko-komunikacijske tehnologije. Razvijanje digitalnih kompetenc je za učitelja ena ključnih, saj le-ta prispeva k njegovi strokovni rasti in uspešnosti v razredu. Učenci so ob uporabi interaktivnih virov bolj motivirani za delo in se ob učenju tudi zabavajo. Učitelji se v razredu srečujemo z nizko motiviranostjo, nemirom in neustreznim vedenjem. Vse bolj je jasno, da so dnevi, ko so učenci izvajali enovrstno aktivnost celo šolsko uro, minili. Nova dognanja nevroznanosti na področju učenja nas silijo k spremembam. Le-te moramo vpeljati na način, ki je današnji generaciji blizu. Tu nam daje odlično priložnost koncept igrifikacije. Platforme Kahoot, Class Dojo in GoNoodle pa so lahko naši pomočniki pri uvajanju novosti.

Ključne besede

Igrifikacija v razredu, Kahoot!, Class dojo, pavza za možgane, GoNoodle

ABSTRACT

The challenges of teaching in an age where children are constantly surrounded by mobile devices, social networks and the digital world in general, require that teachers follow new developments in the field of information and communication technology. The development of digital competences is the key to professional development and classroom success. With the use of interactive resources, the students show a higher level of motivation and are having fun as well as learning. Teachers in the classroom are faced with low motivation, boredom, distraction, inattention and inappropriate behavior. It is clear that the days when students were doing one activity for the whole lesson are definitely over. New neuroscientific research in the field of education are making us change the process of learning. This change needs to made in a way that is this new generation of students feels close to. The concept of gamification is an excellent opportunity to do just that. Platforms such as Kahoot!, Class Dojo and GoNoodle are the tools that offer us just that.

Keywords

Gamification in the classroom, Kahoot!, Class Dojo, brain brake, GoNoodle

1. UVOD

Razvoj računalniške tehnologije je v 21. stoletju napredoval bliskovito. Z njenim razvojem se vsakodnevno spreminja tudi družba, v kateri živimo. Današnje življenje si je težko predstavljati brez pametnih telefonov, tablic in prenosnih računalnikov. Lahko bi celo rekla, da so ti pripomočki postali naš podaljšek, t. i. tretja roka. Če so včasih majhni otroci sestavljali lesene kocke, s poskušanjem ugotavljali, katera telesa sodijo v katero luknjo, je danes mogoče opaziti vse več majhnih otrok (malčkov), ki brez problema obvladajo zaslone na dotik na pametnih telefonih in tablicah. Nova generacija ima veliko digitalnih kompetenc, ki so ključnega pomena za uspešno delovanje v sodobni družbi, tako rekoč položenih v zibko. Za uspešen vzgojno-izobraževalni proces mora zato učitelj slediti novim trendom, ki jih prinašata razvoj in uporaba informacijske tehnologije ter jo vpeljevati v svoje delo. Slediti mora strateškim usmeritvam vseživljenjskega učenja, ki med drugim pravijo, da mora učenje potekati skozi vse življenje in za potrebe dela.[7] Današnji otroci so t. i. digitalni domorodci. Odraščajo v stiku z digitalno tehnologijo in imajo drugačne učne stile, nov pristop k učnemu procesu in višje zahteve do procesa poučevanja in učenja. Učitelji so soočeni z novimi izzivi, kako prilagoditi učne oblike in metode, da bodo ustrezale novim generacijam otrok, ki sedaj prihajajo v šolo. Otroci od nas vse bolj zahtevajo, da so aktivni motivirani soudeleženci v učnem procesu. Moderne učne paradigme in trendi v poučevanju, podkrepljeni z uporabo sodobne tehnologije, ustvarjajo predpogoje za uporabo novih pristopov in učnih metod, s katerimi ustvarjamo okolje za aktivno učenje.[6]

Ena izmed novejših metod je koncept igrifikacije, s pomočjo katerega se pedagoškemu procesu dodaja elemente iger, kar popestri proces izobraževanja. S tem lahko učenci pridobijo večjo motivacijo za učenje, kar pa lahko pripelje tudi do boljših učnih rezultatov.[5] Oblikovanje inovativnih učnih okolij pomeni odgovor vzgojno-izobraževalnega sistema na zahteve sodobne družbe, ki z vedno večjo kompleksnostjo ob hitrih ekonomskih in socialnih spremembah za šolo gotovo pomenijo nov izziv. Spremembe danes namreč zahtevajo oblikovanje kakovostnega učnega okolja, v katerem bo učenec lahko razvil spretnosti 21. stoletja, kot so ustvarjalnost in inovativnost, kritično mišljenje in reševanje problemov, zmožnost učinkovitega komuniciranja ter spretnosti medsebojnega sodelovanja.[10]

Za učinkovito učenje morajo možgani pošiljati informacije, ki jih dobijo prek čutil (kar slišimo, vidimo, preberemo, občutimo, si predstavljamo in doživimo) v predel možganov, namenjen pomnjenju – spomin. Na našo sposobnost shranjevanja v spominsko bazo najbolj vplivata stres in preobremenjenost. Da nova informacija postane spomin, mora skozi čustveni filter, ki se imenuje amigdala in šele nato preide v prefrontalni korteks. Ko učenčevi možgani postanejo anksiozni, zelo zmedeni ali preobremenjeni, amigdala zaustavi prehajanje informacij. Nove informacije ne prehajajo več v prefrontalni korteks in s tem v spominski del možganov. Tudi če učenci niso v stresni situaciji zaradi hitrosti ali vsebine nove snovi, pridejo do točke, ko amigdala prekorači svojo kapaciteto pretvajanja informacij skozi svojo mrežo v spomin. Tako reakcijo lahko preprečimo s pomočjo t. i. ″brain breakov″.[13]

Da bo učenje uspešno, vse pogosteje poslušamo o formativnem spremljanju, procesu za izboljšanje znanja, kjer učitelj učencu daje povratno informacijo v obliki nasveta za izboljšanje znanja in ne kot analizo napak v preteklosti ali celo sodbo v obliki ocene.[12]

Namen prispevka je predstaviti tri spletne aplikacije Kahoot!, Class Dojo in GoNoodle, ki omogočajo sodobne načine učenja, preverjanja predznanja, ponavljanja in utrjevanja znanja, spremljanja vedenja učencev, formativno spremljanje, v pouk vnesejo elemente igrifikacije z brain brake-om in nekatere primere njihovih praktičnih uporab pri pouku.

2. IGRIFIKACIJA

Igra že vse od začetka razvoja človeka predstavlja zabavo in sprostitev, obenem pa človek skozi igro pozabi na vse stresne trenutke. Otroci se skozi igro učijo pomembnih veščin 21. stoletja. Spodbujajo k medsebojnemu sodelovanju, da se kaj naučimo in nas silijo k razvoju. Izraz igrifikacija je prvič uporabil Nick Pelling v poslovnem svetu leta 2002. Od leta 2010 pa je termin postal široko uporabljen v poslovnem in izobraževalnem svetu. Igrifikacija pomeni, da uporabimo način razmišljanja, pristop in elemente, ki jih imamo v igri, in le-te postavimo v drugačen okvir. Uporaba mehanizmov igre izboljša motivacijo in učenje v formalnih in neformalnih oblikah.[6] Pri igrifikaciji se uporablja nekatere pomembne lastnosti iger:

- vsi lahko sodelujejo,
- naloge, ki jih igralci izvajajo, so ciljno naravnane,
- točke se pridobivajo z doseganjem cilja.

Raziskave so pokazale, da uporaba igrifikacije izboljša učenje novega znanja za 40 %. Tak uspeh se pripisuje tudi aktivni vlogi sodelujočih v procesu učenja s pomočjo igrifikacije.

3. KAHOOT!

Kahoot je brezplačna spletna platforma, ki omogoča učenje na zabaven in interaktiven način. Gre za digitalno platform, kjer učenci odgovarjajo na vprašanja na osnovi igrifikacije. Učiteljem in učencem v razredu omogoča interakcijo na osnovi učno tekmovalnih iger. Razvija metakognitivne sposobnosti, empatijo, skupinsko delo in povečuje motiviranost za učenje.[4] Do nje lahko dostopamo preko telefona, tabličnega računalnika ali prenosnika. Ponujeni sta dve možnosti uporabe: preko aplikacije ali spletnega brskalnika. Aplikacija je dostopna v vseh sistemih Android in iOS. Platformo uporabljajo učitelji, učenci, podjetja in vsi, ki so vključeni v vseživljenjsko učenje. S Kahootom je mogoče sestaviti KAHOOT (»igro/kviz«) v katerem koli jeziku in na katero koli temo v zelo kratkem času. Platforma ima veliko zbirko (t. i. knjižnico) že obstoječih iger, med katerimi lahko izbiramo in jih prilagodimo svojim učnim ciljem in potrebam. Igramo ga lahko »v živo« s pomočjo projekcije na velikem zaslonu ali preko povezave, ki je aktivna samo določen čas. Kahoot nam ponuja več možnih iger. Lahko ustvarimo kvize z več možnimi odgovori, med katerimi učenci izbirajo, ali kvize, kjer je potrebno odgovore razvrstiti v pravilni vrstni red. Lahko ga uporabljamo za vodeni razgovor ali kot vprašalnik. Vrsto vprašanj in število odgovorov prepuščajo izdelovalcu kviza. V kviz lahko dodamo video posnetke, slike in diagrame, s katerimi lahko zadovoljimo večjo paleto učnih stilov (vizualni, avditivni, kinestetični).

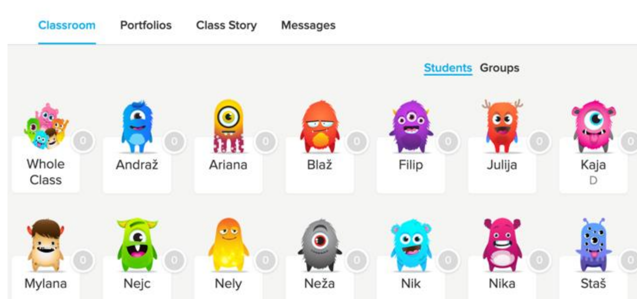
3.1 Formativno spremljanje s Kahoot-om

Kahoot nam ponuja tudi povratno informacijo o uspehu vsakega posameznega učenca za vsako vprašanje. Takšna informacija pa je dragocen pripomoček za formativno spremljanje. Z uporabo rezultatov lahko spremljamo in analiziramo učenčev uspeh in njegov napredek ter mu pri tem damo dragoceno povratno informacijo o njegovem znanju in napredku. Spremljanje je formativno, ko je povratna informacija v obliki nasveta za izboljšanje znanja in ne analize napak za nazaj ali celo sodbe v obliki ocene.[12] Rezultate si lahko takoj po igri prenesemo za vpogled ali pa do njih dostopamo preko zavihka Reports. Tam so rezultati vseh odigranih kvizov v kronološkem vrstnem redu. Lahko jih prenesemo v obliki Excelove datoteke ali shranimo na Google Drive. Ko odpremo datoteko, takoj vidimo osnovne podatke, npr. kdo je bil upravitelj igre, koliko je bilo sodelujočih, koliko vprašanj je bilo odgovorjenih, odstotek pravilnih in nepravilnih odgovorov in povratno informacijo učencev o kvizu. V Excelovih zavihkih si lahko ogledate rezultate po različnih kriterijih in končni rezultat vseh igralcev po vrstnem redu s številom pravilnih in nepravilnih odgovorov. Vsako vprašanje ima svoj zavihek, kjer si lahko ogledate rezultate učencev, si ustvarite sliko njihovega znanja in pripravite strategijo za izboljšanje znanja učencev.

4. CLASS DOJO

Class dojo je brezplačna spletna aplikacija, namenjena predvsem učiteljem. Gre za aplikacijo, ki nam pomaga v učencih ustvarjati pozitivne in ustrezne modele obnašanja, jih motivira, hitro razdeli v skupine in učitelju daje možnost učencem po principu igrifikacije dodeljevati točke ali dojo-te. Po potrebi ali želji lahko učitelj k uporabi aplikacije povabi tudi starše, z njimi deli uspeh učencev in vsakodnevno dogajanje pri pouku preko fotografij ali krajših video posnetkov. Učitelj na platformi ustvari svoj brezplačni profil. Ustvari razred in vanj vnese učence. Vsak učenec ob vnosu pridobi svoj avatar ali - kot jih imenujejo učenci - svojega pošastka. Avatarju lahko skozi uro dodelujemo pozitivne ali negativne točke. Učitelj lahko s programom operira preko računalnika ali preko aplikacije na mobilnem telefonu ali tabličnem računalniku. Vsakič, ko učitelj dodeli točko, program z zvokom opozori razred. Vsaka točka se shrani na otrokov profil in jo lahko pogledamo skozi celo leto. Sami se odločimo, katere vrednote so za naš oddelek pomembne. Lahko se odločamo med že obstoječimi: pomoč drugim, zbrano delo, sodelovanje, vztrajnost, skupinsko delo, trdo delo ali pa določimo svoje.

Za učitelja, ki ima težave v razredu, je to odlično orodje, s katerim lahko spremlja izboljšave na področju vedenja. Najprej mora seveda določiti, katere vidike vedenja v razredu je potrebno izboljšati. Vsaka postavka ima lahko individualno vrednost točk (od 1 do 5). V primeru, da učenec pride k pouku nepripravljen ali brez domače naloge, pa lahko točke izgubi. Starše se k sodelovanju lahko povabi preko pisnega vabila ali emaila, ki vsebuje kodo, s katero dostopajo do profila svojega otroka.



Slika 1. Prikaz avatarjev

Učiteljeva stran ima tri podmenije: učilnica, razredna zgodba in sporočila. V meniju učilnica si učitelj lahko pogleda, koliko točk je zbral posamezen oddelek, posamezen učenec in ustvarja poročila o vedenju. Ravno tako si lahko ogledamo poročilo o prisotnosti in različne grafe, ki prikazujejo vedenjske vzorce učencev ali celega razreda. V razredni zgodbi lahko učitelj objavlja fotografije ali videoposnetke dogajanja v razredu. Sporočila pa omogočajo pošiljanje sporočil staršem. Pri uporabi platforme v razredu ima učitelj kar nekaj privlačnih orodij za lažjo izpeljavo ure. Sama veliko uporabljam naslednja orodja. Na voljo je časovnik, izbira naključnega učenca, izdelovalec skupin, merilec glasnosti, navodila za delo, vprašanja za razmišljanje ali razpravo, danes – potek dela v razredu in glasba (glasba za aktivno delo ali umirjena glasba za zbrano delo). Sama sem zelo veliko uporabljala izdelovalca skupin. To orodje v 2 sekundah ustvari skupine s številom učencev, ki jih želimo v skupini. Ravno tako pa nam nudi možnost, da določimo, kateri učenci ne smejo biti skupaj v skupini. S tem lahko nekompatibilne učence že vnaprej ločimo v različne skupine. V primeru, ko želimo, da vsi učenci sodelujejo pri odgovarjanju v naključnem vrstnem redu, je orodje naključni učenec odlična izbira. Ker lahko platformo naložimo na mobilne naprave kot aplikacijo, se lahko po učilnici prosto sprehajamo in izbiramo naključne učence. Učenci se na spodbude in pridobivanje točk odzivajo zelo pozitivno. Veselijo se točk in skušajo svoje vedenje čim bolj uskladiti s pravili, ki veljajo pri pouku.

Raziskovalci na oddelku za izobraževanje na St. Mary's College of Maryland so opravili tritedensko raziskavo o učinkovitosti Class Doja. Raziskava je primerjala vedenje pred in po uporabi Class Doja. Raziskovalci so ugotovili, da je prišlo do povečanja pozitivnega in samopopravnega vedenja pri učencih ter da so se negativne oblike vedenja bistveno zmanjšale. Prav tako so postali učenci bolj motivirani in so sprejemali osebno odgovornost za vedenje v šoli. Do enake ugotovitve so prišli na Univerzi St. Catherine, kjer so opravili študijo, dolgo 6 tednov.[2]

5. GONOODLE

GoNoodle je spletna platforma, ki nudi različne aktivnosti za pavze med poukom.

5.1 Nevroznanost o počitkih za možgane oziroma brain brakes

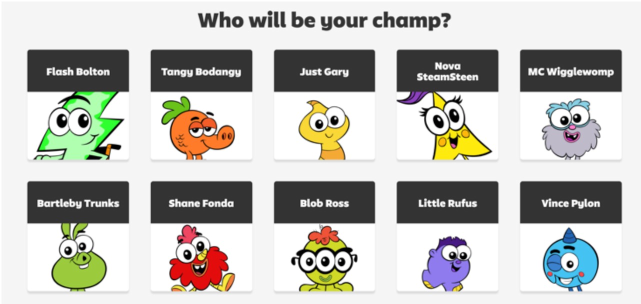
Kot sem povedala že v uvodu, anksioznost, preobremenjenost in preutrujenost povzročijo, da amigdala ne prepušča več informacij v prefrontalni korteks in s tem preprečuje ustvarjanje spomina. Pavze med učnim procesom lahko načrtujemo na tak način, da se učenec povrne v stanje, ko je amigdala znova v optimalnem stanju za prepuščanje informacij.

Nevrotransmiterji ali živčni prenašalci so skupina heterogenih biokemičnih snovi, ki prenašajo informacije med nevroni preko sinaps.[1] Ti prenašalci so nujni za umirjenost, pozornost in ohranjanje spomina. Vsaka sinapsa ima omejeno količino nevrotransmiterjev in lahko jih uporabimo v npr. 10 minutne, ponavljajoče učne aktivnosti (pozorno poslušanje, urjenje, pisanje zapiskov). S tem, ko naredimo pavzo oz. prekinitev neke miselne aktivnosti in jo zamenjamo z drugo aktivnostjo, prestavimo komunikacijo možganov na drugo "omrežje", ki je še polno nevrotransmiterjev. Taka pavza povzroči, da se biokemične substance v "počivajočem" omrežju obnovijo. [13] Seveda se takoj postavi vprašanje, kdaj prekiniti neko aktivnost s pavzo za možgane. Brain brake je potrebno opraviti, preden se začne utrujenost, zdolgočasenost, odvračanje pozornosti in nepozornost. Za razredno stopnjo velja, da je tak čas približno na 10-15 minut, za predmetno stopnjo ter srednjo šolo na 20-30 minut. Pavza naj bi trajala 3-5 minut. Učitelju se v glavi takoj porajajo misli o neučinkovitosti, hrupu v učilnici ipd. Večinoma je dovolj, da se učenci dobro pretegnejo, premaknejo na drugo mesto v učilnici ali pa zapojejo pesem. [13]

V nadaljevanju bom predstavila spletno platformo GoNoodle, ki s pomočjo igrifikacije nudi hiter in učinkovit način pavz za možgane.

5.2 Spletna platforma GoNoodle

GoNoodle je brezplačna spletna platforma (seveda jo lahko nadgradite v plačljivo plus izvedbo), ki nudi veliko število kratkih interaktivnih gibalnih dejavnosti. Mednje sodijo pesmi, plesi, vaje za čuječnost, umirjanje, dihalne vaje, tek in poskoki. S prijavo v platformo si ustvarite račun in v svojem računu lahko ustvarite več razredov. In sedaj pridemo do elementa igrifikacije. Z učenci v razredu nato izberemo junaka, ki se bo spreminjal in rastel s pomočjo njihove aktivnosti. Ko junak zraste, učenci izberejo novega.



Slika 2. Prikaz junakov

Učitelj nato izbira med mnogimi aktivnostmi za pavze: raztezanje, šport, voden ples, dihanje, joga za otroke in različne pesmi. Otroci si vedno izberejo aktivnosti, ki so jim najljubše in v njih vzbujajo pozitivne občutke. Le-te lahko označimo kot priljubljene za posamezen oddelek.

Pri naših učencih je seveda problem v jeziku, saj je vse v angleščini. Izbiramo dejavnosti, pri kateri razumevanje jezika ni pomembno ali pa lahko, če učitelj razume (vsaj pri vajah za čuječnost), sproti prevaja. Sama sem platformo uporabljala pri pouku angleščine v 1. triadi in 4. razredu. Učenci so bili navdušeni nad tem, da lahko z gibanjem prispevajo k rasti svojega junaka. Izvajali smo aktivnosti, ki so se deloma povezovale tudi z letno delovno pripravo za razred. S pomočjo programa so bili učenci po pavzi veliko bolj motivirani za delo kot prej. S svežim pristopom so nadaljevali učenje in v treh minutah so nezavedno sprejemali zvočnost angleškega jezika, se gibali in poskrbeli za ponovno vzpostavitev nevrotransmiterjev v omrežju, ki ga potrebujejo za učenje tujega jezika.

6. ZAKLJUČEK

Živimo v času, ko našo osnovno šolo obiskujejo otroci t. i. digitalne generacije oziroma - kot jih imenujejo nekateri - digitalni domorodci. Prensky (2001), idejni oče skovanke digitalni domorodci, z njo opisuje generacije, ki odraščajo z digitalno tehnologijo in z »maternim« digitalnim jezikom, zato so njihova osebna izkustva informiranja, komuniciranja, povezovanja in tudi učenja radikalno drugačna od izkustev predhodnih analognih generacij.[3] Spremenjene vsakdanje navade digitalnih generacij so po izsledkih nekaterih študij (Vincze, 2015, Jones, 2010, Livingstone, 2012) povezane z določenimi spremembami tudi na ravni učnih spretnosti, veščin ter kompetenc, ki naj bi zaznamovale sodobne digitalne generacije. Otroci so nenehno povezani z digitalnimi mediji, poslušajo glasbo, igrajo interaktivne igre, se učijo in iščejo informacije, ki jih zanimajo. Temu moramo prilagoditi tudi načine poučevanja, interakcijo z učenci in naš pristop k reševanju problemov, s katerimi se srečujemo v razredni situaciji. Ena izmed zelo učinkovitih metod, ki se nam ponuja v današnjem času, je igrifikacija. Z njo se lahko lotimo reševanja cele palete problemov, ki jih imamo razredu. Od nizke motivacije, nemira, nezbranosti do neustreznega vedenja. Spletne platforme, ki sem jih predstavila, nam ponujajo možnost, da se spopademo s temi problemi na način, ki je današnjim otrokom blizu.

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Zabavno preverjanje znanja s Plickersom

Amusing assessment of knowledge with Plickers

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POVZETEK

Za sprotno preverjanje znanja učencev lahko uporabljamo različne prijeme. Bolj kot so zanimivi, učinkovitejši so. Pri tem so nam lahko v veliko pomoč tudi mobilne naprave in razne aplikacije. Eno izmed uporabnih spletnih orodij je tudi spletno orodje Plickers, ki nam omogoča preprosto sestavo vprašanj izbirnega tipa za sprotno preverjanje znanja.

Ključne besede

Preverjanje znanja, vprašanja izbirnega tipa, Plickers

ABSTRACT

Various approaches can be used for continuous assessment of students' knowledge. The more interesting they are, the more effective they are. Mobile devices and various applications can be of great assistance. One of more useful web applications is Plickers which can be used to easily generate multiple-choice questions for continuous assessment.

Keywords

Assessment of knowledge, multiple-choice questions, Plickers

1. UVOD

Željo po znanju lahko pri učencih sprožimo na različne načine. Bolj so motivirani za delo, boljši je uspeh. Če uspemo učence motivirati in v njih vzbuditi pozitivna čustva, smo na dobri poti, kajti motivacija in čustva imata bistveno vlogo pri učenju [1]. Zagotavljajo namreč, da učenci usvojijo znanje in veščine na zanje smiseln način. Če bi bile dejavnosti vedno zanimive in zabavne, bi učence že same po sebi pritegnile. Zato moramo učitelji prilagajati načrtovanje in poučevanje tako, da pripravljamo za učence zanimive didaktične dejavnosti, ki ustrezajo namenu in ki jih učenci z veseljem opravljajo.

1.1 Vloga učitelja za uspešno poučevanje

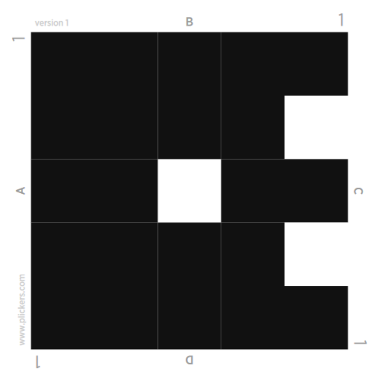
Mladi učitelji so zelo dobro opremljeni z znanjem ter obvladovanjem učne snovi, manj pa s samim poučevanjem. Vloga današnjega učitelja za uspešno učenje in poučevanje je predvsem kot spodbujevalec in moderator učenja in ne več le kot prenašalec znanja [2]. Za celovito učenje pa je pomembno tako učno okolje, kot tudi tehnike in načini podajanja snovi. Optimalno učno okolje je tisto, v katerem smo sproščeni in brez stresnih pritiskov (naravna svetloba, svetle učilnice v pastelnih barvah, na stenah plakati in slike, ki se skladajo z učno vsebino …). Učitelj naj pri učencih spodbuja domišljijo, humor, nudi priložnost za pristno komuniciranje, se prilagaja namenu učne situacije ter uporablja pristope za brezstresno podajanje učne snovi skozi igro. Vsi, nekateri bolj, drugi manj, smo omejeni in pogojeni z lastnimi prepričanji o sebi, drugih in o svetu [3]. Neuspeh v šoli je pogosto predvsem posledica napačnih predstav, ki jih je učenec dobil o svoji sposobnosti, in ne toliko posledica premajhne nadarjenosti in prizadevnosti [4]. Pomembno vlogo pri tem ima tudi učitelj, saj lahko takšnim učencem pomaga preseči tisto, kar jih omejuje. S svojim ustvarjalnim pristopom lahko pri učencih vzbudi zanimanje za neki predmet in jih tudi motivira za delo in učenje. Pri samem učnem procesu je zelo pomembno sprotno preverjanje znanja, saj nam omogoča vpogled kako smo bili učinkoviti pri podajanju določenih učnih vsebin. Sprotno preverjanje znanja pa lahko izvajamo na različne načine.

1.2 Preverjanje znanja

Načinov preverjanja znanja je zelo veliko. Nekatere metode zahtevajo več, druge manj priprav in pripomočkov [2]. V zadnjem času se je veliko osnovnih šol moderniziralo in odločilo za nakup interaktivnih tabel. Na spletu je ogromno interaktivnih nalog in vsebin, ki učiteljem predstavljajo izzive in nove priložnosti na področju učenja in poučevanja. Med njimi je tudi spletno orodje Plickers, ki omogoča sestavo vprašanj izbirnega tipa. Ker je med učenci zelo dobro sprejeto in nam omogoča hitro preverjanje osvojenega znanja ali kratko ponovitev snovi, bi rada predstavila primer dobre prakse pri naravoslovju v sedmem razredu [5].

2. PRIMER DOBRE PRAKSE - PLICKERS

Plickers je spletno orodje, ki nam omogoča pripravo vprašanj izbirnega tipa. Za samo izvedbo potrebujemo pametni telefon ali tablico, kartice za učence ter računalnik s projektorjem. Registracijo uredimo na spletni strani [6]. Registracija je možna z Google računom ali elektronskim naslovom. Program nam omogoča kratko predstavitev preden se lotimo dela. Za izvedbo učenci potrebujejo vsak svojo kartico za odgovor (Slika 1), ki jo lahko brezplačno natisnemo s prej omenjene spletne strani.

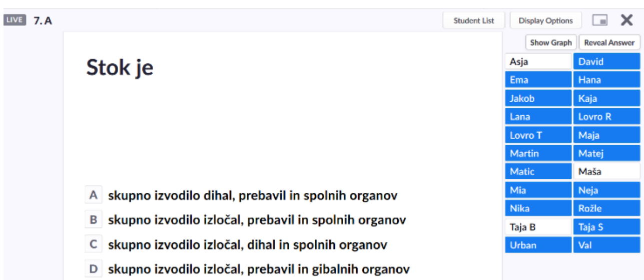


Slika 1. Kartica učenca z zaporedno številko 1

Vsaka kartica je uniktna – ima edinstven vzorec, tako da učenci ne morejo svojih odgovorov primerjati s sošolcem (Slika 1). Kartice razdelimo učencem po abecednem vrstnem redu, kakor so zapisani v redovalnici. Tako učenci takoj vedo katera kartica je njihova. Po tem ključu tudi vpišemo učence v spletno orodje Plickers. Na pametni telefon ali tablico naložimo aplikacijo Plickers, ki jo lahko brezplačno prenesemo z uporabo orodja Trgovina Play. V spletnem orodju Plickers izberemo New Class in vpišemo učence po abecednem vrstnem redu. S klikom na New Set lahko sestavimo niz petih vprašanj izbirnega tipa. Vprašanjem lahko vstavimo tudi sliko (Slika 2).

Slika 2. Primer vprašanja

Ko smo v spletno orodje vnesli seznam učencev in sestavili vprašanja, pričnemo z izvedbo. V spletnem orodju izberemo razred ter pritisnemo Play Now. Na pametnem telefonu ali tablici odpremo aplikacijo Plickers ter pritisnemo na moder obroč. Učenci na projekciji vidijo vprašanja ter seznam vseh učencev v razredu. S kamero pametnega telefona ali tablice poskeniramo kartice učencev (Slika 4). Tistim učencem, katerim je kamera zaznala kartico z odgovorom, se imena na seznamu obarvajo modro (Slika 3).

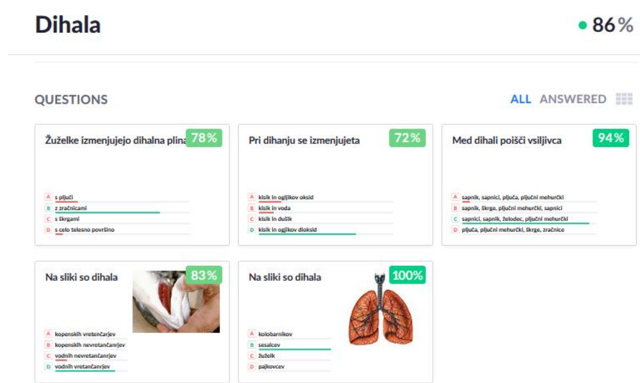


Slika 3. Projekcija na tabli

Slika 4. Učenci odgovarjajo na vprašanja

Učitelj na ekranu pametnega telefona ali tablice vidi kateri učenci so odgovorili pravilno (tem učencem se ob imenu prikaže zelena pika) in kateri so se zmotili (ob imenu se pokaže rdeča pika).

Po končanem preverjanju nam spletno orodje ponuja povratno informacijo o reševanju nalog. Za vsako nalogo nam v odstotkih prikaže v kolikšni meri je bila naloga pravilno rešena (Slika 5).



Slika 5. Statistika nalog

Prav tako pa ponuja povratno informacijo tudi za učence. V odstotkih prikaže v kolikšni meri so učenci pravilno rešili vseh pet nalog, kateri odgovor so izbrali pri določeni nalogi in ali je bil izbran odgovor pravilen (obarvan je z zeleno) ali pa napačen (obarvan je z rdečo). Omogoča pa tudi pregled vseh preverjanj, ki smo jih izvedli v posameznem razredu. Na ta način lahko ugotovimo napredek pri učencih, če ponovimo isti niz vprašanj čez nekaj časa.

3. REZULTATI

Sprotno preverjanje znanja z orodjem Plickers je enostavno, hitro in zelo dobro sprejeto pri učencih. Uporabljamo ga lahko tudi za preverjanje predznanja učencev na začetku posameznega učnega sklopa. Niz istih vprašanj nato ponovimo tudi po obravnavani učni snovi. Ker nam program omogoča vpogled kako so učenci odgovarjali na vprašanja pred in po obravnavani učni snovi, lahko opazujemo njihov napredek. Učence pa lahko tudi aktivno vključimo v proces sestavljanja nalog – jim dodelimo vlogo učitelja. Tako so še toliko bolj motivirani za delo, sestavljajo bolj kreativna vprašanja, saj želijo za sošolce iz paralelnega razreda sestaviti čimbolj zagonetna vprašanja.

Seveda pa nobena metoda ni idealna. Tudi preverjanje znanja s tem spletnim orodjem ima svoje pomanjkljivosti. Vsega obsega snovi ne moremo preverjati samo z vprašanji izbirnega tipa, prav tako pri takšnem načinu preverjanja posegamo le po nižjih taksonomskih stopnjah [7]. Spletno orodje nam v brezplačni registraciji omogoča sestavo preverjanja s samo petim nizom vprašanj. Da postane praktična izvedba hitra, je potrebno kar nekaj ponovitev – razdeljevanje kartic po številkah zna biti tudi zamudno.

4. ZAKLJUČEK

Kljub pomanjkljivostim, pa je spletno orodje zabavno in dobrodošlo za popestritev pouka. Uporabljamo ga lahko tudi na razrednih urah, za ponovitev vsebin različnih dnevov dejavnosti in podobno.

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Utrjevanje geometrije z uporabo IKT v 2. razredu

Practising geometry in 2nd grade using ICT

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POVZETEK
Mnoge raziskave so potrdile, da je pouk z vključevanjem informacijsko-komunikacijske tehnologije (IKT) učencem bolj privlačen in vodi do boljših učnih rezultatov. Pred nekaj leti smo izdelali model vključevanja računalnika v pouk geometrije za drugošolce ter ga preizkusili v eksperimentalni skupini dvajsetih učencev. Z raziskavo smo dokazali, da vključevanje računalnika pozitivno vpliva na doseganje ciljev geometrije, še posebej ravninske. Od tedaj IKT redno uporabljamo pri pouku geometrije ter jo tudi nadgrajujemo z novimi vsebinami. V prispevku predstavljamo nekaj nalog, s pomočjo katerih učenci pridobivajo in utrjujejo znanje geometrije.

Ključne besede
Matematika, geometrija, utrjevanje, računalnik

ABSTRACT
A large body of evidence indicates the application of information and communications technology (ICT) in classroom activities both appeals to pupils and results in more favourable learning outcomes. Several years ago, we devised a pilot project introducing a computer-assisted geometry lessons to a selected group of twenty second-graders. The research clearly demonstrated a positive effect of using a computer program on meeting learning objectives in planar geometry. Ever since, ICT has been used regularly in teaching geometry with updates added to its content. This article presents a handful of tasks whereby pupils acquire and consolidate their knowledge on geometry.

Keywords
Mathematics, geometry, consolidation, computer

1. UVOD
IKT nas danes spremlja na vsakem koraku, na vseh področjih življenja. Menimo, da je zato nujno potrebno, da jo vključujemo v pouk in tako najmlajšim učencem, ki običajno v njej vidijo predvsem zabavo, približamo tudi njene izobraževalne potenciale ter hkrati dvigujemo digitalno pismenost med učenci.

V učnem načrtu za matematiko [6] v prvem izobraževalnem obdobju uporaba IKT ni omenjena, najdemo jo zgolj v splošnih didaktičnih priporočilih, zato je vključevanje le-te v pouk odvisno od učitelja samega. Upoštevati mora usposobljenost učencev za uporabo IKT, pripraviti učne vsebine, predvideti strukturo in potek učnega procesa ter vključevanje učencev. V času izvajanja spremlja delo učencev, jim svetuje ter daje povratne informacije.

Ko smo pred nekaj leti za namen raziskave pripravljali naloge za pouk geometrije v 2. razredu, smo ugotovili, da ustrezne programske opreme za najmlajše učence ni veliko, saj večina spletnih vsebin ni na voljo v slovenskem jeziku. Uporabili smo programski paket Igrive številke 1 in 2 [1], idejno zasnovali igro SlikoKviz, za doseganje ciljev s področja dvodimenzionalne geometrije (liki, črte) pa smo uporabili program Slikar (OS Windows). Vključili smo tudi nekaj tujih spletnih iger, kjer za delo ni bilo potrebno razumevanje navodil.

Oblikovali smo dejavnosti, ki so jih učenci izvajali s pomočjo omenjenih programov. V razredu nimamo interaktivne table, zato smo uporabljali računalniško učilnico, kjer je vsak učenec imel svoj računalnik in po potrebi slušalke, ali pa smo naloge vključili v delo po postajah v razredu na dveh računalnikih (stacionarnem in prenosnem). Učenci so naloge najpogosteje reševali individualno, občasno tudi v parih.

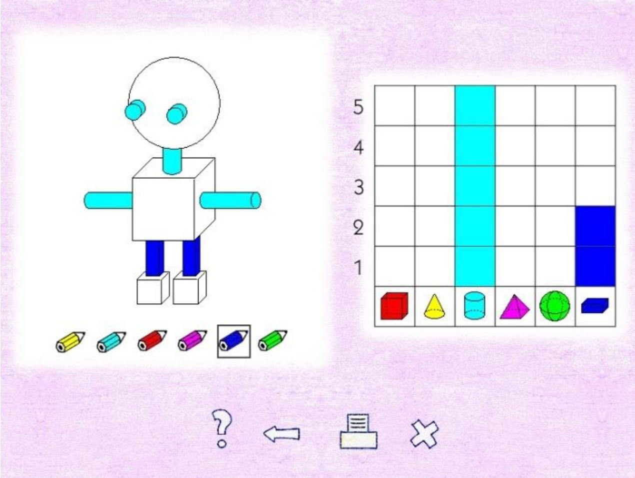
Ker z vključevanjem IKT začnemo že v 1. razredu, je večina učencev računalniško pismenih do te mere, da jim uporaba miške in tipkovnice ter poznavanje osnovnih funkcijskih tipk ne dela težav.

2. UTRJEVANJE GEOMETRIJE Z IKT
V nadaljevanju predstavljamo nekaj didaktičnih iger in dejavnosti [3], ki so jih učenci reševali v okviru pouka geometrije v 2. razredu. Sledili smo naslednjim ciljem:

- učenec se navaja na uporabo IKT pri učenju matematike,
- prepozna in zna poimenovati preprosta geometrijska telesa,
- razvija prostorske in ploskovne predstave,
- prepozna, zna poimenovati in risati preproste geometrijske like v programu Slikar,
- prepozna nekatere lastnosti posameznih geometrijskih likov,
- zna dani sliki poiskati simetrično polovico in simetrično dopolniti sliko,
- zna v programu Slikar risati ravne, krive, sklenjene in nesklenjene črte ter označiti presečišča.

2.1 Iz česa sem sestavljen
Učenci v programu Igrive številke 1 [1] izberejo didaktični program Telesa. Na stikalu sredi 'sobe' imajo možnost vklopiti ali izklopiti izpolnjevanje preglednice. Dogovorimo se, da najprej poimenujejo vsa telesa v razpredelnici in s klikom nanje aktivirajo zvočno poimenovanje ter tako preverijo pravilnost poimenovanja.

Nato izberejo sestavljanko iz teles in jo ustrezno pobarvajo (barvo določa telo v preglednici). Zvočni signal potrdi pravilno pobarvano telo ali jih opozori na napako.



Slika 1. Sestavljanka v programu Telesa (Igrive številke 1)

2.2 Določi pogled

Učencem, ki imajo zelo dobro prostorsko predstavljivost, ponudimo spletno igro *Point out the view* – Določi pogled [5] (bližnjico predhodno ustvarimo na namizju).

Na mrežastem polju so v določeno obliko sestavljene kocke (različno število). Učenci morajo ugotoviti, kako jih vidijo otroci, in to predstaviti na prazni mreži (dvodimenzionalno). Ko označijo ustrezna polja, s klikom na gumb OK dobijo povratno informacijo (zelena barva pomeni pravilno označitev, oranžna napačno; v pomoč je gumb *hint* – namig, ki na telesu osvetli določen del, enaka barva se pojavi tudi v razpredelnici in učencu pomaga pri orientaciji). Igro nadaljujejo s klikom na gumb *rotate* (zavrti) in tako določijo poglede vseh štirih otrok.

Igra ima več stopenj. Učenec lahko nadaljuje na naslednjo stopnjo takrat, ko določi vse štiri poglede pri eni obliki.

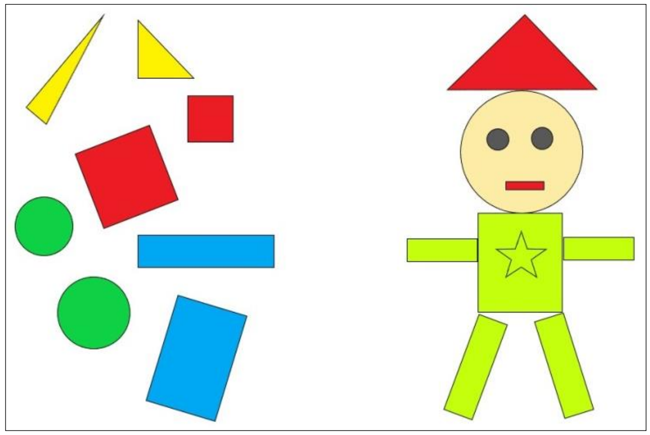
Slika 2. Prva stopnja igre *Point out the view* (Določi pogled)

2.3 Rišemo like

Učenci zaženejo program Slikar v OS Windows. Vodeno rišejo različne like (kroge, kvadrate, pravokotnike in trikotnike) z orodjem za risanje likov (2D-oblike). Poizkusijo oblikovati čim bolj raznovrstne like (široke, ozke, različno orientirane, različno velike). Pri tem so pozorni na nekatere lastnosti posameznih geometrijskih likov (slika 3, levo).

Za brisanje likov uporabijo radirko ali razveljavitev. Seznanimo jih z uporabo tipke 'shift', ki jo moramo držati, če želimo narisati krog ali kvadrat, in drugimi možnostmi, ki jih ponuja orodje (barvno polnilo, zrcaljenje, podvajanje ...).

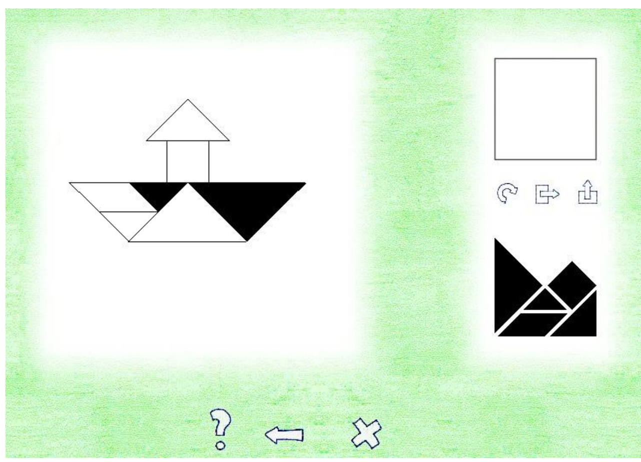
Ko so učenci dovolj spretni pri risanju likov, lahko iz različnih likov sestavijo sliko (slika 3, desno) in jo natisnejo. Poimenujejo like, iz katerih je sestavljena.



Slika 3. Različni liki in sestavljena slika v programu Slikar

2.4 Tangram

Učenci v programu Igrive številke 1 [1] izberejo didaktični program Tangram. Na levi strani je iz praznih likov sestavljena figura, na desni pa različni liki črne barve, s katerimi učenci zapolnijo figuro. Posamezni lik s pomočjo obračanja in zrcaljenja postavijo v pravilno lego ter ga s klikom prenesejo na ustrezno mesto v figuri. Na napačno postavitev učence opozarja zvok. Ko pravilno zapolnijo vse dele figure, zaigra glasba, ob kateri plešejo številke in učencem sporočajo, da so bili uspešni. Na voljo je več različnih figur. S klikom na vprašaj program samodejno izbere lik, ga orientira in postavi na pravo mesto.



Slika 4. Primer figure v programu Tangram

2.5 SlikoKviz

Za utjrevanje prepoznavanja likov in teles smo izdelali didaktično igro *SlikoKviz*.

Učenci ob zagonu izberejo igro (telesa ali liki). V levem oknu se prikazujejo različna telesa (modeli teles in različni predmeti) oziroma liki (različne barve, velikosti, orientacije), ki jih mora učenec prepoznati. Na desni strani pa so imena teles oziroma likov (tudi zvočno, če se z miško postavijo na napis), med katerimi izberejo pravega.

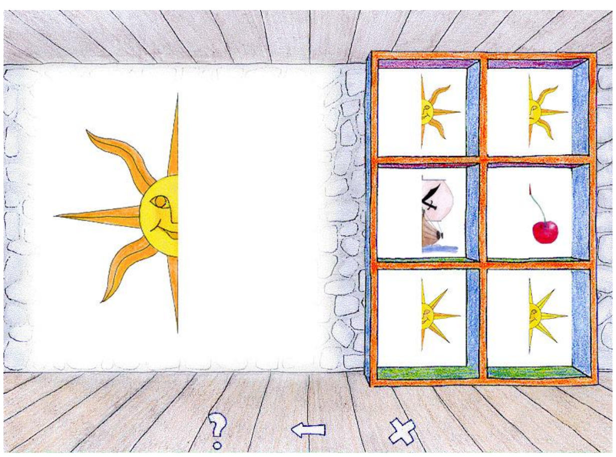
S klikom na pravo ime dobijo pohvalo, prikaže se nova oblika, v nasprotnem primeru pa ostane v levem oknu ista oblika in učenci morajo poskusiti znova. Igra je končana, ko je stolpec skrajno desno zapolnjen z modro barvo.

Slika 5. Primer prepoznavanja lika v SlikoKvizu

2.6 Simetrija

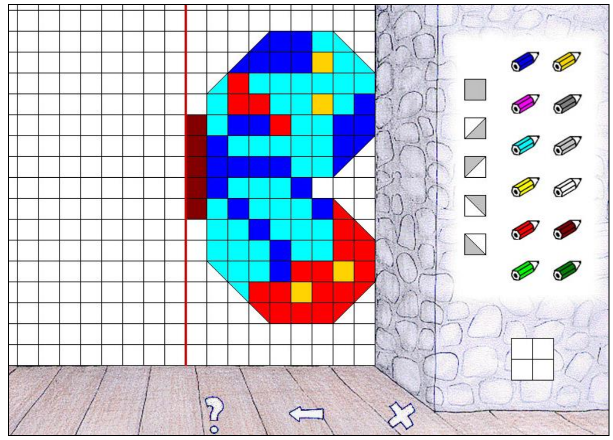
Za utrjevanje področja simetrije smo uporabili dve didaktični igri v sklopu programa Igrive številke 2 [1] ter spletno igro *Reflection painter* [2].

Učenci v didaktični igri *Dopolni sliko* (Igrive številke 2) dani polovici slike poiščejo zrcalno simetričen del. Razpredelnica ponuja šest možnosti, s klikom na pravilno sliko se dopolni dana slika, nato se odpre nov primer. Če se učenci zmotijo, jim kratek zvok pove, da izbira ni pravilna.



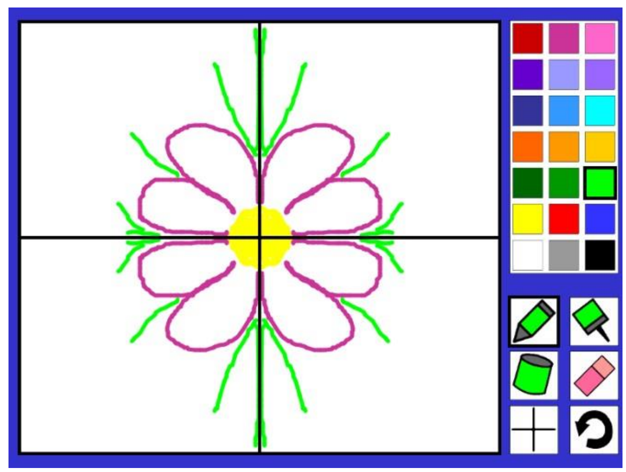
Slika 5. Primer iskanja simetričnega dela slike

Didaktična igra *Simetrija* (Igrive številke 2) ponuja simetrično dopolnjevanje obstoječe polovice slike na mreži. Učenci izberejo ustrezen kvadrat, ga pobarvajo in postavijo na mrežo (slika 6).



Slika 6. Primer simetričnega dopolnjevanja slike

Spletna igra *Reflection painter* [2] ponuja zanimivo izkušnjo simetričnega ustvarjanja (bližnjico predhodno ustvarimo na namizju). Ob tem, ko učenci prosto rišejo z izbranim orodjem, čez simetralo nastaja zrcalna slika. Izbirajo lahko med vodoravno in navpično simetralo, možno pa je izbrati tudi obe hkrati (slika 7).

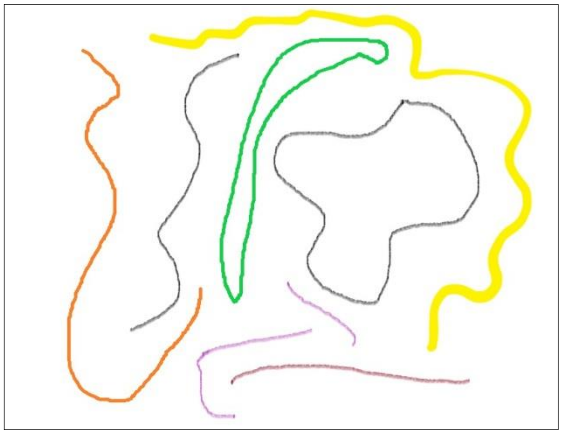


Slika 7. Primer simetričnega ustvarjanja

2.7 Črte

Učenci v programu Slikar (OS Windows) najprej preizkusijo orodje za risanje črt (ustvarjanje ravnih, krivih, sklenjenih in nesklenjenih črt, vlivanje barve na sklenjeno površino), nato pa vodeno ustvarjajo slike iz samih ravnih nesklenjenih črt, ravnih sklenjenih črt, krivih nesklenjenih črt, krivih sklenjenih črt ... Pri sklenjenih in nesklenjenih črtah lahko naredimo preizkus z vlivanjem barve: pri sklenjeni črti barva ostane v liku, pri nesklenjeni se razlije po celi površini.

Na koncu ustvarijo še risbo z različnimi črtami. Najbolj zanimive risbe lahko natisnemo.



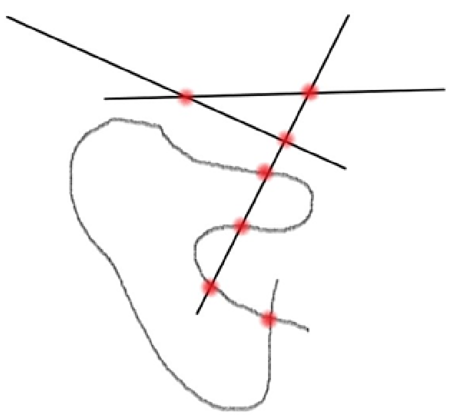
Slika 8. Krive črte, ustvarjene v programu Slikar

2.8 Točke

Učence seznanimo s potekom dela v programu Slikar (OS Windows): narisali bodo različne črte in iskali presečišča, kjer nastanejo točke. Rišejo po navodilih, npr.: narišejo dve modri ravni črti tako, da se sekata; presečišče označijo z določenim orodjem (razpršilec rdeče barve). Nato narišejo zeleno krivo črto tako, da seka obe ravni črti ...

Ko usvojijo postopek, nadaljujemo z nalogami na vnaprej pripravljenih učnih listih, ki določajo število črt in presečišč na eni sliki (slika 9). Sestavimo različno zahtevne naloge, učenci začnejo z lažjimi, po vsaki nalogi pokličejo učitelja, da potrdi pravilnost, šele nato lahko nadaljujejo s težjo nalogo.

število ravnih črt	število krivih črt	število presečišč ×A
3	1	7



Slika 9. Izvedba naloge z učnega lista

3. ZAKLJUČEK

Zavedamo se, da učenci na začetku šolanja geometrijo spoznavajo predvsem z aktivnim raziskovanjem svoje okolice na konkretnem nivoju (manipulacija s predmeti, opazovanje, ustvarjanje, opisovanje ...) in preko igre.

Z raziskavo, ki smo jo izvedli pred nekaj leti, smo ugotovili, da je vključevanje IKT v pouk prineslo boljše rezultate na določenih področjih ravninske geometrije, zato v pouk še naprej vključujemo izbrane dejavnosti, jih izboljšujemo in iščemo nove.

Poleg tega, da učenci ob teh dejavnostih pridobivajo oziroma utrjujejo svoje znanje geometrije, pa je pomemben tudi vidik pridobivanja digitalne pismenosti in ne nazadnje visoka motivacija, ki se pri najmlajših učencih praviloma pojavi ob uporabi IKT. Delo z IKT jim predstavlja igro, kar je za uspešno učenje v tem obdobju zelo pomembno.

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Medpredmetno povezovanje glasbenih vsebin z uporabo spletne strani 8notes

Cross-curricular integration of music content using the 8notes website

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POVZETEK
V prispevku je predstavljen primer izvedbe medpredmetnih ur, ki so se izvajale v prvem razredu osnovne šole. Namen izvedbe je bil povezati glasbene vsebine z drugimi predmeti, še posebej s tujim jezikom. Raziskave kažejo, da glasbene sposobnosti vplivajo na govorni razvoj, ritem in fonološko zavedanje, kar je pri zgodnjem učenju angleščine zelo pomembno. Medpredmetne dejavnosti so potekale pet šolskih ur. Poudarek je bil na razvijanju glasbenih sposobnosti z uporabo spletnega programa 8notes.

Ključne besede
Medpredmetno povezovanje, 8notes, glasbene vsebine, tuji jezik

ABSTRACT
The article presents an example of the implementation of cross-curricular lessons, which were taught in the first grade of primary school. The purpose of the performance was to connect music content with other subjects, especially with a foreign language. Research shows that musical abilities influence speech development, rhythm and phonological awareness, which is very important in the English language teaching. Cross-curricular activities have been carried out for five school hours. The emphasis was on developing musical skills using the 8notes online program.

Keywords
Cross-curricular lessons, 8notes, music content, foreign language

1. UVOD
Tuji jezik, šport, likovna in glasbena umetnost so predmeti, ki v prvem vzgojno-izobraževalnem obdobju devetletne osnovne šole zajemajo najmanjše število ur, čeprav je razvojna potreba po gibanju in ustvarjanju v tem starostnem obdobju najbolj pomembna za celostni razvoj otroka. Poleg naštetih učnih predmetov učenci odraščajo v tehnološko naprednem okolju, ki ga je smiselno vpeti v učne vsebine. Da bi omogočili večjo povezanost vsebin in ciljev ter ustvarili motivirano učno okolje, smo na Osnovni šoli Vide Pregarc v prvem razredu izvedli medpredmetne ure, ki se ne ločujejo po predmetih, ampak se povezujejo tako vsebinsko kot ciljno ter obenem omogočajo uporabo spleta.

2. TEORETIČNA IZHODIŠČA
Ob uvedbi devetletne osnovne šole je bilo poudarjeno, da namen izobraževanja ni strogo poučevanje po predmetih, ampak povezovanje in celostni pristop k učenju. Namen medpredmetnega poučevanje je celosten pristop k učenju in dojemanju znanja kot celote. Če želimo, da učenec napreduje in se optimalno razvija, je potrebno razvijati varno okolje, v katerem se ponujajo priložnosti za iskanje znanja in za razvijanje strategij učenja. Že pred desetletji so številni pedagogi opozarjali na pomen celovitega pristopa, saj mladi učenci dojemajo znanje celostno in ga ne ločujejo na jezik ali naravoslovje ali družboslovje. Tudi učni načrti po posameznih predmetih priporočajo, da se vsebine in cilji po predmetih povezujejo in osmišljujejo – saj bo samo osmišljeno in uporabno znanje trajnejše. Učni načrt za glasbeno umetnost pri sami opredelitvi predmeta poudarja, da interdisciplinarne povezave glasbe z drugimi področji omogočajo široko razgledanost na različnih umetniških in znanstvenih področij [3].

Razvojne značilnosti šest in sedem let starih učencev v prvem razredu osnovne šole v ospredje postavljajo gibanje, ustvarjanje, govorjenje, poslušanje, petje. Vzporedno potekajo dejavnosti začetnega opismenjevanja, med drugimi tudi spoznavanje informacijsko-komunikacijske tehnologije, ki je vpeta v šolski kurikul. Ker informacijska pismenost ne poteka samostojno in ločeno, jo je v nižjih razredih potrebno združiti z ostalimi predmeti. Kot pravita Borota in Brodnik, je tehnološka podpora bolj namenjena učenju kot procesu pridobivanju znanja, ne pa toliko poglabljanju in širitvi vsebin v učbeniku ali delovnem zvezku [1]. Medpredmetni dnevi ali medpredmetno izpeljane ure so dober primer, procesno zasnovanega učenja, ki omogoča uporabo informacijsko-komunikacijske tehnologije.

Razvijanje glasbenih sposobnosti vpliva tudi na druga področja otrokovega razvoja. Božič, Habe in Jerman ugotavljajo, da se glasbene sposobnosti vplivajo na govorni in jezikovni razvoj ter fonološko zavedanje tudi v slovenskem prostoru [2]. Raziskava sicer zajema predšolske otroke, ki so stari 5 in 6 let, vendar prvi razred osnovne šole zajema prav tako 6 let staro populacijo. Razvojne značilnosti tega obdobja so povezane z elementi glasbe, z ritmom, vzorci, gibanjem ob glasbi, orientacijo, posnemanjem glasov, besednimi igrami, katerih ozadje je priprava na ritem jezika in fonološkega zavedanja skozi uporabo lastnega telesa. Glasbene vsebine se tako prepletajo tudi z gibalno-plesnimi aktivnostmi, likovnim izražanjem, s slovenščino, tujim jezikom, navsezadnje tudi z naravoslovnimi in družboslovnimi predmeti. Zgodnje učenje tujega jezika se vsakodnevno povezuje z glasbenimi elementi. Splošni cilj tujega jezika v zgodnjem otroštvu je razvijanje senzibilnosti za tuje jezike [4]. Specifika angleškega jezika je v izrazitem ritmu in fonološkem zavedanju, ki je drugačno od maternega jezika večine učencev. Prav zato učitelji tujih jezikov radi posegajo po glasbenih elementih, ki približajo otroko jezikovne značilnosti in razvijajo senzibilnost za jezike.

Otroci so že od rane mladosti vpeti v sodobno tehnologijo, zato jih je smiselno že od prvega razreda dalje načrtno seznanjati s tehnologijo in z uporabo različnih orodij. Pri tem je zelo pomembno, da je uporaba tehnologije ciljno usmerjena, razumljiva in da omogoča možnost učenja. Večina sedemletnikov že pozna socialna omrežja, internet, spletne igrice in različne aplikacije za pametne telefone. Šola je postavljena pred velik izziv, da učence spozna z drugačnimi, poučnimi, uporabnimi orodji in obenem opozori na pasti in morebitne zasvojenosti.

Da bi povezali znanje po predmetih, razvijali globalne cilje, nudili drugačno izkušnjo in omogočili celostni pristop, smo se na osnovni šoli Vide Pregarc odločili za izvedbo medpredmetnih ur, ki so se izvajale v mesecu maju. Pri medpredmetnih dejavnostih je sodelovalo 26 učencev prvega razreda, izvedenih je bilo 5 šolskih ur v dveh tednih, pokrita so bila različna predmetna področja: glasbena umetnost, likovna umetnost, šport (gibalno-plesne vsebine) in neobvezni izbirni predmet angleščina.

3. PRAKTIČNI DEL

3.1 Priprava

Za izvedbo medpredmetnih ur je bilo najprej potrebno načrtovati cilje in dejavnosti, nato organizirati prostor in pripraviti opremo.

Zastavljeni cilji v medpredmetnih urah so bili:

- V skupini sproščeno pojejo obravnavane pesmi v slovenščini in tuje jeziku.
- Ritmično izrekajo besedila v slovenščini in tujem jeziku.
- Prepoznavajo pesem po melodiji in ritmu.
- Se gibljejo ob glasbi.
- Spoznajo slikovni zapis in se orientirajo v njem.
- Poznajo klasična glasbila in jih razvrščajo v skupine.
- Razvijajo zvočno občutljivost jezika in prepoznavajo značilnosti tujega jezika (ritem, intonacija, izgovorjava).
- Slikajo od celote k detajlu in se spontano likovno izražajo brez predhodnega risanja.

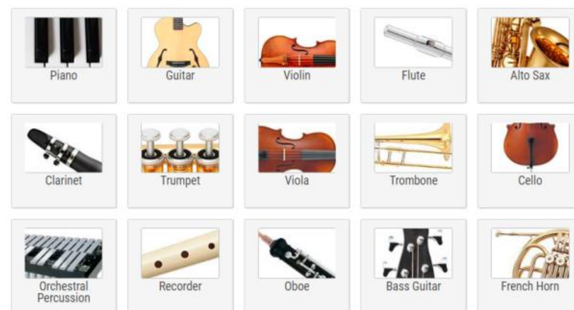
Strojno in programsko opremo:

- stacionarni računalnik,
- prenosni računalniki,
- projektor, interaktivna tabla, dostop do spleta,
- 8notes, YouTube.

3.2 Izvedba

Učenci prvih razredov so po obisku glasbene šole ponovili, katera klasična glasbila so spoznali. Ob slikovnih karticah so opisovali glasbila in jih razvrščali v skupine glasbil. Prva šolska ura je bila namenjena ponavljanju in sprotnemu preverjanju znanja. Učenci so z gibalnimi igrami oponašali igranje na inštrumente, slušno prepoznavali inštrumente na predvajanih zvočnih posnetkih, nato pa s pomočjo PowerPoint predstavitve razvrščali inštrumente po eni spremenljivki.

Druga šolska ura je potekala tako, da so učenci ob slikah spletne strani 8notes poimenovali inštrumente (glej sliko 1), nato so izžrebali sliko inštrumenta na lističu ter ga likovno upodobili. Vse izdelke so učenci postavili po navodilih in tako so sestavili orkester. Nato so si na YouTube posnetkih ogledali postavitev orkestra in ga primerjali s svojo postavitvijo. Ugotovili so, zakaj imajo določena glasbila svojo postavitev in kje stoji dirigent.

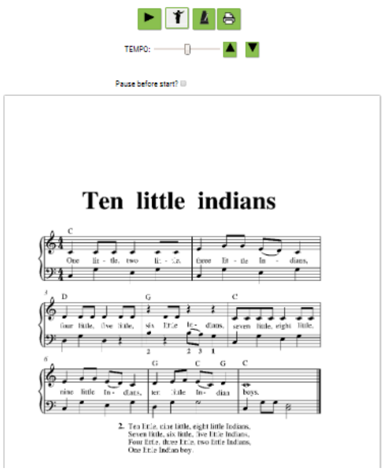


Slika 1. Primer prikaza inštrumentov v 8notes

Tretja šolska ura je potekala tako, da so učenci v skupinah na računalnikih preizkušali različne zvočne posnetke in se v skupini pogovorili, katerim inštrumento pripadajo. Po poročanju skupin smo preverili rezultate in se pogovorili, kateri zvočni posnetki so učencem bolj všeč. Učencem je bil predstavljen repertoar klasičnih skladb ter otroških pesmi. Zanimiva ugotovitev je bila, da je večini sedemletnikov klasična glasba zelo všeč. Za zaključek ure smo učencem pokazali, katere otroške pesmi so bile priljubljene, saj program 8notes nudi vpogled v najbolj poslušane zvočne posnetke.

Četrta šolska ura je potekala v angleščini. Učenci so najprej izvedli kviz, poslušali so melodijo in poimenovali naslov angleške pesmi, ki so se jo naučili v 1. razredu. Nato so v parih ponovili vajo tako, da so izmenično izvajali melodične uganke. Sledilo je igranje na Orffova glasbila, s katerimi so ponavljali ritem učiteljice. Ob ponovnem ogledu spletne strani 8notes so spoznali še angleška poimenovanja za klasična glasbila ter ugotovili podobnosti in razlike pri poimenovanju. Sledilo je učenje pesmi Ten little Indians po metodi odmeva, kjer otroci ponavljajo melodične fraze z odmevom. V učenje pesmi so bile vključene tudi gibalne igre ter spremljanje z bobni. Učenci so nato ob vodenem raziskovanju spletne strani 8notes prepoznali notni zapis pesmi. Spletna stran omogoča poslušanje zvočnega posnetka melodije v različnih glasbenih spremljavah. Da bi bil izziv zahtevnejši, smo poiskali gumb za nastavitev tempa (glej sliko 2) in s petjem spremljali zahtevano hitrost. Spremljanje je najprej potekalo v ritmičnih izgovorjavah, nato pa še s petjem.

Peto šolsko uro je potekalo preverjanje po skupinah. Prvi del je predstavljal kviz, kjer so učenci morali prepoznati skriti inštrument po opisu. Drugi del je potekal tako, da so skupine zapele pesem Ten little Indians v določenem tempu, ki ga je predvajal 8notes. Za zaključek smo izvedli evalvacijo in povpraševali učence o tem, kaj so se novega naučili in ali jim je bil pristop všeč. Odgovori so seveda bili pozitivni, uporaba računalnika jim je bila zelo všeč, radi so sodelovali pri izbiri in povedali so, da se počutijo pomembne, če se njihovo mnenje upošteva.



Slika 2. Primer notnega prikaza pesmi z nastavitvijo tempa

4. ZAKLJUČEK

Po izvedbi medpredmetnih ur je bilo opazno, da je bil način poučevanja drugačen in prav zato zanimiv. Vsebine so se prepletale, omogočene so bile drugačne izkušnje kot ponavadi, učenci so imeli možnost sodelovanja in evalvacije, kar je pripomoglo k pozitivni razredni klimi in visoki stopnji motivacije.

Spletna stran 8notes je dosegljiva od leta 2001 in je namenjena vsem, ki jih zanima glasba. Je pregledna, slikovno podprta in nudi veliko število zvočnih posnetkov ter glasbenih zapisov. Obstajata brezplačna in plačljiva različica. Plačljiva različica odklepa poglavja, omogoča večji dostop in neomejeno število predvajanja zvočnih posnetkov. Brezplačna različica ima okrnjen dostop, do nekaterih vsebin se ne da dostopati, omejeno je tudi število zvočnih posnetkov. Kljub okrnjenemu dostopu pa je za potrebe učiteljev v prvem vzgojno-izobraževalnem obdobju brezplačna različica dovolj dobra za uvajanje v svet glasbe, saj nudi veliko slikovne in zvočne podpore, ki je ključna za začetno avdio-vizualno učenje pri mlajših otrocih.

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Motivacijske programerske naloge za boljše dijake

Motivational programming tasks for better students

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POVZETEK

Pri poučevanju programiranja je, predvsem v zaključnih letnikih, opaziti velik razpon znanja pri dijakih. Tisti najboljši, ki tudi doma veliko programirajo, se nemalokrat pri urah dolgočasijo, saj večino tega znanja že imajo. Zato občasno izvedem uro tako, da izpostavim preprost problem, dijaki pa skušajo izdelati rešitev v programskem jeziku, saj je problem brez uporabe računalnika praktično nerešljiv, vsaj ne v realnem času zaradi velikega števila operacij. Boljši dijaki rešitev tudi ustrezno sprogramirajo, vendar na različne načine in ne vsi enako hitro. Končno so tudi oni izpostavljeni izzivu, kdo bo prej in najbolje napisal kodo. To jih motivira in v njih sproži še dodatne ideje za kasnejšo optimizacijo kode. Nekatere najboljše rešitve nato pogledamo vsi preko projektorja in tako tudi tisti najboljši lahko primerjajo svojo kodo z ostalimi in se tudi sami pri tem kaj novega naučijo. Predstavila bom par takih nalog in opisala odzive dijakov.

Ključne besede

Programiranje, problemska naloga, optimiziranje kode

ABSTRACT

When teaching programming, especially in the final year of schooling, one notices that the knowledge levels of students vary greatly. Those who do a lot of programming at home, often find the lessons boring and the tasks too simplistic, because they have already mastered most of this knowledge by themselves. That's why I occasionally design lessons so that I expose a simple problem, and leave the students to it, so they try to work out a solution in a programming language, since the problem is insoluble without the use of a computer, at least not in real time due to the large number of operations. The better students will write a program that solves the problem properly, however, they will do it in different ways, and not all of them equally quickly. In this way, they are also challenged by the task since they can compete with their peers: who will be the first one to write the code first and who will find the best solution. This motivates them and triggers additional ideas for later code optimization. We then look at some of the best solutions together – via a projector, so that even the best students can compare their code with the others and learn something new from their peers. I will present some such tasks and describe the students' responses.

Keywords

Programming, problem task, code optimization

1. UVOD

V razredu so dijaki z različnim znanjem iz programiranja, pouk pa ni nivojski. Zato se nam pri poučevanju velikokrat zgodi, da se preveč ukvarjamo s šibkejšimi dijaki, na boljše pa kar pozabimo, saj z njimi ni težav. Ravno zato, ker so samoiniciativni pri učenju, se mi zdi prav, da se tudi zanje pripravijo motivacijske učne ure, kjer lahko pokažejo svoje znanje in se še kaj dodatnega naučijo.

2. NAKUP ŽIVALI

Imamo sledečo, razmeroma preprosto problemsko nalogo. Za 50 eur moramo kupiti natanko 100 živali, pri čemer moramo zapraviti ves denar, na voljo pa imamo kokoši po 10 centov, ovce po 1 eur in konje po 5 eur. Koliko primerkov vsake živali moramo kupiti? [2]

2.1 Začetek reševanja

Najprej se zagotovo najde kdo, ki pripomni, da so živali občutno prepoceni. Razložim mu, da je žival lahko tudi v obliki igračke. Nato nekateri hitro ugotovijo, da kupijo pač deset konj in je naloga rešena. Njim razložimo, da so spregledali podatek o stotih živalih. Tako počasi vsi pridemo do točke, ko razumemo bistvo naloge. Gre za dve enačbi s tremi neznankami s celoštevilskimi rešitvami. Nekaj dijakov začne na slepo vstavljati v enačbi različne vrednosti in preverjati, če se rezultat izide vendar kaj hitro ugotovijo, da s poskušanjem ne bodo prišli prav daleč. Ugotovimo, da je kombinacij zelo veliko in da bo treba napisati računalniški program, ki bo namesto nas hitro preveril vse možnosti.

2.2 Primerjava rešitev

Dijaki začnejo s pisanjem kode in kmalu se zasliši vzklik prvega, ki najde pravilno rešitev. Kupimo lahko enega konja, 39 ovc in 60 kokoši. Preverim kodo in dam namig za njeno optimizacijo. Počakamo še naslednjih nekaj dijakov, da dokončajo svoje kode, ki jih nato pregledamo preko projektorja. Večina je napisanih s pomočjo treh gnezdenih zank, najdejo pa se tudi povsem unikatne in presenetljive rešitve. Ena izmed njih je izbira naključnih vrednosti za število posameznih živali in preverjanje, če ustrezajo enačbama. Načeloma smo pričakovali, da bo ta rešitev počasnejša, izkazalo pa se je, da je največkrat celo hitreje našla ustrezno trojico od algoritma, ki preverja vse kombinacije po vrsti.

2.3 Optimiziranje kode

Pri najbolj običajni rešitvi s tremi zankami večina dijakov nastavi števec tako, da teče od ena do sto, saj je sto omejitev za število živali. To pomeni, da računalnik preveri 100x100x100 torej 10^6 možnih kombinacij, od katerih pa jih je večina nesmiselnih. Konjev ne moremo kupiti več kot 10, saj smo omejeni z denarjem, ovc pa ne več kot 50. Že samo s tem premislekom zanjšamo število kombinacij na 50000 (slika 1). Upoštevati pa je treba tudi to, da se števec začne z nič in ne z ena, saj bi teoretično bila lahko rešitev tudi brez ene vrste živali.

```
private void button1_Click(object sender, EventArgs
 {
   for (int i = 0; i < 100; i++)
     for (int j = 0; j < 50; j++)
       for (int k = 0; k < 10; k++)
         if (i + j + k == 100 && i*0.1+j+k*5==50)
          MessageBox.Show("Kokoši:"+i+"\nOvce:"+j +"\nKonji:"+k);
  }
```

Slika 1: Koda v Visual C# s tremi zankami

Lahko bi dodali ukaz, ki prekine delovanje programa takoj, ko bi računalnik našel rešitev, vendar bi s tem izgubili ostale morebitne rešitve. Pri tem primeru se sicer izkaže, da je rešitev natanko ena, vendar dokler ne pregledamo vseh kombinacij, tega ne vemo.

2.4 Ideje za nadgradnjo kode

Dijaki, ki jih je naloga pritegnila, zdaj dodelujejo svoje kode z raznimi idejami. Največkrat jih zanima, v katerem koraku računalnik pride do rešitve in koliko časa porabi. Omenjena parametra vstavijo v kodo in primerjajo njune vrednosti pri različnih algoritmih. Nekateri ugotovijo tudi, da je vrstni red gnezdenih zank pomemben. Z drugimi besedami, ni vseeno katera zanka šteje konje, katera kokoši in katera ovce. Za zaključek jim povem, da smo imeli opravka z Diofantskimi enačbami. Imenujejo se po grškem matematiku Diofantu, ki je že v 2. stoletju raziskoval tovrstne problem. [4]

3. PRIJATELJSKA ŠTEVILA

Dve celi števili sta **prijateljski,** če je vsota njunih pravih deliteljev (brez števila samega) navzkrižno enaka drugemu številu [5] [1]. Prvi prijateljski par sta števili 220 in 284.

Pravi delitelji števila 220 so:

1, 2, 4, 5, 10, 11, 20, 22, 44, 55,110.

Njihova vsota je 284.

Pravi delitelji števila 284 so: 1, 2, 4, 71,142

Njihova vsota je 220.

Napišimo kodo, ki ugotovi in izpiše vse pare prijateljskih števil do 10000.

3.1 Programiranje rešitev

Problem lahko rešimo postopoma. Najprej napišimo program, ki sprejme dve števili in ugotovi ali sta prijateljski ali ne. Boljši dijaki to rešitev nadgradijo tako, da program sam preišče in izpiše prijateljske pare števil. Kodo prikazuje slika 2.

3.2 Optimiziranje kode

Pri tej nalogi so rešitve pri posameznih dijakih precej podobne. Najprej opazijo, da program najde tudi pare enakih števil. Prvi tak par je število 6, saj so njegovi delitelji 1, 2 in 3, njihova vsota pa 6. Ker iščemo pare različnih števil, dodajo pogojni stavek, ki enake pare ignorira. Dalje ugotovijo, da se pari ponovijo. Najprej najde 220 in 284, nato pa še 284 in 220. Dodajo kontrolo, da program ne pregleduje podvojenih parov. Nekaj malega optimizacije prinese tudi iskanje deliteljev števila, če se števec v zanki povečuje le do korena števila.

```
private void button1_Click(object sender, EventArgs e)
        {
            int vsota1 = 0;
            int vsota2 = 0;
            for (int prvo = 1; prvo < 500; prvo++)
            {
              for (int drugo = 1; drugo < 500; drugo++)
              {
                 for (int i = 1; i < prvo; i++)
                 {
                    if (prvo % i == 0) //našli smo delitelja
                     {
                         vsota1 += i;
                     }
                 }
                 for (int i = 1; i < drugo; i++)
                 {
                    if (drugo % i == 0)
                     {
                        vsota2 += i;
                     }
                 }
                 if (vsota1 == drugo && vsota2 == prvo)
                 {
                  MessageBox.Show("Prijateljski števili:"+prvo+"  "+ drugo);
                 }
                 vsota1 = 0;
                 vsota2 = 0;
              }
           }
```

Slika 2: Programska koda za iskanje prijateljskih števil

4. KITAJSKI IZREK O OSTANKIH

Oglejmo si zgodbo iz 6. stoletja, ki jo je pripovedoval indijski matematik in astronom Brahmagupta.

Ženica gre na trg prodajat jajca. Ko zloži jajca na stojnico, podivja konj in ji podre stojnico. Jajca se razbijejo. Jezdec ženici ponudi poravnavo, vendar mu ženica ne zna povedati, koliko jajc je bilo na stojnici. Spomni se, da je pri zbiranju jajc prosila hčer, da zleze v kurnik in ji podaja jajca. Dajala ji je po dve jajci naenkrat in na koncu ji je dala še eno jajce. Ko je ta jajca zlagala v škatlo, je prijemala po tri jajca in takrat ji je na koncu ostalo ravno eno jajce. Ker je škatle razmočil dež, je bilo jajca potrebno preložiti. Takrat je hči v roko prijela po dve jajci in jih z obema rokama hkrati podajala materi. Na koncu ji je dala eno samo jajce. Potem je jajca prestavljal še oče in sicer po pet jajc naenkrat in tudi njemu je bilo potrebno na koncu seči po eno jajce. Na koncu so jajca zložili v škatle po šest in za zadnjo škatlo je ostalo eno jajce. Nato se oglasi še sin in pove, da je pred tem jajca postavil v vrsto po sedem in se je ravno izšlo. V bližini stoji nek mož in posluša zgodbo nato pa ženici prišepne, da naj od jezdeca zahteva plačilo za 721 jajc. Jezdecu se je zdelo vseeno malo preveč denarja in premalo strtih jajc. [6]

Je imel mož prav?

4.1 Preverjanje predlagane rešitve

Dijaki takoj ugotovijo, da gre za ostanke pri celoštevilskem deljenju in napišejo programsko kodo, ki preveri, če število 721 res da pri deljenju s števili 2, 3, 4, 5, in 6 ostanek 1, pri deljenju s številom 7 pa se ravno izide.

Izkaže se, da število 721 ustreza. Zdaj postavim vprašanje, ali je to edina rešitev oz. morda obstaja rešitev, ki je manjša od 721, saj res težko verjamemo, da je ženica prinesla na trg toliko jajc. Primer kode prikazuje slika 3.

```
namespace ConsoleApp2
{
    class Program
    {
        static void Main(string[] args)
        { int st = 721;
            if (st % 2 == 1 && st % 3 == 1 && st % 4 == 1
                && st % 5 == 1 && st % 6 == 1 && st % 7 == 0)
                Console.Write("721 je rešitev.");
            else
                Console.Write("721 ni pravilna rešitev.");
            Console.ReadLine();
        }
    }
}
```

Slika 3: Koda za preverjanje predlaganega števila jajc

4.2 Iskanje drugih rešitev

Kodo dijaki spremenijo tako, da program sam preverja števila, dokler ne naleti na število, ki ustreza navodilom naloge. Vključijo torej zanko. Primer prikazuje slika 4, rezultate pa slika 5.

```
namespace ConsoleApp2
{
    class Program
    {
        static void Main(string[] args)
        { for(int st=1;st<=721;st++)
            if (st % 2 == 1 && st % 3 == 1 && st % 4 == 1
                && st % 5 == 1 && st % 6 == 1 && st % 7 == 0)
                Console.WriteLine(st+ " je rešitev.");
            Console.ReadLine();
        }
    }
}
```

Slika 4: Koda za iskanje števila jajc

```
301 je rešitev.
721 je rešitev.
1141 je rešitev.
1561 je rešitev.
1981 je rešitev.
2401 je rešitev.
2821 je rešitev.
3241 je rešitev.
3661 je rešitev.
4081 je rešitev.
4501 je rešitev.
4921 je rešitev.
5341 je rešitev.
5761 je rešitev.
6181 je rešitev.
6601 je rešitev.
7021 je rešitev.
7441 je rešitev.
7861 je rešitev.
8281 je rešitev.
8701 je rešitev.
9121 je rešitev.
9541 je rešitev.
9961 je rešitev.
```

Slika 5: Izpis rešitev za število jajc do 10000

Zdaj poleg števila 721 najdejo tudi število 301. Verjetno je ženica imela 301 jajce in ne 721. Povečamo pogoj v zanki do 10000, da preverimo še več števil in s tem ugotovimo, ali so še druga števila, ki ustrezajo kot rešitve. Ugotovimo, da jih je kar nekaj, še več, nekateri celo opazijo, da so rešitve v določeni povezavi in sicer, da je razlika med dvema sosednjima vedno 420. Na hitro še omenimo, da gre za aritmetično zaporedje z začetnim členom 301 in diferenco 420.

4.3 Optimiziranje kode

Razmislimo, kakšna števila so tista, ki ustrezajo kot rešitve. Najprej ugotovimo, da zanko zagotovo lahko začnemo pri števcu 7 in ne 1, saj števila od 1 do 6 izloči zadnji pogoj v navodilu naloge. To sicer ni nek ključen prihranek, pa vendar. Nato razmislimo, da se nekateri pogoji v pogojnem stavku lahko izločijo. Preverjanje ostanka pri deljenju z 2 lahko izpustimo, saj jih preveri ostanek pri deljenju s številom 4. Število 4 je namreč deljivo s številom 2. Mirno lahko izpustimo tudi pogoj za ostanek pri deljenju s številom 3, saj ga preveri že ostanek pri deljenju s številom 6. Število šest je namreč deljivo s številom 3.

4.4 Matematično ozadje

Na videz preprosta naloga skriva v sebi zanimivo teorijo ostankov pri deljenju. Pri reševanju naloge smo ponovili pravila za deljivost števil, pojme tuji si števili ter najmanjši skupni večkratnik in največji skupni delitelj. Omenim, da teorija ostankov ne velja le na celih številih temveč tudi pri polinomih. S Kitajskim izrekom o ostankih sta se kasneje ukvarjala švicarski matematik Leonhard Euler in nemški matematik Carl Friderich Gauss. Neodvisno eden od drugega sta prišla do istega rezultata pri iskanju množice rešitev sistema linearnih kongruenc. [6]

5. ZAKLJUČEK

Po poklicu sem profesorica matematike in računalništva, po duši pa predvsem matematik. Zato se mi zdijo matematične naloge pri urah programiranja zanimive. Tako spoznajo nekatere matematične vsebine tudi z drugega vidika. Dijakom so bile tako izvedene ure všeč, vsaj večini. Nekateri so si na internetu poiskali še dodatne informacije. V večini primerov so dobri programerji tudi dobri matematiki in zato se mi zdi še posebej primerno, da se vsebine medpredmetno povezujejo in da spoznajo tudi kaj novega, kar v matematičnem učnem načrtu ni zajeto.

6. VIRI

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Interaktivni uporabniški vmesnik za dostop do podatkov eksperimenta Belle II

An interactive user interface to access the Belle II data

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POVZETEK

Za obdelavo podatkov, ki jih zajamemo pri eksperimentih v fiziki osnovnih delcev, so potrebni kompleksni rekonstrukcijski algoritmi in računalniška orodja, ki za učenje zahtevajo od nekaj dni do nekaj tednov. Prispevek predstavlja interaktivni grafični vmesnik eksperimenta Belle II, ki omogoči, da lahko postopke dela približamo dijakom, študentom in drugi zainteresirani javnosti. Orodje uporabljamo v sklopu International Masterclasses, kjer udeležencem delavnic v enem dnevu približamo eksperimentalno fiziko osniovnih delcev.

Ključne besede

Belle II, grafični uporabniški vmesnik, rekonstrukcija razpadov

ABSTRACT

For the processing of data obtained in experiments in the elementary particle physics, complex reconstruction algorithms and computer tools are required which require learning from a few days to a few weeks. The paper presents an interactive graphical interface of the Belle II experiment that brings experimental high energy physics work procedures closer to high school and university students as well to the other interested public. We employ this tool in the International Masterclasses program, where the participants of the workshops meet the experimental particle physics for one day.

Keywords

Belle II, graphical user interface, decay reconstruction

1. UVOD

V eksperimentalni fiziki osnovnih delcev pri poskusih v trkalnikih med sabo trkamo osnovne delce, ki jih prej pospešimo skoraj do svetlobne hitrosti. Zaradi velike energije, ki se sprosti ob trku, pri trkih nastajajo novi delci, ki pa so večinoma kratkoživi in zelo hitro razpadejo na lažje delce. Visoko-energijski fiziki s študijem razpadov preiskujemo lastnosti delcev in interakcij med njimi.

Eksperiment Belle II v Cukubi na Japonskem je namenjen študiju redkih razpadov mezonov B, D in leptonov tau, ki nastanejo pri trkih pozitronov in elektronov v pospeševalniku SuperKEKB. Z analizo razpadov iščemo odstopanja od Standardnega modela osnovnih delcev, splošno veljavne teorije, ki opisuje osnovne delce in elektromagnetno in šibko in močno jedrsko silo, ki delujejo med njimi.

Eksperiment zajema podatke s spektrometrom Belle II (slika 1), ki je postavljen okoli interakcijske točke, kjer se križata pozitronski in elektronski curek. Sestavlja ga velik magnet z močnim magnetnim poljem 1,5 T, ki poskrbi, da se sledi nabitih delcev ukrivijo. Delci med letom preletijo več detektorjev, s pomočjo katerih z zapletenimi rekonstrukcijskimi algoritmi določimo gibalno količino in identiteto delcev.

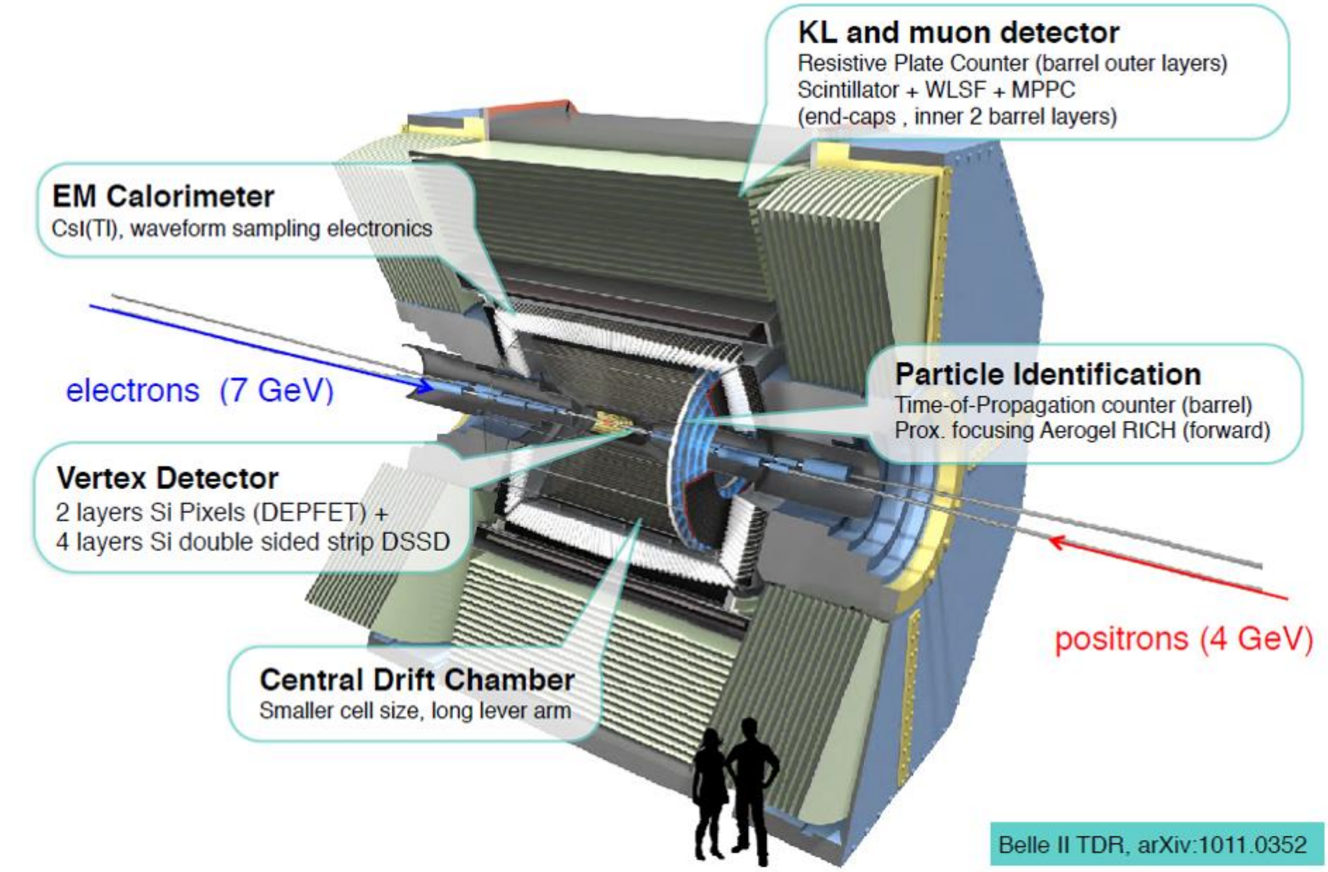
Del podatkov o rekonstruiranih razpadih je dala mednarodna raziskovalna skupina Belle II v prosto uporabo. Kompleksna orodja za analizo razpadov, ki jih uporabljamo znotraj raziskovalne skupine, zahtevajo vsaj nekajdnevno seznanjanje, ki je za javnost zelo nepraktična. Čeprav je program za analizo uporabniku prijazen, še vedno zahteva, da je uporabnik seznanjen s programskim jezikom Python. Vsaka skladenjska napaka v skriptu upočasni in ustavi analizo ter zahteva razhroščevanje kode. Nevešči uporabniki so zato hitro demotivirani, saj je njihova pozornost preusmerjena stran s fizike analiziranega procesa. Na Institutu »Jožef Stefan« smo zato razvili interaktivni uporabniški vmesnik, ki omogoča, da lahko vsakdo, tudi brez računalniških znanj, analizira podatke in dobi začetni vpogled, na kakšen način eksperimentalni fiziki osnovnih delcev raziskujemo.

2. METODE DELA

Vmesnik za javno uporabo mora biti preprost, hkrati pa mora še vedno imeti možnost konfiguracije, da uporabnika vključi v delo. Na primer, povezovanje podatkov s preprostim spletnim obrazcem ne omogoča vključitve uporabnika v analizni proces. Da bi zmanjšali vrzel zaradi manjkajočih veščin programiranja, smo ustvarili predstavitveno in izobraževalno aplikacijo BelleIILab, namenjeno srednješolcem in študentom.

Namen aplikacije je predstaviti raziskovalne metode, ki jih uporabljamo, in prikazati, kako se izvede fizikalna analiza na nekaj primerih iz spektroskopije osnovnih delcev. Belle2Lab ponuja učencem odkrivanje novih delcev z združevanjem že rekonstruiranih. Raziskovalna skupina Belle II je zagotovila dovolj velik vzorec podatkov, ki omogoča odkrivanje najpogostejših delcev. Aplikacija je uporabniku prijazna, saj uporablja grafični uporabniški vmesnik, v katerem uporabnik interaktivno izbere in poveže gradnike za nadzor analize in opis fizikalnih procesov.

Aplikacija je razdeljena na dva dela. Opisni del z grafičnim uporabniškim vmesnikom se izvaja v brskalniku, ki podpira HTML5 (spletni odjemalec), ki komunicira z izvedbenim delom (spletni strežnik), kjer se izvaja analiza. Po koncu izvedbe se



Slika 1: Spektrometer Belle II zaznava delce okoli interakcijske točke pospeševalnika SuperKEKB

rezultati, histogrami po različnih karakterističnih spremenljivkah delcev v razpadu, pošljejo nazaj odjemalcu. Z ločitvijo opisa razpada in izvajanja analize lahko aplikacijo uporabljamo v dveh konfiguracijah: bodisi v enem samem spletnem strežniku bodisi z lokalnim spletnim strežnikom in odjemalcem, ki jih lahko distribuiramo skupaj s podatki v eni sami virtualni napravi.

3. REZULTATI

3.1 Implementacija aplikacije

Belle2Lab temelji na blokovno generiranem grafičnem vmesniku Blockly JavaScript [5], ki ga je navdihnil MIT Scratch [6]. Privzeti uporabniški vmesnik sistema BelleIILab je sestavljen iz nekaj osnovnih blokov in delovne površine, kamor jih uporabnik povleče in kasneje preureja. Delovna površina vključuje ikone za povečavo in koš za brisanje za brisanje blokov. Uporabniki lahko ustvarijo zaporedja blokov in jih povežejo tako, da blokovni izhod priklopijo na vhod drugega bloka. Vrste povezav je mogoče omejiti, tako da lahko v vhodne vtičnice priključite samo določene vrste izhodnih priključkov.

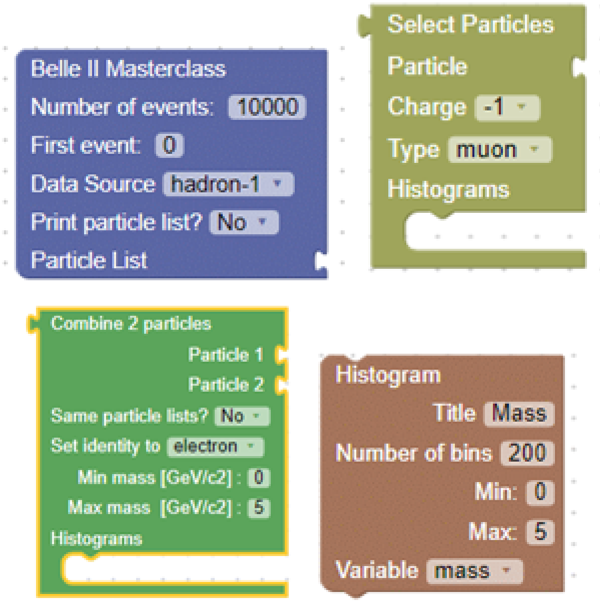
Odjemalec v brskalniku, ki podpira standard HTML5, ustvari niz JSON, ki opisuje razpad (slika 2). Niz pošlje preko HTTP zahteve izvršilnemu strežniku Apache HTTP, kjer se pretvori v skripto ROOT [7], in se izvede. Program odpre podatkovno datoteko ROOT s seznamom delcev TTree, izvede zanko po dogodkih, združi delce in napolni histograme. Histogrami na koncu izvajanja pretvorimo v niz JSON vrnemo nazaj na spletni odjemalec, kjer jih prikaže knjižnica JSROOT JavaScript [8].


```
{{"analysis": {"neve": "50000", "first":
"0", "print": "0", "vir podatkov": "2",
"List": {"combiner": {"list1": {"selektor":
{"list1": "", "zaračuna": "- 1",
"Pid": "PION", "histogram": {"h1d":
{"varname": "GetMass", "name": "pionska
masa",
"Nbins": "100", "min": "0", "max": "1"}}}},
"list2": {"selektor": {"list1": "",
"Dajatev": "1", "pid": "PION", "histogram":
""}}, "isti delci": "0",
"Pid": "KAON", "m0": "0", "m1": "1",
"histogram": {"h1d": {"varname": "GetMass",
"Name": "pipi Mass; GeV / c; N", "nbins":
"400", "min": "0", "max": "1"}}}}}}
```

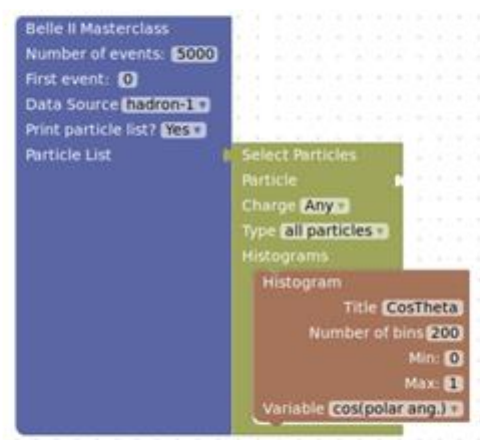

Slika 2: Primer niza JSON, ki ga je ustvarila aplikacija.

V orodjarni so štiri vrste blokov, ki jih lahko uporabimo za opis razpada (slika 3): glavni blok za krmiljenje zanke po dogodkih, blok za izbiro delcev, blok za združevanje delcev in blok za histogramiranje.

Glavni blok Belle II MasterClass omogoča, da izberete vir podatkov, nastavite številko začetnega dogodka ter nastavitev možnosti tiskanja seznama delcev. V začetni fazi delovanja Belle II je skupina omogočila prost dostop do dveh nizov podatkov s spektrometra Belle [3] s skupaj okoli 6 mio. razpadi delcev. Z izbiro zastavice za seznam delcev lahko dobite seznam delcev, gibalno količino, energijo in identiteto v prvih 100 dogodkih (sliki 4 in 5).



Slika 3: Osnovni gradniki aplikacije.

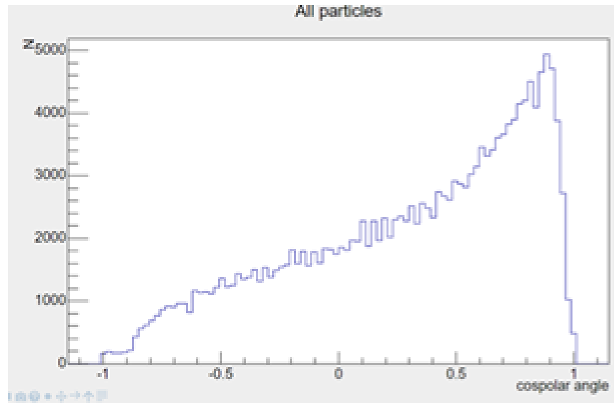


Slika 4: Opis procesa, ki omogoča izris različnih porazdelitev.

Blok histogram omogoča risanje porazdelitve izbrane spremenljivke (npr. energije / gibalne količine / identitete) delcev na seznamu v enodimenzionalni histogram. Uporabnik lahko definira število kanalov, meje in naslov histograma in spremenljivko, ki jo želi narisati.

Blok za izbor delcev omogoča izdelavo seznama delcev z izbiro tipa naboja in delcev. Ima dva vhoda: seznam vhodnih delcev, ki je lahko seznam delcev, shranjen v podatkovni datoteki ali kateri koli drug seznam, ustvarjen med analizo, in drug vhod histogram, kjer je mogoče dodati poljubne histograme.

Združevalec delcev združuje dva seznama delcev, upoštevajoč tudi primere, ko sta izbrana delca s seznama enaka. Nov seznam delcev se ustvari z masnim rezom na invariantni masi kombiniranega delca. Združevalec delcev omogoča dodajanje seznama histogramov za spremljanje postopka.



Primary particle list for Event 1

N	px(GeV/c)	py(GeV/c)	pz(GeV/c)	p(GeV/c)	Energy(GeV)	Charge	ID
1	-0.99205	0.255215	-0.298016	1.06682	1.06682	-1	electron
2	0.379417	0.416063	0.292391	0.634475	0.634475	-1	electron
3	0.448819	0.279332	0.857395	1.00727	1.01689	1	pion
4	-0.381274	0.317797	0.666425	0.830956	0.842596	-1	pion
5	-0.404262	0.0618774	0.419536	0.58589	0.602285	-1	pion
6	0.0363708	-0.337713	0.696636	0.775032	0.787499	1	pion
7	-0.125205	0.251112	0.201202	0.345276	0.372418	-1	pion
8	0.111522	0.10243	0.139017	0.205559	0.248464	1	pion
9	0.0599534	0.0198644	0.0726116	0.0962364	0.169532	-1	pion
10	-0.0335806	0.0421883	0.0666954	0.0857659	0.163816	1	pion
11	0.180846	-0.00941455	0.265317	0.321227	0.321227	0	photon
12	0.354789	0.0498766	0.227253	0.424272	0.424272	0	photon
13	0.393443	-0.310244	0.28901	0.578425	0.578425	0	photon
14	0.254512	-0.0893971	0.113315	0.29259	0.29259	0	photon
15	0.152624	-0.0325375	0.296991	0.335494	0.361627	0	pion
16	0.650451	-0.401558	0.403939	0.864582	0.875054	0	pion

Slika 5: Rezultati osnovnega opisa: porazdelitev po izbrani spremenljivki (zgoraj) in seznam delcev (spodaj)

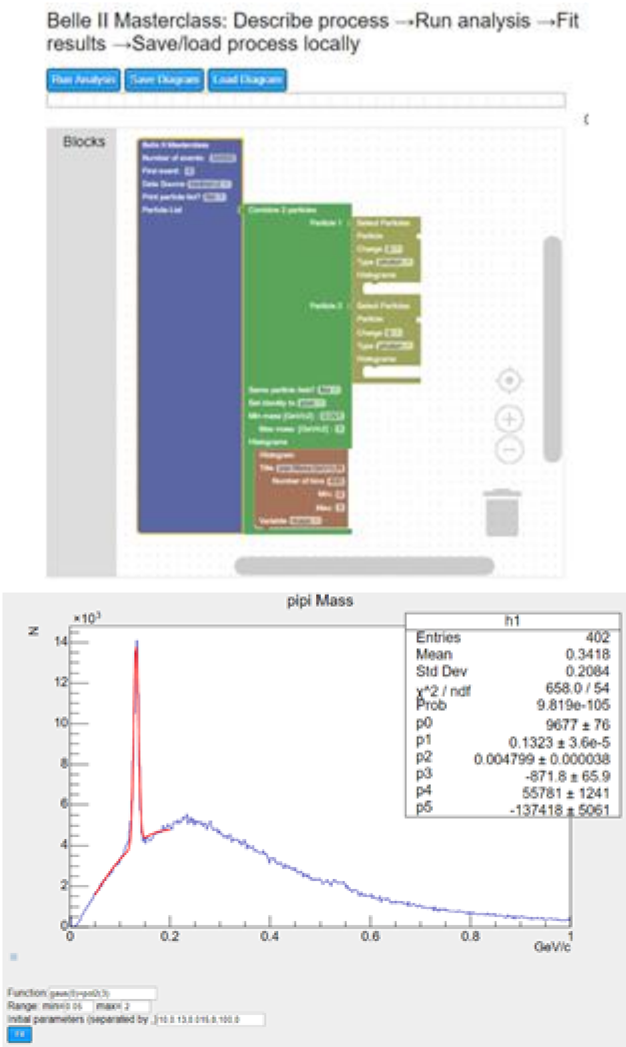
3.2 Izvajanje analize

Po opisu razpada podatke lahko obdelamo s klikom na gumb **Analiziraj** (slika 6). Uporabniški vmesnik generira psevdokodo in jo pošlje izvršilnemu strežniku, ki obdela podatke in na koncu vrne histograme.

V najenostavnejšem primeru lahko iteriramo skozi seznam delcev in narišemo porazdelitve različnih delcev in natisnemo seznam delcev (sliki 4 in 5). Ta korak je zelo pomemben z izobraževalnega vidika, saj omogoča spremljanje kombiniranega procesa in prikaz lastnosti rekonstruiranih delcev na seznamu.

Dvo-delčne razpade lahko opišemo z vključitvijo združevalca delcev (slika 6). Na primeru je prikazan razpad nevtralnega piona π^0 na dva žarka gama. Na vrnjeni histogram lahko interaktivno prilagodimo uporabniško definirano modelsko funkcijo.

Z združevanjem treh delcev lahko preučujemo bolj zapletene razpade, na primer razpad B+ na J/psi K^+ , ki mu sledi upad J/ψ na μ^+ μ^- (slika 7). Na ta način lahko rekonstruiramo različne razpade delcev. Vzorec podatkov vsebuje dovolj podatkov za rekonstrukcijo delcev π^0, K_s, ϕ , J/ψ, D^0, $D^\pm$ in $B^\pm$.

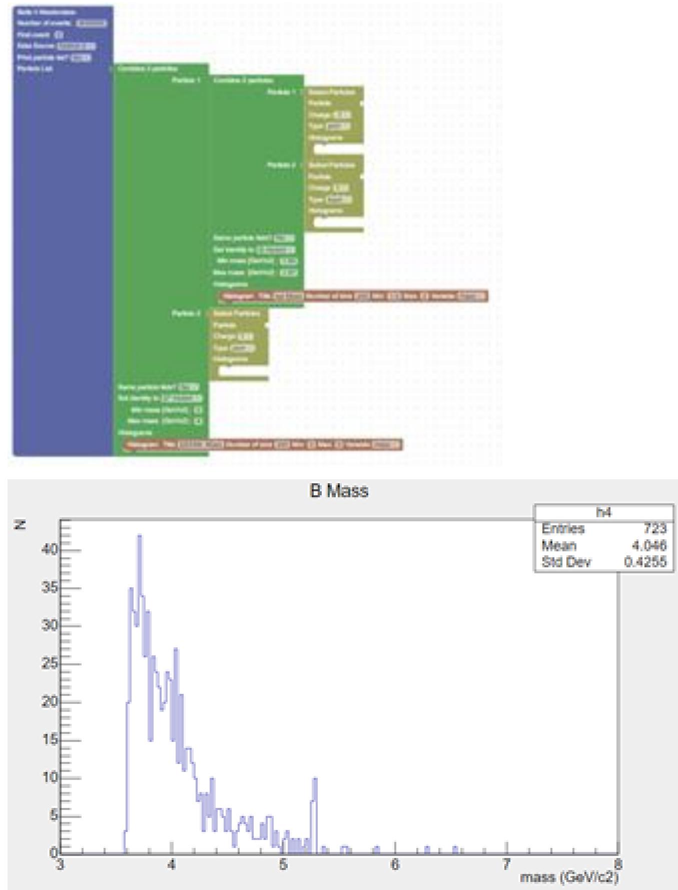


Slika 6: Primer razpada na dva delca.

3.3 Uporaba

Belle2Lab je dostopen na dva načina: gostuje lahko na javnem spletnem strežniku (dostopen na spletnem naslovu http://belle2.ijs.si/masterclass) ali kot del virtualne naprave VirtualBox [9], ki je sestavljena iz operacijskega sistema Ubuntu 18.04 LTS, podatkov, aplikacije in zasebnega spletnega strežnika (slika 7). Prvi način je uporaben za enostaven dostop, medtem ko je slednji bolj primeren za uporabo na delavnicah.

Aplikacijo uporabljamo kot del izobraževalnih delavnic Belle II International Masterclasses [10], kjer dijaki po navodili rekonstruirajo nekaj najbolj zanimivihrazpadov, na koncu pa rezultate zberejo v tabeli (slika 8).



Slika 7: Primer razpada na tri delce.

4. DISKUSIJA

Aplikacija Belle2Lab uporabnikom ponuja osnovna orodja za izbor delcev. Omogoča opis različnih razpadov delcev z izbiro in združevanjem delcev iz podatkovne datoteke, enostavnim histogramiranjem in prikazom rezultatov z uporabo knjižnice JSROOT.

Aplikacija na ta način uporabniku omogoča enostavno in intuitivno orodje za opis procesov fizikalnih razpadov in analizo javno dostopnega vzorca podatkov Belle II.

Z risanjem invariantne mase kombinacije delcev lahko odkrijemo "nove" delce kot v vrhove v porazdelitvi. Nastalim histogramom, prikazanim v spletnem brskalniku, lahko interaktivno prilagodimo uporabniško določeno funkcijo. Orodje je dostopno na internetu. Zaradi omejitev obdelave na posameznem strežniku smo pripravili virtualno napravo, ki jo je mogoče namestiti na več računalnikov in uporabiti na delavnici. Rezultate nalog (npr. identiteto delcev, širino in položaj vrha) lahko uporabniki primerjajo med.

Slika 8: Internetna različica programa BelleIILab z uvodom (zgoraj) in navidezno napravo (spodaj).

Na podlagi izkušenj z uporabo aplikacije v več poletnih šolah, nameravamo uporabiti aplikacijo BelleIILab tudi na naslednjih dogodkih International MasterClasses [10], hkrati pa pritegniti k uporabi še druge, ki aplikacijo lahko uporabljajo preko spletne povezave.

Combine The following particles	Mass (GeV/c²)	Number of events	Number of particles - combinations	Probability	Width of the particle (GeV)	Your
γ γ						
π+ π -						
K+ K -						
e+ e-						
μ+ μ-						
K+π-						
K-π+						
D⁰ π+						
D⁰ π-						
J/ψ K+						
J/ψ K-						

Slika 9: Delovni list BelleIILab s predlaganimi kombinacijami delcev in prostorom za rezultate.

5. VIRI IN LITERATURA

[1] T.Abe et al., Belle II Technical design report, arXiv:1011.0352 [physics.ins-det]

[2] Belle II experiment www.belle2.org

[3] A. Abashian et al., Belle experiment, Nucl. Inst. and Meth. in Phys. Res. A 479 (2002) 117–232

[4] T. Kuhr et al., Comput Softw Big Sci (2019) 3, https://doi.org/10.1007/s41781-018-0017-9

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[6] MIT Scratch https://scratch.mit.edu/

[7] Rene Brun and Fons Rademakers, ROOT - An Object Oriented Data Analysis Framework, Proceedings AIHENP'96 Workshop, Lausanne, Sep. 1996, Nucl. Inst. and Meth. in Phys. Res. A 389 (1997) 81-86. glej tudi http://root.cern.ch/.

[8] B. Bellenot and S. Linev, J. Phys.: Conf. Ser. 664 062033 (2015)

[9] VirtualBox https://www.virtualbox.org/

[10] International Particle Physics Outreach Group, International Masterclasses http://physicsmasterclasses.org/

Učenje skozi igro – primeri dobre prakse pri izbirnem predmetu Robotika v tehniki

Learning through play - successful hands-on cases at subject of choice Robotics in Technology

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POVZETEK

Učenci se lahko v osnovni šoli z robotiko prvič spoznajo pri interesni dejavnosti ali izbirnem predmetu Robotika v tehniki. Učno snov lahko učencem predajamo na več načinov, saj je učni načrt za ta izbirni predmet napisan precej odprto in imamo zato učitelji izvajalci pri tem bolj proste roke. Na šoli imamo nekaj kompletov Lego kock iz serije Education, zato sem se odločil, da jih bom uporabil za doseganje učnih ciljev. Pri poučevanju sem se spoznal z dvema različnima kompletoma kock – WeDo in Mindstorms. Prvi komplet je primeren za poučevanje že na razredni stopnji, drugi pa od druge triade dalje. Omeniti je treba tudi, da je pri pouku Robotike v tehniki več kot 75 % ciljev dosegljivih s temi kompleti.

V prispevku bom predstavil in opisal nekaj primerov dobre prakse, ki so se v letih mojega poučevanja robotike izkazali za zelo uspešne.

V večini primerov gre za učenje skozi igro, kjer je prisotnih nekaj elementov formativnega spremljanja, saj se kot učitelj postavim v vlogo svetovalca oziroma mentorja, ki usmerja in spremlja napredek učenca. Delo poteka v parih in je projektno ter omejeno na nekaj ur. Učencem so učni cilji predstavljeni jasno in konkretno, še preden izvedo, kaj bodo morali delati oziroma kakšna bo njihova naloga.

Ključne besede

Robotika, učenje skozi igro, robotika v tehniki, lego, WeDo 1.0, NXT 2.0, verižni eksperiment

ABSTRACT

Children in primary school can come in touch with robotics as an additional activity or subject of choice at Robotics in Technology. There are numerous ways we can teach students robotics, because the curriculum is very open and the teacher thus has a lot of freedom while teaching this subject. We have some Lego kits from the Education series at school, so I decided to use them to achieve my teaching goals. As a teacher I have acquainted myself with two different sets of blocks – WeDo and Mindstorms. The WeDo 1.0 set is suitable for children from 6 to 8, the NXT 2.0 is suitable for children from 9 to 14. More than 75% of curriculum goals are achievable with these kits. In this article I will present some good examples that have proven to be very successful during my years of teaching robotics. In most cases, it is a learning through play, where some elements of formative monitoring are present. As a teacher I put myself in a role of mentor who directs and monitors the student's progress. Work progresses in groups of two and is project-based. It is also limited to a number of lessons. The pupils are presented with clear learning goals, even before they find out what they would have to do and what their task would be.

Keywords

Robotics, learing through play, robotics in technology, Lego, WeDo 1.0, NXT 2.0, chain experiment, successful hands-on cases

1. Ustreznost kompletov

V prvi triadi učencem predstavim komplete WeDo 1.0. Ti vsebujejo kocke, iz katerih se lahko sestavi 12 različnih izdelkov. Po večini so to roboti, podobni živalim (opica, krokodil, ptica ...), lahko pa se sestavijo tudi letalo, ladja, »spinner« itd. Našteti izdelki so iz prve različice WeDo 1.0 in se razlikujejo od sodobnejše različice WeDo 2.0. Vendar to ni edina razlika med obema kompletoma. Prva različica je narejena za delo s PC-jem, medtem ko je druga bolj prilagojena za delo s tabličnim računalnikom[1].

Navodila za sestavljanje so vključena v programski opremi Lego. So pregledna in enostavna za uporabo, saj vsebujejo slikovni prikaz sestavljanja kock po korakih.

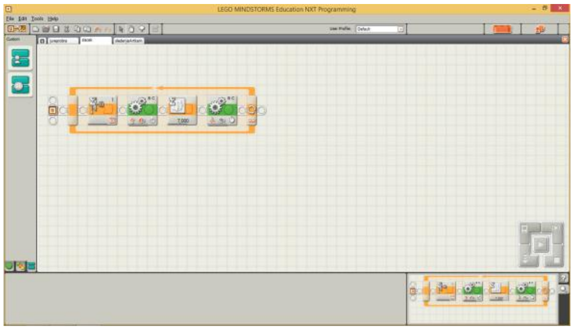
V programski opremi je vključen programski jezik, s katerim je možno programirati in krmiliti pametno kocko oz. »Hub«. Programiranje je enostavno in pregledno z malo možnosti povzročitve napake v programski kodi.

Za drugo in tretjo triado, ko so otroci že nekoliko samostojnejši, je ustreznejši komplet Mindstorms, saj jim omogoča več svobode pri sestavljanju in programiranju. V tej seriji je prav tako na voljo več različic: RCX, NXT 1.0, 2.0 ter najnovejši EV3. Različice se med seboj kar precej razlikujejo, in sicer po številu kock, programskem jeziku, komunikaciji s PC-jem, številu senzorjev in svoji občutljivosti …[2]

[1] Je kompatibilna le v primeru povezave z Bluetooth 4.0 adapterja BLED112 ([1]).

[2] https://en.wikipedia.org/wiki/Lego_Mindstorms, http://robotsquare.com/2013/07/16/ev3-NXT-compatibility/.

V programski opremi je vodič po sestavljanju različnih oblik robotov in nekaj osnovnih algoritmov. Vodič je enostaven in pregleden, saj pri vsakem koraku pokaže gradnike, ki so potrebni za sestavljanje in njihov pravilen položaj, kar prikazuje slika 4.



Slika 1. Primer uporabe zanke v programskem okolju NXT 2.0. Zanka ponovi program v neskončnost oziroma, dokler želimo.

2. Sestavljanje

Pri pouku v prvi triadi se uporabljajo kompleti WeDo 1.0. Število gradnikov v kompletu je 154. Poleg osnovnih gradnikov (kock) je v kompletu tudi pametna kocka (hub), ki se sporazumeva z računalnikom preko povezave USB. Novejši komplet WeDo2.0 vsebuje hub, ki je povezan brezžično prek Bluetooth. Hub ima dva vhoda/izhoda, na katerega se lahko priklopi motor, senzor ali lučka (led). Senzorja sta dva, infrardeči senzor in senzor za nagib. V zbirki so poleg tega valjasti in polžasti zobnik ter zobata letev. Slika 3 prikazuje še nekaj drugih posebnih gradnikov sestavljanke. Z različnimi kombinacijami lahko spreminjamo smer in hitrost vrtenja, smeri osi vrtenja ter vrtenje pretvarjamo v linearno gibanje in obratno. Z jermenom in jermenicami je mogoče sestaviti jermenski prenos. Zaradi majhnega števila gradnikov je sestavljanje omejeno na izdelke/robote, ki so v načrtu, to pa otežuje ustvarjalno sestavljanje. Slika 2 prikazuje uvodno stran programske opreme WeDo 1.0, ki ponuja kar 12 različnih robotov, kar vseeno omogoča ustrezno mero ustvarjalnosti.

Slika 2. Roboti/sestavljanke, ki so na voljo v programskem okolju WeDo 1.0 (polna različica).

Slika 3. Sestavljanka vsebuje motorje, zobnike, jermene, distančnike in dva različna senzorja.

V kompletu NXT 2.0, ki se uporablja pri pouku v drugi in tretji triadi, je številko kock 618, kar učencem omogoča več ustvarjalnega sestavljanja. Poleg osnovnih gradnikov je v zbirki še avtonomna pametna kocka »brick«, ki se lahko s PC-jem poveže prek USB kabla. »Brick« ima svoj notranji spomin, kar omogoča, da se program na njem izvaja tudi, ko je povezava z USB prekinjena. V zbirki so na voljo še štirje različni senzorji : senzor za dotik, infrardeči in ultrazvočni senzor ter senzor za jakost zvoka (mikrofon)[3]. Na voljo so trije motorji. »Brick« omogoča priklop treh motorjev ter štirih senzorjev. Številni zobniki različnih oblik omogočajo spreminjanje smeri in hitrosti vrtenja, smeri osi vrtenja ter pretvarjanje vrtenja v linearno gibanje in obratno. Zbirka s kotnimi elementi, zglobi in distančniki omogoča, da posamezni učenec sestavi popolnoma unikaten izdelek/robot po svoji zamisli.

Slika 4. Navodila za sestavljanje so natančna in pregledna. Pri vsakem koraku je označeno, kateri gradniki so potrebni v tem koraku ter kakšna je njihova pravilna lega.

3. Programiranje

Programska oprema WeDo 1.0 omogoča enostavno in pregledno programiranje. Na sliki 5 in 6 je opaziti, kako so z barvami ločeni ukazi za premikanje motorja, uporabo senzorjev in zvoka. Na voljo je nekaj matematičnih operacij, kot so seštevanje, odštevanje ter množenje in deljenje. Z zanko (loop) se program ponovi, ko pride do zadnjega ukaza. Slika 1 prikazuje primer uporabe zanke. Programiranje je podobno jeziku scratch, ki ga učenci spoznajo pri pouku računalništva[4]. Zaradi majhnega števila ponujenih

[3] Dokupiti je mogoče še senzorje za barvo, kompas, žiroskop itd ([2]).

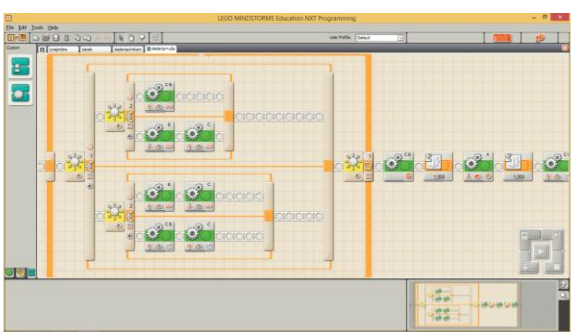
[4] https://scratch.mit.edu/.

ukazov je programiranje enostavno, saj skoraj vsaka kombinacija nekaj pomeni, rezultat pa se izraža kot sprememba na robotu (vizualna ali zvočna).
Programiranje je vizualno, blokovno. Vsak blok predstavlja ukaz (premik motorja, zvok, naključna številka, senzor, ponavljanje ...), posamezni ukazi pa se sestavljajo v (logično) zaporedje.

Slika 5. Uporaba zanke in nekaterih ukazov gibanja motorja v programskem okolju WeDo 1.0.

Slika 6. Branje blokovnega programiranja poteka od leve proti desni. Če ukaz ni pravilno postavljen, se ne izvede.

Podobno programiranje je tudi v okolju NXT 2.0, ki je na voljo v programski opremi zbirke Mindstorms. Razlika je v številu blokovnih ukazov, saj je nabor ukazov prilagojen večjemu številu senzorjev in motorjev, ki jih uravnavamo. Na voljo sta zanka in pogojni stavek, ki sta prikazana na sliki 7. Več je matematičnih in logičnih funkcij, zaradi česar se lahko sestavijo tudi zahtevnejši algoritmi. Zato je v tem okolju možnost nelogičnih, napačnih programov večja.



Slika 7. Uporaba zanke in pogojnih stavkov za program sledenja črte.

4. Učni cilji

Za doseganje učnih ciljev je potrebnih nekaj manjših prilagoditev, tako pri delu s kompletom WeDo 1.0 kot pri delu z NXT 2.0. Zahtevnost je prilagojena posameznim skupinam in njihovim sposobnostim. V tem poglavju so izpostavljeni sklopi, kjer so cilji dosegljivi z uporabo kompletov za učne vsebine predmeta Naravoslovje in tehnika ([3]) ter izbirnega predmeta Robotika v tehniki ([4]), ki ga lahko izberejo učenci v 8. razredu.

Naravoslovje in tehnika, 4. razred, operativni cilji
Področje/tema: Razvrščanje snovi in lastnosti snovi

- dokazati, da nekatere snovi prevajajo električni tok, nekatere pa ne.

Področje/tema: Sile in gibanje

- ugotoviti različne načine premikanja teles,
- prikazati, da se telesa premikajo navzdol zaradi teže (sile),
- izdelati in preizkusiti model vozička ter predlagati izboljšave,
- pojasniti pomen lastnosti površin glede na različne načine gibanja (drsanje, tek).

Področje/tema: Pretakanje snovi

- izdelati model mlinčka (vodnega kolesa) iz različnih gradiv.

Naravoslovje in tehnika, 4. razred, operativni cilji
Področje/tema: Naprave in stroji

- prikazati sestavne dele gugalnice nihalke (stojalo, nihajni drog, vrtišče in sedalo),
- graditi model gugalnice, ga preizkusiti in vrednotiti,
- dokazati, da je za začetek nihanja potreben sunek,
- vzpostaviti ravnovesje na gugalnici prevesnici, izdelati model in ga skicirati,
- uporabiti princip gugalnice pri dvigovanju bremen in uporabljati različno dolge ročice,
- prikazati primere, kjer je uporabljen princip vzvoda (ki olajša fizikalno delo),
- ugotoviti, kako bi lahko dvignili predmet na večjo višino, kot ga lahko dvignemo z vzvodom,
- opisati dvigalo ali njegov model in poimenovati posamezne dele,
- dokazati, da jermen prenaša gibanje, lahko pa tudi breme,
- sestaviti model jermenskega gonila in naprave z jermenskim gonilom,
- narisati skico svojega modela in opisati njegovo delovanje,
- preveriti možnosti uporabe jermenskega gonila.

Področje/tema: Tekočine tečejo

- načrtovati, izdelati in preizkušati napravo za merjenje vetra in napravo, ki jo poganja veter.

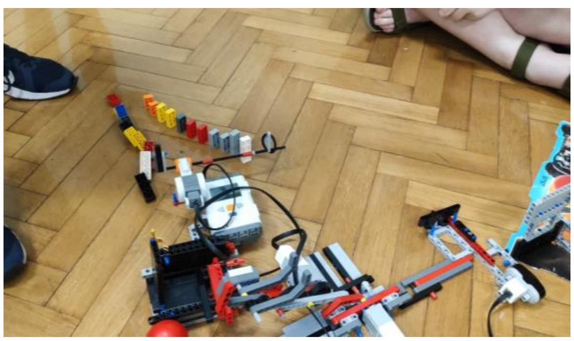
Pri izbirnem predmetu Robotika v tehniki, 8. razred, so dosegljivi skoraj vsi operativni cilji, razen tistih, za katere so potrebni obiski delavnic oziroma terensko delo ter delo s polprevodniškimi elementi, ki v zbirkah NXT 2.0 niso na voljo.

Slika 8. Na spletu je dostopen učni načrt za Izbirni predmet Robotika v tehniki ter spremembe v učnem načrtu iz leta 2009 ([5]).

5. Primeri dobre prakse projektne naloge

5.1 Verižni eksperiment

Pri prvi uri projektne naloge se z učenci pogovorimo o končnih in vmesnih ciljih projektne naloge. Cilji so pojasnjeni po sklopih tako, da jih vsak učenec razume in ve, kaj mora storiti. Vsak sklop naloge je pomemben, saj učenec naloge ne more nadaljevati, dokler ne izpolni vmesnega cilja. Sklope in cilje si učenci opišejo oziroma zapišejo na liste, ki jih pustijo v svojih škatlah s kockami.



Slika 9. Zadnji sklop verižnega eksperimenta se je končal s podiranjem domin iz Lego kock.

Če je le možno, sodelujejo v parih, ti pa med seboj sodelujejo pri dosegi končnega cilja. Primerna naloga je verižni eksperiment, za katerega večina učencev prvič sliši. Da bi ga lažje razumeli, jim pokažem videoposnetek iz prejšnjih let. Verižni eksperiment je razdeljen po sklopih. Vsak par učencev ima svojo nalogo , vsi pari skupaj pa poskrbijo, da verižni eksperiment v celoti deluje. Vsakemu paru so dodeljeni posebna naloga in omejitve. En par mora na primer sestaviti poskus, pri katerem se žogica ne sme dotakniti tal, drugi par se ukvarja s premagovanjem višinske razlike, tretji par mora uporabiti poševni met itd. Eksperiment je sestavljen iz toliko delov, kolikor je otrok oziroma parov otrok. Vsak njegov del mora delovati samostojno, zato je nekaterim dodeljena naloga (ali omejitev), da uporabijo senzorje ali sprožilec, kot si sami zamislijo. Dimenzije sklopov so omejene na polovico šolske mize. Poleg tega je omejeno število ur, saj s tem spodbudimo delovno vnemo. Naloga učitelja pri tem je, da spremlja njihov napredek in ali se držijo omejitev. Vse ostalo učenci morajo in zmorejo narediti sami, od komunikacije, vrstnega reda sestavnih sklopov eksperimenta do končnih natančnih popravkov. Zadnja ura je namenjena preizkusu delovanja eksperimenta ter njegovemu ocenjevanju, slikanju in snemanju poteka. Celoten delujoč verižni eksperiment učenci z veseljem pokažejo ostalim otrokom iz šole v šolski avli (slika 10). Na sliki 9 je prikazana zadnji sklop verižnega poskusa, pri katerem je žogica morala podreti, v vrsto postavljene, domine.

Slika 10. Vzdušje v šolski avli med demonstracijo verižnega eksperimenta.

5.2 Olimpijske igre

Ta naloga je še posebej aktualna v času olimpijskih iger, sicer je za učence zanimiva tudi v času, ko jih ni. Pri prvi uri se z učenci pogovorimo o ciljih, omejitvah in smernicah, ki jim morajo slediti med igrami. Učencem so predstavljene discipline, v katerih se bodo morali pomeriti, in časovni okvir sestavljanja. Discipline si sledijo v takem zaporedju, da njihovega robota ni treba preveč preoblikovati in spreminjati, da bodo osvojili naslednji cilj. Discipline v katerih tekmujejo s celotno skupino so:

- avtonomno sledenje črni črti z enim senzorjem ter pravilnim programom,
- hitrostno dirkanje (drag race), pri katerem morajo uporabiti multiplikator in povečati število vrtljajev na kolesih,
- slalom med stožci s pomočjo daljinca ali pametnega telefona,
- sumo borba, pri kateri morajo uporabiti reduktor za lažje izrivanje nasprotnika z omejene površine,
- ter met žogice v daljino, pri kateri morajo sami ugotoviti način metanja ter obvezno uporabiti multiplikator.

Vsaka disciplina/naloga zahteva od učenca posebne prilagoditve na robotu, saj mora pravilno sestaviti zobniške prenose, uporabiti prave senzorje in obliko robota. Ob vnaprej določenih urah je v šolski učilnici tekmovanje v eni ali največ dveh disciplinah, čemur sledi predstavitev širši publiki v šolski avli.

6. Zaključek

V prispevku sem se osredotočil izključno na dva kompleta iz serije Education, tj. WeDo 1.0 ter NXT 2.0, saj ju pri svojem delu največ uporabljam. Vsekakor je podobne ali skoraj enake projekte mogoče izpeljati tudi z drugimi podobnimi kompleti.

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Uporaba računalnika pri pouku: podpora ali potuha?

The use of computer in the classroom: support or indulgence?

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POVZETEK

V prispevku želimo predstaviti možnost uporabe IKT pri šolskem delu. Posebej smo izpostavili osebe, ki imajo specifične učne težave (SUT) in bi jim uporaba pripomočkov vsakdanje šolsko delo močno olajšala, a kljub dosegljivosti računalnika, pogosto ni pripravljenosti za uporabo. Predstavili smo nekatere prilagoditve, ki jih lahko pri pripravi gradiv upošteva učitelj in s tem omogoči lažje sledenje pouku. Izpostavili pa smo tudi nekaj glavnih področij, kjer imajo učenci s SUT primanjkljaje in predstavili na kašen način se poslužujemo prilagajanja gradiv in drugih prilagoditev, ki jim pripadajo. Pri tem je pomembno sodelovanje šole in družine za ustrezno izbiro pripomočka, programa ali aplikacije, ki bo predstavljala optimalno prilagoditev za učenca. V prispevku smo želeli ozavestiti pomen uporabe IKT učencev s SUT in pomagati tudi drugim staršem, učiteljem in širši javnosti dokazati, da je uporaba računalnika v učnem procesu otrok s SUT nujna.

Ključne besede

IKT, specifične učne težave, računalnik

ABSTRACT

In the paper, we want to present the possibility of using ICT with school work. Special attention was given to persons with specific learning disabilities as they could benefit from the use of ICT but usually there is lack of willingness. We described some of the adjustments teachers can use to make lessons easier to follow. We focused on some of the main areas where students experience difficulties and adjustments to help to resolve them. It is important that school and parents work together to find the right technology, program or application that will represent optimal working conditions for the student. In the article we want to raise awareness aout using ICT with students with learning disabilities and help parents, teachers and the public understand that using ICT in the learning processes of the children with learning disabilities is necessary.

Keywords

ICT, specific learning disabilities, computer

1. UVOD

Preden otroci prestopijo prag šole, njihovo učenje večinoma poteka preko igre. Ta poteka v sproščenem vzdušju, v skladu z interesi otrok. V današnje času je veliko želja, tudi pri igri, usmerjenih v računalnik in računalniške igrice. V zgodnjem otroštvu odsvetujemo pogosto uporabo računalnika, kasneje pa ta postane nepogrešljiv pripomoček za iskanje informacij, zapisovanje in predstavljanje idej. Kljub temu, da se vsi zavedamo v kakšno pomoč so nam lahko različne IKT naprave, pa šola ostaja prostor, kjer, razen za uporabo učiteljev, niso zaželene.

Pri svojem delu, kjer se srečujem z otroci s posebnimi potrebami, opažam, da kljub navedenim prilagoditvam in možnostim uporabe IKT tehnologije, le ta ni podprta in pogosto predstavlja vir sporov. Kadar se učencu s SUT zagotovi uporaba določenega pripomočka, se oglasijo sošolci, njihovi starši in nekateri učitelji, ki menijo, da predstavlja učencu prednost pred drugimi. V nadaljevanju želimo predstaviti kdo so učenci, ki IKT pripomočke potrebujejo, in zakaj ter na kakšen način jim lahko omogočimo, da v učni proces, ne glede na svoje težave, lahko vstopajo enakovredno kot drugi.

2. POUK

Temeljne naloge vzgojno izobraževalnega procesa so:

- razumevanje temeljnih informacij o razvoju narave, družbe in človeka (informativna naloga)
- razvijanje spoznavnih in drugih duševnih sposobnosti ter spretnosti, zlasti mišljenja, na višji ravni, ki je največkrat povezano z videnjem in reševanjem problemov (formativna naloga)
- razvijanje zmožnosti in lastnosti ustvarjalnega delovanja in ravnanja, povezanih z vedno novimi lastnimi izkušnjami (formativna naloga)
- vzgojno-socializacijsko oblikovanje mlade osebnosti (formativna naloga) [9]

Da bi učitelji to zmogli zagotoviti, usklajujejo predpisane kurikulume, učne načrte z interesi, značilnostmi in zmožnostmi učencev. Metodika in didaktika pouka se počasi razvijata in prilagajata novim standardom, koncept inkluzije se počasi trudi zaživeti in omogočiti optimalen razvoj posameznika. Današnje šolstvo naj bi to zagotavljalo vsem, vendar pri otrocih s posebnimi potrebami ostaja mnogo nedorečenih tem.

V nadaljevanju želimo predstaviti kdo so otroci s specifičnimi učnimi težavami, nekatere njihove značilnosti in pomen prilagoditev, ki jih lahko omogočijo optimalno funkcioniranje v šolskem sistemu.

2.1 Specifične učne težave

V Zakonu o usmerjanju otrok s posebnimi potrebami (ZUOPP)[10] je navedenih več različnih posebnih potreb, ki jih učenci lahko imajo. V našem prispevku se bomo osredotočili na učence s specifičnimi učnimi težavami, ki niso tako izrazite in ne potrebujejo posebnega usmerjanja le nekaj prilagoditev in na učence, ki so opredeljeni kot otroci s posebnimi potrebami s pridobljeno odločbo o usmerjanju ter usmerjeni kot učenci s primanjkljaji na posameznih področjih učenja.

Po kriterijih za opredelitev motnje [6] so otroci usmerjeni kadar imajo težjo obliko specifičnih učnih težav, pri katerih se zaradi znanih ali neznanih motenj ali razlik v delovanju centralnega živčnega sistema kljub povprečnim ali nadpovprečnim intelektualnim sposobnostim pojavljajo izrazite težave pri branju, pisanju, pravopisu in/ali računanju. Pojavljajo se tudi zaostanki v razvoju in/ali motnje pozornosti, pomnjenja, mišljenja, koordinacije, komunikacije, socialnih sposobnosti in/ali emocionalnega dozorevanja. Primanjkljaji vplivajo na kognitivno predelovanje besednih in nebesednih informacij, ovirajo usvajanje in avtomatizacijo šolskih veščin ter vse življenje vplivajo na učenje in vedenje. So notranje narave in niso primarno pogojeni z neustreznim poučevanjem in drugimi okoljskimi dejavniki, vidnimi, slušnimi ali motoričnimi okvarami, nevrološkimi motnjami in motnjami v duševnem razvoju ter vedenjskimi in čustvenimi težavami ali motnjami, čeprav se lahko pojavljajo skupaj z njimi.[5]

Za identifikacijo otroka s primanjkljaji na posameznih področjih učenja je potrebno izpolnjevanje vseh kriterijev

1. kriterij pomeni dokazano neskladje med strokovno določenimi in utemeljenimi pokazatelji globalnih intelektualnih sposobnosti in dejansko uspešnostjo na naslednjih področjih učenja, in sicer branja, pisanja, računanja in pravopisa.
2. kriterij so obsežne, izrazite težave na enem ali več izmed štirih področij šolskih veščin (branje, pisanje, pravopis, računanje), ki vztrajajo in so izražene do te mere, da otroku izrazito otežujejo napredovanje v procesu učenja.
3. kriterij vključuje slabšo učinkovitost učenja zaradi pomanjkljivih in/ali motenih kognitivnih in metakognitivnih strategij (sposobnosti organiziranja in strukturiranja učnih zahtev) in/ali motenega tempa učenja (hitrost predelovanja informacij).
4. kriterij je dokazana motenost enega ali več psiholoških procesov, kot so pozornost, spomin, jezikovno procesiranje, socialna kognicija, percepcija, koordinacija, časovna in prostorska orientacija, organizacija informacij itd.
5. kriterij izključuje senzorne okvare, motnje v duševnem razvoju, druge duševne in nevrološke motnje, čustvene in vedenjske motnje, kulturno in jezikovno različnost ter psihosocialno neugodne okoliščine in neustrezno poučevanje kot glavne povzročitelje primanjkljajev na posameznih področjih učenja, čeprav se lahko pojavljajo tudi skupaj z njimi.[6]

Skupina motenj je heterogena in vključuje specifične motnje branja (disleksijo), pravopisne težave (disortografijo), specifične motnje računanja (specifične aritmetične učne težave in diskalkulijo), motnje pisanja (npr. disgrafijo) in primanjkljaje na področju praktičnih ter socialnih veščin (neverbalne motnje učenja in dispraksija). [5].

ZUOPP [11] določa, da se otrokom s posebnimi potrebami, ki so usmerjeni v izobraževalne programe s prilagojenim izvajanjem in dodatno strokovno pomočjo, glede na vrsto in stopnjo primanjkljaja, ovire oziroma motnje lahko prilagodi organizacija, način preverjanja in ocenjevanja znanja, napredovanje in časovna razporeditev pouka ter zagotovi dodatna strokovna pomoč.

Zaradi raznolikosti težav je delo v razredu za učitelja velik izziv. Kljub temu ima možnost, da opisanim učencem, z uporabo računalnika in druge IKT, olajša učenje in omogoči lažje sledenje pouku. Nekaj nasvetov za izboljšanje učnega gradiva navajamo v nadaljevanju.

2.2 Računalnik kot pomoč učitelju

Učitelju računalnik služi kot pripomoček priprave na delo, hkrati pa ga uporabljamo tudi med poukom za bolj nazoren prikaz snovi, interaktivnejše predajanje snovi in s tem izboljšamo motivacijo učencev za učenje, hkrati pa naredimo pouk bolj zabaven.

Prednost materiala pripravljenega na računalniku je, da lahko material večkrat uporabimo, prilagodimo, dopolnimo. Omogoča tudi večjo izmenjavo gradiva med kolegi in po potrebi učenci.

V pomoč učencem s specifičnimi učnimi težavami brez težav spremenimo obliko in velikost črk, barvno podlago za izboljšanje kontrasta, možnost digitalnega izpolnjevanja različnih gradiv (učnih listov, delovnega zvezka) in pripravo izročkov.

Pri načrtovanju moramo biti pozorni na povsem tehnične podrobnosti:

- večji razmik med vrsticami (1,5),
- uporaba odstavkov, ki jih dodatno ločimo z dvema presledkoma,
- ustrezna oblika črk (Arial, Comic Sans, Verdana, Helvetica),
- večja velikost pisave (12-14),
- odebeljene črke,
- brez podčrtavanja celotnih vrstic,
- levostransko poravnavo,
- namesto praznega prostora, črte za zapis odgovora,
- več prostora in časa za reševanje,
- sprememba barve ozadja v rumeno ali zeleno oziroma v barvo, ki je učencu za oči najbolj udobna,
- brez uporabe sličic za ozadje,
- barvno označeni ali odebeljeni ključni podatki. [4]

2.3 IKT kot pomoč učencu s specifičnimi učnimi težavami

Učenci s specifičnimi učnimi težavami, so učenci, katerih intelektualne sposobnosti ne odstopajo, vendar je njihovo funkcioniranje zaradi drugačnega delovanja možganov v našem šolskem sistemu omejeno [7].

Učenci s specifičnimi učnimi težavami so popolnoma enaki vsem svojim vrstnikom. Ima enake čustvene in socialne potrebe, potrebe po sprejetosti, varnosti, druženju z vrstniki, po spoznavanju novih stvari. Od njih se razlikujejo samo po določeni značilnosti [9]. Potrebujejo nekatere prilagoditve in pripomočke, da jim lahko zagotovimo enakovredno možnost sprejemanja in izkazovanja svojega znanja.

Ravno prilagoditve so pogosto vir težav, nasprotovanj, podtikanj in nezadovoljstva med učenci, starši, učitelji, sošolci in izvajalci pomoči. Pri zapisovanju prilagoditev v individualizirane programe, ki so zakonsko obvezujoč "podaljšek" odločbe, podpisan s strani strokovne skupine in staršev, moramo dobro poznati učenca in njegove potrebe. Prilagoditve omogočajo otroku, da pokaže svoje znanje in s tem pridobi bolj enakovredne pogoje v primerjavi z vrstniki. Kljub temu, da imamo možnost uporabe različnih pripomočkov, šola lastnim IKT ni najbolj naklonjena.

2.3.1 *Izdelovanje zapiskov*

Zapisovanje informacij je zahteven proces, saj je potrebno usklajevanje in stalno preusmerjanje pozornosti od poslušanja k zapisovanju in obratno, hkrati pa odmisliti ostale moteče dejavnike in dražljaje. Osebe, ki to zmorejo, so pri zapisovanju uspešne.[2]

Spretnost zahteva dober delovni spomin in dobro zmožnost predelavanja novih informacij in povezovanja z informacijami, ki jih imajo v dolgoročnem spominu. Prav te spretnosti so pri osebah z SUT okrnjene. Prav tako so pogosti primanjkljaji s hitrostjo obdelave, usmerjanjem pozornosti.

Boyle [1] je raziskoval in primerjal spretnost izdelovanja zapiskov pri učencih z in brez SUT. Rezultati so pokazali, da učenci, ki imajo SUT zapišejo manj besed (SUT 57, 3 besede, brez SUT 130,5 besed), manj pomembnih informacij (SUT 17%, brez SUT 42%) in imajo slabši rezultat pri preverjanju znanja (SUT 47%, brez SUT 67%).

Hughes in Suritsky [3] sta raziskovala med populacijo študentov in prišla do podobnih rezultatov. V svoji raziskavi (prav tam) sta ugotovila, da študenti s SUT zapišejo manj pomembnih informacij, kot osebe, ki nimajo težav. Osebe s SUT so zapisala le 36% vseh informacij (brez Sut 56%) in 46% pomembnih informacij (brez SUT 77%). Navajali so težave s hitrostjo zapisa, sledenjem predavatelju in vzdrževanjem pozornosti. Težje tudi določajo pomembnost informacij in slabše razumejo lasten zapis.

2.3.2 Uporaba IKT za izboljšanje zapiskov

Učenci s SUT potrebujejo pomoč pri izdelovanju zapiskov in pri organizaciji zapiskov.

Prenosni računalnik

Prenosni računalnik omogoča hitrejše zapisovanje informacij. Pri tem je pomembno opozoriti, da je to le v primeru, ko je učenec vešč tipkanja. Pri tem priporočam učenje slepega desetprstnega tipkanja, ki je na voljo tudi brezplačno na spletni strani https://www.typingstudy.com/sl/. Takrat, ko učenec ne zmore hitrega tipkanja, moramo biti pri uporabi previdni, saj lahko pe dodatno upočasni delo.

Tablični računalnik

V primerjavi s prenosnim računalnikom so tablični manjši in ekonomsko ugodnejši. Podpirajo možnost različnih aplikacij, omogočajo snemanje in imajo možnost priključka različnih tipkovnic. Brez tipkovnice pa je zapisovanje počasnejše kot pri prenosnih računalnikih.

Pametni telefoni

So pravzaprav računalniki v malem, ki lahko služijo za fotografiranje zapiskov ali knjig, ki jih nato s pomočjo aplikacij pretvorijo v pdf dokumente. Omogočajo snemanje, pa tudi kratke zapise ali opomnike, ki so v pomoč organizaciji in načrtovanju dela.

Snemalnik zvoka

Če ima učenec možnost, da posname slišano snov, se lahko med samim predavanjem bolj osredotoči na slišanje informacije in si jih tudi bolje zapomni. Zato lahko ob ponovnem poslušanju lažje uredi zapiske, saj že ima nekaj informacij, da se lažje organizira in ustrezno dopolni zapiske.

Pametna pisala

Pametna pisala imajo na konici vgrajeno kamero s katero se digitalizira zapise in risbe. Listi so opremljeni s pametno tehnologijo, ki omogoča pisalu, da natančno ve na kateri strani pišete ali rišete in prepozna ročno napisane zapiske, ki jih prenese na ekran. Pametno pisalo prepiše ročni zapis v digitalno obliko, ki se jo lahko ureja, briše, popravlja barvo in debelino pisave ali označite tekst z označevalcem teksta.

Obstaja tudi nekaj aplikacij za urejanje zapiskov:

- Učenci za izdelavo miselnih vzorce večinoma poročajo o uporabi aplikacije **Coggle** ali **MindNode**. Sta enostavni za uporabo, omogočata, da se izdelek lahko izmenjuje in dopolnjuje, shrani ter nato natisne.

- **OneNote** je program in aplikacija, s katero se ureja zapiske kot v zvezku. Omogoča dopolnjevanje, podčrtavanje, obkroževanje, označevanje, dodajanje, idr.

- **PaperNote** omogoča urejanje in shranjevanje dokumentov, tudi skeniranih.

Za učinkovito uporabo aplikacij je potrebno preizkušanje in trening, da izberemo tisto, ki nam najbolj ustreza. Veliko aplikacij ponuja izmenjavo med udeleženci, kar omogoča številne možnosti sodelovanja med učenci, učitelji in starši.

2.3.3 Dopolnjevanje zapiskov in delovnih zvezkov

Učencu, ki ima v individualiziranem programu v prilagoditvah določeno, da dobi izpiske v naprej, se mu lahko v naprej lahko pošlje oziroma pripravi Power Point predstavitve ali delovne liste, ki jih nato dopolnjuje na računalniku. To je namenjeno predvsem učencem, ki zaradi okrnjene grafomotorike ne zmorejo slediti pouku z zapisovanjem, delajo preveč napak ali pa je njihova pisava slabše berljiva njim in učiteljem.

V nekaterih založbah imajo možnost posredovanje e-delovnih zvezkov, če obstajajo ali delovnih zvezkov v digitalni obliki. Včasih založbe zahtevajo dodatno plačilo, pogosto pa je dovolj kopija računa, da ste kupili delovni zvezek. Pred uporabo se je potrebno zavezati, da se gradiva ne širi.

Izpolnjevanje delovnih zvezkov na računalnik močno olajša domače in šolsko delo. Rešene naloge se shrani in nato pregleda, po potrebi dopolni. Učenci postanejo s tem bolj samostojni iz v krajšem času opravijo več nalog.

2.3.4 *Branje daljših besedil*

Ne samo zapisovanje, tudi branje učencem s specifičnimi učnimi težavami predstavlja izziv. Učenci se pogosto zgubijo med vrsticami ali vsebino, ne razumejo prebranih besed, izpuščajo in zamenjujejo črke, zloge, včasih cele besede. Sama tehnika branja je za njih tako zahtevna, da ne zmorejo slediti vsebini prebranega. Pogosto se zgodi, da ne prepoznajo osrednje teme in ne razumejo o čem govori besedilo. Posledično ne zmorejo ustrezno odgovoriti na vprašanja. Pri tem ne gre za lenobo, ampak za drugačno funkcioniranje možganov, zato smo jim dolžni omogočiti, da jim navodilo oziroma besedilo prebere nekdo drug. Pogosto se poslužujemo nadomestnega bralca, z razvojem IKT tehnologije pa lahko uporabimo eBralca.

Sintetizatorji govora, omogočajo prebiranje poljubnih besedil. Za angleško govoreče okolje obstaja več spletnih različic, ki se jih lahko poslužujemo tudi pri učenju tujih jezikov (http://text-to-speech.imtranslator.net/) [13], medtem ko sem na spletu našla dve slovenski različici. Prva je na strani Knjižnice slepih in slabovidnih (http://www.kss-ess.si/ebralec-sintetizator-govora-slovenskega-jezika/) [11] in je brezplačno dostopen v okviru ustanov javnega sektorja, slepim in slabovidnim ter osebam z motnjami branja, drugi pa je nastal v okviru projekta Instituta Jožef Stefan in UKC Ljubljana in je dosegljiv na spletni strani (https://dis.ijs.si/dyslex/index.html). [12]

2.3.5 Organizacija šolskega in domačega dela

Pri učencih s SUT pogosto zaznavamo šibke organizacijske, časovne in prostorske spretnosti. Pogosto se izgubijo, ne vedo katera ura sledi in v katero učilnico morajo, ne znajo ustrezno razporediti in oceniti čas, ki ga za neko aktivnost potrebujejo [8].

V pomoč pri učenje strukture in načrtovanja dela je na voljo več aplikacij, s katerimi učencem olajšamo prehajanje med dejavnostmi in razporejanje lastnega časa. Google koledar omogoča nastavitev opomnikov, dogodkov, ki jih lahko delimo ali usklajujemo z drugimi. Obstaja pa tudi možnost aplikacij, ki se prenesejo na mobilni telefon in omogočajo načrtovanje aktivnosti, označevanje opravljenih nalog: Microsoft To Do, To – Do Calendar Plan. Omogočajo sinhroniziranje med več napravami.

2.3.6 Praktična uporaba računalnika pri pouku in domačem delu

Za mnenje uporabe računalnika smo prosili mamo dveh učencev z disleksijo, ki nam je odgovorila na vprašanja o uporabi IKT pri pouku in doma

Mama pove, da sta sina dobila odločbi v 3. razredu OŠ, z uporabo računalnika pa sta začela v 4. razredu. Pri starejšem sinu je bilo vse novo. V šoli kljub odločbi niso poznali vseh možnosti in nam vedeli svetovati. Zato smo se starši sami že v 3. razredu odločili in kupili lasten prenosni računalnik, na katerem je sin začel vzporedno delati domače šolske obveznosti že doma in se tako pričel navajati na računalniške programe. Z učiteljico so se na začetku 4. razreda uspeli dogovoriti, da bo računalnik uporabljal tudi med samim poukom. Sprva je bilo vse malo težje, potem pa sta uskladila delo s tem, da mu je učiteljica določene učne liste posredovala na e-pošto in jih je potem med poukom dopolnjeval. Kar nekaj nevšečnosti se je pokazalo tudi s strani sošolcev, saj so videli računalnik kot nek privilegij in ne pripomoček za lažje sledenje pouku. Tu je precejšnjo vlogo odigrala specialna pedagoginja, ki je tako učiteljici kot tudi sošolcem predstavila sinove težave in obrazložila kaj mu pomeni uporaba računalnika med poukom in kasneje tudi pri ocenjevanju. Kasneje, v 5. razredu, je počasi steklo, tudi učitelji so sprejeli njegovo delo na računalniku kot pripomoček, ki mu omogoča normalno sledenje pouku in ne več kot privilegij. Mlajši sin takšnih težav z uvajanjem računalnika v pouk ni imel, saj so učitelji že sami videli napredek pri starejšem sinu.

Mama pove, da oba uporablja prenosni računalnik in predvsem delo s programom WORD in EXCEL. V letošnjem letu pa sta oba pridobila tudi licenci za e-bralca.

Delo z uporabo računalnika je šolsko delo tako v šoli kot doma zelo olajšalo. Sedaj so zapiski skoraj popolni in predvsem berljivi. Tudi domača opravila je na računalniku opraviti lažje, hitreje in s precej manj napora kot prej, ko je bilo potrebno vse pisati na roke. Prav tako se je zmanjšalo število slovničnih napak pri zapisu besedil. Veliko učiteljev je povzetke snovi že pred obravnavo poslalo na elektronsko pošto in tako sta oba lahko med samo uro vso pozornost usmerjata v učiteljevo podajanje snovi in se ne obremenjevala s tem kako bosta uredila svoje zapiske, da bi se kasneje lahko po njih doma tudi učila. V veliko pomoč se je v preteklem letu izkazalo tudi izvajanje pisnih ocenjevanj na računalnik. Oba sta po besedah specialnih pedagoginj svoje znanje pokazala precej bolj sproščeno, hitreje in manj obremenjena, saj se nista obremenjevala s samim zapisom odgovorov ampak sta se posvečala vsebini.

Mama je izboljšavo z uporabo računalnika tako pri šolskem kot domačem delu, na lestvici od ena do pet ocenila s štiri.

3. ZAKLJUČEK

Učenci, ki obiskujejo redne osnovne šole in imajo SUT so pogosto tarča raznih zasmehovanj. Pogosto jim ne priznajo uspeha in jim očitajo, da imajo potuho. Učenci s težjimi SUT imajo zapisane prilagoditve v individualiziranih programih, ki so za šole zakonsko zavezujoči. Kljub temu se zaradi različnih razlogov se tem učencem nekatere prilagoditve ne omogoča, saj se zaradi nepoznavanja narave specifičnih učnih težav pogosto dogaja, da prevladuje mnenje o nepotrebnosti takšnih pripomočkov.

S širjenjem informacij o SUT, le te postajajo bolje prepoznane, diagnosticirane, otroci in učenci pa z ustrezno usmeritvijo pridobijo nekatere prilagoditve in pripomočke, ki jim lahko olajšajo šolsko delo in so določene v Odločbi za usmerjanje otrok s posebnimi potrebami.

Pri tem se pogosto zastavlja vprašanje, če osebi, ki je gibalno ovirana tudi vzamemo voziček in ji rečemo, naj se potrudi hoditi sama. Zakaj je torej toliko nejevolje, kadar bi učencu želeli omogočiti le uporabo računalnika ali druge IKT tehnologije, ki bi mu olajšala delo in omogočila, da ustrezno prikaže svoje sposobnosti. Ozavestiti je potrebno, da so pripomočki tako kot voziček – so sredstvo, ki nadomesti nek primanjkljaj, ki ga oseba ima in ji omogoči, da pokaže svoje sposobnosti. Tudi v šoli računalnik ne more učencu zagotoviti boljše ocene, lahko pa mu pomaga, da ne porabi toliko časa in energije za stvari, ki jih ne bo nikoli zmogel. S tem bo napredoval tudi v samostojnosti in samozavesti ter gradil boljšo samopodobo.

Gotovo pa moramo biti pri uporabi računalnika in druge IKT pazljivi. Učencu mora računalnik pomagati, ne pa ga dodatno motiti v učnem procesu. V sodelovanju učiteljev, staršev, učencev in specialnih pedagogov je možno poiskati najbolj optimalno varianto v korist učenca.

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eBralec v pomoč učencu z disleksijo

The use of eBralec for studets with dyslexia

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POVZETEK

V prispevku želimo predstaviti možnost uporabe eBralca za učence z disleksijo. Želimo opisati glavne značilnosti oseb z disleksijo in predstaviti na kakšen način jim lahko pomagamo Težave z branjem in pisanjem predstavljajo težavo, ki te učence spremlja preko celega življenja. Zaradi neustreznega branja in s tem nerazumevanja besedila, ne morejo ustrezno prikazati svojega znanja. Pri tem lahko aplikacija eBralec olajša branje v Slovenskem jeziku in pomaga pri reševanju delovnih zvezkov. Dokumente naložimo na računalnik, kjer jih eBralec prebere. To učencem z disklesijo omogoča, da se namesto v dekodiranje in povezavo črk v besede, lahko usmerijo v razumevanju, učenje in povezovanje informacij. Ustvarjalci aplikacije težijo k čim bolj naravnemu zvoku bralca, ki je lažje poslušljiv in razumljiv ter tako še bolj uporaben.

Ključne besede

Disleksija, eBralec, branje

ABSTRACT

In the paper we would like to present the use of eBralec for students with dyslexia. We will describe who persons with dyslexia are and show how to help them. Students with dyslexia have trouble reading and writing during their lifetime, they struggle to understand texts and cannot show their true knowledge. Using eBralec students are able to read easier in Slovenian and it also makes solving workbooks simpler. We upload documents to a computer where the eBralec reads them. This enables students with dyslexia to focus on understanding, learning and connecting information rather than decoding and merging letters into words. App developers try to replicate the most natural voice of the reader that is understandable and easy to listen to for increased usability.

Keywords

Dyslexia, eReader, reading

1. UVOD

Pisanje in branje sta veščini, ki sta pomembni za celo življenje. Gotovo je že kdo slišal, kako hitro eno ločilo, beseda, črka ali naglašenost besede spremeni celotno sporočilo, ki smo ga želeli posredovati ali pa nam ga je želel posredovati nekdo drug. To vodi do napačnega razumevanja in nesoglasij.

Učenci v šolo prihajajo z različnim predznanjem glasov in črk. V času prve triade pridobijo osnovne veščine, ki so temelj celotnemu nadaljnjemu šolanju in jih potrebujemo v vsakodnevnem življenju odrasle osebe. Vsak učitelj tempo poučevanja prilagodi svojim učencem tako, da večina osvoji začrtane cilje. V drugi triadi časa za učenje branja ni več. Pričakuje se, da s prepoznavanjem črk, povezavo glasu in črke, sintezo ali analizo besed ter s samo tehniko branja ni več težav. Našteto vpliva na razumevanje navodil, vprašanj, besedila in s tem na kakovost tako ustnega kot pisnega izražanja znanja ter slabo zmožnost samostojnega učenja. Neavtomatizirano branje in pisanje s seboj prinašata primanjkljaje in težave, ki se nato izkazujejo na drugih področjih in se s prehodom v višje razrede vedno bolj stopnjujejo.

Včasih so ti učenci veljali za lene in neumne, danes pa disleksija in druge specifične učne težave postajajo bolje prepoznane, diagnosticirane, otroci in učenci pa ustrezno usmerjeni in obravnavani. Strokovna skupina v šoli določi vsakemu posamezniku ustrezne prilagoditve, ki mu omogočajo prikazovanje svojega znanja. Med temi prilagoditvami je lahko tudi eBralec, ki učencem z disleksijo olajša šolsko delo.

2. DISLEKSIJA

Disleksija je nevrološko pogojena specifična učna težava, ki je pogosto gensko pogojena in traja vse življenje. Pri njej se nakazujejo težave na področju branja in pisanja.

Gre za skupek težav, ki onemogočajo ustrezno branje in razumevanje besedila. Poleg omenjenega imajo učenci z disleksijo težave na področju predelave in hitrosti procesiranja informacij, delovnega spomina, hitrega poimenovanja in avtomatizacije. Našteto vpliva pri osvajanju in izkazovanju šolskih znanj in spretnosti. [2]

Delovanje možganov učencev z disleksijo se razlikuje od večine. Pri učencih z disleksijo prevladuje desnohemisferični način razmišljanja in delovanja možganov. Pogosto imajo:

- bujno domišljijo
- razmišljajo v slikah
- si dobro predstavljajo stvari
- so izvirni in ustvarjalni
- vidijo drugačne povezave med stvarmi ali podatki
- počnejo več stvari naenkrat [3]

Ti ljudje so pogosto izumitelji in inovatorji, največ težav jim povzroča osnovnošolsko izobraževanje.

2.1 Značilnosti branja učenca z disleksijo

Pri otroku, ki ima diagnosticirano disleksijo lahko opazimo različne težave pri branju:

- Branje je počasno, zatikajoče
- Učenec se pri branju vidno trudi, muči
- Po kratkem branju je vidno utrujen
- Med branjem si pogosto mane oči
- Pri glasnem branju ne upošteva ločil
- Zamenjuje vidno podobne črke (b – d)

- Zamenjuje slušno podobne glasove (t – d)
- Premešča, obrača in zamenjuje glasove v besedi (tri – tir)
- Izpušča ali dodaja glasove, zloge (tri – trili)
- Pri branju nadomešča besede s sopomenkami, čeprav si besedi vizualno nista podobni (babica – oma)
- Pri branju nadomešča besede z vizualno podobnimi, čeprav popolnoma spremeni pomen
- Prebrano slabo razume, ne zmore ustrezno obnoviti in odgovoriti na vprašanja iz vsebine. [3]

2.2 Pomoč in prilagoditve učencu z disleksijo

Branje je osnovna dejavnost za učenje in uspeh posameznika. Je spretnost, ki nas spremlja preko celega življenja in omogoča pridobivanje novih znanj ter nas popelje v skrite kotičke domišljije. Učenci z disleksijo imajo povprečne ali nadpovprečne sposobnosti, ki pa jih zaradi slabega branja ne zmorejo ustrezno prikazati. [4]

Težava, ki jo imajo, ni vidna, zato okolica težko sprejema njihovo drugačnost. Pogosto so krivično označeni za lenuhe, saj določenih stvari ne bodo zmogli nikoli osvojiti.

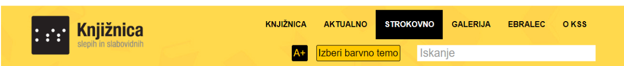
S spremembo zakonodaje in Zakonom o usmerjanju otrok s posebnimi potrebami [5] so učenci s težavami na področju branja uvrščeni v skupino otrok s posebnimi potrebami s primanjkljaji na posameznih področjih učenja [1]. S tem pridobijo pravico do individualiziranega programa in v njem zapisanih prilagoditev. Pogosto imajo pri preverjanjih znanja možnost pomočnika bralca, ki jim prebere besedilo ali navodilo.

Vendar je to le kapljica v morje. Že v drugi triadi besedila postanejo obsežnejša, zahtevnejša in med poukom glasen bralec ni mogoč, pri preverjanjih pa vzame glasno branje veliko časa.

Učiteljice dodatne strokovne pomoči se trudimo ozaveščati širšo javnost, učitelje in starše o pomenu prilagoditev in možnostih, ki jih učenci imajo.

Učenci pri in za šolsko delo prebirajo učbenike, delovne zvezke, različna književna dela in članke, ki jih potrebujejo pri izdelavi projektnega dela ali referatov. Obsežnejša so besedila, več napak pri razumevanju lahko nastane, dalj časa branje traja in zato povzroča frustracije slabemu bralcu.

Da bi učencem olajšali branje knjig za domače branje, jih pogosto napotimo v knjižnico. Knjiga je mogoče natisnjena v obliki, ki je prijaznejša branju. To pomeni, da ima ustrezno obliko in velikst črk, papir ni bleščeč, ustreznejši je kontrast med ozadjem in besedilom, slike so pod besedilom, idr. Možno pa je tudi, da obstaja zvočna knjiga. Veliko zvočnih knjig imajo v Knjižnici za slepe in slabovidne, kamor se lahko brezplačno včlanijo tudi učenci s težavami v branju. Imajo lično urejeno spletno stran (Slika 1) in dostop do gradiv.



Slika 1. Spletna stran Knjižnice slepih in slabovidnih

Z včlanitvijo v knjižnico je omogočen tudi dostop do eBralca in pridobitev licence, ki se potrebuje za namestitev programa. Včlanitev je možna z ustreznim izvidom ali odločbo o usmerjanju.

3. eBRALEC

EBralec je sintetizator govora slovenskega jezika. Bil je razvit v okviru projekta Knjižnice slepih in slabovidnih in nastal kot plod sodelovanja raziskovalnih organizacij (Institut Jožef Štefan) in dveh slovenskih jezikovno tehnoloških podjetij (Alpinenon razvoj in raziskave d.o.o. in Amebis programska oprema), z delnim financiranjem Evropske unije iz Evropskega socialnega sklada.

EBralec olajša delo z računalnikom in pametnim telefonom, omogoča lažji dostop do novic in informacij ter tako zagotavlja boljše e-vključenost v sodobno informacijsko družbo. [7] Omogoča samodejno prebiranje poljubnih elektronsko shranjenih besedil, ki so zapisana v slovenskem jeziku.Brezplačno je namenjen nekomercialni uporabi v okviru ustanov javnega sektorja, za slepe in slabovidne osebe in osebe z motnjami branja. Ebralec basic off-line pa je z operacijskim sistemom Android brezplačen za vse uporabnike. Navodila so dostopna na spletu. [7]

Nameščanje programa:

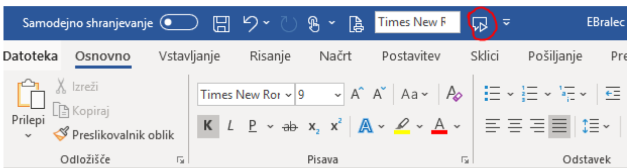
- eBralec za osebne računalnike z operacijskim sistemom Windows, verzija 3.4 se prenese z namestitveno datoteko, se jo zažene in potrdi izvajanje namestitev. Nato je potrebno sledenje programu za nameščanje.

- eBralec za mobilne naprave z operacijskim sistemom Android:

A) On line: v aplikaciji Google "Trgovina Play" (ang. "Play Store") poiščite namestitev za "eBralec KSS". Tu se izbere in potrdi namestitev. Ko je nameščen se ustrezno uredi nastavitve za dostopnost.

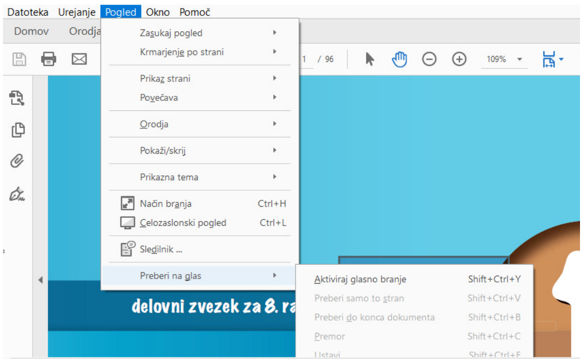
B) off line: Z namestitveno datoteko

EBralec bere datoteke v Word ali Adobe Acrobat Reader programu. Na spletni strani Knjižnjice slepih in slabovidnih so dostopna navodila za uporabo v word in pdf formatu. Ko je program naložen, se v Wordovem dokumentu oblikuje nastavitve, kjer se označi možnost izgovori in se nato v naslovni vrstici prikaže ikona za glasno izgovorjavo besedila (Slika 2). EBralec prebere izbrano besedilo ob kliku na omenjeno ikono. Ikona se lahko doda tudi v ukazni trak, kar je težje urediti.



Slika 2. Naslovna vrstica z ikono za izgovorjavo izbranega besedila

V Adobe Acrobat Reader dokumentu se ikona prikaže po aktivaciji "Aktiviraj glasno branje' v zgornjem traku, v zavihku pogled (slika 3)." Glasno branje lahko aktivirate tudi preko sočasnega pritiska tipk Shift+Ctrl+Y.



Slika 3. Nastavitev v Adobe Acrobat Reader

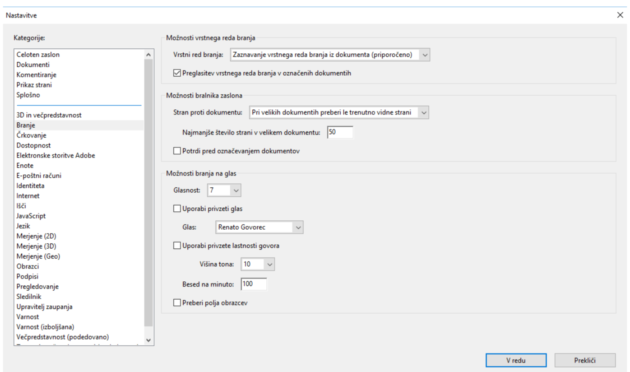
Funkcionalnost vgrajenega bralnika je precej omejena, saj omogoča le enostavno branje stran po stran oziroma branje dokumenta od trenutne strani naprej. Bralnik ima lahko težave tudi s kompleksnejšimi (razbitimi) vsebinami – kot je npr. tekst v okenčku ob glavnem tekstu in podobno. PDF datoteka mora biti ustrezno pripravljena. Program ne more brati PDF datotek, v katerih so shranjene le slike dokumentov (skeni).[7]

eBralec predstavlja najnovejši sintetizator slovenskega govora. V primerjavi s prehodnimi omogoča občutno višjo stopnjo naravnosti sintetičnega govora. [5]

Vsebuje moški (eBralec Renato) in ženski (eBralec Maja) glas. Adobe Acrobat Reader ima možnost nastavitve različnih parametrov (Slika 4):

- upravljanje z branjem
- vrstni red branja
- glasnost
- izbira med govorcem ali bralcem
- izbira med moškim in ženskim glasom
- višino tona
- število besed na minuto

Lahko pa se uporabi privzeti glas ali prevzeti način govora. Možna je tudi izbira govorca, ki predstavlja predhodnika bralca. Njegov govor ni tako tekoč in ustrezno naglašen.



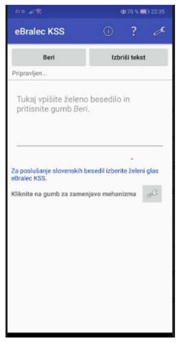
Slika 4 Nastavitve eBralca v Adobe Acrobat Reader

V primerjavi z obstoječimi govornimi zbirkami eBralec predstavlja največjo zbirko, saj vsebuje 77 milijonov besed, 7.145.345 povedi. Obseg govorne zbirke je 4000 povedi, 46.785 besed, 6 ur in 3 minute posnetkov za ženski in 5 ur 33 minut posnetkov za moški glas [5]

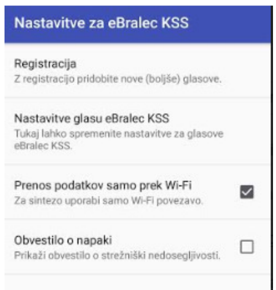
Žganec Gros s sodelavci [5] navaja, da gre za najboljši približek naravnemu govoru, vendar za ustrezno funkcioniranje potrebuje hiter računalnik, da zmore analizator ustrezno prebrati besedilo. Ustvarjalci so bili namreč pozorni tudi na ustrezno naglaševanje besed, saj je v slovenskem jeziku pogosto isto zapisana beseda drugače naglašena in ima takrat drug pomen. Težave se pojavljajo tudi pri daljših stavkih, ki imajo veliko vejic (naštevanja, daljše podložne zveze).

3.1 Mobilna aplikacija On Line

Mobilna aplikacija je dostopna na Google Trgovina Play. Po prenosu za katerega ni potrebna licenca, je eBralec pripravljen na uporabo (slika 5). Kljub temu so pred uporabo priporočljive nastavitve, kjer je možnost izbire hitrosti govora, glas za pretvorbo besedila v govor, frekvenca, idr. V aplikaciji je nastavljen glas Aleš eBralec Basic. V primeru potrebe po dodatnih glasovih je potrebna registracija in internetna povezava (Slika 6).



Slika 5. Ebralec KSS - začetna stran On- line



Slika 6. nastavitev eBralec KSS

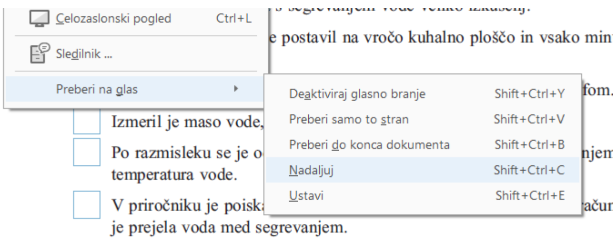
Aplikacija predvaja vpisano besedilo ob pritisku na gumb "Beri". Branje se lahko kadarkoli prekine s pritiskom na tipko "Stop". Besedilo je možno kopirati iz drugih aplikacij z uporabo gumba "Skupna raba".

Glede na dolžino besedila in nastavljenega glasu se govor začne z nekajsekundno zamudo.

3.2 Digitalno reševanje delovnih zvezkov

Na osebno željo je možno pridobiti digitalne oblike učbenikov, nekatere založbe imajo že možnost uporabe e-delovnih zvezkov. Te v pdf obliki lahko bere tudi eBralec. V Adobe Acrobat Reader ima eBralec možnost prebiranja celotnega dokumenta ali trenutne strani, kar je možno izbrati v pogovornem meniju ali s Shift+Crtl+V, vendar šele po aktivaciji glasnega govora. Branje se lahko zaustavi in nadaljuje od prekinitve. V primeru nepoznavanja hitrih tipk, je potrebno vračanje v orodno vrstico ne samo po aktivaciji ampak tudi po vsaki zaustavitvi.

eBralec v delovnih zvezkih ustrezno poimenuje slike, števila, datume, oznake za količine. Ne zazna pa zapisanega odgovora, ki je bil ročno vnesen v dokument.



Slika 7. Aktiviranje branja izbrane strani

3.3 Branje v tujem jeziku

Učenci z disleksijo imajo težave tudi pri več drugih predmetih, še najbolj izrazito pa se kažejo pri učenju tujega jezika.

Sintetizatorjev angleškega govora je več. V šoli je najpogosteje izbrana Text-to-Speech aplikacija na spletni strani http://text-to-speech.imtranslator.net//. Ta omogoča, vnos ali kopiranje besedila v prazen okvirček (Slika 8), ki ga nato bralec ob kliku na tipko "Say it" prebere. Možno je Določiti hitrost branja in spol bralca Aplikacija ima možnost izbire 14 različnih jezikov, pri angleščini in španščini je možna izbira geografskega izvora jezika. Največja pomanjkljivost aplikacije z vidika učenca je vnašanje teksta, če le-ta že ni v elektronski obliki, saj imajo s tipkanjem besedila učenci z disleksijo zelo veliko dela in naredijo še več napak kot v maternem jeziku.

Slika 8. Tabela za vnos besedila Text-to-Speech

3.4 Uporaba eBralca pri pouku

Učitelji računalnikov, ki jih uporabljajo učenci med poukom, ne sprejemajo z navdušenjem. Strah jih je predvsem možnosti zlorabe računalnika pri pouku, v smislu igranja igric, obiskov različnih spletnih strani, uporabi socialnih omrežij, idr. Hkrati pa zaradi nepoznavanja motenj pogosto razmišljajo o potuhi in nepravičnosti uporabe. Ob poznavanju disleksije in značilnostih učenca, ki jo ima, ter zakonsko zavezujočih prilagoditvah je uvajanje lastnega učenčevega računalnika lažje.

Opremo morajo zaenkrat zagotoviti starši, prav tako licenco in učbenike. Za učbenike in delovne zvezke v elektronski obliki je potrebno vzpostaviti kontakt s posameznimi založbami, ki brezplačno, ob dokazilu plačila tiskanega učbenika ali delovnega zvezka ali ob dodatnem plačilu posredujejo potrebne učbenike in delovne zvezke. Nekaj jih je možno pridobiti tudi preko Knjižnice slepih in slabovidnih.

Učenec zaradi interaktivnega pouka redko uporablja eBralca. Potrebuje ga pri tihem, samostojnem delu. V kolikor ima možnost izpolnjevanja delovnih zvezkov in delovnih listov na računalniku, je gotovo v veliko pomoč. Da bralec ne bi bil moteč ostalim učencem v razredu, je nujna uporaba slušalk. Uporabo eBralca se določi v individualiziranem programu

3.5 Uporaba eBralca pri domačem delu

Učencu in staršem učenca z disleksijo eBralec zagotovo prihrani veliko časa za domače delo. Starša razbremeni glasnega branja, učencu pa omogoči bolj samostojno delo. Reševanje domačih nalog, domače branje, pripravo govornih nastopov in drugih projektnih nalog je z uporabo eBralca neodvisno od prisotnosti pravega bralca. Učencu da občutek samostojnosti in samozavesti, da zmore sam narediti domača nalogo ali drugo delo, ki ga njegovi sošolci opravijo brez pomoči.

Pri branju leposlovnih del je eBralec uporaben pri delih, ki so v pdf formatih. Če to ni možno, obstaja velika zbirka zvočnih knjig v Knjižnici slepih in slabovidnih.

4. ZAKLJUČEK

Število prepoznanih in usmerjenih učencev z disleksijo se povečuje. Sedaj razumemo, da njihove težave niso lenoba in nevednost, ampak jih njihovo drugačno funkcioniranje možganov onemogoča prepoznavo in vezavo črk v besede, besed v stavke ter razumevanje prebranega. Kljub temu, da navzven ne izgledajo drugačni in da so na nekaterih področjih se celo uspešnejši od vrstnikov, jih lahko težave z branjem močno onemogočajo pri šolskem delu. Branje je vseživljenjska aktivnost, ki nas spremlja na vsakem koraku. Naša želja je, da bi učenci z disleksijo osvojili vsaj nekaj osnov branja, če tekočega branja nikoli ne bodo zmogli. V prvi triadi se zato IKT pripomočkom izogibamo in težimo k multisenzornemu pristopu, da ustvarimo dodatne povezave v možganih, s katerimi želimo omogočiti vsaj kratkotrajno funkcionalno branje.

EBralec se je tudi v praksi v višjih razredih izkazal kot dober pripomoček, ki učencem z disleksijo olajša branje daljših besedil. Pri pouku uporaba še ni tako pogosta, medtem ko pri domačem delu prihrani veliko časa in energije, saj omogoči učenci, da hitreje in pravilneje prebere navodila in besedila. S tem učenci postanejo pri učenji bolj samostojni kar vpliva tudi na njihovo samopodobo in samozavest.

Pri delu z učenci s posebnimi potrebami je pomembno, da jih naučimo, kako z ustreznimi strategijami premagajo svoje primanjkljaje. Tako kot učencu z gibalno oviranostjo voziček omogoča mobilnost, eBralec učencu z disleksijo boljše razumevanje besedila.

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Positron emission tomography with time-of-flight capabilities

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ABSTRACT
Positron emission tomography (PET) scanners are used for locating cancerous tissues and diagnosing Alzheimer's disease. In this research we improved the operation of a PET scanner, thereby increasing the chances of early diagnosis and the accuracy of location of targeted tissue. This leads to more focused treatment, which yields faster recovery and fewer changes to the patient's body. With a new measurement technique TOF, time-of-flight, a better resolution with fewer measurements can be achieved. A high-resolution time-to-digital (TDC) convertor had to be developed to use the TOF method effectively. TDC was combined with Cherenkov radiators and silicon photomultipliers to create a TOF PET module. It achieved a timing resolution of 190 ps, which is very competitive compared to most advanced PET scanners, which achieve 500 ps. The simplicity of use and design of the TOF PET module would allow it to be used in classroom physics exercises; utilizing the inquiry based learning method.

Keywords
PET scanner, time of flight, high resolution TDC, Cherenkov radiators, silicon photomultiplier, timing resolution

1. INTRODUCTION
At Gimnazija Vič in 2006, based on students interests and in cooperation with different research institutions, a special science project was introduced; the most motivated students in the field of science and technology were invited to enroll on the so called "science class". Science courses (physics, chemistry, biology, computer science) are anchored by short students' experimental tasks and also more demanding project work in teams (learning by doing principle); these projects are carried out under the mentorship of their teachers and/or researchers from different research institutes and science and technology faculties. The project is fully incorporated into the regular high school curriculum. [1]

Through our experiences at Gimnazija Vič, we can provide numerous evidence for the effectiveness of this approach. The number of the science subject exams (which students chose as their optional matura subjects) over the period 2004-2010 was examined; a dramatic growth in 2010 was detected. We believe that this was a direct consequence of the above mentioned project. Students' results at the national final exam in physics, chemistry, biology, and computer science were evaluated for several years; they were and still are high above the national average grades. [1]

Furthermore, these results clearly indicate that inquiry based science learning and possibilities to work and learn under the mentorship of researchers significantly influence the better quality of students' knowledge and have an important impact on choosing their studies in the field of science and technology. A positive feedback information is given on our students' knowledge from the faculties of pure and applied sciences, computer science, medicine, pharmacy… Last but not least, the most motivated and successful students take part in young researchers competitions, as well as competitions in science subjects knowledge, and achieve great results on national, and especially on international level. [1]

One of these students is the main author of this paper. In the first year of high school he developed affordable CO_2 and conductivity sensors, which he presented at international competitions in the USA and the Netherlands. Following this, he began his work on a bigger project, the one presented in this paper. His main contribution was solving a demanding programming problem, but he also combined the results of many scientific papers to even further improve the working of a PET scanner.

2. THEORETICAL BACKGROUND
Positron emission tomography (PET) scanners are medical devices used for locating cancerous tissue and diagnosing people with Alzheimer's disease [2]. The goal of this research was to improve the resolution of a PET scan. The implications of higher resolution are detection of earlier stages of cancer and better localization of cancerous tissue.

One of the uses of PET scanners is detection of cancerous cells inside a patient's body. To locate these cells, they must be differentiated from healthy ones, e.g. by their fast metabolism. Cancerous cells need more energy, thus a higher glucose intake, to be able to reproduce quickly. A higher concentration of glucose can be found at the location of cancer cells. Glucose can be tracked by attaching a radioactive isotope onto it (^{11}C, ^{18}F etc.). When such isotopes decay, two electromagnetic waves (gamma rays) are formed, travelling in opposite directions (forming a straight line). These can be detected with gamma ray detectors. A positron emission tomography (PET) scanner contains gamma ray detectors, which are placed around the patient.

One of the main differences between most PET scanners and the proposed one (TOF PET module) is the measurement method. Commercial PET scanners detect the path of gamma rays (line of response, LOR), but do not determine where on this line the origin of the two rays is located. If the time difference between the two arrivals of gamma rays can be measured, it is possible to calculate where on the line the origin is located (time of flight, TOF) [3]. The higher the accuracy of the time measurement, the higher the precision of locating the origin of the decay.

The difference between the two methods can be seen from Figure 1. LOR method needs much more measurements and produces a lot of noise, which all contributes to a lower PET scan resolution.

The main focus of the research was to develop a fast enough time-to-digital convertor (used for measuring time of arrival) to effectively use the TOF measurement method. This is extremely difficult, as the resolution of the convertor has to be in a few hundred ps range. A different setup of the gamma ray detector was also tested and evaluated.

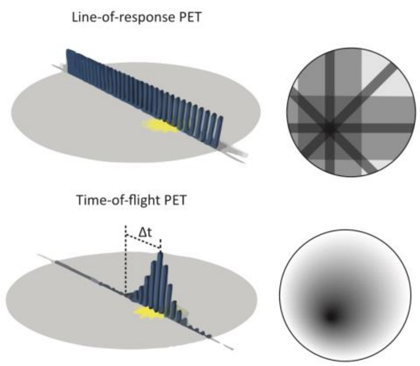


Figure 1: LOR and TOF measurement methods

3. TIME-TO-DIGITAL CONVERTOR

Time to digital convertors (TDC) measure the time of the arrived signal and then output the time data. In the background, a TDC counts the number of clock signals since the start or last reset. When a signal comes in, it triggers the TDC to output the number of clock signals counted from the start until the arrival of the signal.

These are many TDC chips on the market today but only a few of them have a sufficiently high timing accuracy and long enough measuring period. The TDC was therefore implemented on a Field Programmable Gate Array (FPGA) chip. FPGA is a programmable chip with user programmable architecture. In comparison, microcontrollers and microprocessors use existent chip architecture to run programs. Since FPGAs have programmable architecture, they can be optimized for a specific program and thus increase the processing speed.

3.1 Clock counter

All FPGAs, microcontrollers and microprocessors perform operations at a specific pace, determined by the frequency of the clock signal. This property of FPGAs can be used to create a counter. The counter is set at the start to 0 and this value increases with every clock cycle. The timing accuracy of the counter is determined by the clock frequency. The higher the clock frequency, the better the timing accuracy. The upper frequency limit is governed by the speed of the transistors and is in the few hundred MHz range.

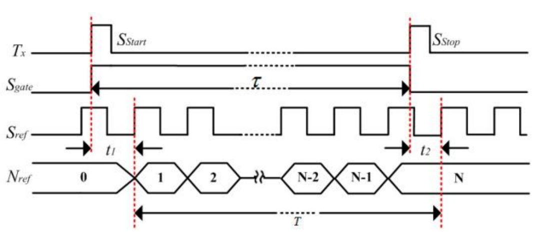


Figure 2: Clock counter [6]

Figure 2 represents the operation of a clock counter. T_x is the input signal, with a start (S_{start}) and stop (S_{stop}) pulse and S_{ref} is the clock signal. τ represents the time difference between input signals and T the measured time difference. N_{ref} displays the counting of the clock. The measurement error is caused by the fact that the counter counts on rising edges of the clock. It is given by the equation below: [6]

$$\Delta T_x = T - \tau = t_2 - t_1$$

The clock counter was designed as a 48-bit counter. The clock used on the Red Pitaya (FPGA development board) is 125 MHz and the timing accuracy is thus limited to 8 ns. This led me to develop and program a sub-clock counter able to achieve a far greater accuracy.

3.2 Sub-clock counter

The fact that FPGAs can only execute a task (counting) on the rising edge of the clock signal cannot be changed. If the input signal is delayed multiple times for an exact amount of time ($\Delta t = nt_0$; $n \in N$), one of these delayed signals is going to match the clock signal. Figure 3 shows the delayed input signals ($S_{gate\ 0}$ – $S_{gate\ n-1}$) and a match of the clock rising edge (S_{ref}) with the rising edge of one of the delayed signals (S_{gate4}).

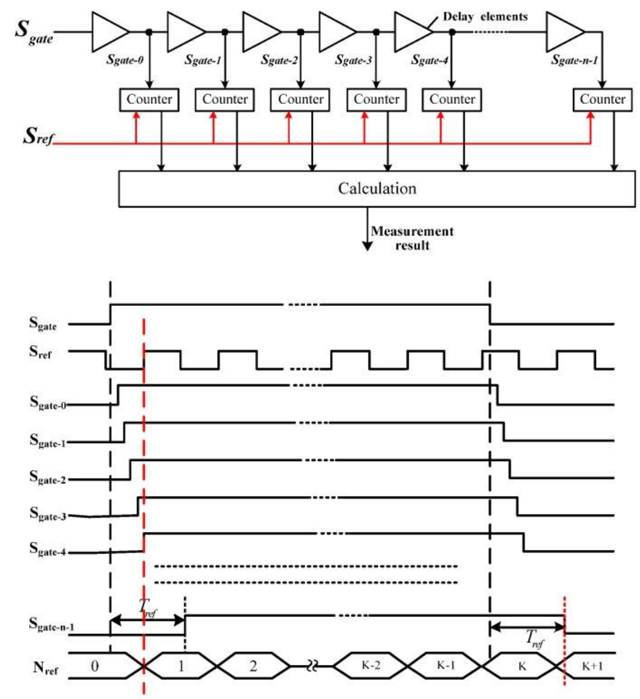


Figure 3: Sub-clock counter [6]

Delays are implemented with a delay element called a carry; multiple delay elements in series form a carry chain or a delay line. The output of a carry is fed into the next carry and a counter. With the use of a counter, the delayed signal and clock signal are checked for a match. The outputs of all counters are then evaluated and converted into a time measurement. The timing resolution is set by the length of the delay element.

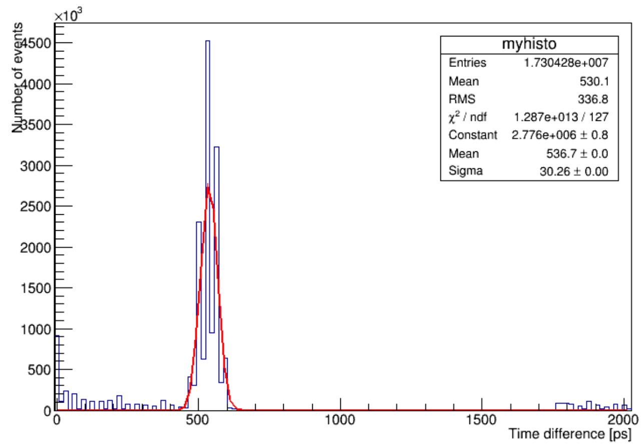
During the design of the sub-clock counter a problem was encountered with the implementation of the carry chain. A compiler can design the architecture of a carry chain, but the delays between each carry will not be the same, making the TDC less accurate. The solution is to set constraints, by defining the placement of the carry elements. The linearity of the counter thus increases. In a paper [6], different placements of carry elements were evaluated; 1024 carries were placed in configurations: 8x128, 16x64, 32x32 and 64x16. The best linearity and accuracy were achieved with an 8x128 configuration. Our experimental results also proved their findings.

3.3 TDC timing resolution measurements

Timing resolution of the TDC was evaluated using a signal generator. The output signal was split in two. One of them was delayed, to produce two square signals delayed by a constant amount.

The timing resolution of the TDC is calculated from a series of delay measurements, it represents the combined timing resolution of clock and sub-clock counter. These are then transformed into a histogram. A Gaussian function is then fitted and standard deviation (sigma, σ) calculated. The timing resolution is given as the standard deviation, but throughout the paper it is expressed as FWHM (full width half maximum, FWHM = 2.35 * σ).

Timing resolution was measured at different time delays. The delay length increased by 0.5 ns. The number of events per measurement ranged from 17 to 19 million. Measurement took around 10 minutes at an input signal frequency of 33 kHz. The bin size was equal to 15.625 ps (8 ns / 512 delay steps).



Graph 1: TDC timing measurement

Graph 1 shows a histogram of timing measurements; with resolution of 90 ps. Measurements were also taken at different time delays. Standard deviations of these measurements were consistent, ranging from 70 to 90 ps.

Since the TDC is the part that is contributing mostly to the error of the TOF PET module, decreasing it was paramount for the next step of the research.

4. GAMMA RAY DETECTOR

Gamma ray detector is used to convert the incoming gamma ray into an electrical signal. This process is done in two stages. The first one is converting the high energy gamma ray into a lower energy visible light. This is achieved with the use of Cherenkov radiators. They were used due to their prompt transformation of a gamma ray to multiple lower energy photons. Prompt transformation and covering the crystal with non-reflective paint ensures low timing error of the crystal. The drawback of using Cherenkov radiators was the lower number of photons emitted compared to scintillators, which are normally used.

The second stage is detecting the lower energy photons and converting them to electrical signal. Conventional gamma ray setups use photomultiplier tubes. Due to high gain, low operating voltage, compactness and large area of detection a different detector was tested, called silicon photomultiplier (SiPM). All of these characteristics contribute to better timing and spatial resolution. There are also other advantages, such as low cost and operation in a magnetic field, and disadvantages such as high noise at room temperature.

Both changes showed promising results as an alternative to the current gamma ray cameras, similar results were also obtained in the following paper [4][5].

5. MEASUREMENTS

Combining the gamma ray detector (Cherenkov radiators and SiPM) with the TDC a TOF PET module was created. In the full scale PET scanner, hundreds of these modules would have been used, but instead we used only two to simulate the operating behavior.

5.1 Experimental setup

Simulating the operation of a TOF PET, two TOF PET single crystal detectors were used in back to back setup. Two SiPMs with attached Cherenkov radiators (PbF_2) were placed opposite to each other.

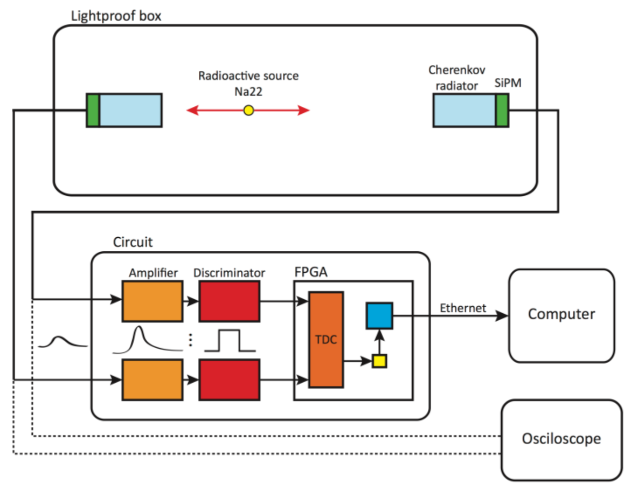


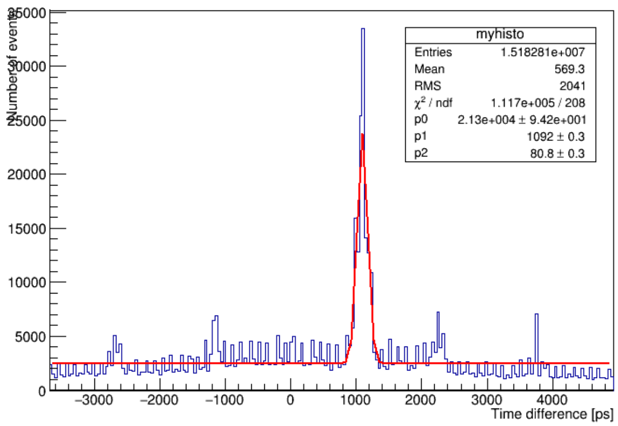
Figure 4: Measurement setup

An ionizing radiation source (^{22}Na, 50 nCi) was placed in between. ^{22}Na was chosen as it produces gamma rays with energy equal to gamma rays produced by PET tracers. Both modules and the radiation source were secured on a wooden stand. Slots in the stand allowed the modules and source to be moved. The whole setup was shielded with lead blocks and secured in a lightproof box. The box can be placed in a freezer to measure the characteristics of the SiPM at a lower temperature (-25 °C). Signal cables were led out of the box and freezer. The signal was processed either by the custom made circuit or an oscilloscope.

5.2 TOF PET module timing resolution measurements

The setup for measuring the TOF PET module timing resolution is shown in Figure 4. Prior to testing the module, each component was checked for errors.

A Gaussian function and a first order polynomial were fitted to best approximate the spread of the measurements. The results showed a timing resolution of 190 ps. Errors surrounding the central peak are caused by random coincidences between background noise and the event.



Graph 2: TOF PET module timing measurement

6. CONCLUSION

Goal of reaching higher PET scan resolution was achieved by the use of various materials and components not used in commercial PET scanners. PbF_2 crystals coated with black paint as Cherenkov radiators have proven to be a very competitive alternative to commercial scintillators.

Custom readout electronics, the main part being high-resolution time to digital convertor (TDC) contributed greatly to improving the timing resolution. The TDC achieved timing accuracy between 70 and 90 ps.

The timing resolution of the developed TOF PET module was 190 ps; this is a substantial improvement in comparison to most commercial PET scanners, which achieve resolution of 500 ps.

7. ACKNOWLEDGMENTS

I would like to thank my supervisors for their support, since without them this research could not have been carried out.

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Enkapsulacija v računalniških omrežjih nekoliko drugače

Encapsulation in computer networks in a different way

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POVZETEK

Pri poučevanju računalniških modulov imamo v učilnicah običajno na voljo računalnike. Le ti dijakom pomagajo, da svoje pridobljeno strokovno znanje praktično preizkusijo, svoj izdelek pa testirajo in izboljšajo. A čeprav si dela brez računalnika ne predstavljamo več, se večkrat zgodi, da je potrebno zadevo izpeljati drugače, kot na primer takrat, ko je obravnavana snov nova in težka za razumevanje.

Prispevek opisuje primer dobre prakse, kako lahko dijakom prikažemo strokovno snov na zanimiv in zabaven način brez računalnika, z računalnikom pa dijaki kasneje pridobljeno znanje preverijo in utrdijo. Dijaki so nove načine zelo dobro sprejeli, njihovo razumevanje in znanje pa kaže boljše rezultate.

Ključne besede

Enkapsulacija, OSI, PDU, TCP/IP, Wireshark

ABSTRACT

When teaching Computer Science subjects, we usually use Computer Science classrooms. Computers help the students put their acquired knowledge into practice as well as test out and improve the work they have produced. Even though we can hardly imagine working without computers anymore, we sometimes have to use other ways, for example, when teaching a new and very difficult topic.

This article describes an example of good practice in how to present topics in an interesting and entertaining way without a computer; the students only use one later to test and refresh their new knowledge. The students accepted the new method very well, their understanding and knowledge have improved and produce better results.

Keywords

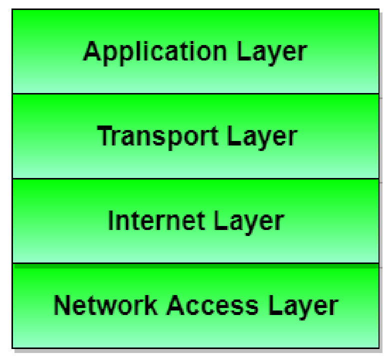
Encapsulation, OSI, PDU, TCP/IP, Wireshark

1. UVOD

Enkapsulacija v računalniških omrežjih predstavlja eno težjih snovi, ki jo dijaki težko razumejo kljub vajam, ki jih naredijo na računalniku. Gre za gnezdenje manjših podatkovnih struktur v večje. Ker si enkapsulacijo lahko predstavljamo kot sistem babušk, kjer manjše babuške zlagamo v večje, se je porodila ideja, da se tudi pri šolski uri nekoliko poigramo s to igračo. Le da liki niso enaki, ampak različni, tako kot so različne tudi podatkovne strukture.

2. KOMUNIKACIJSKI MODEL IN PDU

Da bi lažje razumeli enkapsulacijo, je potrebno razumeti, kako poteka komunikacija v računalniških omrežjih. Komunikacijo ponazorimo s komunikacijskimi modeli. V šoli obravnavamo dva komunikacijska modela: OSI model (Open Systems Interconnection model) ter TCP/IP model (Transmission Control Protocol and Internet Protokol), vendar za razumevanje same enkapsulacije ni pomembno, katerega vzamemo. Na sliki 1 je prikazan TCP/IP model.

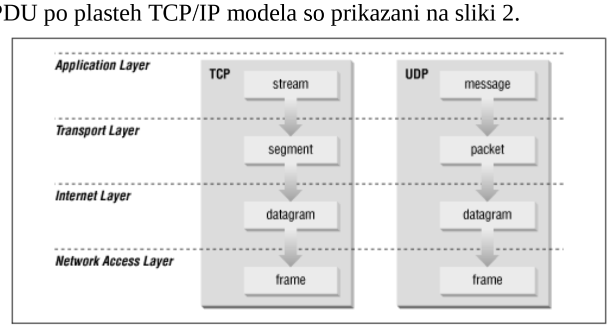


Slika 1: TCP/IP model [3]

TCP/IP model vsebuje štiri plasti: aplikacijska (Application Layer), transportna (Transport Layer), internetna (Internet Layer) in plast omrežnega vmesnika (Network Access Layer). Komunikacijo začne uporabnik na najvišji, aplikacijski plasti. Aplikacijska plast potem komunicira s transportno plastjo, transportna z internetno in internetna z najnižjo, plastjo omrežnega vmesnika.

Pri vsaki plasti govorimo o svojih protokolnih podatkovnih enotah, imenujemo jih PDU (Protocol Data Unit). Pri aplikacijski plasti so PDU podatki (data oz. stream), pri transportni je to segment, pri internetni govorimo o paketu (datagram), pri plasti omrežnega vmesnika pa o okviru (frame).

PDU po plasteh TCP/IP modela so prikazani na sliki 2.



Slika 2: PDU v TCP/IP modelu [2]

3. ENKAPSULACIJA

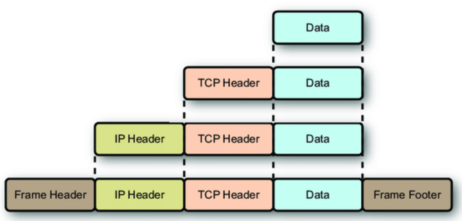
Enkapsulacija je povezava med PDU, ki delujejo na različnih plasteh komunikacijskega modela. Enkapsulacija povzroči, da različne plasti prevzamejo PDU od višjih plasti, jim dodajo svojo glavo, na najnižji plasti pa še rep [1].

Ko aplikacija sproži zahtevo za omrežni vir, se podatki prenašajo od zgoraj navzdol skozi protokolni sklad. Aplikacijska plast pošlje PDU, imenovan podatki, na transportno plast. Ko PDU doseže transportno plast, mu protokol transportne plasti doda svojo glavo. Glava je sestavljena iz polj, ki vsebujejo informacije, ki so značilne za ta protokol. Novi PDU imenujemo segment.

Transportna plast segment pošlje nižje na internetno plast, ki segmentu doda glavo. Dobimo PDU, imenovan paket.

Internetna plast pošlje paket na plast omrežnega vmesnika, ki paketu doda spredaj glavo, zadaj pa rep. Novi PDU se imenuje okvir, saj gre za paket, uokvirjen med glavo in repom.

Potek enkapsulacije je prikazan na sliki 3.



Slika 3: Enkapsulacija v TCP/IP modelu [5]

4. UPORABA BABUŠK

Sistem enkapsulacije je popolnoma enak sistemu babušk, ki jih dijaki poznajo že od otroštva. Najmanjši PDU (podatki) je enkapsuliran v večji PDU (segment). Segment je enkapsuliran v paket in paket je enkapsuliran v največji PDU (okvir).

Da bi dijaki lažje ločili posamezne PDU med seboj, smo si namesto klasičnih babušk omislili različne živalske like. Najmanjši lik je ptiček, ki predstavlja podatke. Ptiček se vgnezdi v opico, ki predstavlja segment. Opica je vgnezdena v tigra, ki predstavlja paket. Vse skupaj se nahaja v največjem PDU (okvir), ki je predstavljen kot lev. Živalski liki, ki predstavljajo posamezne PDU, so prikazani na sliki 4.

Slika 4: Babuške namesto PDU (vir: lasten)

Preden učiteljica izvede predstavitev z babuškami, dijakom na frontalni način natančno pojasni, kaj je enkapsulacija in kako poteka. Potem dijakom pokaže babuške in na tablo zapiše povezavo med živalskimi liki in PDU. Naloga dijakov je, da babuške pravilno zložijo eno v drugo in potem pojasnijo, kako so PDU enkapsulirani.

Prikaz z babuškami uporabljamo le pri uvodni uri, ko se s pojmom enkapsulacija srečamo prvič. Sistem babušk je dijakom blizu in hitro razumejo, za kaj pri enkapsulaciji gre.

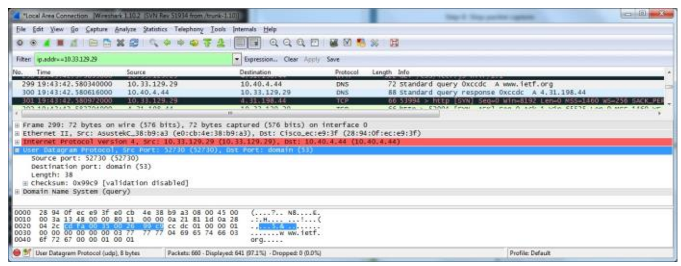
5. UPORABA IKT

Ko dijaki razumejo enkapsulacijo, z babuškami ali brez, jim ni več težko prepoznati PDU. Takrat se lahko začnemo poglabljati v globino posameznih PDU. Pri pouku uporabljamo orodje Wireshark, ki nam natančno prikaže sestavo in enkapsulacijo posameznih PDU.

Orodje Wireshark je "vohljač" (sniffer), ki omogoča opazovanje omrežnega prometa. Vohljači prestrezajo okvire, skupaj z okviri pa zajamejo tudi PDU drugih plasti modela TCP/IP, ki so enkapsulirani v okvir [4]. Wireshark je zagotovo eden najbolj uporabljanih vohljačev, saj je zelo zmogljiv, združljiv z različnimi operacijskimi sistemi ter brezplačen.

Vmesnik Wiresharka prikazuje podatke v treh tabelah: vrhnja prikazuje vse zajete PDU, sredinska vsebuje podrobne informacije o izbranem PDU. Tu lahko dejansko vidimo potovanje PDU skozi različne plasti arhitekture TCP/IP. Zadnja tabela pa prikazuje vsebino PDU v šestnajstiški in ASCII obliki. Dijaki najprej ugotovijo, katere PDU vsebuje promet ter si ogledajo natančno sestavo le teh.

Slika 5 prikazuje posamezne PDU ter njihovo sestavo. Na sliki vidimo, da gre za okvir Ethernet, pakete IP, segment UDP in aplikacijo DNS. S klikom na posamezen PDU se nam pokaže podrobnejša sestava PDU.



Slika 5: Prikaz PDU z orodjem Wireshark [6]

Orodje Wireshark je dijakom všeč, je pa nujno, da enkapsulacijo dobro razumejo že pred uporabo orodja.

6. ZADOVOLJSTVO DIJAKOV PRI UPORABI BABUŠK

Povratno informacijo o zadovoljstvu dijakov s predstavitvijo z babuškami je učiteljica dobila preko vprašalnikov, ki jih je izpolnilo 43 dijakov dveh oddelkov tretjih letnikov v programu tehnik računalništva. Vprašalnik je dijake spraševal o razumevanju enkapsulacije pred predstavitvijo z babuškami ter po predstavitvi, o razlogih za (ne)razumevanje ter o zadovoljstvu s predstavitvijo.

Rezultati vprašalnika so prikazani v tabeli 1.

Tabela 1: Rezultati vprašalnika o uporabnosti babušk za predstavitev enkapsulacije (vir: lasten)

Vprašanje	Odgovori	Število odgovorov
Kako dobro sem razumel pojem enkapsulacije v omrežjih pred predstavitvijo z babuškami?	Snov se mi je zdela težka, nič nisem razumel.	2
	Približno sem razumel dogajanje, vendar mi še ni bil jasen pomen PDU in enkapsulacije.	10
	Razumel sem pojma PDU in enkapsulacija, vendar še	18

	nisem razumel celotnega dogajanja.	
	Po prvotni razlagi mi je bilo vse razumljivo.	13
Kaj je bilo po vašem mnenju tisto, zaradi česar snov(i) (ni)ste razumeli?	Težka snov. Dobro razloženo. Nova snov in veliko novih izrazov. Dobra skica na tabli.	
Kako dobro razumem pojem enkapsulacije v omrežjih po predstavitvi z babuškami?	Snov se mi zdi težka, nič ne razumem.	0
	Približno razumem dogajanje, vendar mi še ni jasno, kaj je pomen PDU in enkapsulacije.	3
	Razumem pojma PDU in enkapsulacija, vendar še ne razumem celotnega dogajanja.	15
	Po razlagi z babuškami mi je vse razumljivo.	25
Kaj je bilo po vašem mnenju tisto, zaradi česar se vam razlaga z babuško zdi boljša/slabša?	Dobra zamisel. Dodatna razlaga ne škoduje. Lažje si predstavljam PDU. Vizualni prikaz. Nič ne bi spreminjal.	
Kakšna se mi zdi ideja razlage pojma enkapsulacije z babuškami?	Ideja mi sploh ni všeč – raje vidim, da ni predstavitve z babuškami.	0
	Ideja mi ni všeč, vendar me ne moti, če učiteljica pokaže tudi babuške.	2
	Ideja mi je všeč, vendar mi je razlaga brez babušk ljubša.	8
	Ideja z babuškami mi je všeč in zaradi nje snov dobro razumem.	33
Imate kakšno zamisel, kako bi učiteljica snov še bolje predstavila?	Po babuškah naj učiteljica ponovno razloži snov enako kot na začetku.	
Naj učiteljica naslednje leto vašim naslednikom še izvede predstavitev z babuškami?	Nikakor ne, je brez pomena.	0
	Seveda, z babuškami si bodo snov veliko bolje predstavljali.	42
	Vseeno mi je.	1
Želim si, da bi učiteljica vedela …	Super ideja. Razumljivo in dobro razloženo. Način z babuškami mi je všeč. Kar tako naprej. Ponazoritev z babuškami koristi le tistim, ki na začetku snovi niso razumeli.	

Rezultati tabele kažejo, da je sicer precej dijakov pojem PDU in enkapsulacije razumelo po prvotni, frontalni razlagi. Večina dijakov pa je snov razumela šele po predstavitvi z babuškami. Vsi dijaki se strinjajo, da naj učiteljica s predstavitvijo babušk nadaljuje. Seveda babuške dijakov ne morejo naučiti celotnega dogajanja v računalniškem omrežju, so pa dober začetek, preden začnemo z uporabo IKT.

7. ZAKLJUČEK

Enkapsulacija je snov, ki jo večina dijakov prvič težko razume, je pa pomembna za razumevanje komunikacije v računalniških omrežjih.

Da bi dijaki enkapsulacijo kar najbolje razumeli, se pri razlagi poslužujemo različnih metod. Dijaki snov slišijo frontalno, pomagajo si s skico na tabli, dodatno je izvedena ura z babuškami, na koncu pa uporabimo še orodje Wireshark. Dijaki so z vsemi metodami zadovoljni, predvsem pa sporočajo, da dodatna razlaga ne škoduje.

Vse omenjene metode so dijakom koristne in všečne, zato nameravamo z njimi nadaljevati tudi v prihodnje.

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Uporaba IKT na šolskih strokovnih ekskurzijah

Using ICT on school field trips

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POVZETEK

Šolske strokovne ekskurzije so dijakom običajno zanimive. Radi spoznavajo nove kraje, njihovo zgodovino, kulturo in ljudi. Navdušenje uplahne, ko dijaki v roke dobijo učne in delovne liste ter učitelji začnejo novo pridobljeno znanje tudi preverjati.

Že nekajkrat smo učitelji poskusili popestriti dogajanje na ekskurzijah z uporabo IKT. Danes imajo že vsi dijaki mobilne telefone, katere znajo spretno uporabljati in s katerimi radi delajo. Učitelji pred ekskurzijo pripravijo vse potrebno, delo dijakov pa poteka kar med vožnjo. Dijaki z mobilnimi telefoni iščejo informacije na spletu, odgovarjajo na zastavljena vprašanja, na koncu pa izpolnijo vprašalnik, ki učiteljem predstavlja povratno informacijo o tem, kaj lahko še izboljšajo.

Uporaba IKT na strokovnih ekskurzijah je med dijaki zelo dobro sprejeta. Za motivacijo najboljši prejme nagrado, ki jo prispevajo spremljevalni učitelji ali vodstvo šole.

Ključne besede

Strokovna ekskurzija, IKT, mobilni telefon, kviz

ABSTRACT

Our students usually find field trips interesting. They like to get to know new places, their culture, history and people. But their excitement decreases when they receive handouts and worksheets and when teachers start checking their knowledge.

My colleagues and I have tried to address this problem by using ICT on several field trips. Nowadays all students have mobile phones, use them skillfully and like working with them. The teachers prepare everything beforehand and the students work during the trip. They look up information online, answer the questions, and finally fill out a questionnaire giving the teachers feedback on what to improve.

Using ICT on field trips has been very well received among the students. To increase motivation further, the best student gets an award, which is contributed by accompanying teachers or by school management.

Keywords

Field trip, ICT, mobile phone, quiz

1. UVOD

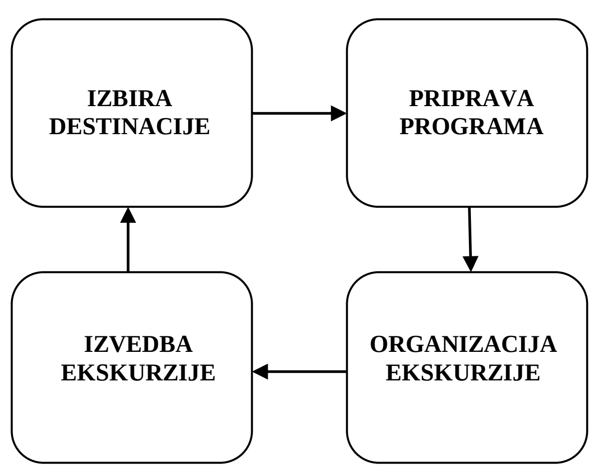
Na šoli že nekaj let v času počitnic organiziramo neobvezne in plačljive strokovne ekskurzije za dijake, ki želijo videti kaj več kot le tisto, kar jim pripada po šolskem delovnem načrtu. Neobvezna ekskurzija dijakom prinese ure v sklopu popolnoma prostih izbirnih vsebin (PPIV). Čeprav je ekskurzija neobvezna, to ne pomeni, da se bodo dijaki na poti samo zabavali. Ravno obratno. Dijaki imajo stroga pravila glede obnašanja, poleg tega pa morajo spremljati vodičevo razlago, saj jih na koncu poti čaka preverjanje znanja. Da pa vendarle ni vse skupaj tako togo kot na obveznih šolskih ekskurzijah, učitelji preverjanje popestrimo z uporabo IKT, pri čemer uporabljamo mobilne telefone.

Med vožnjo z avtobusom se dijaki s pomočjo mobilnih telefonov povežejo s spletnim kvizom in odgovorijo na pripravljena vprašanja. Vodja ekskurzije, ki običajno pripravi spletni kviz, preko svojega mobilnega telefona sproti preverja rezultate dijakov. Spletni kviz sam sešteva dosežene točke in sporoči končni rezultat vsakega dijaka. Da dijake pri reševanju spletnega kviza dodatno motiviramo, najboljšim trem dijaki podelimo nagrado. Zmagovalec je dijak z najvišjim seštevkom točk. Če je takšnih več, se upošteva še hitrost reševanja.

Ideja preverjanja znanja preko spleta pa pomeni precej predhodnega dela za vodjo ekskurzije. Že pred odhodom mora v skladu s programom naštudirati snov, izdelati vprašanja, aktualna za to ekskurzijo, skupaj z vodičem preveriti pravilnost odgovorov, ovrednotiti posamezna vprašanja ter preveriti, ali spletni kviz deluje tudi v primeru, da smo v avtobusu in nimamo dostopa do brezžičnega omrežja.

Ob koncu reševanja kviza dijaki s pomočjo IKT izpolnijo vprašalnik in izberejo destinacijo naslednje eksurzije. Vodja ekskurzije že predhodno določi nekaj primernih destinacij in izdela vprašalnik, ki poleg želja dijakov preverja tudi njihovo zadovoljstvo z izvedbo spletnega kviza.

Na sliki 1 je prikazan potek priprave in izvedbe strokovne ekskurzije od izbire destinacije do končne izvedbe, na kateri ponovno izberemo destinacijo za naslednje leto.



Slika 1: Potek priprave in izvedbe ekskurzije (vir: lasten)

2. ORODJA ZA IZDELAVO SPLETNIH KVIZOV IN ANKET

Za izdelavo spletnih kvizov in anket obstaja več orodij. Vsem je skupno, da so preprosta, učinkovita in jih dijaki radi uporabljajo. Njihova glavna prednost je, da je dostop do urejanja vsebin mogoče doseči iz katere koli pametne naprave; dovolj je, da vnesemo svoj račun ali kliknemo na predhodno kopirano povezavo.

Najbolj znana orodja za izdelavo spletnega kviza in ankete so:

- 1KA je odprtokodna aplikacija, ki omogoča storitev spletnega anketiranja [2].
- Storitev Google Forms omogoča, da ustvarimo anketo z različnimi vrstami odgovorov. Uporabnik ima jasen vmesnik s priročno nastavitvijo vseh elementov prihodnjega vprašalnika. Za razliko od drugih spletnih mest lahko v Google Forms brezplačno ustvarimo neomejeno število raziskav [1].
- Microsoft Forms je preprosta, osnovna aplikacija, ki omogoča preprosto ustvarjanje anket, preskusov znanja in vprašalnikov. V izobraževalnih ustanovah jo je mogoče uporabiti za ustvarjanje preskusov znanja ali pridobivanje povratnih informacij pri učiteljih in učencih [3].

Na šoli uporabljamo oblak MS Office 365, tako da kvize za šolske potrebe izdelamo z orodjem Microsoft Forms, politika šole pa uporabo oblaka MS Office 365 narekuje tudi zaradi zagotavljanja varstva podatkov.

3. IZBIRA DESTINACIJE ZA STROKOVNO EKSKURZIJO

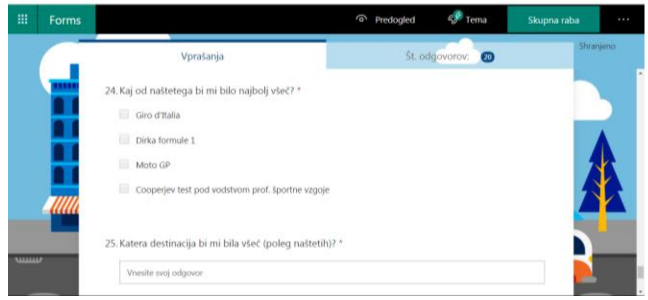
Dijaki, ki se udeležujejo ekskurzije, so ključni element za izbiro naslednje destinacije, saj si želimo, da bi se je udeležilo kar največ dijakov.

Izbira destinacije ni v celoti prepuščena dijakom, saj njihove želje hitro postanejo neuresničljive - na primer na Havaje v organizaciji šole ne moremo iti, pa čeprav si dijaki to želijo. Destinacije morajo biti skrbno izbrane, vsebovati morajo tako strokovne kot kulturne vsebine, nekaj časa pa mora ostati tudi za sprostitev in nakupovanje spominkov. Vodja ekskurzije se pri določanju morebitnih destinacij posvetuje tudi s turističnimi agencijami, z namenom zagotoviti privlačno in finančno ugodno ponudbo, ki vsebuje tudi strokovno izobraževanje.

Ko smo s tovrstnimi ekskurzijami začenjali, so dijaki med potjo dobili vprašalnike na listih, jih izpolnili in oddali učiteljem spremljevalcem, ki so na osnovi preštetih odgovorov določili naslednjo destinacijo. Zdaj je izbira destinacije vključena kar v spletni kviz, tako da dijaki že med reševanjem kviza sporočajo, kam si želijo iti v prihodnje.

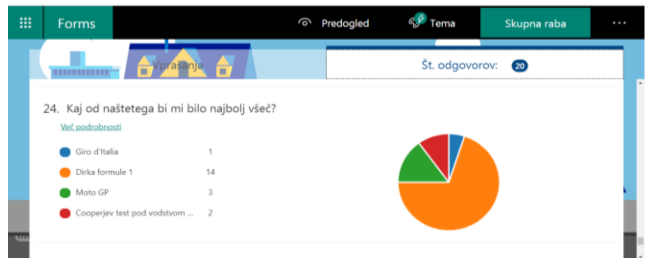
V spletnem kvizu vodja ekskurzije pripravi vprašanje, pri katerem dijaki izbirajo med ponujenimi destinacijami. Možnih je več odgovorov, dijaki pa obkljukajo tiste možnosti, ki so zanje dostopne. Dodatno vprašanje pa dijakom pušča možnost za odgovor po njihovi izbiri. Spletni kviz vodji ekskurzije vrne število zadetkov za posamezne destinacije in tista z največjim številom postane zmagovalna.

Na sliki 2 se nahaja primer, kjer dijaki najprej izberejo med danimi destinacijami in na koncu izrazijo še svoje želje.



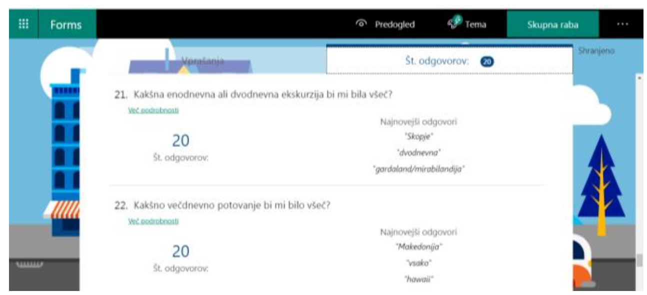
Slika 2: Izbira destinacije za naslednjo ekskurzijo (vir: lasten)

Ko dijaki izpolnijo vse potrebno, pošljejo odgovore vodji ekskurzije. Le ta vidi, katero destinacijo je dijak izbral in katero je dopisal na način, kot je prikazan na slikah 3 in 4.



Slika 3: Glasovanje za naslednjo ekskurzijo (vir: lasten)

Iz slike 3 je razvidno, da se je največ dijakov odločilo za ogled dirke formule 1, kar pomeni, da imamo to destinacijo pripravljeno za eno od naslednjih ekskurzij, in če bo le možno, že v naslednjem šolskem letu.



Slika 4: Želena destinacija za naslednjo ekskurzijo (vir: lasten)

Destinacije, ki jih dijaki vpišejo sami, mora učitelj prešteti, vendar želje dijakov niso vedno uresničljive in ponavadi niso zmagovalne.

4. PRIPRAVA PROGRAMA ZA STROKOVNO EKSKURZIJO

Ko je destinacija izbrana, vodja ekskurzije pripravi okvirni program ogledov. Ne smemo pozabiti, da gre za strokovno ekskurzijo, kar pomeni, da si dijaki tehniške šole ogledajo tudi področje stroke.

Vodja ekskurzije stopi v stik z vsaj dvema turističnima agencijama, ki mu na osnovi okvirnega programa pripravita podroben program s ceno glede na število udeležencev. Vodja ekskurzije nato izbere cenejšo možnost. Sledi obveščanje dijakov in zbiranje prijav. Vse nadaljnje aktivnosti, vključno s financami, prepustimo izbrani turistični agenciji.

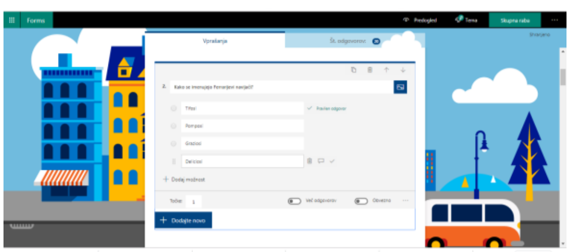
5. ORGANIZACIJA STROKOVNE EKSKURZIJE

Medtem ko večino organizacije glede izvedbe programa prevzame turistična agencija, čaka vodjo ekskurzije in spremljevalne učitelje še kar nekaj dela, med drugim tudi priprava spletnega kviza.

Če želimo z dijaki izvesti spletni kviz, mora biti še pred odhodom poskrbljeno za naslednje:

- Priprava vprašanj: glede na zasnovan program pripravimo čim bolj raznovrstna vprašanja, povezana z destinacijo.
- Izdelava kviza: pripravljena vprašanja vnesemo v spletni kviz. Za dana vprašanja označimo pravilne odgovore in določimo število točk za posamezne odgovore. Na osnovi danih točk bo program sam seštevál točke za pravilne odgovore.

  Primer vprašanja je prikazan na sliki 5. Iz slike je razvidno, da je pravilen le en odgovor, torej prvi. Le ta je vreden eno točko, na vprašanje pa ni obvezno odgovoriti. V kolikor dijak ne odgovori, je enako, kot če je odgovor napačen – dijak ne dobi točke.
- Izdelava vprašalnika: prvotno so dijaki vprašalnik izpolnjevali ločeno od preverjanja, vendar se je kmalu pokazalo, da za nagrado bi tekmovali, vprašalnika pa ne bi izpolnili. Zato je sedaj vprašalnik dodan v spletni kviz takoj po koncu tekmovalnih vprašanj. Dijak, ki tekmuje za nagrado, mora izpolniti vprašalnik še preden pošlje odgovore.
- Kviz in vprašalnik pred potovanjem izpolnijo tudi vodič in ostali učitelji spremljevalci. Dobro je, da vedo, kakšna vprašanja bodo na kvizu, opozorijo na morebitne napake, predvsem pa testirajo delovanje kviza.
- Priprava motivacijskih nagrad: vodja ekskurzije poskrbi za primerne nagrade za najboljše tri dijake. Vodstvo šole prispeva promocijske izdelke, učitelji spremljevalci pa poskrbijo za kakšen kulinarični priboljšek.



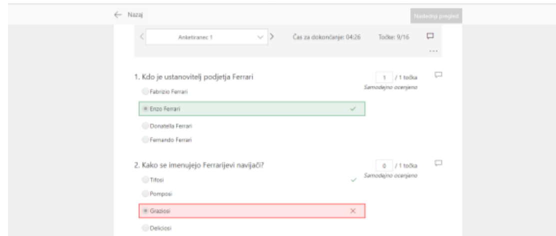
Slika 5: Primer vprašanja na ekskurziji (vir: lasten)

6. IZVEDBA STROKOVNE EKSKURZIJE

Ko nastopi načrtovani datum, se odpravimo na pot. Ekskurzije potekajo kot običajno. Vodič razkazuje različne znamenitosti, ostali poslušamo in si skušamo čim več zapomniti. Spletni kviz bomo reševali na poti proti domu, ko bo pred nami še dolga vožnja z avtobusom.

Vračanje domov dogajanje postane zabavno prav po zaslugi spletnega kviza. Dijakom odmerimo čas, da rešijo kviz, izpolnijo vprašalnik in izberejo novo destinacijo. Pri tem si pomagajo med seboj, iščejo informacije po mobilnem telefonu in se poskušajo spomniti vodičevih razlag. Pomembno je, da na čim več vprašanj odgovorijo pravilno, saj je število pridobljenih točk merilo za zmago. Prav tako pa je pomembno, da kviz rešijo čim hitreje; ponavadi je dijakov z enakim številom točk več in zmaga tisti z najkrajšim časom.

Odgovore sicer preveri aplikacija, vodja ekskurzije pa poišče dijake z največjim številom točk. Primer, kako aplikacija točkuje pravilnost odgovorov, je prikazan na sliki 6.



Slika 6: Odgovor, kot ga vidi vodja ekskurzije (vir: lasten)

Dijaki kviz vzamejo resno, saj se je do sedaj še vsakič zgodilo, da so prva tri mesta zasedli dijaki z vsemi možnimi točkami in je o zmagovalcu odločal čas reševanja kviza.

Za nagrajence pripravimo pravcato prireditev. Prvi trije dijaki prejmejo čestitke in nagrade ter se fotografirajo za šolsko glasilo.

7. ZADOVOLJSTVO DIJAKOV

Da so neobvezne strokovne ekskurzije postale priljubljene, dokazujejo vsakoletno število prijavljenih dijakov in zahvale staršev ter dijakov. Ko dijaki vedo, kaj bo naslednja destinacija, nas učitelje spremljevalce lovijo po hodnikih in sprašujejo, kdaj se lahko prijavijo, še preden je program sploh pripravljen.

Zadovoljstvo dijakov z izvedbo spletnega kviza ponazarja tabela 1.

Tabela 1: Rezultati vprašalnika o zadovoljstvu dijakov s spletnim kvizom na strokovni ekskurziji (vir: lasten)

Vprašanje	Odgovori	Število odgovorov
Ali mi je všeč ideja, da imamo za preverjanje znanja spletni kviz?	Odlična ideja.	9
	Všeč mi je.	10
	Ni mi všeč.	0
	Zanič ideja.	1
Kakšno preverjanje pridobljenjega znanja na ekskurziji mi je najbolj všeč?	Učni listi.	0
	Kviz.	17
	Kasnejše preverjanje v šoli.	1
	Nič od naštetega.	2
Si želim reševanja spletnega kviza tudi na naslednji ekskurziji?	Da.	17
	Ne.	3
Kaj bi bila po mojem mnenju lahko slabost kviza?	Ne vidim slabosti. Dolgočasen je. Premalo časa za iskanje informacij na Googlu. Internet ne deluje.	

Iz tabele je razvidno, da je večini dijakov spletni kviz všeč. Vedno pa se najdejo dijaki, ki najraje ne bi počeli ničesar.

8. ZAKLJUČEK

Dosedanje izkušnje kažejo, da se uporaba IKT ne obnese dobro le pri pouku, pač pa tudi izven šole. Dijaki se ne le zabavajo ob reševanju kviza, pač pa tudi v resnici pokažejo svoje znanje. K priljubljenosti kviza prispevajo tudi nagrade za najboljše dijake in pa popestritev dolge poti proti domu.

Zadovoljstvo dijakov nam je motivacija za nadaljevanje tovrstnih ekskurzij; to sicer pomeni dodatno delo za vodjo ekskurzije, vendar je izkušnja neprecenljiva.

9. VIRI

[1] *Kako odpreti dostop do Googlovega obrazca.* 2019. https://sl.soringpcrepair.com/how-open-access-to-google-form/, pridobljeno s spleta 20.8.2019.

[2] *O 1KA*. 2019. https://www.1ka.si/d/sl/o-1ka/splosen-opis, pridobljeno s spleta 20.8.2019.

[3] *Pogosta vprašanja o aplikaciji Microsoft Forms*. 2019. https://support.office.com/sl-si/article/pogosta-vpra%C5%A1anja-o-aplikaciji-microsoft-forms-495c4242-6102-40a0-add8-df05ed6af61c, pridobljeno s spleta 20.8.2019.

Interaktivno učenje o pomenu zdrave prehrane in presnove

Interactive learning about the importance of a healthy nutrition and metabolism

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POVZETEK

V prispevku je predstavljeno interaktivno učenje o pomenu zdrave prehrane in presnove, ki je v času odraščanja za mladostnike ključnega pomena, saj omogoča zdrav telesni razvoj. Mladostniki se v našem učnem sistemu pogosto srečajo s pomenom zdrave prehrane, prav tako pa je zdrava prehrana pogosto tema v medijih. Kljub pogostem omenjanju pomenu zdrave prehrane, je raziskava pokazala, da mladostniki velikokrat posežejo po nezdravi hrani. Več kot polovica anketiranih mladostnikov je mnenja, da se prehranjujejo zdravo, vendar so rezultati pokazali, da je v resnici takšnih zgolj 28%. Potrošniki pogosto v trgovini kupujemo hrano glede na izgled embalaže, mladostniki pa so glede na vizualni izgled in oglaševanje določenega izdelka še bolj dovzetni. Posledično nezdravo hrano pogosto zamenjajo za zdravo hrano in jo v prepričanju, da je dobra, jedo. Da bi mladostnikom na drugačen način približali pomen zdrave prehrane za njihov razvoj in njeno presnovo, je bila opravljena raziskava, v kateri so dijaki najprej preverili svoje znanje o zdravi prehrani, izpolnili anketo o njihovih prehranjevalnih navadah in bili nato vključeni v delavnice o pomenu zdrave prehrane in presnove. Na delavnicah so dijaki s pomočjo aplikacije Energy for life na interaktivni način spoznali pomen zdrave prehrane in kako se hranila presnovijo v našem telesu. Svoje znanje so nato preverili z vprašalnikom. Na koncu delavnice so dijaki s pomočjo aplikacije Veš kaj ješ? naredili primere zdravih jedilnikov.

Ključne besede

Zdrava prehrana, delavnice, presnova, aplikacija

ABSTRACT

The article presents interactive learning about the importance of healthy nutrition and metabolism, which is crucial for adolescents as they grow up, as they enable healthy physical development. Adolescents are often confronted with the importance of healthy eating in our learning system, and healthy eating is often a topic in the media. Despite the frequent mention of the importance of a healthy diet, research has shown that adolescents often resort to unhealthy foods. More than half of the adolescents surveyed said they were eating healthy, but the results showed that only 28% actually did. Consumers often buy food at the store based on the appearance of the packaging, and adolescents are even more receptive to the visual appearance and advertising of a particular product. As a result, unhealthy foods are often mistaken for healthy foods and eaten in good faith. In order to approach adolescents in a different way the importance of a healthy diet for their development and metabolism, a study was conducted in which students first tested their knowledge of healthy eating, completed a survey of their eating habits, and then participated in workshops on the importance of healthy eating and metabolism. Through the Energy for life application, students learned the importance of a healthy diet and how nutrients are metabolised in our bodies, and then tested their knowledge with a questionnaire. At the end of the workshop, students used the application Veš kaj ješ? and made examples of healthy menus.

Keywords

Healthy nutrition, workshop, metabolism, aplication

1. UVOD

Zdrava prehrana je nekaj o čemer se zadnje čase zelo pogosto govori. Pomen zdrave prehrane je ključen za zdrav razvoj, saj telo za izgradnjo notranjih ogranov, mišic, kostnine in živčevja nujno potrebuje hranila, ki jih vsebuje hrana. V zgodnjem otroštvu se običajno prehranjujemo bolj zdravo in uživamo raznoliko prehrano, ki nam omogoča zdrav razvoj. Otrokov jedilnik določajo starši oz. skrbniki in posledično ne moremo kot posamezniki vplivati na izbor hrane in zaužívati zgolj hrane, ki nam je všeč. V času pubertete, pa mladostniki počasi začnejo sami določati svoj jedilnik in pri tem večkrat ne upoštevajo smernic zdravega prehranjevanja. Nepravilen izbor živil in njihovo uživanje pa lahko pusti posledice, ki se pokažejo kot nepravilna, neenakomerna rast za vse življenje, prav tako pa lahko vpliva na oblikovanje prehranjevalnih navad v kasnejšem življenju. [6]

Zaradi upada upoštevanja smernic zdrave prehrane skozi obdobje pubertete je bila posledično opravljena raziskava katere namen je ugotoviti prehranske navade mladostnikov, v kateri so sodelovali dijaki Srednje ekonomske, storitvene in gradbene šole, Šolskega centra Kranj. Učenci so sprva izpolnili vprašalnik, ki je preveril njihove prehranske navade, nato pa so preko didaktične delavnice, pri katerih so uporabljali interaktivni aplikaciji, ki mladostnike spodbudita k boljšem razumevanju pomena zdrave prehrane in njene presnove, spoznavali načela zdravega prehranjevanja. Z vidika varovanja zdravja je namreč zdrava prehrana za mladostnike izredno pomembna, saj imajo ravno v tem obdobju veliko večje potrebe po beljakovinah, vitaminih in mineralih ter energiji. [1]

2. Pomen zdrave prehrane

Mladostniki se že v času osnovne šole pri pouku gospodinjstva srečajo s pomenom zdrave prehrane, kjer se učijo o prehranski piramidi in različni pripravi hrane. Nato se o prehrani in presnovi učijo pri pouku biologije, kjer največ poudarka namenijo presnovi ter vgradnji hranil v človeško telo in posledicah nepravilne prehrane in prehranskih navad. Njihove prehranske navade so v času osnovne šole običajno dobre, vsaj v prvi in drugi triadi, v tretji trijadi pa mladostniki med glavnimi obroki pogosto uživajo prigrizke za katere je značilno, da vsebujejo veliko energije, zaradi prisotnosti sladkorjev in maščob, ne vsebujejo pa hranilnih snovi, ki jih telo potrebuje za krepitev odpornosti. Ena izmed praks mladostnikov v tretji triadi je opuščanje zajtrka in neustrezen ritem prehranjevanja ter premajhne količine zaužite zelenjave. Vendar se prehranske navade osnovnošolskih otrok v tretji triadi v veliki meri razlikujejo od navad srednješolskih otrok, saj le ti velikokrat nimajo primerne šolske malice. [5]

Zdravo prehrano bi lahko opredelili z naslednjimi smernicami:

- redna prehrana (vsaj 5 obrokov dnevno)
- uživanje hrane glede na prehransko piramido
- raznolikost hrane
- počasno uživanje hrane, ki jo dobro prežvečimo
- izogibanje sladkim in mastnim jedem
- izogibanje prigrizkom [2].

Iskanje krivca slabih prehranskih navad mladostnikov ni enostavno, saj na njihove navade vpliva mnogo različnih dejavnikov. Živimo v okolju, ki spodbuja debelost, saj smo kot družba izredno potrošniko naravnani in nam mediji dnevno posredujejo vedno nove in nove proizvode. Poleg tega, pa nas okolje spodbuja k tem, da smo vedno manj aktivni (električna kolesa, električni skiroji, uporaba osebnega vozila…). Podatki za Slovenijo kažejo naraščajoče gibanje prekomeno hranjenih in debelih mladostnikov in odraslih pri nas, kar kaže da se navade pogosto prenašajo s starejše na mlajšo generacijo [7]. Debelost pri mladostnikih je namreč eden izmed največjih problemov današnjega časa, saj prekomerna telesna teža v mladostniškem obdobju zelo pogosto nakaže na prekomerno telesno težo tudi v odraslem obdobju. Pri mladostniku neuravnotežena prehrana povzroča manjšo delovno storilnost, utrujenost, manjšo sposobnost pomnenja in kronične bolezni.

Strokovnjaki so ugotovili, da so številne bolezni neposredno povezane s hrano, kar pomeni da je od prehrane odvisno naše zdravje. Nepravilna prehrana pa je večkrat povezana z različnimi slabimi navadami kot je telesna neaktivnost in kajenje. Bolezni katere lahko neposredno povežemo s prehrano so:

- beri-beri (posledica, dolgoročnega pomankanja vitamina B1)
- skorbut (nastane zaradi pomanjkanja vitamina C v daljšem časovnem obdobju)
- hipertenzija (povišan krvni tlak zaradi hrane, ki vsebuje visoke vrednosti nitratov)
- zobna gniloba (posledica prekomernega uživanja sladke hrane in slabe ustne nege)

Obstaja še množica drugi bolezni, vendar njihovega nastanka ne morejo povezati izključno z slabimi prehranskimi navadami. [8]

Ker so bolezni, ki jih povzroča nezdrava prehrana velik javnozdravstveni problem, se veliko pozornosti namenja k omilitvami posledic le teh.

3. Interaktivni poučevanje

Ustaljena praksa poučevanja mladostnikov o pomenu zdrave prehrane, očitno ne prinaša dobrih rezultatov, saj se delež mladostnikov, ki imajo slabe prehranske navade in posledično zdravstvene težave, ki se lahko razvijejo tudi v odrasli dobi. Razlog za slabe navade mladostnikov, bi lahko bili tudi zastareli načini poučevanja v šoli, saj so učenci zaradi uporabe interneta, mobitelov in televizije navajeni na interaktivno pridobivanje informacij. Frontalen način poučevanja, katerega uporablja večina učiteljev, v večini primerov ne doprinaša k trajnostnem znanju, saj so učenci do takšnega pridobivanja informacij vedno manj motivirani pri učnem procesu [4]. Učitelj mora dan danes učence spodbujati, da sami pridejo do določenih spoznanj, ne da jim zgolj posreduje znanje. Z uporabo in upoštevanjem konstruktivističnega pristopa pri izkustvenem učenju lahko učitelj učencem pomaga povezati ugotovitve s praktičnimi zakonitostmi.

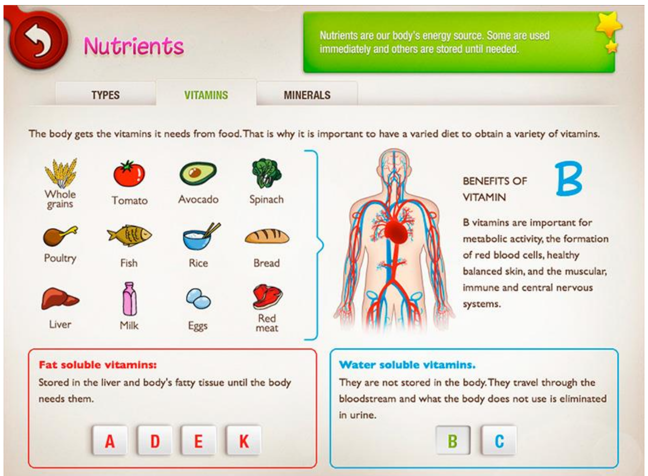
Uporaba IKT (informacijsko komunikacijske tehnologije) lahko omogči posredovanje učne snovi na bolj atraktiven način. Pri pouku lahko uporabimo tako računalnike, kot tudi mobilne telefone, sploh v primeru, da imamo v vzgojno izobraževalnem zavodu težave zagotoviti primerno število računalnikov za večjo skupino učencev. Uporaba mobilnih telefonov pri pouku ima tudi svoje omejitve in predstavlja določene izzive, sploh od učiteljev. Prednost mobilnih telefonov je v tem, da jih ima večina učencev in da so običajno zmogljivejši od šolskih računalnikov [3].

3.1 Aplikacije za poučevanje o zdravi prehrani in presnovi

Na spletu je množica različnih aplikacij in spletnih strani, ki opisujejo zdravo prehranjevanje in presnovo, vendar je zgolj peščica didaktično primernih za uporabo v učnem procesu. Večina aplikacij je namenjena ali izobraževanju ali zabavi, vendar le malo je takšnih, ki bi združevale oba spektra. Ena izmed aplikacij, ki je tako poučna, da igralec pridobi in utrdi svoje znanje, kot tudi zabavna, da se igralec ne naveliča in je pripravljen dlje časa ostati motiviran, se imenuje Energy for life. Aplikacija sicer ne ponuja uporabe v slovenskem jeziku, temveč je zgolj v angleškem in španskem jeziku. Posledično se lahko aplikacijo uporabi kot primer medpredmetnega povezovanja biologije in angleščine. Prednost aplikacije je tudi v tem, da je popolnoma brezplačna in omogoča več različnih učnih modulov.

Aplikacija s pomočjo igrifikacije – uporaba dinozavra, ki pritegne pozornost uporabnika, uči novih konceptov in ga motivira za interakcijo, kar izboljša učni proces. Zaradi enostavnega umesnika je ta aplikacija dostopna vsem učencem različnih starosti, tako v osnovni, kot tudi v srednji šoli. Vizualen prikaz in strokovna natančnost izrazov, se določi s pismenimi sposobnostmi uporabnika. Velik poudarek je na znanstveni pismenosti, povezan z vizualnimi dražljaji, ki uporabnika spodbujajo k aktivni uporabi aplikacije. Aplikacija je zasnovana tako, da se jo lahko uporablja ob spremstvu vodje učnega procesa ali pa se jo uporablja samostojno. Slika 1 prikazuje dinozavra, ki mladostnika nagovarja, kaj vse lahko s pomočjo aplikacije izve. Uporabnik lahko izbira med različnimi področji, ki jih lahko s pomočjo aplikacije osvoji in utrdi svoje znanje. Slika 2 prikazuje modul prebavil, katerega uporabnik lahko izbere v aplikaciji in s pomočjo njega pregleda kaj vse njegovo telo potrebuje za delovanje. Nato uporabnik preveri kaj se zgodi, če tega hranila ne dobi (nastanek različnih obolenj). Prav tako, ga aplikacija spodbuja k nadaljnjem razmišljanju in preizkušanju naučenega znanja.

Slika 1: Prikaz različnih modulov aplikacije



Slika 2: Prikaz modula hranila

Aplikacija Veš kaj ješ? omogoča uporabniku preveriti energijsko vrednost hrane. Prav tako uporabniku omogoča, da s pomočjo prehranskega semaforja ugotovi, katerih živil naj se zaradi prekoračenih vrednosti določenih hranil izogiba. Namen aplikacije je pomoč pri sestavi jedilnika, katerega lahko vsak posameznik sestavi glede na svoje prehranske navade. Slika 3 prikazuje primer uporabe aplikacije na pametnem telefonu med opravljanjem nakupov. Aplikacija nam omogoča uporabo kamere pri pametnem telefonu in s tem skeniranje črtne kode izdelka, katerega prehransko vrednost želi uporabnik preveriti. Aplikacija nam nato s pomočjo barvnega semaforja prikaže katerih hranil je v izdelku v zadostnih, prekomernih ali premajhnih količinah. Pri sliki 4 lahko vidimo kako je razčlenjen prehranski semafor, ki uporabniku sporoča še dopustno vrednost določenih hranil v izdelku.

Aplikacija Veš kaj ješ? ni namenjana zabavi in je posledično manj atraktivna kot aplikacija Energy for life, zato je vsaj uvodna uporaba aplikacije priporočljiva pod vodstvom učitelja.

Učitelj mora pred uporabo mobilnih telefonov kot učnega pripomočka med poukom oceniti smiselnost, pri kateri učni snovi ga bo uporabil in katere učne cilje bo s pomočjo njih usvojil. Prav tako ni namen vsakodnevne uporabe mobilnih telefonov pri učnem procesu, saj bi s tem njegova atraktivnost izzvenela, prav tako pa bi lahko postal moteči faktor v razredu zaradi morebitne nedovoljene uporabe iz strani učencev.

Slika 3: Prikaz aplikacije Veš kaj ješ?

Z barvno lestvico do ozaveščenih kupcev

vsebnost snovi v gramih na 100 g živila	malo	srednje	veliko
maščoba	do 3	3–20	več kot 20
nasičene maščobne kisline	do 1	1–5	več kot 5
sladkor	do 5	5–12,5	več kot 12,5
sol	do 0,3	0,3–1,5	več kot 1,5
	veliko	srednje	malo
prehranske vlaknine*	več kot 6	3–6	manj kot 3

* za uživanje prehranskih vlaknin veljajo ravno obratna priporočila kot za sladkor, sol, maščobo in nasičene maščobne kisline: uživali naj bi jih več in ne manj

DELO Vir: FSA

Slika 4: Prikaz prehranskega semaforja

4. RAZISKAVA

Da bi ugotovili odnos do zdrave prehrane mladostnikov in preverili znanje o pomenu zdravega prehranjevanja in presnove, je bila opravljena raziskava, v kateri so sodelovali dijaki Srednje ekonomske, storitvene in gradbene šole, Šolskega centra Kranj. Za namen raziskave je bilo izbranih 42 dijakov 2. letnika, ki so sprva izpolnili vprašalnik, ki je bil sestavljen iz 14 vprašanj, katerih namen je bil ovrednotiti znanje učencev o zdravi prehrani in presnovi, prav tako pa je bil namen vprašalnika preveriti njihove prehranske navade. Nato so bile izvedene 3 učne ure, pri katerih so dijaki s pomočjo aplikacije Energy for life ugotovili pomen zdrave prehrane in presnove, nato pa so s pomočjo aplikacije tudi preverili svoje znanje. Pri učni uri je bila vloga učitelja zgolj kot usmerjevalec učnega procesa in ne posredovalca znanja.

Po uporabi aplikacije so bili učenci pozvani kakšne so njihove prehanske navade in opisu njihovega tedenskega jedilnika. Ker so imeli pri jedilniku večje težave, so nato s pomočjo aplikacije Veš kaj ješ? preverili kakšne jedi so primerne za določen del dneva in katerih jedi se morajo izogibati pri svoji prehrani.

Po zaključku dela z aplikacijo so učenci s pomočjo razgovora posredovali kaj so se naučili in izročke oblikovane skupaj z učiteljem zapisali v zvezke. Nato so ponovno izpolnjevali vprašalnik, s katerim je bilo preverjeno, kaj so se naučili.

Določeni rezultati vprašalnika so bili pričakovani, saj se je tako znanje kot tudi odnos do zdrave prehrane izboljšalo. Presenetljivo je bilo to, da je bilo 54% odstotkov učencev mnenja, da se prehranjuje zdravo, vendar je bilo nato v nadaljnjem delu rezultatov vprašalnika prikazano, da so zmotno prepričani v svoj zdrav način prehranjevanja.

Kar 48% učencev navaja premalo časa kot glaven krivec za njihove slabe prehranske navade, 35% učencev pa navaja, da stres močno pripomore k njihovimi prehranskimi navadami.

Kot glaven razlog zakaj kupijo določen proizvod so učenci podali izgled in njegovo oglaševanje. Večina učencev ne pregleda hranilnih vrednosti pred nakupom produkta.

Pri vprašanju katera pijača ima najvišjo vrednost sladkorja, je sprva od 42 učencev pravilno odgovorilo zgolj 5 učencev, kar nakazuje na njihovo zmotno znanje o hranilih v sladkanih pijačah. Pri zapoznelen vprašalniku pa je pravilno odgovorilo 18 učencev. Večina učencev, kar 34 od 42 je odgovorila pri zapoznelen vprašalnikov, da bodo več pozornosti namenili svojim prehanskim navadam.

5. ZAKLJUČEK

Ključno je, da se o zdravi prehrani začnemo pogovarjati čim prej v začetku izobraževalnega procesa. Vendar zgolj frontalno poučevanje ne prinaša željenih rezultatov, saj se delež prekomerno debelih mladostnikov v zadnjem časovnem obdobju drastično povečuje. V raziskavi je predstavljen eden kot načinov, da izboljšamo prehranske navade mladostnikov, uporaba interaktivnega pouka s pomočjo aplikacij. Aplikacije, ki jih dan danes lahko učenci uporabljajo pri pouku, se lahko dostopajo preko mobilnih telefonov, kar pomeni, da lahko tudi vzgojno izobraževalni zavodi z omejitvami pri omogočanju dovolj velikega števila računalnikov za vse učence, omogočijo svojim učencem izvedbo pouka na takšen način.

Ali bo uporaba takšnih aplikacij drastično vplivala na prehranske navade učencev je neodgovorno trditi, vendar njihova uporaba lahko pripomore k boljšem ozaveščanju zdravega načina prehranjevanja in razumevanju presnove hranil ter zdravemu načinu življenja.

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Spletna aplikacija desmos kot pomoč pri raziskovanju funkcij pri pouku matematike

Using Desmos app as a teaching aid with mathematical functions

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POVZETEK

V prispevku želim predstaviti uporabo spletne aplikacije Desmos kot pomoč pri raziskovanju in poglobitvi znanj sklopa funkcije pri pouku matematike. Spletna aplikacija Desmos je orodje, ki nam funkcijski zapis, tabelični zapis, zapis funkcij s parametri enostavno in hitro nariše v graf. Na ta način učenci spoznajo kakšen je pomen konstante, spremenljivke ter parametrov pri funkcijah, raziščejo značilnosti še ostalih značilnih funkcij (linearne, kvadratne, konstantne, kubične ...), dobijo lažjo predstavo o množicah točk, ki so omejene z eno ali več funkcijami, spoznajo kakšen je pomen smernega koeficienta in začetne vrednosti pri linearni funkciji.

Uporaba spletne aplikacije Desmos je zelo enostavno in pregledno, učitelju omogoča predpripravo spletnih e-gradiv ter spletne učilnice v katero se učenci prijavijo s pomočjo generirane kode. V prispevku bom predstavila primer uporabe programa Desmos kot pomoč za raziskovalno delo, individualno preverjanje znanja, skupinko delo oz. delo v parih ter utrjevanje in poglablanje že osvojenega znanja.

Ključne besede

Funkcije, graf funkcije, tabele, linearna funkcija, Desmos spletna aplikacija, digitalno opismenjevanje, e-gradiva

ABSTRACT

This paper aims to present the practical uses of Desmos as an aid to Math teaching and how to explore and deepen the knowledge on functions. Desmos is an online application that helps us transform a written function, a table or a function with different parameters into a graph. In this way the students can learn about mathematical constants, variables and function parameters, they can explore the meaning of other typical functions (linear, square, constant and cube). By using Desmos the students can easily understand the meaning of sets of points limited by one or more functions, they can learn about the slope coefficient and the initial value in linear function.

Using Desmos is easy, straightforward and user-friendly. The teacher can use it to prepare online teaching materials as well as an e-classroom where the students can login in by using a class code. This paper will present an example of how Desmos can be used to support research work, individual assessment, group work, pair work and student revision.

Keywords

functions, graphs, tables, linear function, Desmos online application, digital literacy, e-learning materials.

1. Uvod

Kot učiteljica matematike neprestano iščem načine in metode kako učencem matematiko predstaviti na čimbolj slikovit in zanimiv način. Učenci, ki nimajo geometrijske predstave, imajo pri obravnavi snovi funkcije težavo pri povezovanju funkcijskega zapisa, tabel in grafov. Snov tako ponotranijo šele z načrtovanjem številnih grafov, kar pa zahteva veliko časa. Tako sem našla način, ki je učencem bližji in hitrejši, saj je bilo že samo delo z računalniki večja motivacija kot prosto načrtovanje. Tukaj velja poudariti, da delo s spletnimi orodji nikakor ne more zamenjati prostega načrtovanja, saj bi s tem zanemarili »metodo« grafomotorike, ki pa je pri učencih še tako pomembna, ampak se aplikacijo lahko uporabi za utrjevanje ali raziskovanje določene snovi.

Ker nam program Desmos omogoča enostavno in hitro risanje grafov, sem ga uporabila za uro raziskovanja odvisnosti linearne funkcije od smernega koeficienta in začetne vrednosti, raziskovanje različnih funkcij z mejami ter iskanje množice točk v koordinatem sistemu omejene s funkcijami. Sam program pa nam ponuja še veliko več. Učitelji imajo možnost izdelati e-gradiva, kjer se učenci z registracijo vpišejo v njihovo spletno učilnico. Učenci tako individualno ali v paru rešujejo naloge iz spletne učilnice, učitelj pa ima pri tem vpogled v delo vseh vpisanih uporabnikov.

Program Desmos je za uporabo zelo enostaven in pregleden, poleg tega pa nam ponuja še veliko primerov e-gradiv (ki jih lahko kopiramo in prilagodimo) ter videovodičev.

V letošnjem letu sem pri urah uporabila le osnovne funkcije, ki jih program ponuja in te bom podrobneje opisala v prispevku.

2. Spletna aplikacija Desmos

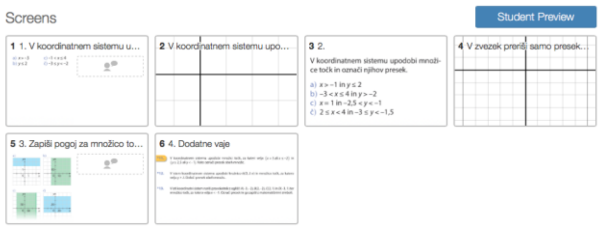
Spletna aplikacija Desmos nam omogoča ogromno »funkcij dela« kot so: načrtovanje grafov s pomočjo funkcijskega zapisa ali tabele, računanje, načrtovanje geometrijskih elementov, računanje vrednosti funkcije v danih točkah, programiranje animacij, izdelava spletnih gradiv, uporaba že pripravljenih e-gradiv, kloniranje in priprejanje že pripravljenih e-gradiv, sodelovanje učencev v e-učilnici ...

Spletna stran aplikacije je podprta s številnimi videovodiči, ki nam nazorno predstaviljajo funkcije programa od najbolj osnovnih do zelo naprednih.

2.1 Uporaba spletne aplikacije Desmos za utrjevanje snovi – Množice točk v koordinatnem sistemu

Ker so se na tej uri učenci prvič srečali s tem programom, smo del ure namenili spoznavanju tega programa. Učenci so uporabljali program brez registracije. Navodila za delo sem projecirala na tablo. Ker je vsak tip naloge vseboval več primerov in sicer od lažjih k težjim, sem lahko tako pri uri upoštevala difereciacijo glede na znanje učencev. Ker so imeli učenci še nekaj težav z učenjem programa, sem dovolila tudi skupinsko delo.

Spodaj je priložen zajem prosojnic z navodili za učence (slika 1).



Slika 1. Primer navodil za učence iz spletne učilnice

2.2 Uporaba spletne aplikacije Desmos za raziskovanje snovi – Smerni koeficient in začetna vrednost linearne funkcije

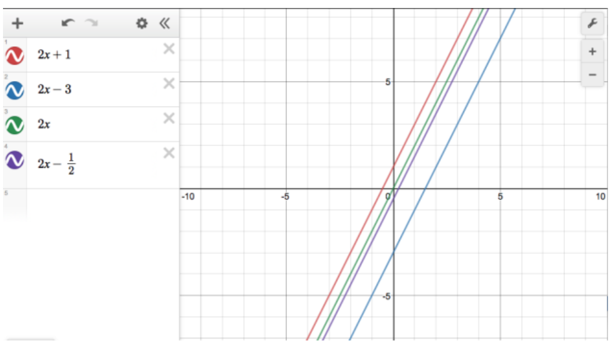
Učenci so dobili vprašanja na katera so morali odgovoriti s pomočjo načrtovanja v programu Desmos:

a) Odvisnost linearne funkcije od smernega koeficienta

Vprašanje: Kaj je značilno za premice, ki imajo enak smerni koeficient?

Učenci so dobili navodilo, da s pomočjo programa narišejo štiri grafe funkcij, ki imajo enak smerni koeficient in različno začetno vrednost. Iz narisanih grafov učenci jasno vidijo, da so funkcije z enakimi smernimi koeficienti vzporedne (slika 2).

Učenci ugotovitve zapišejo v zvezek: Grafi funkcij z enakim smernim koeficientom so med seboj vzporedni. Vzporednice imenujemo snop premic.



Slika 2. Snop vzporednih premic

Vprašanje: Katere premice so naraščajoče, padajoče oz. konstantne?

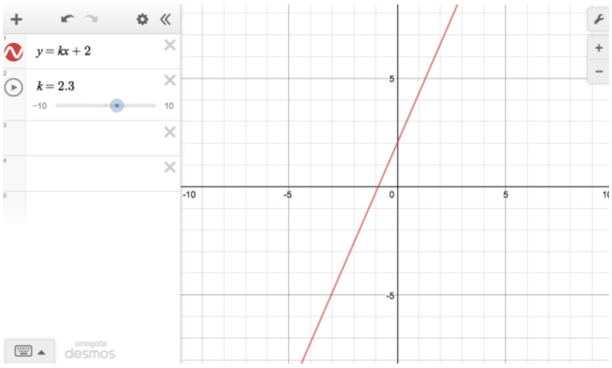
Učenci s pomočjo določene začetne vrednosti in smernega koeficienta kot parametra ugotavljajo kdaj funkcija narašča, pada ali je vzporedna z x-osjo (slika 3)

Ugotovitev: Funkcije, ki imajo pozitivni smerni koeficient so naraščajoče, funkcije z negativnim smernim koeficientom so padajoče, funkcije katerih smerni koeficient je enak nič pa imenujemo konstantne.

Vprašanje: Kakšna je odvisnost strmine grafa od smernega koeficienta

Učenci s pomočjo drsnika spreminjajo smerni koeficient in ugotavljajo kdaj je graf funkcije bolj strm.

Ugotovitev: Čim večja je absolutna vrednost smernega koeficienta, tem strmejši je graf linearne funkcije.



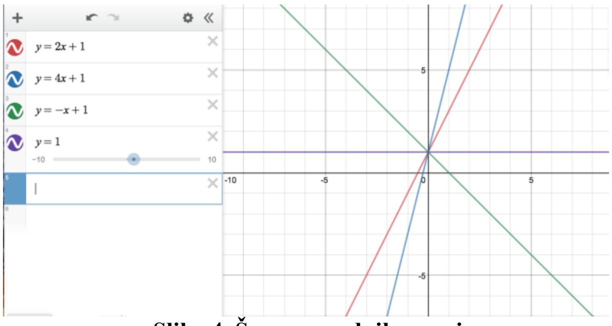
Slika 3. Ugotavljanje lastnosti funkcije: naraščanje, padanje in strmina grafa

b) Odvisnost linearne funkcije od začetne vrednosti

Vprašanje: Kaj je značilno za premice, ki imajo enak smerni koeficient?

Učenci so dobili navodilo, da s pomočjo programa narišejo štiri grafe funkcij, ki imajo enako začetno vrednost in različen smerni koeficient. Iz narisanih grafov učenci jasno vidijo, da funkcije z enako začetno vrednostjo imajo isto točko na ordinatni osi (slika 4).

Učenci ugotovitve zapišejo v zvezek: Grafi funkcij z enako začetno vrednostjo imajo isto presečišče z y-osjo. Grafe linearnih funkcij, ki se sekajo v isti točki, imenujemo šop premic.



Slika 4. Šop vzporednih premic

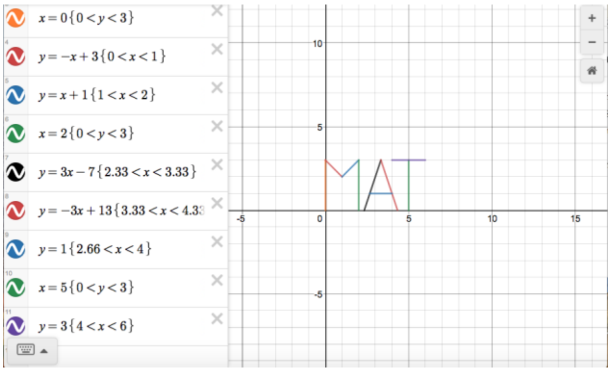
2.3 Uporaba spletne aplikacije Desmos za raziskovanje ostalih matematičnih funkcij.

Pri uri matematike so učenci že spoznali značilne grafe funkcij kot so graf kvadratne in kubične funkcije, graf premega in obratnega sorazmerja ter graf linearne funkcije. S programom Desmos jim predstavim še nekaj grafov krivulij v odvisnosti od parametrov kot so: krožnica, elipsa, parabola, hiperbola. Učenci so dobili navodilo zapisati različne besede s pomočjo funkcij s spreminjanjem parametrov funkcij ter omejitvami grafov po x in y osi.

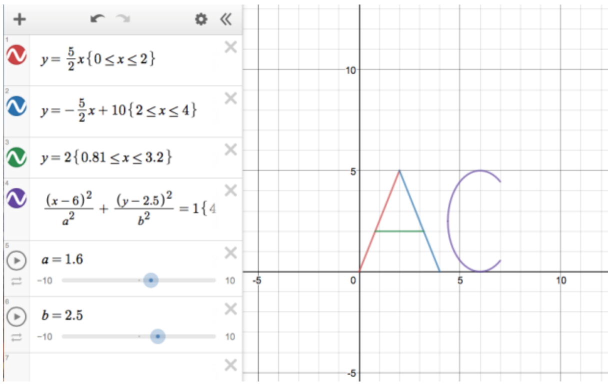
Primer 1: Besedo MATEMATIKA so lahko zapisali z linearnimi funkcijami.

Prednost dela s tem programom je tudi diferenciacija med učenci. Tako so lahko učenci s šibkejšim znanjem zapisali le nekaj črk, hitrejši pa celo besedo.

Primer 2: Naslednja beseda je bilo skrajšano ime učenca ACO. Besedo smo zapisali skupaj, saj so se učenci prvič srečali z risanjem elipse. Tukaj so spoznali značilnosti parametrov a in b ter pomik krivulje po x in y osi. Ta naloga je bila zahtevnejša, zato so učenci lahko delali tudi v parih. Ko so učenci zapisali besedo, so lahko zapisali svoje ime, drugo besedo ali kaj narisali. Program nam ponuja primere različnih funkcij zapisane s parametri. Učenci so tako lahko raziskovali od česa je odvisna velikost in oblika elipse ter kako jo pomikamo po koordinatnem sistemu.



Slika 5. Zapis besed s pomočjo funkcij (primer 1)



Slika 5. Zapis besed s pomočjo funkcij (primer 2)

3. Zaključek

Splet nam danes ponuja veliko brezplačnih aplikacij, ki jih učitelji lahko uporabimo za popestritev pouka. Pri tem se moramo zavedati, da uporaba le-teh lahko doprinese veliko prednosti in pa tudi slabosti. Učitelj mora tako delo s spletnimi gradivi smiselno in kritično umestiti v učni načrt in se pri tem zavedati, da motivacija ne sme biti prvi ali edini razlog njihove uporabe. Pred tem je dobro razmisliti katere cilje učnega načrta bomo spoznali, utrdili ali preverjali.

S programom Desmos lahko pri učencih dosežemo večjo motivacijo pri pouku, pri jemanju snovi dosežemo lažjo geometrijsko predstavo o funkcijah, učenci lahko po navodilih učitelja spoznavajo novo snov, učitelj lahko z izdelavo e-gradiv v spletni učilnici preveri znanje učencev, učenci lahko doma preverijo, če so pravilno načrtovali grafe.

4. Literatura

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Različni pristopi k reševanju problemov med višješolskimi študenti tehničnih smeri

Different approaches to solving problems among students of higher educational courses

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POVZETEK

Pri delu z višješolskimi študenti se vedno znova izkaže, da imajo zelo različne pristope k reševanju enakih nalog in problemov. Hkrati pa se znotraj študijskih programov pojavijo podobnosti. O različnih pristopih torej lahko govorimo na ravni poklicne usmeritve študentov. V prispevku so predstavljene razlike med pristopi višješolskih študentov v programih informatike, mehatronike in varovanja. Spremljali smo, na kakšen način študenti različnih tehniških smeri pristopijo k reševanju problemov, kako rešujejo iste praktične naloge s področja računalništva in koliko časa potrebujejo za dokončanje nalog. Preučevali smo tudi vpliv predhodnega znanja na hitrost in uspešnost reševanja problemov. Ugotovili smo, da so med temi tremi skupinami študenti programa informatike najhitreje reševali zastavljene naloge in imeli tudi inovativne rešitve. S pomočjo predhodno pridobljenega znanja informatiki ustrezno urejajo podatke, rešujejo zastavljene naloge in razvijajo informacijsko pismenost na višjem nivoju. Glavni element kompetence, ki so jo razvijali pri preučevanih vajah, je razumevanje in uporaba zbirk programov Microsoft Office ali primerljivih zbirk.

Ključne besede

Različni pristopi, reševanje vaj, tehniške študijske smeri, programi Microsoft Office

ABSTRACT

Working with students of higher educational courses always proves that students adopt different approaches to solving equal tasks and problems. On the other hand, some similarities occur inside study programmes, so different approaches can be discussed within professional courses. The article presents some different approaches of the students of the higher educational courses of Informatics, Mechatronics and Security at Vocational College. In equal specific educational situations, it was observed what approaches the students of the three courses adopted to solving tasks and problems, how they were solving the same practical tasks, and how long it took them to solve the tasks. We also studied the influence of the prior knowledge on the velocity and successfulness of solving the tasks. We found out that the students of Informatics have a decided advantage and are capable of coming up with innovative solutions. With the help of their prior knowledge, they can manage data, solve tasks and develop their information literacy on a higher level. The key competence which was developed during the observed practical lessons was the understanding and the use of Microsoft Office programmes collections or other comparable ones.

Keywords

Different approaches, solving tasks, technical study courses, programmes MS Office

1. UVOD

Kot predavatelj predmeta Računalništvo in informatika v smereh informatika, mehatronika in varovanje na Višji strokovni šoli Šolskega centra Kranj imam vsako študijsko leto znova pred seboj dokaj nehomogene skupine študentov, ki razpolagajo z različnim predznanjem, imajo izdelane različne metode učenja ter imajo zelo različne načine razumevanja in razmišljanja. Namen prispevka je nekoliko podrobneje predstaviti te razlike med študenti posameznih smeri, saj menim, da predavatelj, ki razlike pri učenju pozna in se jih zaveda, lahko vsaki skupini študentov omogoči pridobivanje znanja na njim najbližji način.

Cilja prispevka sta predvsem: predstaviti razmislek o pomenu znanja uporabe programov MS Office višješolskih študentov ter predstaviti primer dobre prakse poučevanja teh vsebin na višji šoli, ki vključuje upoštevanje razlik v delovanju in učenju pri študentih, problemsko učenje in tudi razvijanje nekaterih drugih veščin..

2. UPORABA MICROSOFTOVIH ORODIJ IN PROGRAMOV

Znanje uporabe Microsoftovih orodij in programov Office (v nadaljevanju MS Office) je danes nepogrešljivo. Težko si predstavljamo izobraževalne procese, delo na številnih delovnih mestih ali izvajanje predstavitev na konferencah, poslovnih srečanjih in drugih dogodkih brez pomoči teh programov. Znanje uporabe MS Office pričakujejo tudi delodajalci v razpisih za prosta delovna mesta. Če na primer v iskalnik na spletni strani careerJET vpišemo »office«, bomo dobili preko 100 zadetkov z delovnimi mesti v Ljubljani najrazličnejših profilov in strok: administrator, nabavni referent, tehnolog, prodajni inženir, vodja projektov, vodja upravljanja blagovnih skupin, raziskovalec z doktoratom, operativni vodja v strojništvu, gradbeništvu, farmaciji, specialist za meritve, programer, analitik, vzgojitelj predšolskih otrok, novinar in še bi lahko naštevali. Približno pri polovici razpisov je zahtevano znanje vsaj enega tujega jezika, pri približno četrtini vozniški izpit, pri vseh pa znanje uporabe programov MS Office.

Množica programov, ki jih študenti vsakodnevno spremljajo in uporabljajo tudi na svojih mobilnih napravah, zahteva ustrezne kompetence in spretnosti, ki jih lahko uporabijo v izobraževalnem procesu in na delovnem mestu in s tem postanejo konkurenčni na trgu dela. Odlično znanje informatike in računalništva predstavlja prednost pri zaposlitvi tudi po mnenju nekaterih teoretikov. Pavlin [5] ugotavlja, da se poleg strokovnega znanja na trgu dela najbolj pričakuje sposobnosti dela pod stresom, učinkovito upravljanje časa, timsko delo in sposobnost dela z računalnikom, saj so te splošne kompetence tiste, ki naredijo strokovno znanje uporabno.

Trbanc [7] meni, da je v primerjavi s tistimi, ki so z izobraževanjem zaključili že pred časom, glavna prednost študentov ob vstopu v zaposlitev po zaključenem izobraževanju njihovo najnovejše znanje. Poleg le-tega kot prednost študentov na trgu dela izpostavlja tudi spretnosti in kompetence, ki so jih pridobili v procesu odraščanja v sodobni družbi. To so uporaba računalnika in interneta, komunikativnost, prilagodljivost, delo v timu, znanje tujih jezikov in podobno.

Znanje računalništva se je izkazalo kot prednost pri zaposlitvi tudi v nedavni raziskavi, ki smo jo izvedli med diplomanti informatike in mehatronike Višje strokovne šole Šolskega centra Kranj, ki so se po končanem šolanju zaposlili. Rezultati so pokazali, da je večina diplomantov, in sicer 76 %, mnenja, da je bilo znanje uporabe računalnika prednost, ki je vplivala na njihovo zaposlitev [6]. Izmed vseh prednosti, ki so jih ocenjevali, so anketirani diplomanti najviše ocenili znanje uporabe računalnika in izkušnje. Sledile so (razvrščene po ocenah navzdol) komunikacijske sposobnosti, sposobnost timskega dela, spretnost vodenja, organizacije in odločanja, ustrezna izobrazba, znanje tujih jezikov, ugled šole, dobre izkušnje podjetja z delom diplomantov šole in poznanstva [6].

3. RAZLIKE PRI REŠEVANJU IN ODDAJANJU VAJ

V nadaljevanju se osredotočamo na ugotavljanje razlik v reševanju vaj med višješolskimi študenti informatike, mehatronike in varovanja pri konkretnih učnih situacijah učenja uporabe programov Excel, Word, Access in PowerPoint pri laboratorijskih vajah predmeta Računalništvo in informatika. Razlike so podrobneje analizirane glede na smer študija, nato pa tudi glede na posamezen program MS Office.

3.1 Razlike pri reševanju in oddajanju vaj glede na smer študija

Želeli smo ugotoviti, s kakšnimi pristopi in kako študenti različnih smeri v okviru laboratorijskih vaj rešujejo iste praktične naloge, s čim si pomagajo pri iskanju rešitev in koliko časa potrebujejo za dokončanje oziroma oddajo rešene naloge v spletno učilnico. Zato smo izvedli sistematično raziskavo med aktivnimi študenti zadnjih treh šolskih let (2014/15, 2015/16, 2016/17). Ocenili smo v prvem poskusu oddane vaje 144 študentov informatike, 84 študentov mehatronike in 51 študentov smeri varovanje.

Vaje so za vse tri smeri enake, tako da je mogoča primerljivost rezultatov. Študenti oddajo rešene vaje v spletno učilnico, po možnosti ob koncu laboratorijskih vaj, vendar najkasneje v šestih dneh. Po tem času se vaja v spletni učilnici zapre za oddajo. To šteje kot prvo ocenjevanje in ti primeri vaj so upoštevani v analizi raziskave. Izjemoma sicer dovolimo kasnejšo oddajo vaj (v roku daljšem od šest dni) študentom z dokazili o bolezni ter študentom s posebnimi potrebami ali s statusom kulturnika oziroma športnika. Te vaje niso bile upoštevane v raziskavi.

Vaje so nadgradnja na predavanjih pridobljenega znanja; tudi navodila in smernice za izdelavo vaj študenti dobijo že na predavanjih. Na podlagi povprečnih ocen vaj lahko sklepamo, da so vsi študenti v veliki meri uspešni pri izdelavi le-teh, čeprav so do končnih izdelkov prišli na različne načine. V tem poglavju navajamo razlike v reševanju vaj, o razlogih za te razlike pa bomo razpravljali v 3. poglavju.

Najbolj uspešni pri izdelavi vseh vaj so bili (93 %) študenti informatike. Tako kot študenti ostali smeri so imeli največ problemov (88 % uspešnost) z vajami v programu Word. Ta program informatiki uporabljajo v glavnem za izdelavo kratkih besedil in seminarskih nalog, pri čemer uporabljajo le osnovne ukaze programa. Bolj uspešni so bili študenti informatike z izdelavo vaj v programu Access (92 % uspešnost) in Excel (93 % uspešnost). Pričakovano so imeli najmanj problemov z izdelavo vaje PowerPoint (97 % uspešnost).

Manj uspešni so bili s povprečno 82 % uspešnostjo študenti mehatronike, ki so imeli največ problemov (72 % uspešnost) z vajami v programu Word. Enako uspešni so bili z 80 % uspešnostjo z izdelavo vaj v programih Access in Excel. Najmanj problemov so imeli z izdelavo vaj v programu PowerPoint, ki so jih rešili z 97 % uspešnostjo.

Najmanj uspešni so bili s povprečno 75 % uspešnostjo študenti varovanja, ki so imeli največ problemov z 59 % uspešnostjo z vajami v programu Word. Bolj uspešni so bili s 74 % uspešnostjo pri izdelavi vaj v programu Excel in s 75 % uspešnostjo v programu Access. Najbolj uspešni so bili s 93 % uspešnostjo z izdelavo vaj v programu PowerPoint.

Tabela 1 prikazuje odstotke povprečne uspešnosti reševanja vaj v posameznih programih MS Office in skupno.

Tabela 1. Uspešnost pri izdelavi vaj v odstotkih

	Excel	**Word**	**Acc.**	**PP**	**Pov.**
Informatika	93	88	92	97	93
Mehatronika	80	72	80	97	82
Varovanje	74	59	75	93	75
Povprečje	82	73	82	96	

Najhitreje so študenti vseh treh smeri oddali vaje programa PowerPoint s povprečno zakasnitvijo oddaje 1,33 dneva, nato vaje programa Word s povprečno zakasnitvijo 2,33 dneva, sledijo vaje za program Excel s povprečno zakasnitvijo oddaje 2,67 dneva. Največ težav so imeli študenti vseh treh smeri z vajami za program Access s povprečno zakasnitvijo oddaje 4,33 dneva, saj se tega programa večina študentov ni učila pri pouku informatike v osnovni ali srednji šoli ali pa ga niso podrobno obravnavali.

Tabela 2 prikazuje zakasnitev oddaje za posamezne vaje po smereh študija.

Tabela 2. Zakasnitev oddaje vaj v dnevih

	Excel	Word	Acc.	PP	Pov.
Informatika	1	1	2	1	1,25
Mehatronika	3	2	5	1	2,75
Varovanje	4	4	6	2	4
Povprečje	2,67	2,33	4,33	1,33	

3.2 Razlike pri reševanju posameznih vaj programov MS Office

Razlike so tudi v načinu reševanja posameznih vaj za programe MS Office. Študenti vseh smeri so imeli v povprečju največ težav z izdelavo vaj programa Word s 73 % uspešnostjo izdelave vaje, sledijo vaje programov Excel in Access z 82 % uspešnostjo in povprečno najmanj težav so imeli vsi študenti z vajami v programu PowerPoint s 96 % uspešnostjo (Tabela 2).

Microsoft Word je najbolj prepoznaven in najpogosteje uporabljen urejevalnik besedil, in sicer v domači rabi, predvsem pa pri delu v podjetjih na najrazličnejših delovnih mestih in v izobraževanju. Program Word ponuja mnogo različnih funkcij, možno pa ga je tudi povezovati z drugimi izdelki iz zbirke MS Office ter tudi s strežniškimi aplikacijami posameznih podjetij. Čeprav je program zelo razširjen in so se z njim študenti večinoma seznanili že v osnovni in srednji šoli, se je pri laboratorijskih vajah izkazalo, da naloge za učenje programa Word za večino študentov niso najlažje.

Pri prvem ocenjevanju je povprečje uspešno in pravilno rešenih oddanih vseh vaj programa Word za vse tri smeri študija 73 %. Najbolj uspešni pri izdelavi vaj z 88 % uspešnostjo za program Word so študenti informatike, sledijo z 72 % uspešnostjo študenti mehatronike in z 59 % uspešnostjo študenti varovanja (Tabela 1).

Največ težav pri izdelavi vaje v programu Word so imeli študenti s kazalom slik in tabel (povprečno 45 % neuspešnost). Večina študentov do sedaj ni uporabljala funkcije Sklici > Napisi in so večinoma kazala slik in tabel izdelovali ročno oziroma so seminarske naloge oddajali brez njih, ker tega profesorji v srednji šoli niso zahtevali. Izdelava kazala slik in tabel jim je na vajah povzročala probleme kljub podrobnemu prikazu na predavanjih.

Probleme so imeli tudi z vstavljanjem prelomov strani in zlasti prelomov odseka (povprečno 38 % neuspešnost), s katerimi se je večina študentov prvič seznanila na predavanjih na višji šoli.

Malo manj težav so imeli z izdelavo stvarnega kazala (povprečno 36 % neuspešnost). Večina je pozabila, kljub opozorilom na predavanjih, da morajo najprej dokument ustrezno urediti tako, da označijo naslove (npr. Naslov1, Naslov 2 itd.) in šele potem pričeti z izdelavo kazala.

Pri oblikovanju tabel (povprečno 31 % neuspešnost) so imeli študenti manj težav z osnovnim oblikovanjem, dodatne težave pa so jim povzročale naprednejše funkcije, kot so spajanje ali razdelitev celic ali ponavljanje naslova tabele na naslednjih straneh.

Pri vaji z izdelavo grafa (povprečno 27 % neuspešnost) so imeli problem z dodajanjem naslova grafa, vpisovanjem besedila pri oseh, z označevanjem vrednosti podatkov ter z urejanjem legende.

Študenti znajo uporabljati stile (povprečno 17 % neuspešnost) in fonte (povprečno 13 % neuspešnost), saj so se teh funkcij večinoma naučili že v osnovni ali srednji šoli.

Najmanjšo težavo so imeli z dodajanjem sprotne in končne opombe (povprečno 8 % neuspešnost).

Tabela 3 prikazuje odstotke uspešno rešenih posameznih nalog v programu Word po smereh študija pri prvem ocenjevanju.

Tabela 3. Uspešnost pri oddaji vaj iz programa Word v odstotkih

	Inf.	Meh.	Var.	Pov.
Kazalo slik in tabel	75	45	45	55
Prelomi strani in sektorjev	75	60	51	62
Stvarno kazalo	86	58	47	64
Oblikovanje tabel	90	69	49	69
Izdelava grafa	89	76	53	73
Izdelava stilov	97	88	63	83
Izdelava fontov	98	89	73	87
Sprotne in končne opombe	95	92	88	92

Microsoft Excel velja za najzmogljivejšo programsko opremo za izdelovanje preglednic, ki je najpogosteje uporabljena. Poleg vseh osnovnih funkcij nudi Excel tudi možnost komunikacije s podatkovnimi bazami ter povezovanja z ostalimi programi MS Office. Študenti so se z njim bolj površinsko spoznali že v srednji šoli, na višji šoli pa znanje obnovijo in poglobijo ter se naučijo uporabe tudi manj pogosto rabljenih funkcij programa.

Pri prvem ocenjevanju je povprečje uspešno in pravilno rešenih oddanih vseh vaj programa Excel za vse tri smeri študija 82 %. Najbolj uspešni pri izdelavi vaj s 93 % uspešnostjo za program Excel so študenti informatike, sledijo z 80 % uspešnostjo študenti mehatronike in z 74 % uspešnostjo študenti varovanja (Tabela 1).

Največje probleme s 37 % neuspešnostjo pri izdelavi vaje v programu Excel je predstavljala določitev minimuma, maximuma in povprečja v D-funkciji. Osnovno funkcijo večina študentov obvlada, problem pa predstavlja D-funkciji, ki je nadgradnja osnovne funkcije.

Problem so imeli tudi s preverjanjem veljavnosti podatkov, kjer so uporabili napačen seznam ali niso upoštevali navodil v vaji (31 % študentov).

Naslednji večji problem s 25 % neuspešnostjo so imeli študenti pri lepljenju Excelove tabele v Wordov dokument s povezavo. Nekateri študenti niso upoštevali navodila, da je potrebno dokument prilepiti s povezavo, in so kljub dodatnim pojasnilom tabelo preprosto kopirali v dokument.

Zaradi nepoznavanja različnih formul 23 % študentov ni uspešno rešilo vaje za uporabo naprednejših funkcij. Študenti tudi pogosto pozabijo vnesti enačaj na začetek formule. Boljši študenti namesto s formulami, ki jih ne poznajo, vajo rešijo s programom SQL.

Povezovanje med delovnimi listi v programu Excel je predstavljalo problem za 16 % študentov. Nekateri pri izračunu oziroma vnašanju formul niso povezali podatkov z različnih delovnih listov in so končni rezultat prikazali le s podatki enega delovnega lista.

Povprečno 13 % študentov je imelo problem z izračunom datumov zaradi neupoštevanja možnosti različnih oblik izpisa datumov (ameriški in evropski). Na predavanjih smo študente opozorili na obstoj različnih oblik oziroma možnosti izpisov datumov, kar je večina študentov upoštevala.

Pri obliki obrazca so bili študenti povprečno 13 % neuspešni pri prvem ocenjevanju in so morali obrazec popraviti. Nekateri študenti so uporabili že v naprej pripravljeno predlogo programa Excel, zato obrazec ni bil v skladu z zahtevo v navodilu naloge.

Z izdelavo in oblikovanjem grafov je imelo problem 12 % študentov, čeprav se je izdelave grafov sicer večina učila že v srednji šoli, podrobno pa smo ga obravnavali tudi na predavanjih.

Najmanj problemov je z 9 % neuspešnostjo predstavljala zaščita strukture dokumenta in lista, kjer posamezniki niso upoštevali navodila v vajah in z 1 % neuspešnostjo uporaba osnovnih matematičnih funkcij, ki jih znajo uporabljati skoraj vsi študenti.

Tabela 4 prikazuje odstotke uspešno rešenih posameznih nalog v programu Excel po smereh študija pri prvem ocenjevanju.

Tabela 4. Uspešnost pri oddaji vaj iz programa Excel v odstotkih

	Inf.	Meh.	Var.	Pov.
Določitev min, max	88	54	49	63
Preverjanje veljavnosti	91	58	59	69
Povezava tabele	88	68	69	75
Formule	98	77	57	77
Povezovanje med listi	90	85	78	84
Izračun datumov	94	89	78	87
Izgled in oblika obrazca	92	89	80	87
Izgled in oblika grafa	94	87	84	88
Zaščita lista	97	89	88	91
Uporaba osnovnih matematičnih funkcij	100	100	98	99

Microsoft Access je program, s pomočjo katerega ustvarjamo podatkovne baze in jih urejamo ali pa uvažamo in ažuriramo podatke iz drugih baz. Program komunicira z drugimi podatkovnimi viri z uporabo protokola ODBC (angl. Open Database Connectivity). Njegove funkcije omogočajo tudi uporabo poizvedb, vnosnih obrazcev in poročil. Access lahko uporabljajo tako začetniki kot tudi najbolj napredni uporabniki. Približno polovica študentov je program lahko spoznala v srednji šoli, če so obiskovali štiriletni program tehnik računalništva.

Pri prvem ocenjevanju je povprečje uspešno in pravilno rešenih oddanih vseh vaj programa Access za vse tri smeri študija 82 %. Najbolj uspešni so študenti informatike z 92 % uspešnostjo, sledijo študenti mehatronike z 80 % uspešnostjo in študenti varovanja s 75 % uspešnostjo (Tabela 1).

Največ težav pri izdelavi vaje v programu Access so imeli z vajami za poizvedbo, in sicer jih 37 % ni uspelo izdelati vaje s poizvedbo za prikaz vseh strank, 32 % ni uspelo izdelati osnovne poizvedbe, 31 % je bilo neuspešnih pri poizvedbi za prikaz strank s poštno številko in 25 % pri poizvedbi za prikaz seznama angleških filmov s slovenskimi podnapisi in parametrično poizvedbo. Študenti so imeli pri poizvedbah problem z razumevanjem zahtev in niso vedeli, kako naredijo poizvedbo.

Vaje za izdelavo obrazca ni uspešno rešilo 16 % študentov. Nekateri so kljub pomoči čarovnika izbrali napačno zaporedje izdelave obrazca ali pa niso upoštevali navodil in so uporabili napačne podatke za izdelavo obrazca.

Pri vzpostavitvi referenčne integritete je bilo neuspešnih 13 % študentov. Posamezniki pri izdelavi relacije niso zaprli vseh tabel, čeprav je bilo pred tem poudarjeno na predavanjih, ali pa so poskušali ustvariti napačno relacijo med tabelama.

Enako neuspešnih (13 %) je bilo študentov pri vaji za ustvarjanje kombiniranih polj, ki jih je bilo potrebno povezati iz dveh tabel. Največkrat je šlo za nerazumevanje ukaza ali nezmožnost iskanja pravega ukaza. Pri tem ukazu je seznam skrit, dokler ne kliknemo spustne puščice, česar nekateri niso upoštevali.

Problem je predstavljalo tudi dodajanje gumba za odpiranje obrazcev, ker so nekateri študenti uporabili napačne ukaze kontrolnikov in niso naredili povezave na obrazec. Vaje ni uspešno rešilo 12 % študentov.

Manj problemov z 10 % neuspešnostjo so imeli s poizvedbo za prikaz stranke brez elektronskega naslova, ker so vse stranke v vaji imele e-naslov.

Tudi dodajanje primarnega ključa ni predstavljalo večjega problema (8 % neuspešnost), saj smo postopek dodatno poudarili na predavanjih, lažje pa je tudi zaradi poznavanja dejstva, da ga program Access lahko samodejno doda.

Zelo malo problemov s 5 % neuspešnostjo je bilo tudi z izdelavo poročila, ki prikazuje izposojo po strankah, kjer je večina uporabila ustrezen filter.

Študenti so imeli le 1 % neuspešnost pri izdelavi osnovnega poročila. Izdelava poročila zaradi splošnega poznavanja preostalih orodij ne predstavlja problema.

Tabela 5 prikazuje odstotke uspešno rešenih posameznih nalog v programu Access po smereh študija pri prvem ocenjevanju.

Tabela 5. Uspešnost pri oddaji vaj iz programa Access v odstotkih

	Inf.	Meh.	Var.	Pov.
Poizvedbe za prikaz vseh strank	88	54	49	63
Poizvedba (splošča)	90	65	49	68
Poizvedba za prikaz strank s poštno številko	91	58	59	69
Parametrična poizvedba	88	68	69	75
Poizvedba za prikaz seznama filmov	90	77	57	75
Izdelava obrazca	90	85	78	84
Vzpostavitev referenčne integritete	92	89	78	87
Ustvarjanje kombiniranih polj	91	89	80	87
Dodajanje gumba	93	87	84	88

Poizvedba za prikaz strank	92	89	88	90
Določanje primarnega ključa	97	89	90	92
Izdelava poročila	97	94	94	95
Poročilo	99	99	98	99

Microsoft PowerPoint je najpogosteje uporabljen program za izdelavo predstavitev, ki ima veliko naprednih možnosti in pregleden grafični vmesnik in je lahek za uporabo. Uporabljajo ga poslovneži, študenti, profesorji in vsi, ki pri svojem delu potrebujejo elektronske predstavitve projektov.

Praktično vsi študenti so bili odlični pri izdelavi vaj v programu PowerPoint. Vse smeri skupaj so imele povprečno 96 % uspešnost, in sicer študenti informatike in mehatronike 97 % uspešnost ter študenti varovanja povprečno 93 % uspešnost (Tabela 1).

Največ težav pri izdelavi vaj v programu PowerPoint so imeli z izdelavo lastne predloge načrta za predstavitev (povprečno 11 % neuspešnost), ker se je večina študentov s predlogo načrta seznanila na predavanjih.

Naslednji problem je predstavljal vnos oznake strani od števila vseh strani v matrico (povprečno 9 % neuspešnost).

Nekaj študentov je imelo težave pri vnosu slik (povprečno 5 % neuspešnost). Na predavanjih smo študentom predlagali, da sliko najprej shranijo, najbolje na namizje, šele potem jo uvozijo v program. Vendar so nekateri študenti slike kopirali neposredno s spletne strani, kar je povzročilo, da se slika ni prikazala na diapozitivu.

Manj problemov (povprečno 3 % neuspešnost) je povzročalo vstavljanje tabel, kjer je bilo potrebno samo izbrati ustrezen ukaz in določiti velikost tabele.

Pri animaciji objektov (povprečno 3 % neuspešnost) so nekateri študenti pozabili označiti predmet, ki so ga želeli animirati, zato se animacija ni izvedla.

Za dodajanje hiperpovezave diapozitivu (povprečno 3 % uspešnost) je bilo potrebno izbrati ustrezen ukaz in nato v pogovornem oknu izbrati mesto, do katerega želimo ustvariti povezavo. Nekateri študenti so to verjetno pozabili narediti.

Študenti niso imeli večjih problemov z dodajanjem videoposnetkov ali zvočnih posnetkov iz datoteke ali s spletnega mesta (povprečno 3 % neuspešnost), saj veliko podobnih programov za zvok in video uporabljajo na mobilnih telefonih. Nekateri pa so imeli težavo z iskanjem posnetka na ustreznem mestu v računalniku ali spletu.

Študenti niso imeli velikih težav s prehodi med diapozitivi, kjer so morali izbrati ustrezen ukaz »Uporabi za vse« (povprečno 2 % neuspešnost), ki pa so ga nekateri prezrli.

Pri tiskanju izročka na šestih straneh v pdf obliko (povprečno 2 % neuspešnost), kjer je bilo potrebno izbrati ustrezen ukaz za postavitev tiskanja, so redki izbrali napačen ukaz ali pa niso izbrali ukaza za pretvorbo v pdf obliko.

Praktično vsi študenti so najprej pričeli izdelovati vajo z izbiro teme, kar jim je bilo predlagano na predavanjih in je splošna praksa od verzije programa iz leta 2003 dalje. Le 1 % študentov se je odločil za izbiro teme nazadnje, kar je povzročilo oblikovno zmedo v diapozitivih.

Tabela 6 prikazuje odstotke uspešno rešenih posameznih nalog v programu PowerPoint po smereh študija pri prvem ocenjevanju.

Tabela 6. Uspešnost pri oddaji vaj iz programa PowerPoint v odstotkih

	Inf.	**Meh.**	**Var.**	**Pov.**
Lastna podlaga načrta	94	94	80	89
Vnos strain	90	94	88	91
Vstavljanje slik	98	95	92	95
Vstavljanje table	97	96	96	97
Animacija objektov	99	99	92	97
Dodajanje videa in zvoka	98	99	94	97
Dodajanje hiperpovezave	97	99	96	97
Prehodi med diapozitivi	100	99	94	98
Tiskanje izročka	97	99	98	98
Izbira teme	100	100	98	99

4. RAZLIČNI PRISTOPI ŠTUDENTOV PRI REŠEVANJU NALOG IN PROBLEMOV

Študenti informatike na laboratorijskih vajah delajo zelo samostojno, uporabljajo svoje predznanje in izkušnje, v pomoč pa jim je tudi poseben način razmišljanja in razumevanja ustroja in delovanja računalniških programov. V primerjavi z ostalima skupinama bolje razumejo programe, njihove ukaze in hitreje sprejemajo odločitve o izbiri pravega ukaza. V primeru nezmožnosti reševanja posameznih nalog ali delov nalog znajo poiskati informacije, najdejo jih na portalu Youtube ali na drugih spletnih straneh. Kadar rešitve kljub vsemu ne morejo najti, pa si pomagajo s programiranjem. Večinoma jim uspe rešeno vajo oddati v spletno učilnico že ob koncu laboratorijskih vaj (97 %) ali največ z enodnevno zakasnitvijo. (Podatek je skupen za vse programe, pri vaji Access pa se pojavi tudi dvodnevna zakasnitev). Študenti informatike so že med predavanji pokazali zanimanje in interes za programe MS Office, se zavedali njegove uporabnosti v praksi in oddali na laboratorijskih vajah od vseh treh smeri najbolj kvalitetne izdelke.

V primerjavi z informatiki posamezni študenti mehatronike manj poznajo programe, nekateri so imeli v srednji šoli manj ur predavanj in vaj iz informatike, zato ne razpolagajo z enakovrednim predznanjem, znajo pa poiskati informacije na svetovnem spletu. Nekoliko manj razumejo delovanje posameznih programov, imajo pa določena tehnična znanja, ki jim pomagajo pri hitrejšem reševanju vaj. Pri laboratorijskih vajah več sprašujejo predavatelja ali pa sodelujejo oziroma se posvetujejo z ostalimi študenti. Rešene vaje 85 % študentov mehatronike uspe oddati v spletno učilnico ob koncu laboratorijskih vaj, ostali pa zaradi različnih razlogov vajo dokončajo doma (z eno- do šestdnevnim zamikom).

Največ težav z izdelavo in oddajo vaj imajo študenti smeri varovanja, ki so zaključili različne smeri srednješolske izobraževalnega sistema in le nekateri so med šolanjem pridobili ustrezna računalniška znanja. Povprečno so imeli večinoma tudi slabši učni uspeh v srednji šoli. Vaje večinoma rešujejo počasneje, veliko sprašujejo in delajo v skupinah. Po navadi študent, ki najde rešitev naloge, pomaga ostalim, da lažje rešijo. Tisti, ki tudi po dodatni razlagi ne rešijo naloge, vajo dokončajo doma tako, da poiščejo pomoč pri domačih, prijateljih ali celo inštruktorjih. Nekateri si žal pomagajo tudi na ta način, da jim sošolci pošljejo rešitev vaj. Rešene vaje uspe oddati ob koncu laboratorijskih vaj 55 %, ostali pa oddajo vaje z zamikom za dva do šest dni..

5. ZAKLJUČEK

V članku predstavljena raziskava je bila priložnost za temeljit razmislek o pomenu znanja vsebin informatike in računalništva, ki jih predavam, o načinu mojega pedagoškega dela ter o načinu razmišljanja in reševanja nalog v treh med seboj dokaj različnih skupinah študentov.

V času nepregledne množice informacij, znanj in podatkov je znanje uporabe programov MS Office izrednega pomena in prav tako nujno kot znanje branja in pisanja za vsakega aktivnega posameznika. Urejanje besedil, izdelovanje tabel, vodenje evidenc, urejanje podatkovnih baz in priprava predstavitev je del našega vsakdana tako na delovnih mestih kot v zasebnem življenju. Izjemno pomembno je zlati za mlade, ki po končanem šolanju iščejo prvo zaposlitev, saj je prav znanje uporabe MS Office ena od nujnih zahtev zaposlovalcev za veliko večino delovnih mest.

Kot predavatelj predmeta Računalništvo in informatika v smereh informatika, mehatronika in varovanje opažam, da študenti teh smeri prihajajo na višjo šolo z različnim predznanjem, različnimi načini učenja, razumevanja in razmišljanja. Raziskava mi je dala temeljit vpogled v te razlike med študenti posameznih smeri; zavedanje teh razlik in njihovo poznavanje mi omogočata, da vsaki skupini študentov na predavanjih, še zlasti pa pri laboratorijskih vajah, omogočim usvajanje znanja na način, ki je njim najbližji.

Vaje strukturirano vsebujejo tudi določene strokovne probleme, ki jih je potrebno rešiti za dokončanje naloge. Gre torej za problemsko učenje, ki tudi po mnenju nekaterih teoretikov spodbuja povezovanje teorije s prakso ter kritično mišljenje [3]. Kritično mišljenje je spretnost, ki se je učimo z razvojem logičnega in doslednega razmišljanja [2] in velja v nekaterih teorijah za enega najpomembnejših konceptov v izobraževanju [1]. Strinjamo se z mnenjem avtorjev Loyens, Kirschner, Paas [4], da je pri reševanju problemov v okviru učnih situacij učinkovitost učenja večja. Ti avtorji navajajo tudi, da študenti kakovost učnih programov, ki vključujejo problemsko učenje, praviloma ocenjujejo višje v primerjavi s študenti, ki so študirali na tradicionalen način [4].

Glede na vse navedeno ugotavljam, da študentom omogočam usvajanje znanja in pridobivanje veščin na strokoven, kvaliteten in hkrati njim najbližji način. V zadovoljstvo pri delu mi je predvsem dejstvo, da bo znanje, ki ga študenti vseh treh smeri usvojijo pri predmetu Računalništvo in informatika, trajno, kvalitetno in nadvse uporabno v praksi, prispevalo pa bo tudi k boljši zaposljivosti študentov.

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Učenje robotskega in računalniškega mišljenja pri interesni dejavnosti robotika

Learning robotic and computational thinking at after-school activity Robotics

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POVZETEK

Robotika je v sodobnem svetu vsesplošno že prisotna tako doma s preprostimi roboti kot tudi v industriji. Zato se je potrebno zavedati, da je potrebno otroke v vrtcih in osnovnih šolah začeti pripravljati na dobo, v kateri nas bodo roboti spremljali v vsakdanjem življenju. V prispevku se bom tako posvetil poti, kako otroke ozavestiti o pomenu računalniškega oziroma robotskega mišljenja in na kak način jih pripeljati do znanj, ki jim bodo v bodoče, gledano iz današnje perspektive, prišla prav tako pri delu kot tudi v življenju doma.

Ključne besede

Robotika, računalniško mišljenje, interesna dejavnost, programiranje robota

ABSTRACT

Robotics is already widespread in the modern world at home with simple robots as well as in the industry. Therefore, we need to be aware that children in kindergartens and primary schools need to start preparing for an era in which robots will accompany us in our daily lives. In this article, I will focus on how to make children aware of the importance of computational or robotic thinking and how to bring them to the knowledge that they will gain in the future, from today's perspective, both at work and at home.

Keywords

Robotics, computational thinking, after-school activity, programming a robot

1. UVOD

Znanje o uporabi sodobne tehnologije bo ključno v nadaljnjem razvoju in delu človeka, tako s stališča gospodarstva kot s stališča upravljanja z energijo, naravnimi viri in tudi človekovega dela in prostega časa. Prav zaradi tega je potrebno otroke že od malih nog začeti učiti uporabljati in upravljati s sodobno tehnologijo. Poseben pomen bo v prihodnosti potrebno dati znanju upravljanja robotov, saj le-ti postajajo hote ali nehote del našega vsakdanjika. Samo vprašanje časa je še, kdaj bodo roboti (humanoidni roboti) postali hišni pomočniki v naših domovih, roboti v industriji pa so že zelo dolgo stvarnost. Tam sedaj prevzemajo raznorazna enostavna dela, čedalje bolj pa se uveljavljajo tudi roboti, ki opravljajo tudi zahtevnejša dela, včasih tudi miselna. Na pohodu je umetna inteligenca, ki bo vse skupaj še bolj spremenila.

Ker se tega zavedam, želim otrokom v šoli čim bolje prikazati način računalniškega in robotskega mišljenja, saj bo po mojem prepričanju v prihodnje robotom še vedno potrebno dajati navodila za delovanje, ki bodo njim razumljiva. Navodila namreč ne morejo biti abstraktna, ampak konkretna, kar je potrebno pri učencih tudi uriti.

S problemom razumevanja računalniškega/robotskega mišljenja pri otrocih se srečujem tako pri pouku izbirnega predmeta računalništva kot tudi pri interesni dejavnosti robotike, ki jo izvajam v šoli. Pri nas je na žalost računalništvo še vedno izbirni predmet, čeprav bi, glede na razvoj in okolje, v katerem živimo, moral biti obvezen za vse osnovnošolske otroke. Niso namreč vsi enako podkovani v uporabi in upravljanju s sodobno tehnologijo. Večina otrok v vrtcu zna drsati po tablici ali telefonu, ne znajo pa kaj konkretnega narediti z napravami oz. uporabljati npr. računalnika, prenosnega računalnika ipd.

2. RAČUNALNIŠKO/ROBOTSKO MIŠLJENJE

Pri interesni dejavnosti robotike, kjer večino časa uporabljamo robote Lego Mind Storm [4], sem se zadeve lotil sistematično od osnov z igro na prostem, igranjem iger na računalniku in kasneje do programiranja robota v programu. V interesno dejavnost so vključeni učenci od 4. do 9. razreda, tako da je potrebna velika mera iznajdljivosti, da uskladimo interese, hitrost razmišljanja in predznanje v neko celoto. Prav zaradi tako raznolikih učencev smo začeli tudi s sestavljanjem Arduino robota, s katerim so se začeli ukvarjati starejši otroci.

2.1 Uvod v interesno dejavnost

Učenci se najprej seznanijo, kaj sploh pri interesni dejavnosti hočemo doseči, kakšen je končni cilj in na kak način bomo ta cilj dosegli. Ker je večina otrok takih, ki mislijo, da veliko vedo in da se bodo pretežni del ur interesne dejavnosti igrali z igrami po njihovi izbiri je potrebno na začetku kar veliko truda in energije, da se jih pravilno usmeri. Otroke se seznani z osnovnimi pojmi, da vedo, o čem govorimo, in se jim pokaže osnovno delo z računalnikom. To je predvsem pomembno, ker nekateri ne znajo delati z računalnikom, poznajo delo s tablicami in telefoni, kaj več pa že ne. Ker računalništvo ni obvezni predmet v osnovni šoli in ker se vsebine vnašajo v ostale predmete, je tudi njihovo znanje o pojmih večkrat pomanjkljivo, saj jim vsak učitelj pove neko svojo razlago, ki pa ni povsem usklajena s stroko.

2.2 Igra z avtomobilčki

Po uvodnem delu, ko so otroci spoznajo osnovne pojme, smo se lotili konkretnega dela oz. igre, pri kateri so otroci videli in spoznali, kako je potrebno na programiranje robota gledati. Otrokom je namreč samoumevno, da imajo čut za sluh, vid otip itd., kar pa pri robotu ni. Pokazalo se je, da ne razmislijo, da je potrebno robotu vse, kar mi že vidimo, slišimo, občutimo…, povedati vnaprej, napisati določene ukaze, kaj naredi v primeru, da se pred njim pojavi ovira itd. Pri tem delu interesne dejavnosti smo si pomagali z avtomobilčki na daljinsko upravljanje. Otroci so prinesli s sabo avtomobilčke, ki so jih vozili po učilnici ali zunaj na igrišču, če je vreme to dopuščalo. Temu smo namenili en del ure interesne dejavnosti. Otroci so preizkusili avtomobilčke od sošolcev, kako se obnašajo na stezi itd. Potem smo začeli načrtovati oz. risati pot, po kateri bodo avtomobilčki vozili.

Ko je bila pot izdelana in ovire postavljene, so otroci začeli voziti avtomobilčke po označeni poti med ovirami. Videli so, da je po določeni poti in z ovirami že težje voziti. Po določenem času smo prešli na ključen del te igre oziroma učenja. Nekateri otroci so se postavili ob progo in bili žive ovire na poti. Vozil je samo eden od otrok, ki je imel zavezane oči. Drugi je bil vodnik, ki mu je dajal navodila. Temu delu igre smo posvetili največ pozornosti, saj sem želel, da otroci vidijo, kako so pomembna pravilna in točna navodila, da ne pride do težav ali celo do nesreče.

Upravljalec avtomobilčka se je lahko zanašal samo na navodila, ki mu jih je dajal vodnik. Zanašal se je lahko na sluh, saj so otroci, ki so bili postavljeni ob progi kot ovira, dajali zvočne signale ob določenem dogodku. Skratka, igra je zelo primerna za uvod v robotiko, saj otroci pridejo do spoznanja, kako pomembna so pravilna in natančna navodila, ki jih bodo kasneje pisali kot program robotu.

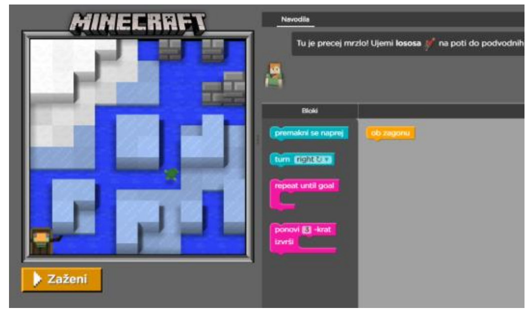
2.3 Igra Minecraft

Po končanem uvodnem delu in igranju igre z avtomobilčki, ko so otroci že vedeli, kako so navodila pomembna, smo prešli na delo z računalniki. Igrali so spletno igro [3] Minecraft, ki je na voljo na spletni strani code.org in pri kateri mora igralec sestaviti program, da pripelje figuro od začetka do konca igre.

Slika 1: Minecraft na code.org [3]

Odigrali so nekaj vaj, po tem pa smo se zopet odpravili na igrišče, kjer so se otroci v dvojicah vodili po začrtani poti. Najprej smo narisali progo in postavili ovire. Eden od dvojice je napisal program vodenja po progi, drugi je moral po njegovem programu preiti progo od začetka do konca z zavezanimi očmi. To je bila še ena podobna izkušnja kot upravljanje avtomobilčkov, le da so tukaj morali dejansko paziti na velikost in število korakov, obrate, ovire itd.

Po tej izkušnji so otroci veliko lažje sestavljali programe v tej spletni igri. Po mojem mnenju je tudi ta igra zelo dobra za otrokovo razvijanje računalniškega oz. robotskega mišljenja, saj se na enostaven način z igro učijo in osvajajo te veščine.



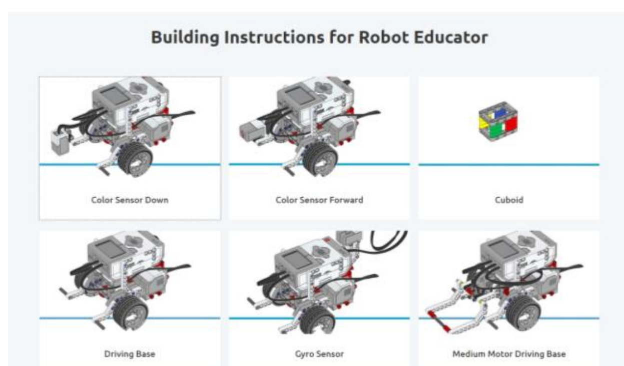
Slika 2: Sestavljanje programa v Minecraft [3]

Otroci so odigrali vse stopnje osnovne igre, kasneje pa poskusili še z drugimi igrami, ki so višje težavnostne stopnje.

2.4 Priprava robota

Za potrebe robotike smo v šoli nabavili robota [4] Lego Mindstorms EV3, ki je podkrepljen tudi z istoimensko programsko opremo za programiranje robota. Tega robota smo izbrali ker obstaja pri nas in tudi v tujini kar nekaj tekmovanj s temi roboti in ker lahko otroci sestavijo robota po lastni želji. Interesno dejavnost obiskuje namreč kar nekaj ambicioznih otrok, ki se radi udeležujejo tekmovanj in ki bi tudi radi od tega imeli kaj več.

Najprej so se otroci morali odločiti, kaj bi radi z robotom počeli oz. kaj bi radi, da bi robot počel, ko ga bodo sprogramirali. Na tej podlagi so začeli z iskanjem primerne oblike in načrta za robota, ki ga bomo lahko uporabili za svoje želje. Pri tem je potrebna velika mera podpore učitelja in spremljanje izbire, saj se nemalokdaj izkaže, da si oči želijo nekaj drugega kot pa so prvotno izbrali.



Slika 3: Načrti za izgradnjo [4]

Na podlagi načrta, ki ga najdejo na spletu za svojega robota, začnejo s sestavljanjem kock in ostalih delov v enoto. Ker so deli majhni in je veliko dela, je potrebno kar nekaj časa, da se pokaže robot v svoji celoti.

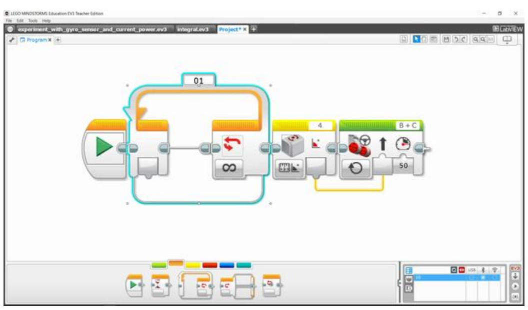
Ko je robot sestavljen, se otroci seznanijo z njegovim delovanjem oz. z njegovim najpomembnejšim delom, kocko EV3, ki je nekak računalnik oz. možgani robota. Pogleda se, kje so priklopljeni kakšni kabli, na katerem vhodu je priklopljen kakšen motor, kako se priklopi oz. poveže kocka z računalnikom in kako se s kocko rokuje (zažene, požene pravilen program, izklopi).

Slika 4: Sestavljen robot

2.5 Programiranje robota

Ko so učenci robota sestavili in se seznanili z osnovnimi funkcijami kocke EV3, so začeli spoznavati programsko orodje Mindstorms za programiranje kocke. Pogledali so, kje na računalniku se orodje nahaja in kako priti do njega. Kako se ga zažene, kje so osnovne funkcije za začetek. Pregledali so funkcije in ukaze, ki jih orodje ponuja. Pogledali smo si nekaj predstavitvenih filmov, ki obstajajo na medmrežju o možnostih programiranja s tem orodjem in kaj je pomembno upoštevati pri sestavi programa za robota.

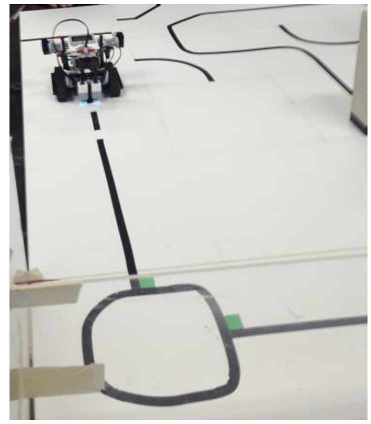
Nato so začeli otroci sami sestavljati preproste programe, da se je robot premikal na primer naprej in nazaj, da se je po določenem času izvajanja programa zaustavil in podobno.



Slika 5: Preprost program

Otroci so preizkušali različne variante, ki jih program dopušča. Ko so znali iz nič sestaviti preprost program, na primer vožnja ravno in obrat v desno ali levo, smo začeli dodajati senzorje na robota in jih tudi vključevati v naše programe. Cilj je bil, da otroci sami sestavijo program, ki bo njihovega robota pripeljal po določeni progi od začetka do konca, kar so na koncu tudi zmogli.

Naslednja stopnja učenja programiranja robota pa je bila sledenje črti. Tukaj so morali uporabiti senzorje za svetlobo, lahko tudi barvo. Naredili smo poligon s progo (črno črto), po kateri je moral robot prepeljati v najkrajšem času. Tak način se uporablja tudi na tekmovanjih. Tudi zaradi tega smo se lotili učenja na ta način.



Slika 6: Sledenje črti

Proti koncu šolskega leta, ko so vsa ta znanja v osnovi usvojili, smo pripravili mini tekmovanje ekip v šoli. Najboljši so se udeležili tudi regijskega tekmovanja, kjer so pokazali svoje sposobnosti.

3. ZAKLJUČEK

Skozi celoten proces učenja pri interesni dejavnosti so otroci usvajali in krepili tudi druge svoje veščine in znanja, ki jih bodo lahko uporabljali v svojem nadaljnjem šolanju in delu. Učenje računalniškega oziroma robotskega mišljenja ni samo učenje določene snovi, ampak je proces razvijanja sposobnosti pogleda stvari iz druge perspektive, je proces drugačnega dojemanja pojmov.

4. VIRI IN LITERATURA

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Didaktične metode pri poučevanju programiranja

Didactical methods for teaching programming

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POVZETEK

V tem prispevku obravnavamo nekaj didaktičnih metod s konkretnimi primeri iz poučevanja programiranja. Pri tem smo izbrali didaktične metode, ki so po našem mnenju za poučevanje programiranja najbolj primerne. S tem postavimo smernice za načrtovanje učnih ur pri programiranju. Pri tem še posebej izpostavimo individualno delo, s katerim si študentje skonstruirajo znanje.

Ključne besede

Didaktične metode, osnove programiranja, poučevanje

ABSTRACT

In this paper, we discuss didactic methods with concrete examples from teaching basic programming skills. We have chosen didactic methods that we think are best suited for teaching programming. Thus guidelines for lesson planning have been set. Individual work which allows students to construct their own knowledge has been emphasized.

Keywords

Didactic methods, basic programming, teaching

1. UVOD

Računalniki so stroji, ki nam pomagajo razumeti svet in reševati probleme. Učenje programiranja pomeni tako učenje načina razmišljanja kot učenje sintakse programskega jezika. Čeprav je prejšnje bolj pomembno kot slednje, je oboje pomemben del znanja programiranja.

Kot velja za vsako organizirano učenje, je tudi k učenju programiranja potrebno pristopiti didaktično smiselno in strokovno. Didaktične metode, ki so se nam izkustveno izkazale za najbolj pomembne in učinkovite, so: razgovor, razlaga, laboratorijsko-eksperimentalne metode, diskusija in povzemanje.

2. DIDAKTIČNE METODE

2.1 Razgovor

Pri prvem srečanju z vsakim študentom naredimo kratek razgovor, s pomočjo katerega ugotovimo njegovo predznanje. Tako ugotovimo, kakšen je najmanjši skupni imenovalec predznanja in temu prilagodimo razlago osnovi. Označimo si študente, ki imajo nadpovprečno znanje in študente, ki predznanja nimajo. Študentom z več predznanja tako ponudimo dodatne izzive, hkrati pa se individualno več posvečamo študentom brez predznanja in s tem poskrbimo, da usvojijo osnove. Izkazalo se je tudi, da študentje z več predznanja radi priskočijo na pomoč kolegom, ki jo potrebujejo in jim je to še dodatna vzpodbuda, da bodo tudi oni lahko zmogli usvojiti zahtevane vsebine.

Kasneje pri študentih večkrat vrednotimo pridobljeno znanje in rezultate dela pri predmetu. S tem se izognemo zanašanju na morebitno napačno ocenitev predznanja na začetku. S povratnimi informacijami ustrezno prilagodimo razlago oziroma se individualno posvetujemo s študenti, ki izstopajo od povprečja.

2.2 Razlaga

Smiselno je, da pri obravnavanju nove snovi s področja programiranja začnemo z razlago. Uvodoma gre za pripovedovanje, pri čemer študentom predstavimo probleme, ki jih bomo reševali s pomočjo na novo pridobljenega znanja. Pri tem poskušamo na čimbolj zanimiv način predstaviti uporabnost in konkretno aplikacijo znanja, ki ga bodo usvojili. Nato se osredotočimo na razlago novih pojmov in načinov programiranja.

Sledi obrazložitev, pri kateri hkrati uporabimo metodo prikazovanja. Pri tem razložimo nova orodja, procese in pojme ter jih obenem predstavimo s projeciranjem na platno. Študentom pokažemo nekaj primerov, ki jih rešimo skupaj. Na platno projeciramo predvsem dejansko pisanje kode, s katero rešujemo kratke naloge, na podoben način kot učitelj pri matematiki na tabli rešuje enačbe. Vmes povemo, s kakšnim načinom razmišljanja smo prišli do rešitve. Gre za enostavnejše primere, ki podprejo razumevanje razloženih pojmov. S tem poskušamo študente navaditi na pravilen pristop k programerskim problemom. Študentje delajo zapiske s prepisovanjem kode, ki jo vmes poganjajo na svojih računalnikih in s tem preverjajo njen rezultat. Spodbujamo jih, da začetne spremenljivke nastavijo poljubno in preverijo, če program še deluje in vrne pravilen rezultat. S tem študentje pridobijo ustrezno znanje za samostojno reševanje problemov.

Na Slika 1: Primer kode, ki je projecirana. je primer kode, ki je projecirana. Koda v tekstovnem načinu izriše kvadrat s pomočjo zvezdic (znak “*”), diagonalno pa z znakom “#”. Študente nato spodbudimo, da s spreminjanjem pogojev v zankah ($i < 10$, $j < 10$) spremenijo velikost kvadrata oziroma pravokotnika. Poleg tega lahko omenjena znaka zamenjajo s poljubnima drugima znaka in spremenijo pogoj v vejitvi ($i == j$). Študentje po poljubni spremembi poženejo program in, če se program prevede, dobijo drugačen kvadrat. Če se program zaradi sintaktičnih napak ne požene ali pa pride do nepričakovanega rezultata, študentom pomagamo razumeti in popraviti napako.

Slika 1: Primer kode, ki je projecirana.

```
// zunanja zanka: spremenljivka i gre od 0 do 9 (ker je 9
strogo manjše od 10)
for(int i = 0; i < 10; i++)
{
    // notranja zanka: spremenljivka j gre od 0 do 9
    for (int j = 0; j < 10; j++)
    {
        if (i == j)
        {
            Console.Write("#");
        }
        else
        {
            Console.Write("*");
        }
    }
    Console.WriteLine();    // gremo v novo vrstico
}
```

2.3 Laboratorijsko–eksperimentalne metode

Ideja konstruktivistične teorije učenja je, da študentje sami razvijejo (skonstruirajo) svoje znanje [1]. Pri stilu učenja, ki sledi temu pogledu, ima posamezen študent več odgovornosti, da se nauči, kot pri klasičnem pristopu. To pa ne pomeni, da je vloga učitelja lažja, saj mora le-ta študente voditi v pravo smer in jih motivirati. Klasičen pristop s pasivnim učenjem ponuja malo možnosti za sodelovanje študentov s pomočjo eksperimentalnih metod in diskusije [2].

Učenje programiranja ni zgolj pomnenje dejstev in njihova interpretacija. Pri programiranju ima kompleksen problem več rešitev, ki so si lahko med sabo zelo različne. Da pridemo do rešitve, potrebujemo pravi način razmišljanja. Do tega najbolj učinkovito pridemo s samostojnim reševanjem problemov. Študentje pri vajah samostojno rešujejo probleme in s tem usvajajo način razmišljanja ter utrjujejo znanje, ki so ga pridobili ob razlagi. Vloga učitelja pri tem je, da jim pomaga, ko se jim zatakne in razloži nejasnosti, ki se tičejo razumevanja problemov in novih pojmov.

Zelo preprost primer naloge je izpis seštevka vseh števil, ki so shranjena v določeni spremenljivki. Pri tem študentom pripravimo primer deklaracije in inicializacije spremenljivke, kot je naprimer spremenljivka tabela na Slika 2: Primer kode, ki sešteje števila v tabeli. (int [] tabela = { 1,2,3 }) in jim povemo, da želimo, da program izpiše seštevek teh števil. Na Slika 2: Primer kode, ki sešteje števila v tabeli. je primer ustrezne rešitve naloge. Program najprej nastavi spremenljivko seštevek na 0, nato pa ji po vrsti prišteje vsa števila, ki so shranjena v spremenljivki tabela. Seštevanje opravimo znotraj zanke for, ki gre po vrsti po vseh indeksih, ki naslavljajo vrednosti v tabeli. Študentje morajo pri tem znati pravilno sintakso. Če pozabijo zaklepaj ali podpičje, se program ne bo prevedel in pognal, temveč bo računalnik javil napako. Gre za sintaktične napake. Študentje morda razmišljajo pravilno, vendar še niso usvojili sintakse. Druga vrsta napak so semantične napake, torej gre za napačno napisan postopek oziroma algoritem, ki se sicer uspešno požene, vendar javi napačen rezultat. Pri tem gre lahko za nerazumevanje navodil, manjšo napako ali pa študent še ni usvojil osnovnega programerskega načina razmišljanja. Bolj zanimivi primeri so, ko program izpiše pravi rezultat, vendar ima rešitev pomanjkljivosti. Trije taki primeri so prikazani v Tabela 1: Primer slabih rešitev, ki izpišejo pravi rezultat..

Slika 2: Primer kode, ki sešteje števila v tabeli.

```
int[] tabela = { 1, 2, 3 };
int sestevek = 0;

for(int i=0; i<tabela.Length; i++)
{
    sestevek = sestevek + tabela[i];
}

Console.WriteLine(sestevek);
```

Tabela 1: Primer slabih rešitev, ki izpišejo pravi rezultat.

Rešitev	Razložitev napake
`int[] tabela = { 1, 2, 3 };` `Console.WriteLine(6);`	Ročen izpis rezultata. Če spremenimo elemente v tabeli, bo rezultat napačen. Študent zagotovo ne razume navodil.
`int[] tabela = { 1, 2, 3 };` `Console.WriteLine(tabela[0] + tabela[1] + tabela[2]);`	Ročno naslavljanje indeksov elementov v tabeli. Če spremenimo število elementov v tabeli, rešitev ne bo več pravilna. Če imamo v tabeli 1000 elementov, bo koda zelo dolga, saj ne uporablja zank, ki so temu namenjene. Študent ne zna uporabljati zank oziroma se ne zaveda, kdaj je uporaba zank primerna.

`int[] tabela = { 1, 2, 3 };`
`int sestevek = 0;`
 	
`for(int i=0; i<3; i++)`
`{`
`    sestevek = sestevek + tabela[i];`
`}`
 	
`Console.WriteLine(sestevek);`
	Ročno nastavljena meja za najvišji indeks v tabeli. Če spremenimo število elementov v tabeli, rešitev ne bo več pravilna. Študent razume nalogo in zna uporabljati zanke, vendar ni pomislil na primernost rešitve za drugačne testne primere.

2.4 Diskusija in povzemanje

Ko študentje zaključijo svoje delo, je zelo pomembna diskusija. Za vsak problem, ki ga študenti rešujejo, namreč obstaja več pravilnih rešitev. Kljub temu je lahko ena pravilna rešitev boljša od druge, prav tako pravilne rešitve.

Ena od bolj pomembnih lastnosti programske kode je njena berljivost oziroma razumljivost. Pri tem je pomembno tudi poimenovanje konstruktov v programskem jeziku, kot so na primer spremenljivke in imena metod. Dobro razumljiva in logično strukturirana programska koda omogoča lažjo kasnejšo nadgradnjo in lažje sodelovanje z drugimi programerji v primeru, ko jih več dela na istem projektu.

Pomembna lastnost programske rešitve je tudi njena performanca. Pri tem se predvsem osredotočamo na časovno in prostorsko kompleksnost algoritma. Dobro napisana rešitev lahko dela hitreje in porabi manj pomnilnika. Te razlike so lahko zelo velike in lahko pomenijo, da bo v enem primeru algoritem terjal nekaj sto let, v drugem primeru pa nekaj milisekund, da se izvede. V prejšnjem primeru je rešitev neuporabna. Lahko pa gre za manjše razlike, ki se odražajo na primer v porabi energije, kar je predvsem pomembno za mobilne naprave.

Na koncu je vse odvisno od konteksta. Velikokrat moramo narediti kompromis med časovno in prostorsko zahtevnostjo ali pa med performanco in berljivostjo kode. Pri tem so lahko različni načini razmišljanja pravilni. Če bi bile rešitve enostavne in matematično izpeljive, se gotovo z učenjem programiranja ne bi ukvarjali. S študenti zato na koncu zberemo skupaj različne zanimive rešitve istih problemov, jih projeciramo na projektor in diskutiramo o njihovih prednostih in slabostih. S tem študente spodbujamo h kritičnemu razmišljanju glede algoritmov in programskih rešitev, ki so v literaturi in na spletu, ter jih motiviramo, da pri reševanju programerskih problemov razmišljajo o alternativnih in inovativnih pristopih.

3. ZAKLJUČEK

Programiranje si lahko predstavljamo kot umetnost [3]. Problemi v resničnem svetu so raznoliki ter terjajo različne pristope in programske rešitve. Vloga učitelja programiranja je, da študente nauči osnovnih pristopov, hkrati pa jih spodbuja h kritičnemu razmišljanju in iskanju alternativnih rešitev. Pri zelo preprostih primerih je sicer prostora za različne rešitve manj. Kljub temu pa je pomembno, da vzpodbujamo tudi manj optimalne rešitve, pri katerih so se študentje znašli po svoje. Cilj je, da so študentje na koncu zmožni samostojno reševati probleme. Pri tem je zelo pomembno individualno delo. Pomembno je tudi, da pri slabših rešitvah izpostavimo pomanjkljivosti in s tem študentom pokažemo pravo smer. Pomembno je, da študentom pripravimo dobro podlago za razvoj znanja, s pomočjo katerega bodo prišli do ustreznih rešitev za prihodnost.

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Medpredmetno povezovanje programiranja s strokovnim ali splošnim predmetom

Cross-curricular integration of programming and professional or general subject

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POVZETEK
V tem prispevku raziskujemo možnosti za medpredmetno povezovanje pri strokovnem predmetu programiranje. Pri tem obravnavamo povezovanje med dvema strokovnima predmetoma ter med strokovnim in splošnim predmetom. Povezava programiranja z angleščino je pomembna, saj se pri stroki v prvi vrsti uporablja angleški jezik. Povezava z drugimi strokovnimi predmeti pa je pomembna, ker le tako znanje programiranja lahko resnično uporabimo za reševanje realnih problemov.

Ključne besede
Medpredmetno povezovanje, programiranje, angleščina, razvoj spletnih aplikacij

ABSTRACT
In this paper, possibilities for cross-curricular integration with the programming course are explored. Options for integrating programming course with other professional subjects as well as with a general subject are explored in detail. Integration between programming and English is important because English is the primary language used in this field. Integration with other professional subjects is important because only such knowledge can be truly used to solve real-world problems.

Keywords
Cross-Curricular Integration, Programming, English, Web Application Development

1. UVOD
Današnji pristop k izobraževanju je tak, da je študij strogo razdeljen po predmetih. Učna snov je razdeljena na manjše dele oziroma predmete, pri čemer se vsak del načeloma izvaja neodvisno od drugega. Znotraj teh predmetov je snov razdeljena po urah. Pri tem je snov po urah znotraj enega predmeta ponavadi povezana in se logično nadaljuje oziroma nadgrajuje, učne snovi v različnih predmetih pa so morda sorodne, vendar so obravnavane ločeno. En predmet zato ponuja le del znanja, medtem ko reševanje realnega problema ponavadi terja celovito znanje, pridobljeno skozi različne predmete in izkušnje. Zaradi teh dejstev se poraja potreba po povezovanju predmetov med sabo.

2. MEDPREDMETNO POVEZOVANJE
Za pridobitev celovitega znanja, ki je resnično uporabno, je potrebno obvladati več različnih disciplin. Za študijski program računalništva je smiselno, da se snov med predmeti nadgrajuje, tako da znanja, pridobljena pri enem predmetu, uporabljamo pri drugem [1]. Pri tem se lahko en predmet izvaja pred drugim in je uspešno opravljen izpit iz prvega predmeta predpogoj za pristop k drugemu predmetu. Primer je lahko predmet, kjer se študentje učijo razvoja mobilnih aplikacij. Predpogoj za ta predmet je lahko programiranje, saj razvoj mobilnih aplikacij terja znanje osnov programiranja. Ta predmeta sta lahko povezana tako, da se pri obeh uporablja isti programski jezik ali pa se pri predmetu razvoja mobilnih aplikacij na začetku razloži glavne razlike med že naučenim in novim programskim jezikom, ki ga bodo študentje uporabljali.

Druga možnost medpredmetnega povezovanja je povezovanje vsebin dveh predmetov, ki se izvajata vzporedno.

2.1 Primer medpredmetnega povezovanja med programiranjem in razvojem spletnih aplikacij
Programiranje v prvem letniku je zelo splošen predmet, pri katerem se študenti seznanijo z osnovnimi pojmi in načinom razmišljanja, ki ga potrebujejo, da znajo rešiti osnovne programerske probleme. Reševanje osnovnih programerskih nalog brez povezovanja s širšim naborom znanj in realnim svetom samo po sebi ni zelo uporabno, vendar pa je obvladanje osnov predpogoj za nadaljnje učenje in delo. Ena od bolj konkretnih stvari, ki terja aplikacijo programerskega znanja, je razvoj spletnih aplikacij. Pri osnovah programiranja delamo s tekstovnimi izpisi v konzolo, pri čemer program poganjamo na klasičnih računalnikih, pri spletnih aplikacijah pa imamo grafičen uporabniški vmesnik, ki ga lahko uporabljamo tudi na mobilnih napravah, kot so telefoni in tablice.

Klasična spletna stran je statična, kar pomeni, da vsi obiskovalci vidijo enako vsebino in se le-ta ne spremeni, dokler lastnik spletne strani ročno ne spremeni vsebine in jo naloži na strežnik. Spletna aplikacija je spletna stran, katere vsebina se ob obisku sproti sestavi s pomočjo programa, ki teče na strežniku. Poleg tega lahko v vsebini vključuje tudi kodo, ki jo ob obisku spletne aplikacije požene odjemalec (brskalnik). Spletne aplikacije dandanes v veliki meri nadomeščajo namizne in mobilne aplikacije. Nekateri menijo, da bo v bližnji prihodnosti večina aplikacij temeljilo na spletnih tehnologijah [2]. S spletnimi tehnologijami lahko v današnjem času implementiramo vse vrste aplikacij, od sistema za vodenje knjižnice do računalniške igre. Znanje s področja razvoja spletnih aplikacij je torej zelo uporabno.

Spletna aplikacija se izvaja na strežniku in odjemalcu. Na strani strežnika imamo na voljo različne programske jezike (C#, PHP, Java, Python), na strani odjemalca pa ponavadi uporabljamo jezik JavaScript, ki ga moderni spletni brskalniki podpirajo. Razvoj spletnih aplikacij poleg programiranja vključuje oblikovanje in pisanje slogovnih predlog v jeziku CSS, uporabo označevalnega jezika HTML ter načrtovanje in uporabo podatkovnih baz. Ker gre za zelo obsežno snov in nadgradnjo znanja o programiranju, je znanje osnov programiranja ključnega pomena. Na Slika 1: Izpis imen študentov v konzolo. lahko vidimo primer dela kode za izpis imen v konzolo in na

Slika 2: Točkovni seznam z imeni študentov v modri barvi. primer kode za vključitev seznama z imeni v spletno aplikacijo. Oba primera sta napisana v jeziku C#, vendar pa je v primeru spletne aplikacije uporabljen tudi označevalni jezik HTML in jezik CSS. Pri obeh primerih je uporabljena zanka “foreach”, ki se jo študentje naučijo pri programiranju. Gre za poenostavljen primer.

Slika 1: Izpis imen študentov v konzolo.

```
foreach(var ime in imenaStudentov) {
    Console.WriteLine(ime);
}
```

Slika 2: Točkovni seznam z imeni študentov v modri barvi.

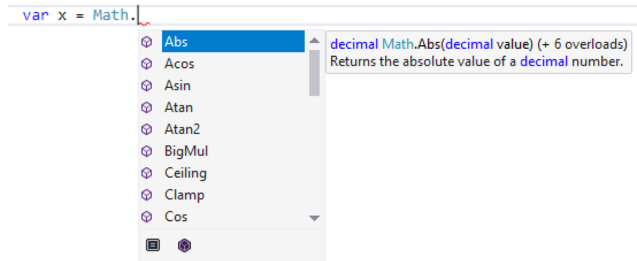
```
<ul style="color: blue;">
@foreach(var ime in imenaStudentov) {
    <li>@ime</li>
}
</ul>
```

Ker je ustvarjanje programov, ki se zaganjajo v konzoli, za študente lahko suhoparno, študentom že pri programiranju na kratko predstavimo, kaj omogoča programiranje v povezavi s spletnimi tehnologijami in jih tako bolj navdušimo nad predmetom. Tistim, ki jih to zanima, lahko ponudimo dodatne naloge v povezavi s spletnimi tehnologijami ter jih tako pripravimo na snov izbirnega predmeta, ki jo bodo jemali po programiranju. Druga pomembna stvar je uskladitev kurikula tako, da je pri razvoju spletnih aplikacij na strani strežnika uporabljen isti ali vsaj čimbolj podoben programski jezik kot pri programiranju. S tem pri predmetu iz razvoja spletnih aplikacij prihranimo čas, ki bi ga sicer porabili za učenje osnov v novem programskem jeziku. Namesto tega se osredotočimo na ostala pomembna znanja, ki so specifična za predmet in tako pokrijemo večji del kompleksne snovi razvoja spletnih aplikacij.

2.2 Primer medpredmetnega povezovanja med programiranjem in angleščino

Pri programiranju je angleščina prvi jezik. Ukazi in imena metod v standardnih knjižnicah so pri vseh priljubljenih programskih jezikih v angleškem jeziku. Prav tako so ponavadi v angleškem jeziku dokumentacija in orodja za pisanje programske kode (Slika 3: Opis metode standardne knjižnice znotraj razvojnega okolja Visual Studio.).

Slika 3: Opis metode standardne knjižnice znotraj razvojnega okolja Visual Studio.



Pri programiranju je pomembno razvijanje kompetenc skozi družbeni splet oziroma tako imenovani splet 2.0 [3].

Eden od načinov razvijanja programerskih kompetenc je preko družbenih omrežij in spletnih forumov. Eden od najbolj priljubljenih strokovnih družbenih omrežij je Stack Overflow. Stack Overflow je stran z vprašanji in odgovori, ki je specifično namenjena programerjem. Entuziasti in profesionalni programerji na tem omrežju najdejo rešitve za svoje programerske probleme tako, da bodisi najdejo odgovore na že zastavljena vprašanja bodisi postavijo svoje vprašanje. Ostali programerji lahko dobra vprašanja in dobre odgovore tudi ocenijo s plusom ali minusom. Za dobra vprašanja in odgovore tako dobiš točke. Šele ko imaš dovolj točk, se tvoje ocene pri drugih vprašanjih in odgovorih štejejo. Stack Overflow zahteva uporabo angleščine [4].

Zaradi tega tako v profesionalnem okolju kot pri izvajanju predmeta programiranje večkrat beremo dokumentacijo, odgovore na vprašanja in vodnike v angleškem jeziku. Pri tem je uporabljenih veliko strokovnih izrazov, ki so specifični za računalništvo. Včasih je težko najti ustrezen prevod teh izrazov v slovenščino, poleg tega pa je zaradi prej omenjenih dejstev pomembno, da študentje vedo strokovne izraze v angleščini. Čeprav je literatura za predmet v slovenskem jeziku, študentje dodatno razlago snovi iščejo tudi s pomočjo spletnih iskalnikov, kot naprimer Google, in pridobijo vsebino snovi z dodatnimi razlagami in primeri v angleščini. Viri na internetu so nepogrešljivi tudi pri nadaljnjem samostojnem izpopolnjevanju znanja, ki presega snov predmeta. Perspektivne študente, ki si želijo naučiti več, napotimo na spletne strani z angleško vsebino in jim jo pomagamo razumeti. Pomembno je, da pri tem sodeluje tudi učitelj angleščine tako, da se pri angleščini študentje spoznajo z nekaterimi strokovnimi izrazi. Poleg tega študentom, ki jim gre angleščina slabše, dodatno pomaga ter učitelja programiranja opozori o posebnih primerih, naprimer če ima kdo z razumevanjem angleščine težave.

3. ZAKLJUČEK

Pri programiranju je medpredmetno povezovanje z drugimi vejami računalniške stroke in angleščine nepogrešljivo. Ko programiranje povežemo s snovjo ostalih računalniških predmetov, lahko dosežemo višji cilj. Z dobro načrtovanim medpredmetnim povezovanjem lahko bolje dosegamo cilje pri vseh predmetih, ki jih povezujemo. Poleg tega študenta naučimo teoretična znanja povezovati tudi v praksi, kar je ključni cilj kurikularnega povezovanja. Kljub vsemu pa medpredmetno povezovanje terja od učiteljev dodaten čas in napor. Zato je še posebej pomembno, da imamo pri tem dobro strategijo. Menimo, da z dobro strategijo in načrtom pozitivne stvari pretehtajo negativne.

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Razvijanje medijske pismenosti pri pouku šolskega novinarstva

Developing media literacy at school journalism lessons

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POVZETEK

Mediji so področje, ki se z razvojem tehnologije nenehno spreminja. Mediji so povsod, naša vsakdanja življenja pa so z njimi tesno povezana. Prav je, da jih poznamo in jih razumemo. Učni načrt izbirnega predmeta šolsko novinarstvo je z mediji neločljivo povezan. Pri poučevanju skušam slediti sodobnim smernicam tako z vsebino predmeta kot s pedagoškimi metodami, ki jih izbiram. V svojem prispevku sem torej predstavila načine, s katerimi razvijam medijsko pismenost pri učencih od 7. do 9. razreda osnovne šole. Ugotavljam, da mladi medijskih vsebin ne izbirajo kritično, ker medijev in sodobne tehnologije ne poznajo dovolj dobro. V svojem prispevku sem skušala prikazati, da bi se moralo o medijski pismenosti sistematično poučevati od prvih let šolanja naprej.

Ključne besede

Medijska pismenost, razvijanje digitalnih kompetenc, šolsko novinarstvo, IKT

ABSTRACT

Media is an area that is constantly changing as technology evolves. Media is everywhere, our daily lives are tightly connected with it. Therefore is necessary that we know and understand it very well. School journalism curriculum is associated with media. Regarding content and pedagogic methods I try to stay in touch with modern trends. This paper describes the methods which I use to develop media literacy by my pupils from seventh to ninth grade of primary school. I have come to conclusion that young people don't select media critically, because they aren't familiar enough with modern technology and media. I've tried to demonstrate that media literacy should be a part of curriculum from early years.

Keywords

Media literacy, developing digital competencies, school journalism, ICT

1. UVOD

Množični mediji, kot smo jih poznali včasih, izgubljajo svojo veljavo. Namesto tiska, televizije, radia v ospredje stopajo družbeni mediji, kot so Facebook, Twitter, YouTube, Wikipedia, Amazon, eBay itd. Kolumnist Novica Mihajlović [4] razmišlja o tem, da nam sodobna tehnologija daje ogromno možnosti. Piše, da se lahko zgražamo, kako nam pametni telefoni poneumljajo otroke, lahko pa skušamo tehnologijo uporabiti sebi v prid ter se pri njeni uporabi zgledujemo po tistih, ki o teh zadevah vedo več kot mi. Pri tem se navezuje med drugim tudi na Billa Gatesa, soustanovitelja Microsofta. V njegovi družini telefoni med jedjo niso dovoljeni, otroci mobilnih telefonov niso dobili do svojega 14. leta. Tudi v družini pokojnega Steve Jobsa, soustanovitelja Appla, je med obedi tehnologija prepovedana, čas otrok pred zasloni pa je strogo omejen. Ob vsem tem se postavlja vprašanje, ali je potemtakem raba IKT-ja v šolskem prostoru sploh smiselna. Bi morala biti šola prostor, kjer se učenci spočijejo od svojih naprav in pridno berejo iz beril, učbenikov in pišejo v zvezke? Sama sem mnenja, da temu ni tako. Branje in pisanje sta veščini, ki sta še kako pomembni in bosta vedno temelj, na katerem lahko učenec pridobiva kompetence za pridobivanje novega znanja. A vsekakor je potrebno učence opozoriti na pasti interneta, treba jih je poučiti o medijih, da jih bodo znali varno in ustrezno uporabljati.

Prav tako je lahko učitelj tisti, ki učencem pokaže aplikacije in orodja, s katerimi bo učenec novo učno snov lažje usvojil, jo bo temeljiteje ponovil. Navsezadnje moramo biti učitelji tisti, ki gremo v korak s časom. Učenci bodo, kar se tiče sodobne tehnologije, vedno korak pred nami. Lahko pa se vsaj trudimo. Po mojih izkušnjah ta trud učenci opazijo, saj znajo ceniti spodbudno učno okolje.

2. APLIKACIJE IN ORODJA, KI JIH UPORABLJAM PRI POUKU ŠOLSKEGA NOVINARSTVA IN SLOVENŠČINE

2.1 Urejanje besedil

Učence zanima sodobna tehnologija, navdušeni so nad metodami, ki vključujejo IKT. Pa če gre le za kviz Kahoot ali Quizizz. Večino mojega pedagoškega dela predstavlja poučevanje slovenščine. V računalniško učilnico ne zahajamo pogosto, saj je pogosto zasedena. Za kvize so učenci uporabljali svoje pametne telefone. Bo pa že to šolsko leto lažje, saj se je vodstvo šole odločilo, da nakupi tablične računalnike za en razred.

V računalniški učilnici učenci z urejevalnikom besedila pišejo svoje življenjepise, prošnje, vabila, zahvale itd. Težave imajo že pri samem oblikovanju teksta, ne najdejo funkcij, s katerimi bi naredili besedilo ustrezno. Radi se igrajo z barvami, radi izbirajo nenavadne pisave. Ko se v 9. razredu pogovarjamo o tem, kako napisati ustrezno prošnjo za zaposlitev, jih tudi poučim, kako se oblikuje življenjepis, prošnja, da obstaja več načinov oblikovanja besedila. Vsekakor z barvami, s pisavo ne bodo prepričali delodajalcev. Besedilo mora biti urejeno, zamiki morajo biti ustrezno nastavljeni, ne sme biti nikakršnih malomarnih napak. Skratka, Word je res minimum, kar bi osnovnošolci morali obvladati. Ker ga nekateri ne, je tudi pouk slovenščine lahko priložnost, da kaj skupaj ponovimo.

Večino učencev že sama prisotnost računalnika spominja na brskanje po spletnih vsebinah, po igranju računalniških igric. So raztreseni in na hitro nekaj pripravijo v Wordu, da bodo lahko ob koncu ure pokukali na kakšno spletno stran. Tistim prizadevnim, ki svoje delo dobro opravijo, to seveda dovolim.

2.2 Uporaba e-pošte

Preden učenci pri uri slovenščine pred razredom izvedejo govorni nastop, mi morajo prek e-pošte poslati svojo pripravo na nastop. Marsikdo ne odda priprave v priponki, ampak kopira osnutek v samo telo besedila. Pogosto se tudi ne podpišejo. Svoj e-naslov pa imajo kdaj čisto nerazpoznaven. Izbirajo vzdevke, pojme, ki so jim blizu.

V letošnjem šolskem letu bom še posebej pozorna, da bodo vsi uporabljali Arnesov račun. Tako bom točno vedela, kdo je ta oseba, ki mi piše. Vse skupaj deluje veliko bolj uradno. Tudi sama uporabljam ta račun. S strani vodstva imamo napotek, da se s starši, učenci komunicira izključno s tem računom in ne npr. z gmailom.

Mislim, da je prav, da se učenci zavedajo, da se prek e-pošte komunicira predvsem uradno. Pravzaprav danes ne moremo predvideti, na kakšen način se bo iskala zaposlitev v prihodnosti. A vsekakor bo komunikacija z uradnimi osebami, z osebami, ki jih ne poznajo, potekala drugače, kot poteka prek družabnih omrežij, kot jih poznajo dandanes. Najpogostejše napake, ki sem jih zasledila, ko pošiljajo e-pošte, so: neustrezno oblikovano besedilo, neustrezna izbira besedišča (neprimeren pozdrav, ni podpisa), uporaba pogovornega jezika.

2.3 OneNote, Socrative in Mentimeter

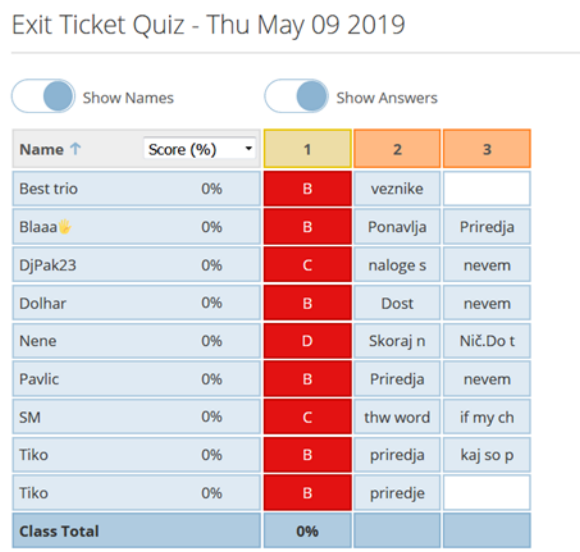
Delo pri šolskem novinarstvu sem v letošnjem šolskem letu uvedla prek storitve Office 365 – OneNote. Učencem sem omogočila, da dostopajo do mojih izročkov, obenem bom na ta način dajala tudi navodila za domačo nalogo, za oddajo prispevkov. Prek aplikacije Forms bom pripravljala kvize za ponovitev snovi.

Za preverjanje predznanja se mi zdi zelo uporabna aplikacija Socrative, saj ta aplikacija med drugim omogoča, da uvajam enega izmed elementov formativnega spremljanja. To je zbiranje dokazov, ki omogoča učitelju vpogled in razumevanje in učenje učencev. [3]

Pri Socrativu lahko ustvarjaš razne kvize, preizkuse znanj. Dobro je, ker si učitelj učenčeve dosežke lahko shrani in preuči. Na podlagi tega lahko načrtuje pouk za naslednje ure. Uporaben se mi zdi Exit Ticket Quiz, ki nadomešča klasične izstopne listke. Vprašanja lahko poljubno zastavimo, paziti pa moramo, da so usmeritve zelo konkretne. Npr. navedi tri stvari, ki si se jih naučil. Dobro vprašanje, ki si ga zastavijo sebi, je, kakšno vprašanje se mi še poraja. Možnosti je veliko. Listič je za učitelja res lahko izhodišče za nadaljnje poučevanje.

Exit Ticket Quiz nam dve vprašanji ponudi, učitelj sam sestavi le tretje, to je zadnje vprašanje, ki se navezuje na konkretno snov. Prvo vprašanje je sledeče: kako dobro si razumel snov. Učenci imajo odgovore podane in le izberejo najustreznejšega. Drugo vprašanje je vezano na to, kaj so se v tej uri naučili. Oblikovati morajo svojo poved. Vse tri odgovore lahko projiciram na projektorju, da vsi vidimo, kako dobro jim je šlo. Zaenkrat odgovarjajo s svojimi pametnimi telefoni, kmalu pa jim bodo na voljo tablični računalniki.

Opazila sem, da so imeli učenci največ težav pri drugem vprašanju, saj celo na koncu 9. razreda težko povzamejo, kaj je bilo bistvo ure, kaj naj bi se naučili. Da ne bi prišlo do zasmehovanja, sem jim dovolila, da so si izbrali svoja imena, vzdevke, karkoli. Zdi se, da bi bilo pametneje, da bi se morali podpisati, saj bi se tako resneje lotili dela. Sama pa bi dobila dobro povratno informacijo, ali so učne cilje usvojili.


Exit Ticket Quiz - Thu May 09 2019

Show Names   Show Answers

Name ↑	Score (%)	1	2	3
Best trio	0%	B	veznike	
Blaaa	0%	B	Ponavlja	Priredja
DjPak23	0%	C	naloge s	nevem
Dolhar	0%	B	Dost	nevem
Nene	0%	D	Skoraj n	Nič.Do t
Pavlic	0%	B	Priredja	nevem
SM	0%	C	thw word	if my ch
Tiko	0%	B	priredja	kaj so p
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Slika 1. Exit Ticket Quiz – reševali so ga učenci 9. razreda

Z aplikacijo Mentimeter lahko začnemo učno uro, da obnovimo usvojeno snov. Učenci torej odgovarjajo na vprašanja, kot je npr. vprašanje, kaj je glagol. Njihove ideje se druga za drugo kažejo na projektorju. Mentimeter je dobro orodje tudi za uvodno motivacijo, ko obravnavamo novo snov. Učence lahko povprašam, kaj jim določena beseda pomeni, npr. lažne novice, rumeni tisk, preiskovalno novinarstvo. Sama sem se odločila za možnost Word Cloud, ker učencem veliko pomeni vizualizacija pri predstavitvi. Besede, ki so grafično večje od ostalih, se tudi v odgovorih največkrat ponovijo. Tako lahko učitelj hitro pridobi vtis o učencih, o njihovih pogledih in tudi znanju.

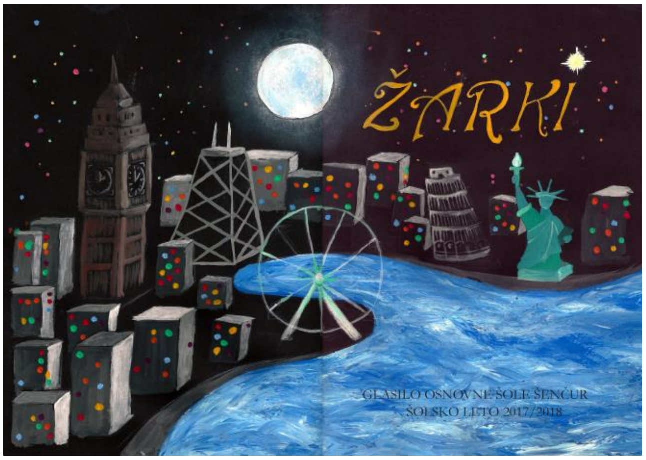
Lahko jih tudi povprašam, zakaj so se odločili za izbirni predmet šolsko novinarstvo in kaj pričakujejo od tega predmeta. Zelo pomembno je, da sami odkrivajo, katere lastnosti so pomembne za novinarja. Morajo se tudi pohvaliti in napisati, zakaj bodo dobri novinarji, katere lastnosti jih odlikujejo.

Moj namen je, da bi spoznali, da so njihove naprave, ki jih imajo tako radi in so nanje mnogokrat kar preveč navezani, učinkovito učno orodje. Z ustreznimi aplikacijami, orodji lahko ustvarjamo spodbudno učno okolje za vse učence. Še posebno za tiste, ki doma nimajo sodobnih naprav in je prav šola prostor, ki omogoča, da se s sodobno tehnologijo seznanijo.

3. OBLIKOVANJE ŠOLSKEGA GLASILA

Enkrat letno izide tudi naše šolsko glasilo. Veseli me dejstvo, da še vedno ohranjamo šolsko glasilo v tiskani izdaji. Veliko šol se že odloča za e-glasilo. Sama sem mnenja, da je čisto drugače imeti glasilo v rokah. Učenci ga z velikim zadovoljstvom prinesejo staršem, da ga potem skupaj prelistajo. Včasih je prav, da kljub vsem novostim ohranimo neko preverjeno formulo, in ta na naši šoli deluje, saj kljub visoki nakladi Žarki ne ostajajo zaprašeni v knjižnici, ampak se po nizki ceni vsako šolsko leto skoraj v celoti prodajo učenkam in učencem.

Pri izbirnem predmetu šolsko novinarstvo učenci samostojno oblikujejo novinarske prispevke, ki so potem objavljeni v šolskem glasilu. Učenci večino informacij med učno uro najdejo na različnih spletnih straneh. Opozarjam jih na navedbo vira. Pozorni morajo biti na raznolikost virov, informacija mora biti namreč preverljiva.



Slika 2. Naslovnica glasila Osnovne šole Šenčur 2017/2018

Pri šolskem novinarstvu je poudarek na sodelovalnem učenju. Učenci bodo lahko z letošnjim šolskim letom z nakupom tabličnih računalnikov po skupinah oblikovali vprašanja za intervjuvanca, lotili se bodo lahko tudi raziskovalnega novinarstva. S tablicami bodo lahko kaj poslikali, posneli in vse to bo del njihovega prispevka. Vse se bo lahko naredilo naenkrat, delo bo lahko potekalo v razredu, saj je zasedenost računalniške učilnice tudi na naši šoli velik problem. Skratka, naše delo se bo lahko preneslo tudi na teren, saj smo bili doslej, kar se tiče IKT-ja, vezani na računalniško učilnico. Učenci seveda imajo svoje mobilne naprave, a jih vsi ne nosijo v šolo. Kar se tiče interneta, bo tudi lažje, saj bodo tablice imele wifi povezavo.

Vzpodbujam tudi kritično razmišljanje, saj smo objavili prispevke, ki so s kritičnim očesom ovrednotili poteze Občine Šenčur. V lanskem letu smo imeli v Šenčurju čistilno akcijo. Ker so se akcije večinoma udeležili učenci, malo pa je bilo odraslih, so o tem naši učenci tudi pisali. Svojega razočaranja nad odraslimi niso skrivali in prav je tako.

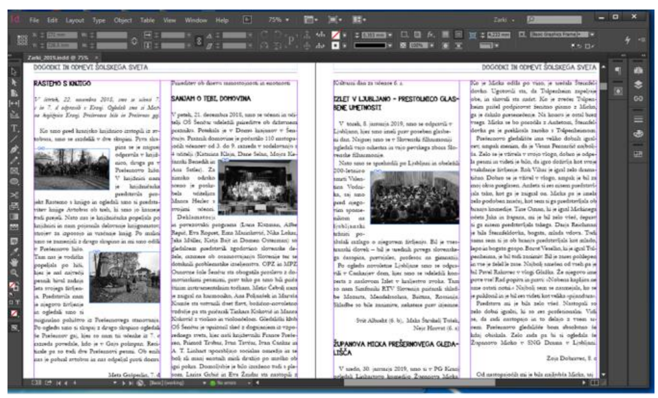
3.1 Oblikovanje s programom Adobe InDesign

Žarke, to je šolsko glasilo Osnovne šole Šenčur, z učiteljico razrednega pouka oblikujeva s programom Adobe InDesign. Uporablja se ga pri oblikovanju in postavitvi raznovrstnih tiskovin. Poleg urejanja in postavitve knjig lahko v InDesignu oblikujemo revije, časopise, letake, plakate, kataloge, priznanja, obrazce itd. InDesign je »najmočnejši tako pri postavljanju dolgih besedil kot tudi nekje vmes, se pravi pri kombiniranju vsakovrstnih besedil z grafičnimi elementi, kjer je zahtevana hitrost, celovitost in profesionalnost rezultatov.« [2]

Učiteljica razrednega pouka zbere, uredi prispevke z razredne stopnje, sama sem zadolžena za prispevke s predmetne. Seveda znotraj šolskega novinarstva in novinarskega krožka tvorimo publicistična besedila, ki obogatijo naše glasilo. V začetku šolskega leta se odločiva, katere rubrike bova ohranili, katere bova spremenili. Potem na podlagi lanskih glasil pripraviva številke strani in ime rubrike, npr. Zabavna stran, Kaj se dogaja, Mladi pesniki in pisatelji itd. Pripraviva torej predloge strani (Master Pages). Besedila, ki jih dobiva od učencev, učiteljev so v Wordu. Te datoteke lahko uvoziva v InDesign ali uporabiva možnost kopiraj – lepi. Avtorja priročnika InDesign in osnove založništva odsvetujeta to drugo možnost, saj se nemalokrat pojavijo razhajanja med originalnim besedilom in besedilom v programu. [2] Slike enostavno vstavimo v besedilo z ukazom Place. InDesign ima tudi zelo dragocen ukaz Undo, ki pogosto pride prav. Za pripravo kateregakoli dokumenta v programu InDesign potrebujemo orodja, ta se nahajajo v orodjarni (Tools), ki je po prevzetih nastavitvah na levi strani zaslona.

Ker vsaka pripravlja glasilo na svojem računalniku, morava v maju predloge združiti, kar je zelo enostavno. Pri InDesignu ne prihaja do zamikov. Ko združiva rubrike, je vse tako, kot sva si zamislili.

Konec meseca maja pripraviva glasilo za tisk, kar pomeni, da vse prispevke še enkrat pregledava, urediva napise pod slikami, preveriva, če je vse tako, kot je bilo v originalu. Potrebno je paziti, da za tiskarja pripravimo Adobe Package. Ta ukaz zagotavlja, da so vse pisave in grafike vključene v datoteko InDesign. Obenem pa so tako dodane informacije, ki so potrebne za tiskanje dokumenta. [7]



Slika 3. Oblikovanje v InDesignu

Smotrno bi bilo, da bi oblikovanje glasila prevzeli učenci sami, a je žal InDesign plačljiv in si ga samo za Žarke šola ne more privoščiti. Učence ob zaključku leta seznanim z InDesignom, pokažem jim, da je vsa stvar dokaj preprosta. Seveda se je pa ravno tako kot pri vseh novih stvareh potrebno InDesigna učiti. Z učiteljico sva si pomagali s priročnikom InDesign in osnove namiznega založništva, ogledali pa sva si tudi veliko izobraževalnih videov.

Ko smo glasilo še oblikovali Wordu, so bile vedno težave. Včasih je prišlo ob kopiranju enega dokumenta v drugega do nepotrebnih zamikov. Marsikatera slika je bila na drugem mestu. Prišlo je pa tudi do težav v tisku, ko so izgubili del prispevka. Zagovarjali so se, da je bilo deloma krivo tudi to, da smo glasilu oblikovali v Wordu.

Seveda bi bilo lažje, če bi učenci oblikovali glasilo pri pouku. Ne zato, da bi bilo manj naporno zame, temveč zato, da bi lahko učence naučila nekaj uporabnega, koristnega za življenje. Morda v prihodnosti, kdo ve … Vodstvo šole se je letos odločilo za nakup 28 tabličnih računalnikov. Morda pa drugo leto pride na vrsto Adobe InDesign, kdo ve?

3.2 Fotografije in slikovno gradivo so del šolskega glasila

Za prispevke učenci tudi sami fotografirajo, te fotografije oblikujejo. Fotografije smo oblikovali s programom Picasa.

Kakovost fotografije je pri oblikovanju glasila zelo pomembna. Še posebno zato, ker nimamo e-glasila, temveč klasično tiskano izdajo. Fotografije so del prispevka. Učence spodbujam, da naj bodo fotografije izvirne. Poudarjam pa, da morajo osebo, ki jo fotografirajo, vedno prositi za dovoljenje.

V Žarke smo dodali tudi slikovno gradivo. Te skenirane slike oblikujemo s programom PhotoFiltre.

4. MEDIJSKA PISMENOST

Dandanes se veliko govori o medijski pismenosti. Kaj pa ta pojem sploh pomeni? Medijska pismenost se nanaša na sposobnosti, znanja in razumevanje, ki uporabnikom omogočajo varno rabo medijev. Tak posameznik je informiran in lahko suvereno sprejema odločitve. [8]

Učni načrt za predmet šolsko novinarstvo me zavezuje, da se osredotočim tudi na kritičen odnos do medijev.

Eden izmed funkcionalnih ciljev je tudi, da učenci prebirajo časopisni in revialni tisk, sledijo radijskemu in televizijskemu programu ter si oblikujejo kritičen odnos do medijev (vzgoja za medije).

V učnem načrtu je tudi zapisano, da naj učenci v posebne mape spravljajo izrezke iz časopisov in revij, jih urejajo po načelu novinarskih zvrstnosti ter opremljajo z zaznamki in opombami. Opombe sama razumem tudi kot to, da učenci vrednotijo besedila, razmišljajo o resnici, o preverljivosti navedenega. Novinar mora slediti resnici in ob kočljivih zadevah je potrebno navesti več virov, več informatorjev. [5]

Ozaveščanje učencev o medijih je dolžnost vsakega učitelja, in to od 1. razreda naprej. Medijem se ne da izogniti, še posebno v dobi, v kateri odraščajo mladi. Brez interneta si dandanes učenci ne znajo predstavljati življenja. Namenoma večkrat omenim, kako smo včasih pridobivali razne informacije, kako smo debatirali o nekem problemu, brskali po knjigah, časopisih, spraševali odrasle … Dandanes klikajo in dobijo informacijo. Ali je ta informacija ustrezna, dovolj poglobljena, je pa drugo vprašanje. Ravno to je tudi eden izmed vidikov, ki ga kot učiteljica pokrivam. Učence opozarjam, da samo en vir ni dovolj, da so nekatere spletne strani zanesljivejše od drugih, da je potrebno preleteti tudi prispevke v časopisih na to temo. Avtorici Karmen Erjavec in Zala Volčič [1] v priročniku za učitelje osnovne šole z naslovom Medijska pismenost pišeta, da moramo spoznati svet medijev, ker se z njimi srečujemo na vsakem koraku in ker nam vedno bolj interpretirajo sliko o resničnosti in našim lastnim izkušnjam dajejo smisel.

Avtorici v nadaljevanju pojasnjujeta, da je v zgodovini prevladovalo mnenje, da otroci še ne morejo tako kritično razmišljati kot odrasli ter da so zaradi pomanjkanja življenjskih izkušenj lahka tarča simbolnih sporočil. Avtorici tudi pišeta, da je že Platon v svoji Republiki zahteval, da so zgodbe in ideje, ki so namenjene otrokom, skrbno nadzorovane. Sama sem prepričanja, da so učenci od 7. do 9. razreda že sposobni kritičnega razmišljanja in vrednotenja, zato je prav, da se o tem, da imajo mediji moč, da nam tudi konstruirajo stvarnost, veliko pogovarjamo. Od medijev je odvisno, kaj bomo izvedeli, o čem bomo brali. Oni naredijo selekcijo za nas. [1]

V okviru pouka se pogovarjamo tudi o tem, da z uporabo družbenih omrežij in aktivnostmi na spletu sami ustvarjajo podatke o sebi. Melita Zajc [6] v priročniku Medijski pojmovnik za mlade poudarja, da te podatke potem ponudniki družbenih medijev zbirajo in drago prodajajo različnim kupcem kot podatke, ki so osnova mnogih gospodarskih dejavnosti.

Erjavčeva in Volčičeva [1] tudi poudarjata, da naj bi televizija delovala negativno, ker spodbuja egoizem, ugodje, takojšno izpolnitev želja in zabavo v vseh življenjskih okoliščinah. Kaj bi šele napisali o internetu … Take neomejene možnosti, kot jih ponuja svetovni splet, so past že za nas odrasle. Kaj šele za mladostnike … Ravno zato podpiram misel, da je potrebno mlade o spletu in o informacijah, ki se lahko dobijo, ozaveščati tudi v šoli.

4.1 Lažne novice

Minulo šolsko leto sem se udeležila spletne konference VOX z naslovom Fake News (Lažne novice). Na usposabljanju na daljavo nam je predavala priznana strokovnjakinja Jessi McCarthy iz organizacije Newseum iz ZDA. Predstavila nam je fenomen lažnih novic in strategije, s katerimi lahko učitelji opolnomočijo učence, da lažne novice sami prepoznajo in jih prenehajo deliti na družabnih omrežjih. Med drugim nam je predstavila spletne strani, ki preverjajo, ali so neke novice lažne ali ne. To so Snopes.com, Factcheck.org, Politifact.com, Hoax-slayer.com.

Strokovnjakinja za medije nam je predstavila tudi računalniško igrico o lažnih novicah, ki je prevedena tudi v slovenščino. V razredu sem jo potem tudi preizkusila. [9] Ta način je za učence dober, saj nevede odkrivajo, kako pravzaprav nastajajo lažne novice in kaj to vzpodbudi pri površnih bralcih, gledalcih. Učenci imajo pri tej igri nalogo, da po navodilih izmišljenega ravnatelja postavijo šolsko spletno stran. Z lažnimi novicami pridobivajo sledilce, a ostajajo navidez verodostojni.

Učence je potrebno opozoriti, da so novice lahko konstrukt posameznikov, ki želijo s svojo spletno stranjo, ki poleg »fake news« objavlja tudi oglase, zaslužiti.

V šolskem letu 2017/2018 so devetošolci v goste povabili dr. Sonjo Merljak Zdovc. Leta 2019 je bila kot odgovorna urednica Časorisa nominirana za prvo evropsko nagrado za medijsko pismenost. Njena delavnica je bila izjemna. Medijsko pismenost je učencem predstavila tako teoretično kot praktično. Razložila jim je, da medijska pismenost pomeni, da znaš ustvariti, oceniti in analizirati medijske vsebine (članke v časopisu in na internetu, prispevke na TV, objave na spletnih družabnih omrežjih). Podobno kot predavateljica Jessi McCarthy je tudi Merljakova opozorila, da so lažne novice predvsem pereč problem za mlade, saj se le-te hitro širijo po družabnih omrežjih.

Z njenim dovoljenjem sem ostalo gradivo preizkusila še v ostalih razredih, to je pri šolskem novinarstvu in novinarskem krožku. Ugotovila sem, da se učenci ne zavedajo, da lažne novice obstajajo oz. da so oni kot uporabniki socialnih omrežij še posebno dobra tarča. V tem šolskem letu nameravamo delavnico ponoviti. Na koncu delavnice je Merljakova pripravila anketo, ki jo bodo reševali prek svojih telefonov ali tabličnih računalnikov. S tem bodo dobili povratno informacijo, kako medijsko pismeni dejansko so.

Slika 4. Delavnica medijske pismenosti z dr. Sonjo Merljak Zdovc

Zelo velik vpliv na mlade imajo v zadnjem času številni blogerji in vlogerji. Pri urah si pogledamo kakšen posnetek. Učence pa opozorim, naj bodo kritični do njihovih zamisli, izjav. To so lahko mladostniki kot oni in ne smejo za njih predstavljati neke moralne avtoritete. Ponovno je potrebno opozoriti mlade, da je vse vsebine potrebno sprejemati kritično in z zdravo mero razuma. Obrnejo se lahko na starše, učitelje. Žal pa so v dobi najstništva njihovi vzorniki predvsem vrstniki, zato je iluzorno pričakovati, da se bodo ob sumljivih novicah obrnili na odrasle. Zato je še kako pomembno, da že v drugi triadi spoznavajo, da je svet poln neresnic, poln propagande in da podjetja želijo čim prej dobiti zveste kupce. Le kako priročni so prav najstniki, ki bodo nekoč služili denar in predstavljali za ta podjetja velik zaslužek.

Cilj medijske pismenosti znotraj učne ure je, da je resnica vrednota, h kateri pravi novinar stremi. Laži nimajo kaj iskati v novinarstvu. Potrebno je učence spodbuditi, da si ne smejo dovoliti, da jih kdo zavaja, da jim tvezi neresnice. Mlajši učenci – učenci druge triade – so presenečeni, da na spletnih straneh, v časopisih ni vse čisto res. Še več – opozarjam jih, da nekateri pisci namenoma lažejo. Pogovarjamo se tudi o satiri in o tem, da določeni novinarski žanri le lahko dodajajo manj preverjene informacije. Seveda pa le-te v informativnem žanru nimajo kaj iskati.

4.2 Kakovostni in popularni tisk

Eden izmed funkcionalnih ciljev je tudi, da govorno razčlenjujejo sporočila medijev, jih presojajo, se o njih pogovarjajo in utemeljujejo. Pri tem cilju je tudi razvidno, da moram pri šolskem novinarstvu poudarjati razliko med kakovostnim tiskom in tabloidi. [5]

Erjavčeva in Volčičeva [1] v svojem delu Medijska pismenost nazorno ponazorita razlike med obema vrstama tiska. Pri popularnem tisku je prisotna visoka stopnja senzacionalizma. »Prevladujoč motiv ni več etika, temveč dobiček.« Opozarjata, da je za popularni tisk značilno, da so besedila kratka in jedrnata. Naslovov je veliko, prav tako je veliko fotografij. Pojav barv je močno povečal naklado popularnega tiska. Tudi naši učenci mi večkrat potožijo, zakaj v našem glasilu ni več barvnih strani. Barvnih strani je več kot v začetku izdajanja glasila, a seveda manj, kot bi sama želela. Barvno glasilo v celoti je za šolo prevelik strošek. Nekaj smo kompenzirali z oglasi lokalnih podjetnikov, a ni bilo dovolj. Tudi naši učenci pod vplivom tiska, ki jim je blizu, želijo vnesti spremembe. To me veseli, ker to pomeni, da so glasilo vzeli za svojega. Ozirajo se k mladostniškim revijam, kot je npr. izredno kakovostni Pil. To je seveda normalno. Trudimo se, da je v našem glasilu tudi kakšna podobna rubrika kot v sodobnih revijah. Sledimo torej smernicam 21. stoletja, a še vedno je prvenstvena naloga našega glasila, da pokrivamo kroniko dogajanja na šoli in da objavimo kvalitetna literarna besedila od 1. do 9. razreda.

Mediji so raznoliki. Prav je tako, da lahko izberemo tisti medij, ki nam ustreza. Pri pouku na primer pogosto prebiramo spletni časopis Časoris ali si ogledamo kakšno oddajo, najpogosteje je to televizijska oddaja za mlade Infodrom, ki nastaja pod okriljem SLO 1. Naši učenci so sodelovali pri obeh medijih, saj so s svojimi prispevki obogatili tako Časoris kot tudi del oddaje Infodrom.

5. ZAKLJUČEK

Na naši osnovni šoli – na Osnovni šoli Šenčur – vsako leto ponudimo šolsko novinarstvo, od interesa učencev pa je odvisno, ali potem tudi v resnici izvajamo ta predmet. Pri predmetu imam običajno od 12 do 15 učencev, kar je malo, če je bilo na naši šoli v šolskem letu 2018/2019 v tretji triadi 369 učenk in učencev. Ker se tako malo učencev poglobljeno ukvarja z mediji, se strinjam s strokovnjaki, ki menijo, da bi morala biti medijska vzgoja del učnih načrtov za obvezne predmete. O pomembnosti digitalnega opismenjevanja razmišljajo tudi v Evropski komisiji. Po brexitu so se komisarji začeli zavedati nevarnosti širjenja laži in manipulacij z informacijami. Januarja 2018 je Evropska komisija ustanovila 39-člansko strokovno skupino za boj proti lažnim novicam, izpeljala je raziskavo javnega mnenja med evropskimi državljani ter anketo med strokovnjaki in zainteresirano javnostjo. [10]

Medijska vzgoja bi morala vsebovati medijsko pismenost in varno rabo interneta. V letnem delovnem načrtu imamo vsako šolsko leto namenjenih več ur za varno rabo interneta, saj zunanji strokovnjaki v obliki delavnic predstavijo te vsebine. Sama menim, da bi morale biti te vsebine del obveznega predmeta, saj bi tako učenci vedeli, da je digitalna pismenost pomembna. Žal je tako, da bi se učenci bolj poglobljeno ukvarjali z digitalno pismenostjo, če bi bili iz tega znanja tudi ocenjeni.

V odraščajoči dobi so mediji del njihove stvarnosti, zato jih morajo dobro poznati. Pravzaprav nimajo izbire. Tudi učitelji je nimamo. Hočeš ali nočeš, moraš slediti svojim učencem, moraš vedeti, kaj je to blog, vlog itd. Tako se jim približaš. V letošnjem letu si bomo ogledali vlogerje in s kritičnim pogledom ocenjevali njihove nastope. Pri slovenščini namreč govorne nastope ocenjujem. Ko obravnavam Gloso, poleg svoje »interpretacije« že drugo leto predvajam Trkajevo. Udeležili smo se tudi njegovega natečaja in pripravili rap na poljubno temo. Skratka, učitelj ni najstnik, a mora najti pedagoške metode, s katerimi se jim približa. Navsezadnje je tudi snov potem lažje usvojena. Na silo v 21. stoletju ne gre. Vedno manj je učencev, ki bi jim zadoščalo predavanje in zvezek, zato učitelj mora slediti sodobnim smernicam. Prav tako je pri IKT. A kot pri vseh novostih je tudi pri uporabi IKT-ja potrebna zdrava mera. IKT je učinkovit pripomoček za uvedbo novejših pedagoških metod, kot so sodelovalno učenje, formativno spremljanje, spodbujanje kritičnega razmišljanja. Ta vidik se lahko razvija pri več družboslovnih predmetih: pri zgodovini, jezikih, državljanski in domovinski kulturi ter etiki in tudi pri izbirnih predmetih, kot sta vzgoja za medije in šolsko novinarstvo.

Slika 5. Snemanje oddaje Infodrom na naši šoli

Aktivna vloga učencev je v vseh novejših pedagoških metodah v ospredju. Učenci niso več le poslušalci in zapisovalci, temveč jim moramo učitelji dati priložnost, da sami pridejo do resnice. Prepričana sem, da IKT omogoča učencem, da se samostojno dokopljejo do rešitve, da sami iščejo poti do nje. Zato pozdravljam odločitev vodstva naše šole, da gremo z letošnjim šolskim letom v projekt Inovativna učna okolja, podprta z IKT. To bo dvoletni projekt. Cilj ekipe učiteljev, ki smo v projektu, je, da je vsaj 30 % učnih ur podprtih z IKT. To je merjeno na letni ravni.

Osnovnošolci se šele srečujejo z mediji, s spletnimi stranmi, zato je pomembno, da jih učitelji in starši naučimo, da je potrebno vse informacije selektivno izbirati in da ni vse res, kar slišijo, vidijo na različnih spletnih straneh, na socialnih omrežjih. Ves čas morajo biti kritični bralci, gledalci. Ves čas morajo vrednotiti prebrano, videno. Še vedno smo odrasli tisti, ki jim lahko s svojimi izkušnjami, védenjem na tej poti iskanja informacij pomagamo.

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[9] https://getbadnews.si/droggame_book/junior/#intro (pridobljeno 22. 8. 2019).

[10] https://www.delo.si/novice/slovenija/sole-so-pri-digitalnemu-opismenjevanju-odpovedale.html (pridobljeno 22. 8. 2019).

Možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu v informacijski dobi

Opportunities for the self-education of economists and policymakers in the field of Brexit-related economic policy uncertainty in the United Kingdom in the information age

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POVZETEK

Uvod: Referendum o članstvu Združenega kraljestva v Evropski uniji je povzročil gospodarskopolitično negotovost v Združenem kraljestvu in potrebo po samoizobraževanju ekonomistov ter oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu. Študije so pokazale, da gospodarskopolitična negotovost negativno vpliva na gospodarsko aktivnost. Cilj tega prispevka je proučiti možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu v informacijski dobi.

Metode: Ta prispevek temelji na študijah primerov.

Rezultati: Ta prispevek je pokazal, da so različne možnosti samoizobraževanje ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu.

Razprava/sklep: Samoizobraževanje ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu dopolnjuje izobraževanje ekonomistov in oblikovalcev politike na področju ekonomije.

Ključne besede
brexit, gospodarskopolitična negotovost, samoizobraževanje, Združeno kraljestvo

ABSTRACT

Introduction: The United Kingdom European Union membership referendum has created economic policy uncertainty in the United Kingdom and the need for the self-education of economists and policymakers in the field of Brexit-related economic policy uncertainty in the United Kingdom. Studies have shown that economic policy uncertainty adversely affects economic activity. The aim of this paper is to study the opportunities for the self-education of economists and policymakers in the field of Brexit-related economic policy uncertainty in the United Kingdom.

Methods: This paper is based on case studies.

Results: This paper has shown that there are different opportunities for the self-education of economists and policymakers in the field of Brexit-related economic policy uncertainty in the United Kingdom.

Discussion/conclusion: The self-education of economists and policymakers in the field of Brexit-related economic policy uncertainty in the United Kingdom complements the education of economists and policymakers in the field of economics.

Keywords
Brexit, economic policy uncertainty, self-education, United Kingdom

1. UVOD

Brexit, tj. izstop Združenega kraljestva iz Evropske unije, izglasovan na referendumu 23. junija 2016, je priljubljena tema pogovorov med ekonomisti in oblikovalci politike. Podatki kažejo, da se je zaradi njega povečala gospodarskopolitična negotovost v Združenem kraljestvu (gl. npr. [1]), kar dela preglavice ekonomistom in oblikovalcem politike.

Gospodarskopolitična negotovost je široka tema. V tem prispevku proučujemo možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu. Po našem vedenju je to edini prispevek na to temo.

2. PREGLED LITERATURE

Brexit je povzročil potrebo po samoizobraževanju ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu.

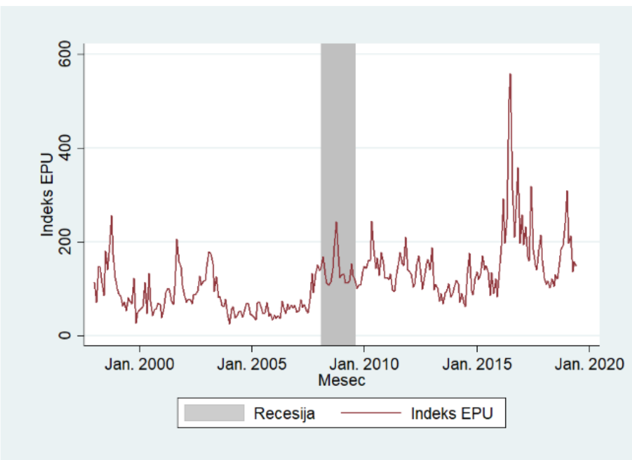
Ta prispevek dopolnjuje literaturo o gospodarskopolitični negotovosti in samoizobraževanju v informacijski dobi.

2.1 Gospodarskopolitična negotovost

V tem poglavju podajamo pregled literature o gospodarskopolitični negotovosti. S. R. Baker, N. Bloom in S. J. Davis [2] so ugotovili, da gospodarskopolitična negotovost v ZDA negativno vpliva na industrijsko proizvodnjo in naložbe ter pozitivno na brezposelnost v ZDA.

Izid referenduma o članstvu Združenega kraljestva v EU je šokiral nasprotnike brexita (angl. *Brexiters*), ki so bili prepričani o svoji zmagi. T. Kostka in B. van Roye [3] sta ugotovila na primeru referenduma o članstvu Združenega kraljestva v EU in predsedniških volitev v ZDA 8. novembra 2016, da lahko gospodarskopolitična negotovost poslabša finančne razmere in zviša premijo za tveganje, P. Kurečić in F. Kokotović [4] pa, da je izid referenduma o članstvu Združenega kraljestva v EU negativno vplival na dvanajst delniških trgov.

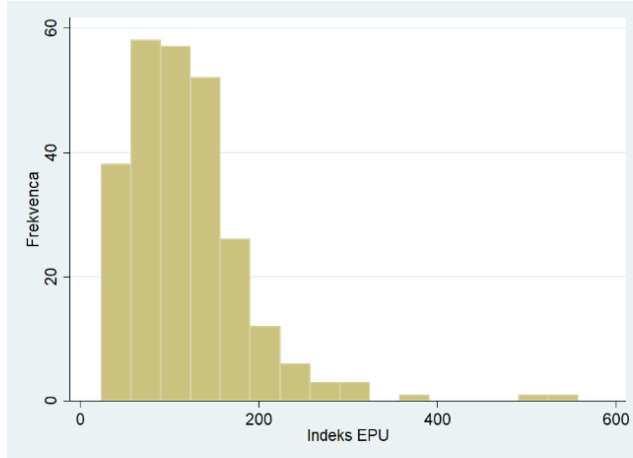
V literaturi srečujemo različne kazalce gospodarskopolitične negotovosti. S. R. Baker, N. Bloom in S. J. Davis [5] so razvili časopisni indeks gospodarskopolitične negotovosti (angl. *newspaper-based index of economic policy uncertainty*), ki je priljubljen med ekonomisti in oblikovalci politike. Slika 1 kaže gibanje, slika 2 pa porazdelitev indeksa gospodarskopolitične negotovosti za Združeno kraljestvo.



Slika 1: Gibanje indeksa gospodarskopolitične negotovosti za Združeno kraljestvo (od jan. 1998 do jul. 2019)
Opomba: Indeks EPU je časopisni indeks gospodarskopolitične negotovosti za Združeno kraljestvo. EPU je kratica za *E(conomic) P(olicy) U(ncertainty)*.
Vir podatkov: http://www.policyuncertainty.com/index.html.

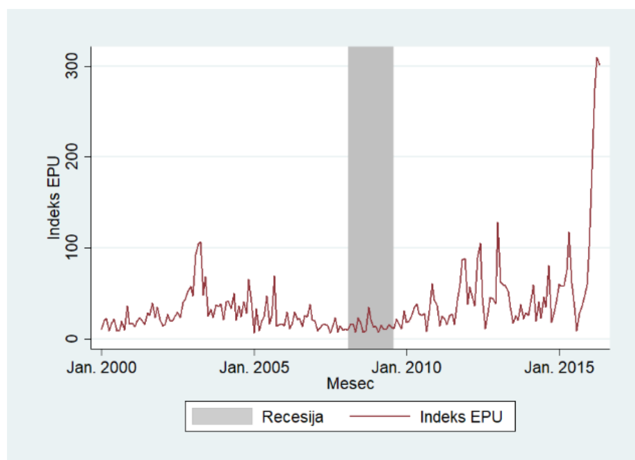
Podatki kažejo, da je gospodarskopolitična negotovost v Združenem kraljestvu dosegla svoj vrh julija 2016, ko je bil časopisni indeks gospodarskopolitične negotovosti za Združeno kraljestvo 558,2, kar je delalo preglavice vlagateljem. H. Asgharian, C. Christiansen, R. Gupta in A. J. Hou [6] so ugotovili, da gospodarskopolitična negotovost v Združenem kraljestvu negativno vpliva na volatilnost britanskega delniškega trga.

V nadaljevanju tega poglavja se omejujemo na z brexitom povezano gospodarskopolitično negotovost v Združenem kraljestvu. Študije so pokazale, da ta negativno vpliva na britansko gospodarstvo (gl. npr. [7]). A. Belke, I. Dubova in T. Osowski [8] so ugotovili, da z brexitom povezana gospodarskopolitična negotovost v Združenem kraljestvu negativno vpliva na volatilnost britanskega delniškega trga.

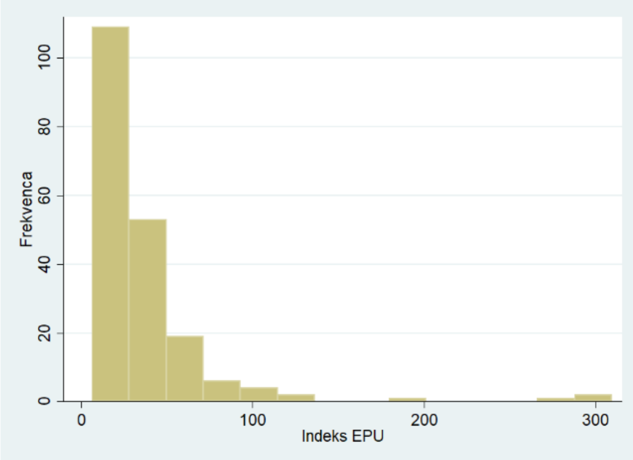


Slika 2: Porazdelitev indeksa gospodarskopolitične negotovosti za Združeno kraljestvo (od jan. 1998 do jul. 2019)
Opomba: Indeks EPU je časopisni indeks gospodarskopolitične negotovosti za Združeno kraljestvo.
Vir podatkov: http://www.policyuncertainty.com/index.html.

Med ekonomisti in oblikovalci politike je veliko zanimanje za z brexitom povezano gospodarskopolitično negotovost v Združenem kraljestvu, kar je samoumevno, saj je London drugo največje finančno središče, britansko gospodarstvo pa peto največje gospodarstvo na svetu. S. R. Baker, N. Bloom in S. J. Davis [9] so razvili časopisni indeks z brexitom povezane gospodarskopolitične negotovosti (angl. *newspaper-based index of Brexit-related economic policy uncertainty*) za Združeno kraljestvo. Slika 3 kaže njegovo gibanje, slika 4 pa porazdelitev. Ta indeks se razlikuje od časopisnega indeksa gospodarskopolitične negotovosti za Združeno kraljestvo.



Slika 3: Gibanje indeksa z brexitom povezane gospodarskopolitične negotovosti za Združeno kraljestvo (od jan. 2000 do maja 2016)
Opomba: Indeks EPU je časopisni indeks z brexitom povezane gospodarskopolitične negotovosti za Združeno kraljestvo.
Vir podatkov: http://www.policyuncertainty.com/brexit.html.



Slika 4: Porazdelitev indeksa z brexitom povezane gospodarskopolitične negotovosti za Združeno kraljestvo (od jan. 2000 do maja 2016)

Opomba: Indeks EPU je časopisni indeks z brexitom povezane gospodarskopolitične negotovosti za Združeno kraljestvo.
Vir podatkov: http://www.policyuncertainty.com/brexit.html.

2.2 Samoizobraževanje v informacijski dobi

V tem poglavju podajamo pregled literature o samoizobraževanju, tj. izobraževanju samega sebe brez šol, v informacijski dobi. Splošno znano je, da se samoizobraževanje spreminja pod vplivom informacijske tehnologije. Informacijska infrastruktura omogoča dostopnost informacij vsakomur, na vsakem mestu in ob vsakem času. R. Bannon [10] navaja različne možnosti samoizobraževanja v informacijski dobi.

V nadaljevanju tega poglavja se omejujemo na samoizobraževanje ekonomistov in oblikovalcev politike v informacijski dobi. Splošno znano je, da je samoizobraževanje obojih v informacijski dobi nujnost. V današnjem času težko sledimo vsem dogodkom. Kot primer navajamo brexit. Izkazalo se je, da je samoizobraževanje ekonomistov in oblikovalcev politike v informacijski dobi še neraziskano, kar nas preseneča. R. Bannon [11] in M. Goodloe [12] menita, da se vloga samoizobraževanja v informacijski družbi povečuje. V tem prispevku se zato sprašujemo, kakšne so možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu v informacijski dobi. M. Bird [13] navaja različne možnosti samoizobraževanja na področju ekonomije v informacijski dobi. Kot pomemben učni pripomoček navaja YouTube.

3. METODE

V tem prispevku proučujemo možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu v informacijski dobi. Kot primer navajamo spletišči https://policyuncertainty.com/ in https://voxeu.org/, ki sta priljubljeni med ekonomisti in oblikovalci politike.

4. REZULTATI

Spletišči https://policyuncertainty.com/ in https://voxeu.org/ dajeta različne možnosti samoizobraževanja na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu, zaradi česar sta priljubljeni tudi med študenti ekonomije. Na spletni strani http://www.policyuncertainty.com/all_country_data.html so dostopni podatki o časopisnih indeksih gospodarskopolitične negotovosti za 22 držav (Avstralijo, Brazilijo, Čile, Francijo, Grčijo, Indijo, Irsko, Italijo, Japonsko, Južno Korejo, Kanado, Kitajsko, Kolumbijo, Mehiko, Nemčijo, Nizozemsko, Rusijo, Singapur, Španijo, Švedsko, ZDA, Združeno kraljestvo), spletna stran http://www.policyuncertainty.com/methodology.html pa obravnava metode za računanje časopisnega indeksa gospodarskopolitične negotovosti.

4.1 Spletišče https://policyuncertainty.com/

Spletišče https://policyuncertainty.com/ daje različne možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju (z brexitom povezane) gospodarskopolitične negotovosti (v Združenem kraljestvu). Na spletni strani http://www.policyuncertainty.com/brexit.html so dostopni članek S. R. Bakerja, N. Blooma in S. J. Davisa o posledicah z brexitom povezane gospodarskopolitične negotovosti za britansko gospodarstvo in podatki o časopisnem indeksu (z brexitom povezane) gospodarskopolitične negotovosti za Združeno kraljestvo.

4.2 Spletišče https://voxeu.com/

Tudi spletišče https://voxeu.com/ daje različne možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju (z brexitom povezane) gospodarskopolitične negotovosti (v Združenem kraljestvu). Na spletni strani https://voxeu.org/content/brexit-beckons-thinking-ahead-leading-economists je dostopna knjiga vodilnih ekonomistov o brexitu, na spletišču https://voxeu.com/ pa so dostopni članki ter zvočni in videoposnetki o (z brexitom povezani) gospodarskopolitični negotovosti (v Združenem kraljestvu). Kot primer navajam spletni strani https://voxeu.org/vox-talks/economics-brexit in https://voxeu.org/vox-talks/investing-brexit, na katerih sta dostopna zvočna posnetka intervjujev z znanimi profesorji ekonomije in nekdanjim luksemburškim finančnim ministrom.

5. RAZPRAVA

Tema tega prispevka je zanimiva za ekonomiste, oblikovalce politike in pedagoge.

Ekonomisti in oblikovalci politike: Brexit je izziv za ekonomiste in oblikovalce politike, njihovo (samo)izobraževanje na področju z brexitom povezane gospodarskopolitične negotovosti pa nujnost. V tem prispevku smo ugotovili, da so v informacijski dobi različne možnosti za to. Kot primer smo navedli spletišči https://policyuncertainty.com/ in https://voxeu.org/, ki omogočata samoizobraževanja ekonomistov in oblikovalcev politike na področju (z brexitom povezane) gospodarskopolitične negotovosti (v Združenem kraljestvu) z branjem (člankov), gledanjem (videoposnetkov) in poslušanjem (zvočnih posnetkov).

Pedagogi: Jasno je, da vsi ekonomisti in oblikovalci politike nimajo enakih možnosti samoizobraževanja na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu, kar je izziv za družbo kot celoto. Jasno je tudi, da njihovo samoizobraževanje na tem področju dopolnjuje njihovo izobraževanje na področju ekonomije.

6. SKLEP

Z brexitom povezani dogodki povzročajo gospodarskopolitično negotovost, o kateri se premalo govori in piše. V tem prispevku smo proučevali različne možnosti samoizobraževanja ekonomistov in oblikovalcev politike na področju z brexitom povezane gospodarskopolitične negotovosti v Združenem kraljestvu v informacijski dobi. Iz razprave sledi, da daje svetovni splet različne možnosti samoizobraževanja ekonomistov in oblikovalcev politike na tem področju. Jasno pa je, da morajo za to imeti strokovno predznanje.

7. ZAHVALA

Zahvaljujemo se lektorjema za odpravo slovničnih in slogovnih napak.

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[2] Baker, S. R., Bloom, N., in Davis, S. J. 2016. Measuring economic policy uncertainty. *The Quarterly Journal of Economics* 131, 4, 1593–1636. DOI= https://doi.org/10.1093/qje/qjw024.

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Izobraževanje in tekmovanje v študiji primera: primer Fakultete za organizacijske vede

Case study education and competition: the case of the Faculty of Organizational Sciences

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POVZETEK
V prispevku je predstavljena izobraževalna metoda študije primera in izkušnje z omenjeno metodo na Fakulteti za organizacijske vede Univerze v Mariboru. V omenjeni organizaciji se metoda študije primera upravlja že več let in sicer v okviru dogodka Izobraževanje in tekmovanje v študiji primera za študente, ki se ga organizira skupaj s partnerskim podjetjem in študenti. Študija primera se v nekaterih primerih in predmetih uporablja tudi v okviru samega izobraževalnega procesa. Predstavljen so prednosti, ki jih omenjena metoda prinaša za fakulteto, partnersko podjetje in študente. Sledi prikaz razvoja in uporabe študije primera na fakulteti in predlogi za prihodnje delo. V prispevku je predstavljen potek dogodka, ki je namenjen študentom in sicer od oblikovanja projektne skupine, organizacije dogodka, izvedbe in vsebine izobraževanja. Predstavljena so obravnavana strokovna področja potrebna za razumevanje predstavljenega problema, delo strokovne komisije, izvedba tekmovanja in drugo.

Ključne besede
Izobraževanje, tekmovanje, problemsko učenje, študija primera

ABSTRACT
The article presents the educational method of case study and experiences with this method at the Faculty of Organizational Sciences of the University of Maribor. In the mentioned organization this method has been managed for several years as a part of the event Education and competition in a case study for students, which is organized together with a partner company and students. The case study method is also used in some cases and subjects within the educational process itself. The article introduces the advantages that this method brings for the faculty, company and for the students. An overview of the development and use of a case study at the faculty and suggestions for future work are also presented. In the paper the course of event, which is intended for the students, from the formation of the project team to the organization of the event, completion and content of the education is described. It introduces the discussed expert areas necessary to understand the presented problem, the work of the expert commission, realization of the competition and other.

Keywords
Education, competition, problem-based learning, case study

1. UVOD
Podjetja in organizacije se morajo nenehno prilagajati spremembam v okolju in v samem podjetju. Spremembe se velikokrat nanašajo na spremenjeno zakonodajo, tehnologijo, konkurenco, spremembe v vedenju ljudi in drugo. Uspešno prilagajanje je najpogosteje odvisno od znanja in veščin vseh vpletenih. Znanja in veščine, ki jih dobimo v procesu osnovnošolskega, srednješolskega in fakultetnega izobraževanja, niso vedno zadosten za pogoj za nemoteno opravljanje vseh nalog v podjetniškem okolju. Še težje pa je prilagajanje najnovejšim zahtevam, ki so posledica že omenjenih sprememb. Razkorak med uporabnim znanjem in znanjem, ki ga pridobimo v uradnih izobraževalnih inštitucijah lahko zmanjšujemo na različne načine in z različnimi metodami in tehnikami. Ena izmed takšnih metod je zagotovo študija primera, ki je izpeljanka tako imenovanega problemskega učenja. Študija primera je pedagoška metoda v kateri udeleženci večinoma rešujejo probleme, ki se pojavljajo v realnem okolju. V ta namen je potrebno sodelovaje med fakulteto in partnersko institucijo, ki zagotovi problem, katerega rešujejo študenti. Študenti oblikujejo ekipe v katerih ima vsak svojo nalogo. V poenostavljenem opisu je celoten dogodek sestavljen iz izobraževalnega in tekmovalnega dela, ki sta razdeljena v glavne faze, in sicer: (1) oblikovaje organizacijske ekipe, (2) izobraževanje in usposabljanje študentov, (3) predstavitev problema s strani partnerja (podjetja), (4) iskanje rešitve in pripravljanje predstavitve za komisijo, ki je sestavljena iz predstavnikov podjetja in fakultete (načeloma tudi študentov), (5) ocenjevanje predstavitev posameznih ekip, (6) obrazložitev najboljše izbrane rešitve, (7) podelitev nagrad s strani partnerske organizacije, ki je sponzor tekmovanja.

2. IZOBRAŽEVANJE
Izobraževanje je zelo pomembna dejavnost, saj vpliva na razvoj vsakega posameznika in tudi celotne družbe. Demografske spremembe in stalna potreba po posodabljanju znanja zaradi spreminjajočih se gospodarskih in socialnih razmer zahtevajo vseživljenjsko učenje (izobraževanje »od zibelke do groba«) in izobraževalne sisteme, ki se hitreje odzivajo na spremembe in so bolj odprti za širši svet [1]. Zavedati se je potrebno dejstva, da je v šolah in fakultetah klasično poučevanje (frontalno podajanje snovi) še vedno najpogostejši način podajanja snovi [2]. Profesorji in fakultete se soočajo z neprestanimi spremembami, od spreminjajočega se števila študentov v razredih, vedno večje

raznolikosti med študenti, do zahtev vlade in delodajalcev, ki želijo več odgovornosti in diplomante, ki so pripravljeni na delo že ob samem vstopu v podjetje [3]. Nekateri avtorji [4] so mnenja, da se znanje na univerzitetnem nivoju razlikuje od splošno pridobljenega znanja, saj se zahteva večja sposobnost logičnega mišljenja, prehajanja med abstraktnim in konkretnim koncepti in dognanji, ki so empirično podprta. Ko govorimo o izobraževanju nikakor ne smemo spregledati pomena informacijsko-telekomunikacijske tehnologije. Uporaba informacijsko-telekomunikacijske tehnologije in digitalnih socialnih omrežij je v zadnjih desetletjih hitro narasla, omenjene tehnologije pa so vedno bolj vključene v proces izobraževanja [5]. Kljub uporabi informacijsko-telekomunikacijske tehnologije v izobraževanju in drugih izobraževalnih pripomočkov, pa še vedno niso rešeni nekateri glavni problemi povezani z izobraževanjem. Eden izmed vedno bolj perečih problemov na področju izobraževanja je dejstvo, da se znanja in veščine za reševanje problemov, ki se pojavljajo v realnem okolju prepočasi uvajajo v izobraževanje. Delno se omenjeni problemi rešujejo v obliki sodelovanja med podjetji in izobraževalnimi inštitucijami. Ena izmed njih je zagotovo tako imenovano študija primera, ki je ena izmed oblik problemskega učenja.

3. PROBLEMSKO UČENJE

Problemsko učenje je pristop k učenju oziroma poučevanju, kjer se udeležence postavi v situacijo, kjer rešujejo določen problem oz. izziv. Postopek reševanja problema vključuje različne pristope. Poznamo dve vrsti problemov in sicer abstraktne in konkretne narave. Pri problemih abstraktne narave je sočasno več možnosti oziroma alternativnih rešitev, te pa so usmerjene v razvoj (t.i. divergenten tip) ali pa iskanje pravih rešitev z več možnostmi (t.i. konvergentni tip) [6].

Pri problemskem učenju gre za način izvajanja, kjer je učitelj v vlogi vodje procesa učenja in ne podaja oziroma razlaga učnih vsebin [7]. Omenjeni avtor opredeljuje proces problemskega učenja v štirih točkah:

- predstavitev problema in analiza obstoječega znanja skozi razpravo;
- opredelitev potreb po dodatnih znanjih, iskanje potrebnih informacij, določanje problema in oblikovanje skupin oziroma timov;
- samostojno delo skupin na osnovi podane literature in izdelava predloga rešitve;
- razprava o podanih rešitvah in oblikovanje predlogov rešitev problema.

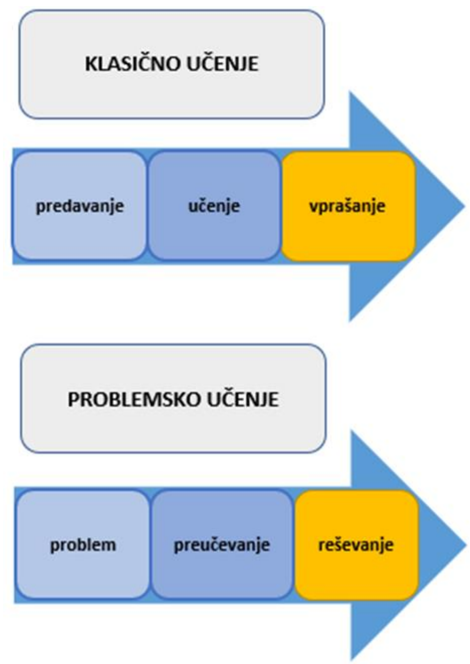
Problemsko učenje prepoznamo tudi pod angleško besedo problem-based learning (PBL). Slovensko pa se problemsko učenje omenja tudi kot problemski pouk, učenje z reševanjem problemov, učenje z odkrivanjem ter raziskovalna metoda. Izvor omenjene besede pa izhaja iz grškega izvora (problema), ki pomeni težko rešljiva naloga, nerešeno ali težko rešljivo vprašanje ter sporno vprašanje [7].

Pomembno je, da se v procesu problemskega učenja doseže aktivnost udeležencev, ki preko teorije spoznavajo način, kako rešiti problem [8]. Gre za naraven proces, kjer se človek sreča s problemi že pred samim formalnim izobraževanjem, samo problemsko učenje pa lahko označimo kot pogonsko silo za učenje [9]. Pomemben del je tudi sama refleksija na dogodek, saj udeleženci dobijo informacije in spoznanja, ki jim lahko koristijo oziroma pomagajo pri nadaljnjem delu [8].

Problemsko orientirani pouk je oblika (ne)posredno vodenega učenja, ki je naravnan na bistvo učne snovi, razkrivanje nasprotij in metodološko ter metodično osnovo spoznavanja. Značilno je, da ta vsebuje izrazite, celovite ali delne, neposredne ali posredne problemske situacije. Te učitelj v sodelovanju s študenti oziroma udeleženci vključuje v pouk in jih ne obravnava le kot posamezne dele [10]. Problemski pouk lahko opišemo kot metodični sistem učnih vprašanj, spoznavnih in učnih nalog ter tudi posebnega sistema povezav besede in ponazoril, opredelimo pa ga lahko kot skupnost didaktičnih postopkov, kot so [10]:

- organiziranje problemskih situacij,
- formiranje problemov,
- zagotavljanje pogojev za ustvarjalno in raziskovalno delovanje učencev,
- zagotavljanje primerne učne pomoči učencem in
- sistematiziranje in utrjevanje problemskih spoznanj in sposobnosti.

Slika 1 prikazuje razliko med klasičnim učenjem, pri katerem je prva stvar razlaga snovi, nato učenje le-te ter na koncu zastavljena vprašanja na katere je potrebno odgovoriti in problemskim učenjem, pri katerem se najprej zastavi problem oziroma raziskovalno vprašanje, nato se problem preuči ter na koncu poda idejo oziroma rešitev problema [11].



Slika 1: Razlika med klasičnim in problemskim učenjem [11]

4. ŠTUDIJA PRIMERA

Mesec in Lamovec [12] omenjata, da je ena izmed izpeljank problemskega učenja tako imenovana metoda študija primera. Izraz študija primera se je v Sloveniji uveljavil iz angleške besede ″case study″, pri kateri gre za podrobno raziskavo, ki večinoma temelji na dejanskih podatkih. Študijo primera pa lahko delimo na več kriterijev in na različne vrste [12]:

1. Glede na naravo posameznega primera (posameznika, družbe, organizacije, postopkov, kulturnih proizvodov, idr.).
2. Glede na število primerov, ki jih proučujemo (en primer, več primerov).
3. Glede na to ali gre za sestavljeno ali enostavno enoto analize:
- enostavna enota (majhno podjetje);
- sestavljena enota (večja organizacija, veliko podjetje, mesto, idr.).

4. Glede na vrsto empiričnega gradiva:
- primarno (gradivo dobimo le z opazovanjem ali spraševanjem);
- sekundarno (gradivo so dokumenti),
- kombinirano.

Študija primera se uporablja za pristop pri raziskovanju pojavov, pri čemer si pomagamo s posameznimi primeri, družbenimi entitetami, družbenimi procesi in poizkusi ter s proizvodi materialne in duhovne kulture v njihovem realnem življenjskem kontekstu. Za podroben in celosten opis je potrebno podatke zbirati iz različnih virov in z različnimi metodami. Na podlagi tega se oblikuje teoretične pojme, pojasnitve in posplošitve [12].

Veliko študentov se lažje nauči različne snovi, če se sami soočijo z izzivi v realnem delovnem oz. poslovnem okolju, saj je tak način učenja zelo učinkovit. V tem kontekstu se postavlja vprašanje ″Kaj bi ti naredil?″. Gre pravzaprav za zgodbo, ki je kompleksna in ki študente pripravi do raziskovanja in sprotnega učenja, saj študenti z raziskovanjem iščejo ustrezne rešitve. Študenti so tako sposobni najti ustrezne informacije, opredeliti problem in njegove parametre, opredeliti možne rešitve, oblikovati strategijo in ideje za ukrepanje ter narediti odločitev, kako rešiti problem [13].

Študije primera se razlikujejo glede na trajanje, ki je lahko 24 ur, 48 ur, en teden, šest mesecev ali več. Glavne lastnosti, ki jih ima študija primera so skupinsko delo, uporaba konkretnih znanj in veščin, delo pod časovnim pritiskom in drugo.

Študija primera ima številne prednosti za udeležence (študente), izobraževalno ustanovo in partnersko podjetje. Nekatere glavne prednosti za študente so:
- vpogled v področje uporabnega znanja in iskanja novih rešitev,
- razvijanje novih kompetence,
- delo v skupini,
- stik z delodajalci,
- spoznavanje novih ljudi in
- drugo.

Za izobraževalno ustanovo je študija primera koristna predvsem zaradi dodatnega ob študijskega dogajanja. Sledijo še nekatere prednosti:
- povezovanje z zunanjimi organizacijami oz. podjetji,
- večanje ugleda,
- prenos znanja na fakulteto,
- karierno usmerjanje študentov in
- drugo.

Za podjetje je glavna prednost pridobivanje novih idej in dobrih kadrov. Pomembna prednost je večanje razpoznavnosti blagovne znamke podjetja in drugo.

5. ORGANIZACIJA DOGODKA ŠTUDIJE PRIMERA

Organizacija dogodka na Fakulteti za organizacijske vede poteka po ustaljenem procesu. Začne se s prijavo projekta na Poziv za sofinanciranje in delovanje študentskih svetov, ki ga razpiše Univerza v Mariboru (UM). Poziv potrdi Komisija za interesne dejavnosti študentov UM. Dogodek je namreč organiziran s strani Študentskega sveta Fakultete za organizacijske vede v sodelovanju s Kariernim centrom Fakultete za organizacijske vede. Sledi oblikovanje delavne skupine, ki sestoji iz več članov in sicer:
- prodekan za študentska vprašanja,
- prodekanica za izobraževalno dejavnost,
- vodja Kariernega centra FOV UM,
- predstavniki Študentskega sveta FOV UM in
- ostali zaposleni v Kariernem centru FOV UM.

Organizacijski odbor določi termin dogodka ter pripravi vso potrebno dokumentacijo za izvedbo samega projekta. Dokumentacija oziroma naloge vključujejo: vlogo vodstvu za potrditev izvedbe projekta, časovnico dogodka, iskanje ponudb za naročila in priprava naročilnic za nakup potrebnih stvari, priprava in izvedba promocije ter ureditev spletne strani. Pomembna naloga organizacijskega odbora je tudi poiskati podjetje oziroma zunanjo organizacijo za pripravo študije primera in sodelovanje z izbrano organizacijo pri oblikovanju izziva. Pomembna je tudi organizacija izobraževanja, za katerega je potrebno poiskati izvajalce posameznih predavanj.

Organizacija izobraževanja sestoji iz več stopenj:
- določitev tem izobraževanja,
- podaja predloga za izvajalce posameznih sklopov znotraj izobraževanj,
- kontaktiranje morebitnih izvajalcev,
- usklajevanje terminov med izvajalci,
- določitev časovnice predavanj,
- rezervacija predavalnice,
- priprava predavalnice in
- izvedba predavanj.

Pridobivanje študentov za izobraževanje in tekmovanje ter promocija dogodka, ki potekata na več načinov in sicer:
- objava dogodka in vabila za sodelovanje na spletni strani,
- pošiljanje vabil za sodelovanje ostalim članicam UM,
- promocija dogodka na socialnih omrežjih,
- promocija dogodka s plakati in letaki in
- promocija dogodka s predstavitvami le-tega v času pouka po razredih.

Na izobraževanju so študenti seznanjeni z različnimi znanji in veščinami, ki jih lahko uporabijo za reševanje zastavljenega problema. Najpogosteje predstavljena znanja in veščine so s področij:
- problemskega učenja,
- koncepta in metode študije primera,
- pravil tekmovanja,
- komunikacijskih in predstavitvenih veščin,
- timskega dela,
- uporabe informacijsko-komunikacijskih tehnologih ter pripomočkov za analiziranje in pridobivanje podatkov,

- načinov izdelave in zakonitosti atraktivnih predstavitev in
- drugo.

Poleg izobraževanja je seveda pomembna tudi organizacija tekmovanja. Postopek opredeljujejo naslednji elementi:

- določitev datumov izvedbe,
- priprava predloga izvedbe,
- odobritev predloga s strani vodstva,
- iskanje zunanje organizacije, ki bo podala izziv,
- uskladitev teme oziroma izziva s podjetjem,
- urejanje spletne strani,
- izdelava in pošiljanje vabil,
- promocija dogodka na socialnih omrežjih,
- zbiranje prijav,
- oblikovanje komisije,
- rezervacija prostora za tekmovanja,
- naročanje oziroma nakup hrane, pijače in promocijskega materiala,
- izvedba izobraževanja,
- predstavitev podjetja in izziva tekmovalcem,
- samostojno delo tekmovalcev,
- izvedba predstavitev skupin,
- sestanek komisije za določitev zmagovalca in
- razglasitev najboljše skupine.

Po končanem izobraževanju in poteku časa za reševanje zastavljenega problema sledi tekmovanje, ki je v obliki javnih predstavitev študentskih rešitev. Za potrebe tekmovanja in ocenjevanja rešitev je oblikovana ocenjevalna komisija, ki je sestavljena iz najmanj štirih članov. Komisijo sestavljajo najmanj en član ali članica, ki zastopa partnersko podjetje ali organizacijo, predstavnik s strani profesorjev in načeloma tudi predstavnik študentov. Za ocenjevanje predstavitev ima komisija izdelana posebne ocenjevalne obrazce na katerih so kriteriji in lestvica ocenjevanja (od ena do deset). Kriteriji ocenjevanja predstavitev so sledeči:

- razumevanje problema, ki ga je predstavilo partnersko podjetje ali organizacija,
- izvedljivost predlagane rešitve,
- struktura in kakovost predstavitve in veščine predstavlja in
- dodatno znanje, ki je bilo prikazano kot posledica vprašanj s strani komisije.

Omeniti velja še nekaj podrobnosti. Zadnji dan izobraževanja se vodje posamezne ekipe udeležijo žreba vrstnega reda predstavitev, ki bo upoštevan na tekmovanju. Vrstni red se javno objavi in vse ekipe so tem obveščene oz. seznanjene. Na osnovi žreba se pripravi časovnica, kjer je natančno določen čas predstavitve posamezne epike, odmori in razglasitev zmagovalcev. Poleg časovnice vsaka ekipa prejme tudi predstavitev partnerskega podjetja in kontakt predstavnika podjetja za morebitne dodatne informacije. Poleg žreba se zadnji dan izobraževanja predstavijo tudi pravila tekmovanja in delo komisije. Dolžina posamezne predstavitve je do 10 do 15 minut, odvisno od števila ekip. Če je predstavitev predolga ima komisija pravico prekiniti predstavitev. Po predstaviti ima potem vsak član komisije možnost postavitve dodatnih vprašanj. Po končani zadnji predstavitvi komisija določi zmagovalca, glede na skupni seštevek točk in mnenj komisije. Sledi razglasitev zmagovalcev in podelitev nagrad. Na koncu dogodka pa sledi skromna pogostitev vse udeležencev izobraževanja in tekmovanja.

6. RAZVOJ ŠTUDIJE PRIMERA V PRIHODNOSTI

Želja izvajalcev Izobraževanja in tekmovanja v študiji primera je seveda kontinuiran razvoj le-tega. Pojavlja se želja predvsem v povečanju udeležbe na tovrstnem dogodku s strani študentov. Ključno za to je seveda priprava ustrezne promocije dogodka in študentom ponuditi bonitete za udeležbo. Iz dosedanjih izkušenj smo videli da so bonitete lahko naslednje:

- priznavanje študijskih obveznosti pri določenih predmetih,
- možnosti nadaljnjega sodelovanja z zunanjo organizacijo v obliki študentskega dela,
- možnost pridobivanja novih kompetenc in
- možnost pridobivanja novih izkušenj.

Iz izkušenj lahko sklepamo tudi, da se veliko študentov ne odloči za sodelovanje pri tovrstnem dogodku, saj imajo težavo z uskladitvijo študijskih in ob študijskih dejavnosti ali študentskega dela s terminom projekta oziroma dogodka. Na slednjega sicer ne moramo vplivati, za usklajevanje z študijskimi obveznostmi pa bi bilo potrebno sodelovanje organizacijskega odbora s plansko službo na fakulteti, kar bi več študentom omogočilo sodelovanje ali pa bi bilo potrebno udeležencem na tekmovanju in izobraževanju ponuditi olajšave glede udeležbe na predavanjih in vajah, ter jim tako zagotoviti čas za ustrezno pripravo na tekmovanje.

Za nemoteno in pravno vzdržno izvedbo dogodka je potrebno upoštevati vedno več zakonskih zahtev. Omeniti moramo, da je dne 25. 5. 2018 je začela veljati Uredba (EU) 2016/679 Evropskega parlamenta in Sveta z dne 27. 4. 2016 o varstvu posameznikov pri obdelavi osebnih podatkov in o prostem pretoku takih podatkov ter o razveljavitvi Direktive 95/46/ES (Splošna uredba o varstvu podatkov - GDPR). GDPR izjave so pomembne iz razloga, ker se dogodki lahko dokumentirajo v obliki fotografij. Določene fotografije pa se lahko objavilo na spletnih straneh fakultete in socialnih omrežjih za potrebe promocije.

7. ZAKLJUČEK

Kot je bilo že omenjeno predstavlja študija primera eno izmed izpeljank problemskega učenja. Pri študiji primera se študenti soočijo z določeno problemsko situacijo in se lahko postavijo tudi v vlogo vodje. Skupno za vse študije primera je, da študenti dobijo pozitivno izkušnjo, ki jo lahko uporabijo kasneje v praksi. Tako študenti namesto pridobivanja zgolj teoretičnega znanja pri reševanju študije primera samostojno iščejo rešitve, ki se lahko uporabijo v praksi.

Iz večletnih izkušenj na področju izvajanja študije primera se je v primeru Fakultete za organizacijske vede izkazalo, da je optimalna izvedba izobraževanja za študente takšna pri kateri sodelujejo profesorji, zunanji izvajalci in študenti, ki so že sodelovali na izobraževanju in tekmovanju. Omenjena kombinacija izvajalcev izobraževanja ponuja kontinuiteto na področju izvajalcev, kar daje celotni organizaciji dogodka večjo stopnjo verjetnosti izvedbe brez zapletov. Druga pomembna pozitivna lastnost je dinamika predstavitev in manjša monotonost, saj so za nekatere študente določeni profesorji zanimivi za določene žal ne. Kratke dinamične predstavitve določenih področij do neke mere prisilijo tudi izvajalce predavanja, da se osredotoči na pomembne zadeve.

Problemi, ki jih rešujejo študenti so zelo aktualni in predstavljajo dejanske probleme s katerim se srečujejo podjetja s katerimi smo sodelovali. Pri pripravi predstavitve problema njegovi metodološki pravilnosti ter razumljivosti člani organizacijskega odbora dogodka pomagajo pripraviti problem skupaj s predstavniki podjetja. Za potrebe optimalne izvedbe dogodka se pripravi in podpiše tudi pogodba med partnerskim podjetjem in Fakulteto za organizacijske vede. V pogodbi so določene obveznosti posamezne organizacije, kot so zagotovitev prostorov za izobraževanje in tekmovanje, zagotovitev izvajalcev izobraževanja, zagotovitev nagrad za prve tri uvrščene ekipe in drugo.

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Uporaba mobilne aplikacije Nexto na dnevih dejavnosti

Using mobile application Nexto on activity days

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POVZETEK

Prispevek predstavlja možnost izvedbe inovativnega pouka po sodobnih pristopih poučevanja. Osredotočamo se na celostno učenje, za katerega je potrebno ustvariti bogato učno okolje, ki spodbuja domišljijo, krepi pozornost in k aktivnosti pritegne čim več posameznikov. Sodobni pouk posebej poudarja in spodbuja aktivne oblike in metode dela. Uporaba informacijsko-komunikacijske tehnologije ni več izbira, temveč nuja. Učenci bodo učno uspešni in posledično motivirani za delo takrat, ko jim bodo dejavnosti in naloge predstavljale izziv. Uporaba mobilne aplikacije Nexto za izobraževalne namene predstavlja svojevrstno multimedijsko izkušnjo, ki na igriv način, preko kvizov, izzivov in nalog skozi obogateno resničnost ustvarja novo izkušnjo spoznavanja kulturnih in naravnih znamenitosti. Uporabna je predvsem na dnevih dejavnostih za spoznavanje geografskih, zgodovinskih in kulturnih vsebin, ki jih običajno izvajamo na terenu. Uporaba aplikacije pri učencih dviga učno motivacijo s pomočjo katere dosegamo pozitivne učne učinke.

Ključne besede

Inovativni pouk, sodobni pristopi poučevanja, informacijsko-komunikacijska tehnologija, mobilna aplikacija Nexto

ABSTRACT

The paper presents the possibilities for delivering innovative teaching following contemporary teaching approaches. We are focused on holistic learning, and to do this we need to create a rich environment that works, imaginative, enhances attention in activities and attracts as much attention as possible. Modern teaching is used in active forms in working methods. Use of ICT is not a choice anymore, but a necessity. Pupils will be motivated and learning successfully in when the tasks are challenging for them. Using Nexto's educational applications is a kind of multimedia experience that, through quizzes, challenges in the assignment through the augmented reality of creating new experiences of learning about cultural and natural sights. The user used daily activities to get to know the geographical, historical and cultural content that they performed in the field. Use apps with students who are moving in good motivation to achieve positive effects.

Keywords

Innovative teaching, modern teaching approaches, information and communication technology, Nexto application

1. UVOD

Interaktivne metode poučevanja postajajo del šolskega vsakdana, saj je izjemen tehnološki napredek posegel v vse segmente našega življenja. Informacijsko-komunikacijsko tehnologijo ljudje danes uporabljajo v vseh delovnih okoljih na vseh področjih. Pri tem šola ni nobena izjema. Sodobni pristopi poučevanja in učenja učence vodijo k samostojnemu razmišljanju in raziskovanju. Da bi dosegli čim večjo pozornost in odzivnost učencev pri pouku je potrebno preseči vsakdanje okvire poučevanja in se osredotočiti na tiste, s katerimi bomo dosegli visoke učne učinke, učence pa motivirali za delo. K inovativnim pristopom poučevanja sodi sodelovalno učenje, projektno delo ter uporaba informacijsko-komunikacijske tehnologije, slednja postaja že integralni del sodobnega pouka. Ustrezno e-kompetenten učitelj lahko informacijsko-komunikacijsko tehnologijo uporabi za atraktivnejšo pot do znanja.

Uporaba mobilne aplikacije Nexto predstavlja privlačnejšo pot za spoznavanje geografskih in zgodovinskih vsebin. Aplikacijo uporabimo za potrebe usvajanja nove učne snovi ali pa za utrjevanje in ponavljanje znanja.

S predstavitvijo te aplikacije želimo učitelje spodbuditi k atraktivnejšemu in dinamičnemu poučevanju, ki bo pri učencih dosegla pozitivne učne učinke.

2. SODOBNI PRISTOPI POUČEVANJA

Sodobni pristopi poučevanja temeljijo na aktivnem delu učencev. Cilj sodobne šole je inovativen učenec, ki je opremljen z znanjem za njegovo ustvarjalno rabo. Naloga učitelja je, da razvija kreativnost, neodvisnost mišljenja, kritično presojanje, reševanje problemov, sodelovanje in sprejemanje odgovornosti. Z efektivnimi didaktičnimi pristopi ustvarimo spodbudno učno okolje, v katerem bodo učenci aktivni, motivirani in v katerem bodo razvijali svoja močna področja v vseh segmentih izobraževanja [4]. Učitelji naj bi uporabljali takšne pristope in ustvarjali takšne situacije, ki bodo zagotavljale učinkovito učenje, kakovostno znanje in pri učencih razvijali samostojno ustvarjalno mišljenje. Pri uresničevanju učnih ciljev je pomembna procesna naravnanost, kako učni proces peljati tako, da bodo učenci na čim bolj učinkovit način dosegali cilje. Učitelj mora torej razmisliti, kakšne korake in dejavnosti v procesu bo izbral, da bo učence pripeljal do razumevanja, uporabe, povezovanja, kritične presoje itd. Učitelj mora strateško načrtovati tiste dejavnosti, ki bodo najbolj učinkovito spodbujale učenje z razumevanjem in razvijale učenčevo ustvarjalno razmišljanje [10].

Učenci bodo učno uspešni in posledično motivirani za delo takrat, ko jim bodo dejavnosti in naloge predstavljale izziv. Vendar »namen aktivnih učnih metod ni samo v tem, da bi učenci radi hodili k pouku, ampak je prvi namen doseganje načrtovanih ciljev/standardov ter trajnost in uporabnost znanj, ki so pridobljena/zgrajena na tak aktiven način« [4].

Cilj sodobnega načina poučevanja in učenja je doseči metakognitiven način mišljenja. Priti mora do ponotranjanja metakognitivnih strategij oz. razvijanja proaktivnega in samoregulativnega odnosa do učenja. Številne raziskave so namreč potrdile, da s konsistentnim umeščanjem razvijanja metakognitivnih strategij v učni proces omogočamo učencem, da razvijejo zmožnosti nadzorovanja lastnega procesa učenja, pridobijo sposobnost presoje kakovosti svojega znanja in da sami zaznavajo potrebo po širjenju, poglabljanju in regulaciji svojega znanja[11]. Poučevanje se tako pojmuje kot podpiranje smiselnega učenja, podpiranje učenčeve gradnje pojmov, pa tudi spreminjanje pojmov, vodenje učencev k globljemu razumevanju, spodbujanju samostojnega odkrivanja, povezovanja novega z izkušnjami. S takšnim načinom poučevanja dosežemo višje oblike učenja pri učencih [6].

Učitelj se pri svojem poučevanju poslužuje raznovrstnih metod dela. Sodobni pouk posebej poudarja in spodbuja aktivne oblike in metode dela.

2.1 Sodelovalno učenje

Sodelovalno učenje je skupno delo za doseganje skupnega cilja. O sodelovalnem učenju govorimo takrat, kadar pouk poteka v manjših skupinah z namenom doseči skupni cilj. Delo je organizirano tako, da vsak član doseže največji učni učinek in hkrati pomaga drugim, da tudi oni dosežejo kar največ. Interakcija ima pri tem osrednje mesto. Učitelj usmerja in vodi celoten proces, nudi pomoč, če jo katera izmed skupin potrebuje [6] . Sodelovalno učenje nudi možnost aktivnega sodelovanja vseh učencev, učence spodbuja, da so pri učenju dejavni, da utemeljujejo svoje zamisli in se vsak zase in skupaj poglobijo v vsebino in pridobijo znanje na obravnavanem področju [3].

Sodelovalno učenje uporabimo pri tistih učnih vsebinah, ki so primerne za delo po skupinah. Za delo v skupini so potrebne posebne komunikacijske veščine in občutek za kolektivno sodelovanje.

2.2 Projektno delo

Projektno delo je v šolski praksi zelo aktualno, saj predstavlja inovativno metodo, ki spodbuja učenčevo aktivnost in u zagotavlja celosten razvoj. V Slovarju slovenskega knjižnega jezika [12] je projekt opredeljen kot načrt, ki določa, kaj se misli narediti in kako naj se to uresniči. Projektno delo je definirano tudi kot metodični postopek, s katerim se udeleženci učijo razmišljati in delati projektno[7].

Pri projektnem učnem delu učitelj vodi učence skozi učni proces v smeri uresničevanja vzgojno-izobraževalnih ciljev in nalog, ki jih je postavil v sodelovanju z učenci na začetku izvajanja projekta. Udeleženci so aktivni izvajalci, ki ob pomoči vodje dajejo pobude, predloge, načrtujejo potek, sodelujejo med seboj, izmenjujejo različne poglede itd. Temeljno vodilo pri projektnem delu je spodbujanje celovitega in skladnega osebnostnega razvoja vsakega posameznika[7].

2.3 Informacijsko-komunikacijska tehnologija pri pouku

Pouka brez uporabe informacijsko-komunikacijske tehnologije si ni mogoče več predstavljati, vendar je uporaba le-te seveda odvisna od učitelja, od njegovega individualnega znanja, lastnega prepričanja in pristopa k poučevanju. Možnosti sodobnejšega in kvalitetnejšega pouka in poučevanja sovpadajo z ustrezno izbiro učne tehnologije. Zelo pomembna je učiteljeva samozavest in prepričanje v lastne sposobnosti na področju informacijsko-komunikacijske tehnologije. Bolj samozavestni in sposobni učitelji so hitro pripravljeni sprejeti nove učne pristope, medtem ko manj samozavestni redkeje pristopijo k uporabi novih tehnologij. Učitelji z bolje razvitimi osebnimi sposobnostmi za uporabo informacijsko-komunikacijske tehnologije lažje razumejo potencial, ki ga informacijsko-komunikacijska tehnologija nudi, in so tudi bolj odločni za uporabo pri poučevanju [13].

V povezavi z informacijsko-komunikacijsko tehnologijo govorimo o informacijski pismenosti na eni strani ter računalniški pismenosti na drugi strani. Informacijska tehnologija je le orodje, ki omogoča dovolj hiter in zanesljiv proces, ki nam pomaga pri iskanju rešitev, ne more pa nadomestiti učitelja. Učitelj v učni proces vnaša izkušnje in perspektivo, ideje in drugačne poglede, informacijska tehnologija pa hitrost in zanesljivost obdelave podatkov [15].

V zadnjem času se namesto računalniške pismenosti uporablja nov pojem, in sicer digitalna zmožnost oziroma digitalna kompetenca. »Digitalna zmožnost oz. kompetenca je zavedanje, odnos in sposobnost vsakega posameznika, da smiselno uporablja digitalna orodja in storitve za razločevanje, dostopanje, upravljanje, vključevanje, vrednotenje, analiziranje in sintetiziranje digitalnih virov, da ustvarja nova znanja, nove medijske izraze in se sporazumeva z drugimi v specifičnih življenjskih okoliščinah, da bi tako omogočil konstruktivna družbena dejanja in da bi lahko razmišljal o teh procesih« [5].

Uporaba informacijsko-komunikacijske tehnologije ni več izbira, temveč nuja. Digitalna zmožnost vključuje zavestno in kritično rabo informacijske tehnologije pri opravljanju šolskih obveznosti in dejavnosti. Omogoča rabo raznih oblik in metod dela, učence večinoma motivira za pouk in omogoča hitrejše in kakovostnejše doseganje ciljev pouka [14].

2.3.1. Uporaba mobilnih telefonov pri pouku

V zadnjem času velik izziv predstavlja uporaba mobilnih telefonov s številnimi možnostmi rabe v učnem procesu. Ker je mobilni telefon lahko dober didaktični pripomoček, center za varnejši internet Safe.si spodbuja učitelje k rabi mobilnih telefonov pri pouku, vendar spodbuja tudi kritično mišljenje o njegovi uporabi. Prednosti uporabe mobilnih telefonov v šoli so številne. Mladostniki imajo na svojih mobilnih telefonih na dosegu prstov več informacij, kot jih lahko ponudi knjižnica ali učitelj. Vendar je pri tem potrebno biti kritičen o presoji internetnih virov in njihovi ustrezni uporabi. Tudi raziskave kažejo, da imajo lahko mobilni telefoni pozitiven učinek v razredih [1].

3. PREDSTAVITEV APLIKACIJE NEXTO

Nexto je razvila mlada slovenska ekipa Proxima. Aplikacija obiskovalcem muzejev in znamenitosti nudi obogateno multimedijsko izkušnjo. Platforma je ustvarjena kot lokacijska igrifikacija z elementi obogatene resničnosti za destinacije na področju kulturnega turizma. Platforma omogoča ustvarjanje in posredovanje interaktivnih lokacijskih pripovedi, ki obiskovalčevo doživetje kulturnih turističnih destinacij (muzeji, naravni parki, zgodovinska mesta, arheološka najdišča) pretvarjajo v zanimivo in zabavno dogodivščino z elementi razširjene resničnosti [8].

»Nexto je pametni mobilni vodnik po destinacijah kulturne in naravne dediščine. Mobilna aplikacija deluje na platformah iOS in Android in nadgrajuje klasično izkušnjo avdio vodenja, saj s pomočjo Bluetooth ali GPS-senzorjev zaznava uporabnikovo lokacijo in ga opozarja na zanimivosti v njegovi bližini. Obiskovalec lahko s slušalkami v ušesih in telefonom v žepu med raziskovanjem destinacije vsebine prejema samodejno, brez neposredne interakcije s telefonom. Doživetje mu še posebej izboljšata hiter dostop do jasno označenih vodenih poti in interaktivnih zemljevidov ter vizualno privlačna predstavitev multimedijskih vsebin. Samo izkušnjo popestrijo unikatni Facebook selfie filtri« [9].

4. UPORABA APLIKACIJE NEXTO NA DNEVIH DEJAVNOSTI

Dnevi dejavnosti so tisti del obveznega programa osnovne šole, ki medpredmetno povezujejo discipline in predmetna področja, vključena v predmetnik osnovne šole. Dnevi dejavnosti potekajo po šolskem kurikulumu, ki določa njihovo vsebino in organizacijsko izvedbo. Cilji dni dejavnosti so učencem omogočiti utrjevanje in povezovanje znanja pridobljenega pri posameznih predmetih in predmetnih področjih, uporabljanje tega znanja in njihovo nadgrajevanje s praktičnim učenjem v kontekstu medsebojnega sodelovanja in odzivanja na aktualne dogodke v ožjem in širšem družbenem okolju. Koncept dni dejavnosti sta sprejela Nacionalni kurikularni svet in Strokovni svet Republike Slovenije za splošno izobraževanje leta 1998. Z dnevi dejavnosti pri učencih spodbujamo vedoželjnost, ustvarjalnost in samoiniciativnost. Usposabljamo jih za samostojno opazovanje in pridobivanje izkušenj in znanja, za razvijanje spretnosti ter za samostojno reševanje problemov. Ob teh dejavnostih učenci znanje različnih področij povezujejo v celoto. Dnevi dejavnosti so vsebinsko pestri in se nadgrajujejo iz leta v leto oziroma iz triletja v triletje [2].

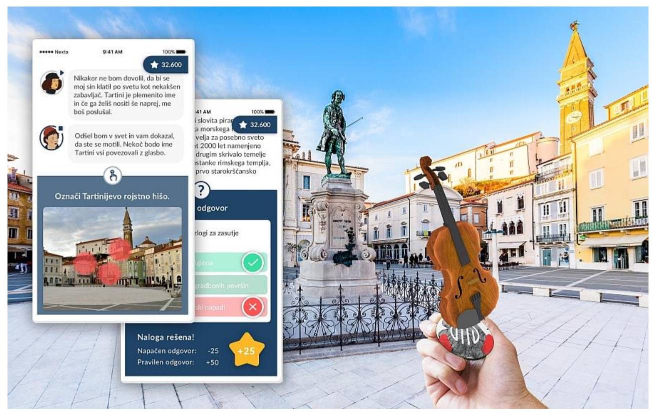
Pri izvajanju dni dejavnosti pogosto uporabimo projektni način dela. Na ta način dnevi dejavnosti omogočajo razvijanje elementov raziskovalnega učenja. Pogosto dneve dejavnosti izvedemo na terenu, kjer si ogledamo kulturne spomenike, naravne in kulturne znamenitosti, izvedemo ogled zgodovinskih spominskih krajev ali obiščemo kulturne ustanove.

Da bi bili dnevi dejavnosti izvedeni čim bolj pestro ter vsebine in pristopi čim bolj blizu učencem, se lahko poslužujemo tudi mobilne aplikacije Nexto. S pomočjo aplikacije lahko spoznavamo kulturne turistične destinacije (muzeji, naravni parki, zgodovinska mesta, arheološka najdišča …), ki obiskovalčevo doživetje pretvarjajo v zabavne dogodivščine z elementi razširjene resničnosti. Aplikacija ponuja raziskovanje številnih krajev, kulturnih ustanov in naravnih znamenitosti po Sloveniji, ki jih v okviru dni dejavnosti obiščejo učenci.

Za potrebe raziskovanja Pirana v okviru šole v naravi smo uporabili igrifikacijski in interaktivni vodič Legende Pirana, s katerim smo odkrivali znamenitosti, spoznavali zgodovinske like, reševali uganke in se s pomočjo obogatene resničnosti zazrli v preteklost.

Slika 1. Spoznavanje znamenitosti na Tartinijevem trgu [3]

Aplikacija ima na voljo šest izzivov, in sicer Vražji Tartini, Zlobni jeziki, Piranski ščit, Ogenj in voda, Vrata skozi zgodovino in Srce Pirana.



Slika 2. Reševanje izzivov [3]

Ob poučnem sprehodu po mestu s pomočjo obogatene resničnosti ob Tartinijevem trgu zagledajo vražjega trilčka in poslušajo zvoke znamenite sonate, spoznajo zgodbo kamnite plošče z napisom »lasa pur dir« in Benečanke, ki jo lahko pobarvajo v rdeče. Na poti spoznajo zgodbo o sv. Juriju, ki je rešil mesto pred neurjem, se seznanijo z nastankom piranskega svetilnika, dobijo informacije o Dolfinovih vratih ter o zasutju mandrača. Z uspešnim reševanjem izzivov obiskovalci lahko odklepajo virtualne spomenike, 3d afekte, ki jih lahko tudi doma ali v šoli občudujejo v obogateni resničnosti.

5. ZAKLJUČEK

Sodobno šolo z inovativnimi pristopi poučevanja je potrebno graditi v skladu s tehnološkim napredkom in sodobnimi smernicami didaktike. Z ustvarjanjem bogatega učnega okolja v katerem bodo učenci motivirano pridobivali znanje in se učili samostojno razmišljati in raziskovati, bomo dosegali visoke učne učinke. Uporaba informacijsko-komunikacijske tehnologije ni več izbira, temveč nuja. Z uporabo mobilnih naprav kot didaktičnega pripomočka v šolah lahko učencem približamo posamezno učno snov, dejavnosti pa organiziramo tako, da bodo le-te učencem predstavljale izziv. Uporaba mobilne aplikacije Nexto z namenom spoznavanja kulturnih znamenitosti Pirana je dosegla visok učni učinek. Preko multimedijske izkušnje so učenci na igriv način preko kvizov, izzivov in nalog skozi obogateno resničnost spoznavali srednjeveško mesto. Naj predstavitev aplikacije spodbudi učitelje k atraktivnejšim in dinamičnim načinom poučevanja.

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Razvijanje računalniškega mišljenja pri otrocih z lažjo motnjo v duševnem razvoju

Computational thinking and students with mild cognitive impairment

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POVZETEK
Poročilo strokovne delovne skupine za analizo prisotnosti vsebin računalništva v programih slovenskih šol razkriva, da so te vsebine slabo zastopane. Prispevek predstavlja poskus uvajanja vsebin kodiranja v prilagojeni program z nižjim izobrazbenim standardom, v katerega so usmerjeni učenci, ki imajo motnje v duševnem razvoju. Z dejavnostmi kodiranja lahko razvijamo učenčevo računalniško mišljenje, ki spada med osnovne digitalne kompetence, ki naj bi jih pridobili vsi v digitalni družbi.

Ključne besede
Računalniško mišljenje, posebne potrebe, kodiranje, digitalne kompetence

ABSTRACT
Authors of the report on ICT themes in Slovenian curriculum agree that ICT is underrepresented and not compulsory. In this paper we present an attempt to teach coding in special classes for children with special educational needs (with profound learning difficulties). With coding we can develop computational thinking, one of main digital competencies, which all persons in today's digital society should possess.

Keywords
Computational thinking, special needs, coding, digital competence

1. UVOD
Strokovna skupina RINOS (strokovna delovna skupina za analizo prisotnosti vsebin računalništva in informatike v programih osnovnih in srednjih šol ter za pripravo študije o možnih spremembah) je leta 2018 ministrici za izobraževanje predala poročilo z naslovom Snovalci digitalne prihodnosti ali le uporabniki? V poročilu avtorji analizirajo analizo vključevanja računalništva v vzgojno-izobraževalni proces v Sloveniji, ga primerjajo v vključevanjem v drugih državah in predlagajo možne spremembe za izboljšanje stanja[7]. Med njimi so predvsem pomembni predlogi: uvesti temeljne vsebine RIN (računalništva in informatike) v kurikul vrtcev ter učne načrte osnovne in srednjih šol; zagotoviti celovito preverjanje opismenjevanja in uporabe tehnologij v okviru vseh predmetov skladno z obstoječimi učnimi načrti; postaviti učinkovit sistem za kakovostno izobraževanje in nadaljnje strokovno usposabljanje vzgojiteljev in učiteljev na področju RIN ter vzpostaviti sistem odprtega izobraževanja, ki omogoča vključevanje deležnikov v oblikovanje vizije ter zagotavljanje in spremljanje kakovosti poučevanja RIN. Strokovno poročilo je eden od korakov modernizacije in informatizacije slovenskega šolstva, ki pa sistemsko ni podprt.

Tako omenjeno poročilo obravnava tudi vključenost vsebin RIN v učnih načrtih osnovnih in srednjih šol. Skupina ugotavlja, da je v učne načrte osnovne šole smiselna in kritična raba IKT vključena pri vseh predmetih, vendar posebnega predmeta, ki bi razvijal digitalne kompetence in uporabo IKT v obveznem programu ni. Tudi sicer je vključenost temeljnih znanj računalništva in informatike v obvezni predmetnik OŠ minimalna.[7] Izbirni predmeti s področja RIN vključujejo znanja vseh digitalnih kompetenc, vendar pa jih obiskujejo učenci, ki se zanje odločijo, nekatere vsebine (npr. programiranje) pa so izbirne znotraj izbirnega predmeta. Sistematičnega in obveznega poučevanja vsebin RIN ter s tem razvoja digitalnih kompetenc, kot jih predvideva Okvir digitalnih kompetenc za državljane, DigComp, ni. Omenjeni okvir na več nivojih opisuje kompetence na področjih informacijske pismenosti, komuniciranja in sodelovanja, izdelovanja digitalnih vsebin, varnosti in reševanja problemov. [5] Zadnja od navedenih kompetenc opisuje t.i. računalniško mišljenje.

Poročilo strokovne skupine RINOS v analizi ni upoštevalo vseh izobraževalnih programov. V Sloveniji se učenci s posebnimi potrebami, ki jih opredeljuje Zakon o usmerjanju otrok s posebnimi potrebami (ZUOPP)[8], lahko usmerijo v programe s prilagojenim izvajanjem, v prilagojene programe ali posebni program vzgoje in izobraževanja. Učenci z lažjo motnjo v duševnem razvoju so običajno usmerjeni v prilagojene programe z nižjim izobrazbenim standardom (PPNIS), ki imajo prilagojen predmetnik in tudi učne načrte. Predmetnik obveznega programa opredeljuje v drugi triadi v 4., 5. in 6. razredu obvezno izvajanje specialno-pedagoške dejavnosti računalniško opismenjevanje, v tretji triadi pa si učenci lahko med izbirnimi predmeti izberejo računalništvo.[6]

V učnem načrtu specialno-pedagoške dejavnosti računalniško opismenjevanje je kot eden od splošnih ciljev predmeta navedeno, da učenci pridobivajo in razvijajo sposobnost samostojnega reševanja problemov.[2] Razvijanje računalniškega mišljenja je kot cilj torej že vključeno v učni načrt, pregled vsebin in operativnih ciljev pa eksplicitno tega splošnega cilja ne udejanja. Tudi veljavni učni načrt za izbirni predmet računalništvo ne predvideva vsebin, ki bi se nanašale na razvijanje računalniškega mišljenja.

2. RAČUNALNIŠKO MIŠLJENJE
Računalniško mišljenje (angl. computational thinking) je skupek metod, s katerimi probleme predstavimo tako, da za njihovo

rešitev lahko pripravimo koračna navodila, podobno kot v računalniških programih. Toda računalniško mišljenje ni le v povezavi z računalniki. Učinki računalniškega mišljenja se v izobraževanju kažejo na vseh področjih tako, da ojačajo in podpirajo ostale pridobljene miselne veščine.[4] McClelland in Instructional[3] navajata, da računalniško mišljenje lahko način spoprijemanja s problemi prenese na širok nabor situacij, na primer na zaupanje vase in na vztrajnost pri spoprijemanju s težjimi primeri, na zmožnost reševanja odprtih primerov, z več različnimi rešitvami, in na zmožnost sodelovanja z drugimi za dosego skupnega cilja.

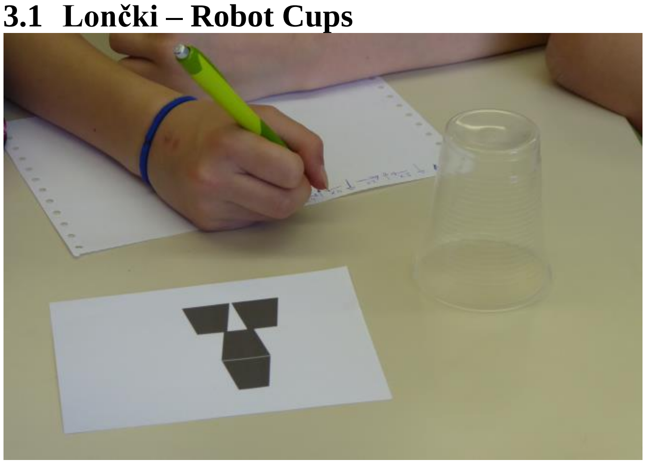
Barr, Harrison in Conery navajajo, da bi se vsak učenec moral uriti v računalniškem mišljenju, saj vpliva tudi na osnovne veščine – branje in računanje, učencu pa so vse veščine kasneje na voljo v čim večji meri.[1] Ker pa je računalnik danes skorajda osnovno orodje v praktično vseh panogah človekovega delovanja, je računalniško mišljenje ena od osnovnih veščin, ki bi jih sleherni posameznik moral pridobiti.

3. PRIMER RAZVIJANJA RAČUNALNIŠKEGA MIŠLJENJA Z UVAJANJEM PROGRAMIRANJA

Pri pouku izbirnega predmeta računalništvo smo v šolskem letu 2018/19 poskusno uvedli vsebine programiranja. V skupini so bili učenke in učenci od 7. do 9. razreda prilagojenega programa z nižjim izobrazbenim standardom. Skupina je bila heterogena po starosti in kognitivnih sposobnostih, zato je bila izbira teme sprva vprašljiva.

Metodika dela specialnih pedagogov temelji (tudi) na načelu konkretnosti. Učenci z zmanjšanimi kognitivnimi zmožnostmi namreč težje razumejo abstraktnejše koncepte, zato smo iskali načine, kako lahko koncepte programiranja predstavimo učencem na konkreten in enostaven način.

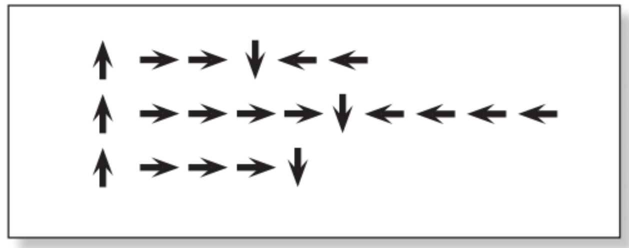
3.1 Lončki – Robot Cups



Slika 1: Robot Cups - zapis zaporedja ukazov

Uvodoma smo za predstavitev uporabili didaktično igro Robot Cups, ki je opisana na spletišču Science in school[1]. Namen dejavnosti je, da učenci z enostavnimi grafičnimi ukazi »robotu« (sošolec, učitelj) napišejo »program« - zaporedje ukazov – s katerimi robot sestavi figuro iz lončkov (slika 1).

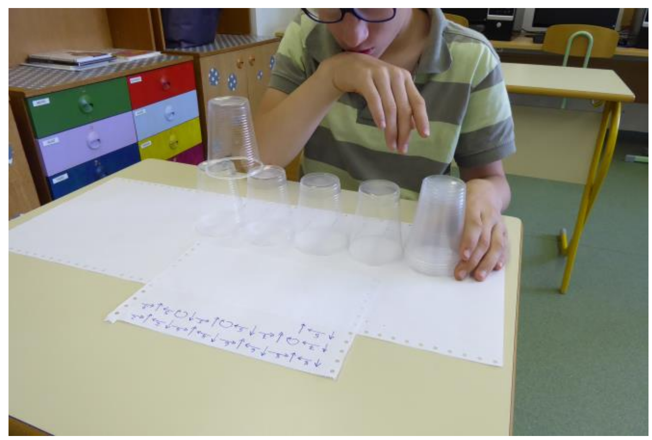
[1]https://www.scienceinschool.org/content/coding-without-computers



Slika 2: Primer zapisanega zaporedja ukazov (programa) za kompozicijo iz treh lončkov (vir: https://csedweek.org/files/CSEDrobotics.pdf)

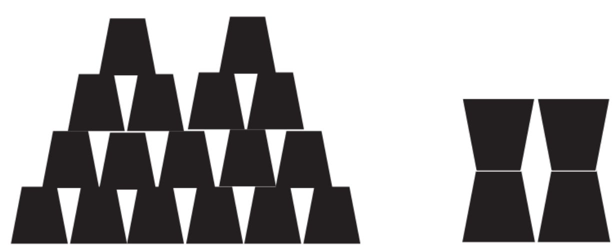
S skupino učencev smo najprej naredili nekaj primerov skupaj, nato so delali v parih ali trojicah. V parih je en član imel vlogo programerja in drugi vlogo robota, pri delu v trojicah pa je tretji član skupine imel vlogo nadzornika – programerja je nadzoroval in skušal že v fazi kodiranja odkriti napake, v fazi delovanja »robota« je preverjal, da je le-ta zaporedje ukazov izvrševal pravilno, ob napakah pa je pomagal pri »razhroščevanju« programa. Za oporo pri delu so imeli učenci pripravljeno matriko, s katero so si pomagali pri premikanju (prenašanje lončka in premikanje robota določeno število enot v dogovorjeni smer), ki je prikazana na sliki 2.

Dejavnost je bila učencem izredno všeč in so v njej radi sodelovali (slika 3).



Slika 3: Učenec v vlogi robota pri izvrševanju zapisanega programa

Z didaktičnega vidika je dejavnost primerna za heterogene skupine, saj pri samostojnem delu (dvojic in trojic) učenci lahko uporabljajo predloge postavitev glede na svoje sposobnosti. Pri tej dejavnosti so se nekateri učenci že naučili uporabljati bližnjice za serije ponovljenih ukazov (slika 4).



Slika 4: Primer zapletene (levo) in enostavnejše (desno) kompozicije (vir: https://csedweek.org/files/CSEDrobotics.pdf)

3.2 Kodiranje s papirjem – Space Race

V drugi fazi so učenci kodirali ukaze v dejavnosti Space Race (https://www.fractuslearning.com/coding-with-paper-printable-game/). Cilj dejavnosti je bil sestaviti zaporedje ukazov, po katerih se v "vesolju" premika vesoljsko plovilo (slika 5).

Učenci so na enem listu papirja imeli že pripravljeno mrežo, v katero so sami namestili ovire, začetek in cilj potovanja plovila, nato pa s sestavljanjem ukazov pripravili program v »konzoli«. Učenci so tudi v tej aktivnosti sodelovali v dvojicah, le da je istočasno vsak lahko sestavljal program. Ob napakah so morali učenci sami poiskati mesto napake in jo s spreminjanjem programa tudi odpraviti.

Slika 5: Primer pripravljenega prostora (vesolja) in sestavljenega zaporedja ukazov

Pri tej dejavnosti so učenci težavnost s postavitvijo ovir določali sami. Zanimivo je bilo predvsem spoznanje, da do cilja lahko pridemo po več poteh in da rešitev vedno ni le ena.

Nekateri učenci so se že preizkusili tudi v optimizaciji kode, ko smo jih spodbudili k razmišljanju, kako bi cilj dosegli v čim manj korakih, s čim krajšo kodo.

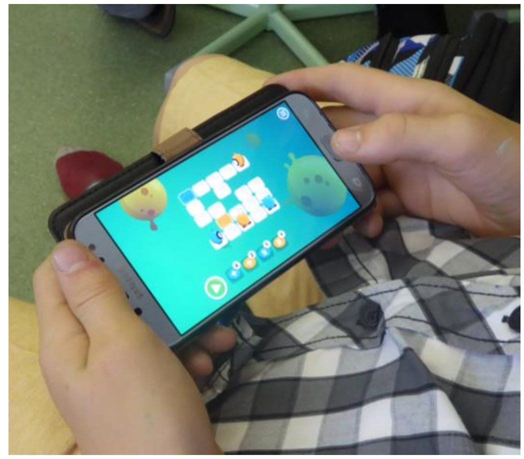
3.3 Kodiranje na spletu

Kmalu smo s kodiranja brez računalnika prešli na spletne aplikacije, ki omogočajo kodiranje.

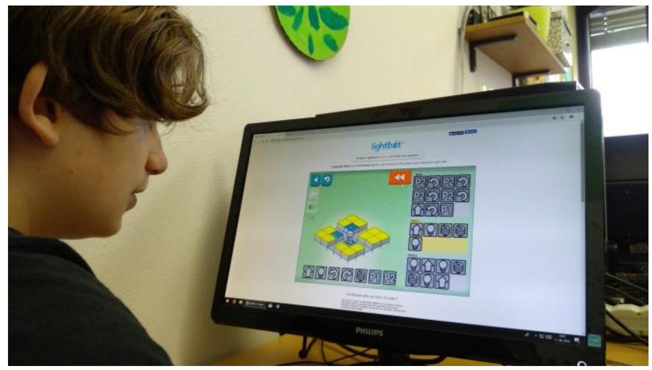
V prvem delu so učenci kodirali v aplikaciji Bit By Bit (slika 6), ki je pripravljena za mobilni operacijski sistem. Pri tem so učenci uporabljali mobilne naprave. V igri Bit By Bit (http://rikaigames.com/bitbybit/) učenec uporablja grafične ukaze podobno kot v dejavnosti Robot Cups, le da je pri tem omejen z določenim številom razpoložljivih ukazov na vsaki stopnji. Igra omogoča visoko stopnjo individualizacije, saj je vsaka stopnja težja od prejšnje, učenci pa so naloge reševali vsak na svoji napravi. Nekateri učenci so tako končali že po nekaj stopnjah, sposobnejši učenci pa so uspešno rešili bolj zapletene stopnje.

Prednost omenjene igre je predvsem v tem, da ni točkovanja, učenec pa ob neuspehu lahko popravi postavitev ukazov in poskuša, dokler mu ne uspe.

Kot zadnjo dejavnost programiranja pa so učenci kodirali v spletni aplikaciji LightBot (https://lightbot.com/hour-of-code.html), ki je prirejena za splet in za mobilne operacijske sisteme (slika 7).



Slika 6: Igra Bit By Bit



Slika 7: Učenec pri kodiranju v aplikaciji LightBot

Učenci so se v tej aplikaciji spoznali z zankami, nekateri pa so reševali probleme, kjer je bilo zahtevano večplastno načrtovanje korakov.

Aplikacija LightBot se je izkazala za izredno primerno za učence v prilagojenem programu, saj so ukazi na simbolni ravni, učencem pa ob kodiranju ni potrebno brati. Učenci so po stopnjah napredovali po svojih zmožnostih, ob dejavnosti pa so se predvsem izkazali v pomoči sošolcem, ki jim je šlo počasneje.

4. POVZETEK

S prikazanimi dejavnostmi smo poskusili vpeljati elemente računalniškega mišljenja v pouk v prilagojenem programu z nižjim izobrazbenim standardom. Kljub temu, da gre pri kodiranju za zapletene miselne procese, učenci v prilagojenem programu z NIS pa imajo primarno znižane splošne kognitivne sposobnosti (oz. lažjo motnjo v duševnem razvoju) in imajo praviloma velike težave pri kompleksnejših nalogah, so se aktivnosti izkazale za zelo primerne, učenci pa so bili pri izvedbi zelo uspešni. Kljub temu, da pri nekaterih aktivnostih nismo uporabljali naprav (pri urah računalništva), so se izkazale kot dober motivator in so vsi učenci radi sodelovali.

Omenjene dejavnosti so le del možnih dejavnosti za spodbujanje računalniškega mišljenja. Ob prenovi že desetletje starih učnih načrtov v prilagojenem programu z NIS je smiselno, da bi se tovrstne vsebine vključile v učni načrt računalništva, saj s tem krepimo digitalne kompetence tistega dela učencev, ki so zaradi svojih posebnosti hitreje marginalizirani in jim s tem pomagali k bolj enakovrednemu vključevanju v digitalno družbo.

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Usvojimo teorijo za kolesarski izpit s pomočjo IKT

Let's adopt the theory for cycling exam using ICT

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POVZETEK

V času osnovnošolskega izobraževanja učenci opravljajo kolesarski izpit. Teoretična vsebina, ki jo morajo obvladati, je precej obsežna. Na začetku obravnavanih vsebin so zaradi želje po samostojni udeležbi v prometu večinoma motivirani, kasneje pa motivacija za ponavljanje in utrjevanje znanja upade. Največkrat se slaba pripravljenost pokaže ob koncu obravnavanih vsebin, ko se učenci prijavijo v spletno učilnico in tam rešujejo simulacijo izpita. Ker je varnost v prometu zelo pomembna, morajo učenci res obvladati teoretične (in tudi praktične) vsebine, kar pomeni, da morajo pravilno rešiti skoraj vse naloge. Želeli smo, da bi že pri prvi simulaciji izpita učenci dosegli dobre rezultate. V prispevku je predstavljeno, kako smo s pomočjo spletne in mobilne aplikacije pred obravnavo učne snovi preverjali njihovo predznanje, pa tudi preverjali in utrjevali usvojeno teoretično znanje za pripravo na kolesarski izpit. Rezultati so pokazali, da so učenci ob koncu obravnavane učne snovi bistveno uspešneje prvič reševali simulacijo izpita v spletni učilnici, saj so bili bolj sproščeni in so zaupali v svoje znanje.

Ključne besede

Kolesarski izpit, informacijska tehnologija, izobraževalno spletno orodje, Plickers

ABSTRACT

During elementary education, students take the cycling exam. The theoretical content they need to master is quite extensive. In the beginning, students are mostly motivated for learning by desire to participate independently in traffic, but later the motivation to repeat and consolidate knowledge declines. In most cases, poor readiness is shown at the end of the content discussed when students log into the online classroom and solve the exam simulation there. Because traffic safety is very important, students really need to master theoretical (as well as practical) content, which means that they have to solve almost all tasks correctly. We wanted students to achieve good results in the first exam simulation. The article presents how (through an online and mobile application, before examining the subject matter) we tested their background, as well as verified and consolidated the theoretical knowledge acquired to prepare for the cycling exam. The results showed that, at the end of the study, the students had a much better first time results in solving the exam simulation in the online classroom because they were more relaxed and confident in their knowledge.

Keywords

Cycling Exam, Information Technology, Educational Web Tool, Plickers

1. UVOD

Kolesarski izpit je za večino učencev prvi izpit, s katerim se srečajo v svojem življenju, zato je toliko bolj pomembno, da jim pri doseganju tega pomembnega življenjskega mejnika učitelji olajšamo pot. Učencem omogoča, da postanejo mobilnejši, saj so v promet do takrat samostojno vključeni le kot pešci. Kot sopotniki ali kolesarji pa imajo ob sebi vedno še nekoga starejšega, običajno odraslo osebo. S kolesarskim izpitom lahko premagujejo večje razdalje ter skrajšajo svoje običajne poti, ki jih opravljajo vsakodnevno (npr. hoja v šolo). Prvi korak na poti usposabljanja za vožnjo kolesa in pri pripravi na kolesarski izpit je teoretično znanje. Dobro znanje poleg pridobivanja vključuje veliko ponavljanja in utrjevanja, kar pa hitro lahko postane za učence dolgočasno. Pouk lahko popestrimo s pomočjo Plickers kartic, ki nam na enostaven način podajo povratno informacijo o znanju posameznega učenca, hkrati pa zahtevajo od slehernega učenca aktivno vključenost v dejavnost.

2. KONCEPT USPOSABLJANJA ZA VOŽNJO KOLESA IN KOLESARSKEGA IZPITA V OSNOVNI ŠOLI

V Sloveniji imamo dobro zasnovano pripravo na kolesarski izpit. V okviru osnovnošolskega izobraževanja so v teoretično usposabljanje vključeni vsi učenci. Šola se skupaj s starši odloči, kdaj bo izvajala usposabljanje za vožnjo kolesa in kolesarski izpit. To naj ne bi bilo pred otrokovim dopolnjenim osmim letom, priporoča pa se po dopolnjenem desetem letu, saj naj bi bili učenci takrat telesno in umsko sposobni za vožnjo kolesa [6].

Usposabljanje za vožnjo kolesa je sestavljeno iz treh delov: teoretično usposabljanje, praktično usposabljanje na poligonu in praktično usposabljanje v javnem prometu [6]. Učitelji v 4. ali/in 5. razredu v svoje letne priprave vključijo vsebine, ki so del teoretičnega usposabljanja.

3. VSEBINE V UČNIH NAČRTIH, KI SO VEZANE NA USPOSABLJANJE ZA VOŽNJO KOLESA

Učenci se s prometom in učnimi cilji, ki so vezani nanj, srečujejo že v prvi triadi. V učnem načrtu za spoznavanje okolja [4] so vsebine v prvih dveh razredih vezane predvsem na varnost v prometu. Učenci so v tej starosti udeleženi v prometu kot pešci ali sopotniki. V operativnih ciljih za tretji razred pa zasledimo tudi cilje, ki so povezani s kolesarjenjem. Učenci naj bi poznali pomen prometnih znakov, ki so pomembni za vedenje kolesarjev, ter vedeli, da promet onesnažuje zrak, vodo in prst (in bi zato izbirali za pot sredstva, ki manj onesnažujejo okolje).

V drugi triadi so učni cilji, ki so vezani na promet, zapisani v učnih načrtih za družbo, naravoslovje in šport.

Učni načrt za naravoslovje in tehniko [3] vsebuje največ ciljev, ki so povezani s pripravo na kolesarski izpit. Učenci naj bi znali utemeljiti pomen varnostne čelade pri vožnji s kolesom, poimenovati in opisati sestavne dele in obvezno opremo kolesa in ga znali pravilno vzdrževati ter razložiti in utemeljiti pomen ravnanja v prometu skladno s predpisi in glede na razmere na cestišču.

Po učnem načrtu za družbo [2] naj bi učenci v 4. razredu prepoznali in analizirali varne in manj varne poti za pešce in kolesarje ter poznali različne dejavnike, ki vplivajo na ravnanje udeležencev v prometu.

Učni načrt za šport [5] pa vsebuje predvsem vsebine, ki so povezane z varnim kolesarjenjem.

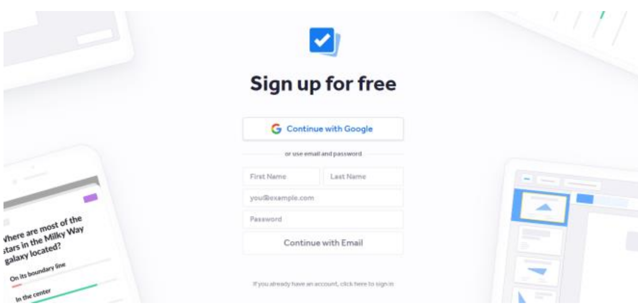
4. PRIMER DOBRE PRAKSE

4.1 Plickers

Plickers je eno od spletnih orodij, s katerim lahko preverjamo stopnjo usvojenega znanja pri posameznem učencu. Omogoča uporabo informacijske tehnologije, pri kateri učenec ne potrebuje nobene naprave, uporablja le posebno kartico s QR kodo. Učitelj pri pouku potrebuje računalnik, projektor, platno, mobilni telefon ali tablico ter dostop do svetovnega spleta. Plickers deluje tako, da učitelj na platno (ali interaktivno tablo) projicira enega od vprašanj z možnimi odgovori. Vsak učenec ima pri sebi na papirju ali kartonu natisnjeno QR kodo, s katero odgovarja na posamezno vprašanje. Učitelj z mobilnim telefonom ali tablico posname njihove odgovore.

4.2 Ustvarjanje uporabniškega računa, tiskanje Plickers kartic ter vpisovanje učencev

Učitelj si najprej na spletni strani https://www.plickers.com/ ustvari uporabniški račun (slika 1).



Slika 1: Registracija je brezplačna [1].

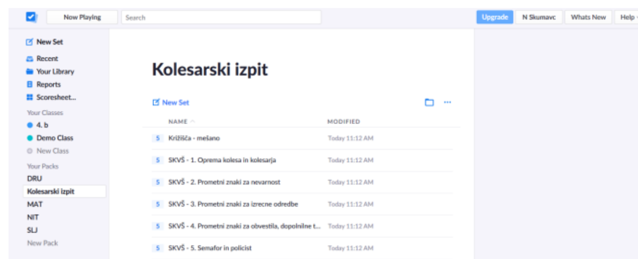
Nato si natisnemo Plickers kartončke za učence. To storimo tako, da desno zgoraj izberemo gumb »Help«, s spustnega seznama pa nato še »Get Plickers Cards«. Kartice so v pdf formatu. Vsaka Plickers kartica je unikatna in je sestavljena iz kombinacije 25 črnih ali belih kvadratov, ki so razporejeni v mrežo velikosti 5x5. Tisk je brezplačen, lahko pa se odločimo tudi za naročilo že izdelanih kartic preko spletne strani Amazon.com. Plickers kartice si natisnemo v željeni velikosti (velikost A5 z velikimi ali manjšimi črkami, velikost A4). Za uporabo v razredu so dovolj velike tiste v velikosti A5. Sama sem kartončke še plastificirala, da bodo dlje časa lahko uporabni. Splača se uporabiti mat folije, saj s tem preprečimo odboj svetlobe, ki bi nas lahko oviral pri snemanju kod.

Spletno orodje nam omogoča, da vnesemo tudi imena učencev in si tako olajšamo delo. Učence lahko vnesemo ločeno po oddelkih ali skupinah (če poučujemo v več oddelkih ali skupinah nam to pride prav). V levem delu zaslona izberemo »New Class«, ga poimenujemo in vsakemu učencu dodelimo številko Plickers kartice, ki jo bo uporabljal. Dodamo lahko do 64 oseb, kar je več kot dovolj za uporabo v razredu.

4.3 Ustvarjanje Plickers setov

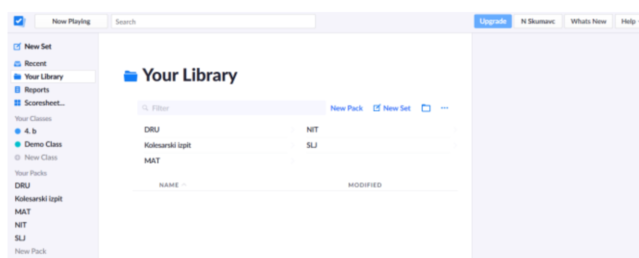
Komplet vprašanj ustvarimo s klikom na »New set«. V brezplačni različici lahko v en set vstavimo do 5 vprašanj, kar je običajno dovolj, če želimo aktivnost izvesti v uvodnem (preverjanje predznanja, ponovitev stare učne snovi) ali zaključnem (ponovitev ravnokar obravnavane učne snovi) delu učne ure.

Sama sem sete ustvarjala sproti, v času, ko so učenci pridobivali teoretično znanje, ki ga bodo potrebovali za kolesarski izpit (slika 2). Poimenovala sem jih glede na temo, ki smo jo takrat obravnavali, npr.: oprema kolesa in kolesarja, prometni znaki za nevarnost, prometni znaki za izrecne odredbe, prometni znaki za obvestila, dopolnilne table, križišča …



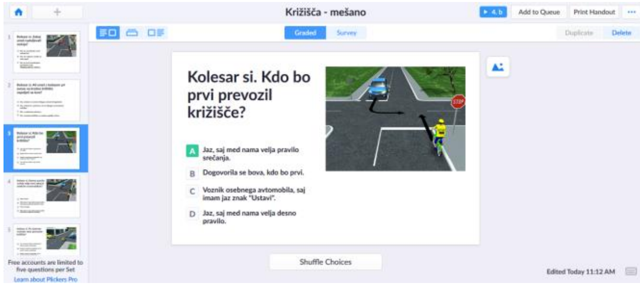
Slika 2: Seznam setov vprašanj [1].

Če uporabljamo to spletno orodje pri več učnih temah ali predmetih, lahko te organiziramo v skupine, podobno kot na računalniku datoteke urejamo v mape (slika 3). Z izbiro »New Pack« ustvarimo novo mapo in jo poljubno poimenujemo. Prestavljanje setov v posamezne mape je enostavno, saj deluje podobno kot prestavljanje ter urejanje datotek v mape na domačem računalniku (»drag and drop« oz. »primi in spusti«).



Slika 3: V knjižnici so seti lahko organizirani v skupine [1].

V posameznem setu sem ustvarila vprašanja, ki so se nanašala na trenutno obravnavano temo. Pri nekaterih vprašanjih sem dodala tudi sliko, saj so pomemben del izobraževanja.



Slika 4: Poleg vprašanja in do štirih možnih odgovorov lahko v sete vstavljamo tudi slike [1].

Poleg vprašanja zapišemo tudi do 4 možne odgovore (slika 4). Ker sem ustvarjala želela dobiti povratno informacijo o znanju posameznih učencev, sem dodala možne odgovore, enega od njih pa označila kot pravega.

Spletno orodje Plickers nam omogoča tudi ustvarjanje vprašanj oz. trditev, kjer ni pravilnega odgovora. To so npr. vprašanja, kadar nas zanima mnenje učencev. V tem primeru v zgornjem delu zaslona izberemo »Survey«.

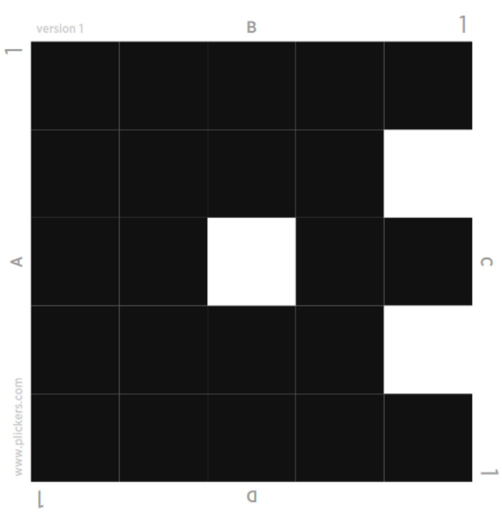
4.4 Nalaganje aplikacije na mobilni telefon ali tablico

Učitelj si mora na mobilni telefon ali tablico naložiti mobilno aplikacijo Plickers, s katero posname odgovore učencev.

4.5 Priprava učencev

Po ustvarjenem setu vprašanj z možnimi odgovori je sledila izvedba v učilnici. Učencem sem razdelila kartončke, pri čemer sem morala paziti, da je vsak učenec prejel pravega (vsakemu posamezniku dodelimo številko). Nato sem učencem razložila, kako bo potekalo delo.

Vsak učenec prejme unikaten kartonček, na katerem je kombinacija skupno 25 črnih ali belih kvadratov, ki so razporejeni na različne načine (slika 5). Učenec poda svoj odgovor tako, da kartonček obrne tako, da je črka izbranega odgovora zgoraj oz. tako, da jo lahko prebere (črka je pravilno orientirana). Nato ga dvigne in usmeri proti kameri na učiteljevem mobilnem telefonu.

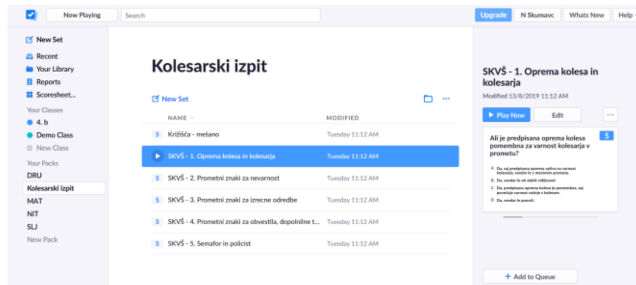


Slika 5: Glede na to, kako učenec obrne kartico, se zabeleži njegov odgovor – v tem primeru bi učenec s številko 1 izbral odgovor B [1].

Po končani aktivnosti sem kartončke pobrala. Spravili smo jih na točno določeno polico v učilnici. Ker sem aktivnost izvajala večkrat, sem pred dejavnostjo le povedala, da bomo delali s Plickers karticami, dežurna učenca pa sta že kar sama razdelila kartice. Tako smo pridobili tudi nekaj dragocenega časa, ki bi ga sicer izgubili s ponovnim dajanjem navodil.

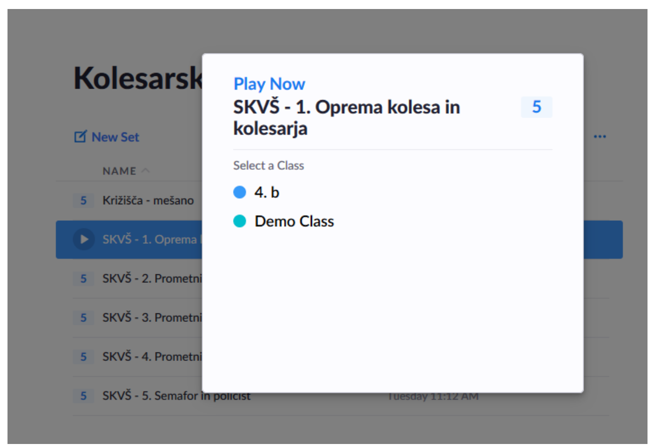
4.6 Začetek aktivnosti

Za začetek aktivnosti v naši knjižnici izberemo set vprašanj, ki ga bomo obravnavali (slika 6). Kliknemo nanj. Na desni se nam odpre meni. Izberemo »Play Now«.



Slika 6: Izbira prve teme pri obravnavi vsebine oprema kolesa in kolesarja [1].

Nato izberemo še razred oz. skupino (slika 7), s katero bomo izvajali aktivnost (če smo jih vnesli). Sicer izberemo »Demo Class«, kjer imamo označene le številke Plickers kartic (učenci niso poimensko vpisani).



Slika 7: Izberemo razred ali skupino, s katero bomo izvajali aktivnost [1].

Učitelj nato na mobilnem telefonu ali tablici odpre mobilno aplikacijo Plickers. V primeru, da smo aktivnost že zagnali preko računalnika, se nam v spodnjem delu pokaže izbrana aktivnost. Sicer enostavno izberemo razred oz. skupino in aktivnost, ki jo želimo izvesti.

Na platnu se pokaže prvo vprašanje v setu z možnimi odgovori. Vsak učenec je na platnu videl vprašanje ter možne odgovore. Nato se je moral odločiti, kateri od ponujenih odgovorov je pravi. Odgovori so bili označeni s črkami A, B, C in D (lahko jih je tudi manj). Glede na to, kateri odgovor se mu je zdel pravi, je dvignil kartonček tako, da je bila črka njegovega odgovora na vrhu.

Učitelj na svoji mobilni napravi ali tablici vidi enako vprašanje z možnimi odgovori, kjer je označen tudi pravilen odgovor (slika 8). Nato izbere krog (znak za snemanje) in na ekranu se pojavi slika, kot jo vidimo skozi kamero. S kamero »preleti« kartice, ki so jih učenci dvignili. Pri tem takoj dobi povratno informacijo, kdo je odgovoril pravilno in kdo napačno (zelen ali rdeč krog pri posamezniku).

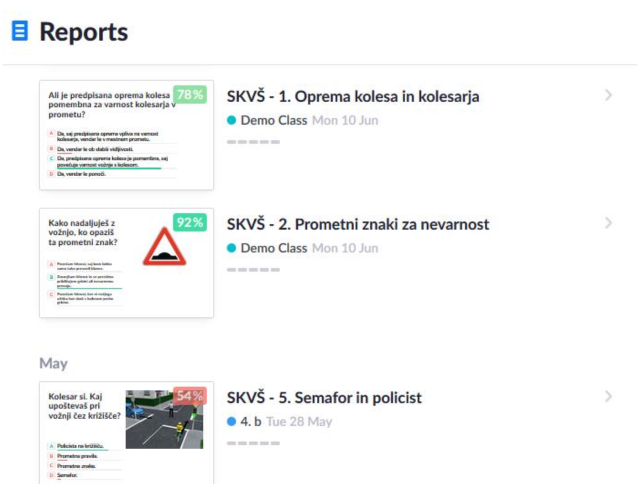
Slika 8: Učitelj na zaslonu mobilne naprave vidi enako vprašanje, kot ga vidijo učenci na platnu [1].

Učitelj lahko na mobilniku ali tablici vidi, čigavo kartico je že zajel in čigave še ne. Prav tako lahko med ali po zajetju vseh kartic na platno projicira graf njihovih odgovorov, pri čemer lahko pokaže ali skrije pravilen odgovor. Če želi, lahko na platno projicira tudi posameznikove odgovore. Jaz se večinoma odločam, da učencem pokažem le graf.

Potek aktivnosti lahko učitelj upravlja preko mobilnega telefona oz. tablice ali pa preko računalnika.

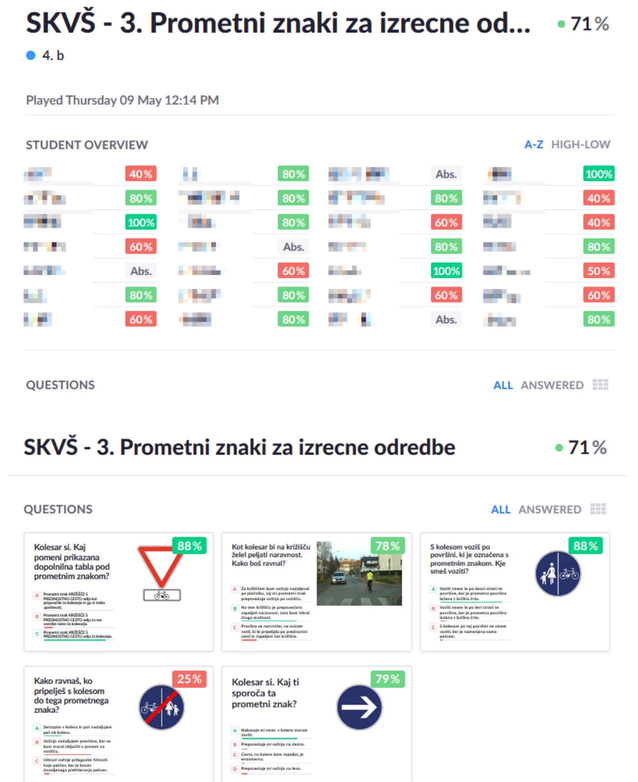
4.7 Pregled rezultatov

Ob koncu dejavnosti si učitelj lahko ogleda, kako uspešni so bili učenci. To storimo tako, da na levi strani izberemo »Reports« (slika 9). Prikaže se nam seznam vseh aktivnosti, ki smo jih izvedli.



Slika 9: Poleg vsake izvedene aktivnosti je z odstotki prikazana uspešnost reševanja [1].

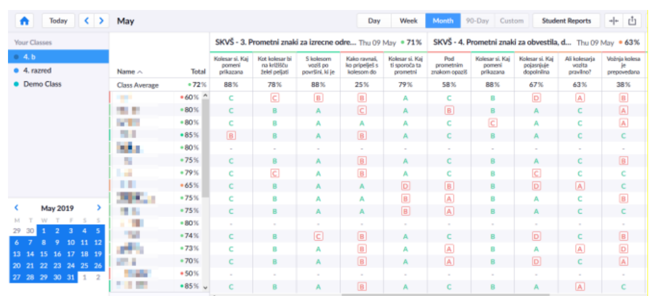
Ko eno od njih izberemo, se nam pokaže uspešnost reševanja po učencih ali pa po odgovorih (slika 10).



Slika 10: Ogledamo si lahko uspešnost posameznega učenca ter odstotek učencev, ki je pravilno odgovoril na posamezno vprašanje [1].

Lahko si ogledamo tudi, kako je posamezen učenec odgovoril na posamezno vprašanje.

Spletno orodje nam omogoča tudi, da si ogledamo zbirnik rezultatov v poljubnem časovnem obdobju (slika 11).



Slika 11: V zbirniku vidimo uspešnost posameznega učenca v določenem časovnem obdobju [1].

Vsakega od setov vprašanj sem ponovila dvakrat. Prvič sem aktivnost izvedla pred obravnavano temo (ugotavljanje predznanja), drugič pa kot ponovitev snovi pri naslednji učni uri. Učenci so podobne naloge kasneje reševali še v spletni učilnici. Rezultati so pokazali, da so učenci imeli veliko manj težav pri simulaciji kolesarskega izpita, ki so ga kasneje opravljali v spletni učilnici. Glede na pretekle izkušnje iz prejšnjih let so posamezno simulacijo rešili hitreje in uspešneje. K temu je sigurno precej pripomogla tudi uporaba spletnega orodja Plickers. Popestrila je del učnih ur, učence pa na zabaven način motivirala, da so bili ves čas aktivni. Učencem so bili aktivnosti s karticami Plickers všeč, zato smo jih kasneje uporabili še pri drugih predmetih.

5. ZAKLJUČEK

Živimo v času informacijsko-komunikacijske tehnologije, zato je dobro, če jo občasno vključimo v pedagoški proces. Ker pa pogosto nimamo možnosti koriščenja računalniške učilnice, želimo pa, da je vsak posameznik karseda aktiven, lahko aktivnost s pomočjo spletnega orodja Plickers izvedemo kar v matični učilnici. To je ena od glavnih prednosti. Poleg tega imamo dober vpogled v znanje tako posameznika kot skupine. Od učencev ne zahteva nobenega računalniškega znanja, jim pa pomaga pri navajanju na določen tip nalog.

6. VIRI

[1] Plickers https://www.plickers.com/

[2] Učni načrt, Družba. 2011. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: DOI: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_druzba_OS.pdf (pridobljeno 2. 8. 2019)

[3] Učni načrt, Naravoslovje in tehnika. 2011. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: DOI: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_naravoslovje_in_tehnika.pdf (pridobljeno 2. 8. 2019)

[4] Učni načrt, Spoznavanje okolja. 2011. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: DOI: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_spoznavanje_okolja_pop.pdf (pridobljeno 2. 8. 2019)

[5] Učni načrt, Športna vzgoja. 2011. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: DOI: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_sportna_vzgoja.pdf (pridobljeno 2. 8. 2019)

[6] Žlender, B. 2016. Koncept usposabljanja za vožnjo kolesa in kolesarskega izpita v osnovni šoli. Ljubljana: Zavod RS za šolstvo. DOI: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/devetletka/program_drugo/Usposabljanje_za_voznjo_kolesa_kolesarski_izpit.pdf (pridobljeno 30. 7. 2019)

Z uporabo IKT dvigujemo bralno pismenost

Raising reading literacy with use of ICT

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POVZETEK

Bralna pismenost je eden od ključnih dejavnikov za uspešen razvoj posameznika in družbe. Priprava na opismenjevanje se pri večini začne že zelo zgodaj, s prvim branjem slikanic in knjig otroku, ko je še malček. Nekaterim otrokom pa je žal branje pravljic pred nočnim počitkom tuje in vstopajo v vrtec ali šolo brez pozitivne izkušnje s knjigo. Tako imajo pri prvih stikih s pisano besedo stisko, zavračajo branje in se mu skušajo izogniti. Poleg tega prihajamo v čas, ko nam informacijska tehnologija omogoča dostop do informacij tudi v drugačnih oblikah, preko npr. zvočnih posnetkov ter videov. Otroci praviloma radi uporabljajo informacijsko tehnologijo, saj jih obdaja na vsakem koraku, starši pa se zaradi nevarnosti, ki jih prinaša uporaba le teh, večinoma trudijo svoje otroke čim dlje obdržati stran od računalnikov, tablic in telefonov. V prispevku je predstavljeno, kako smo s pametno uporabo informacijske tehnologije učencem približali branje, spodbujali bralno pismenost in jih do neke mere tudi informacijsko opismenjevali. Uporaba spletne platforme, ki je predstavljena v prispevku, je motivirala vse, tako dobre kot tudi šibke bralce, kljub sodelovalnemu učenju pa je spodbujal aktivno vlogo slehernega učenca. Vsak posameznik je za uspešno opravljene naloge moral natančno prebrati besedilo, vprašanja in naloge pa so od njega zahtevala uporabo najrazličnejših taksonomskih stopenj. Učencem je bil drugačen način dela všeč, najpomembnejše pa je, da so bili aktivni prav vsi, tudi tisti, ki ne marajo brati.

Ključne besede

Bralna pismenost, informacijska tehnologija, izobraževalno spletno orodje, Socrative

ABSTRACT

Reading literacy is one of the key factors for the successful development of the individual and society as well. For most preparation for learning to read and write takes place with reading books to a child when he is still at an early developmental stage. For some children, however, reading fairy tales before night rest is foreign so they are entering kindergarten or school without a positive experience with books. Thus, they experience distress in the first contact with a written word, so they refuse to read and try to avoid it. In addition, we are going through times when information technology allows us to access information in different forms, for example, audio recordings and videos. As a rule, children like to use information technology because they surround them at every step, and parents, because of the dangers of using them, mostly try to keep their children away from computers, tablets and phones as long as possible. This paper presents how we encouraged reading literacy with the use of information technology, brought students closer to reading and, to some extent, information literacy. The use of the online platform, presented in the paper, motivated all, both good and weak readers and despite cooperative learning, promoted the active role of each student. Each individual had to carefully read the text for successful completion of tasks while questions and tasks required them to use a range of taxonomy levels. Pupils liked a different approach to work but the most important thing was that everyone, including those who did not like to read, were active.

Keywords

Reading literacy, information technology, educational online tool, Socrative

1. UVOD

Branje je ena od spretnosti, ki je izjemno pomembna tako v šolskem obdobju kot tudi v času odraslosti. Z branjem širimo svoj besedni zaklad, splošno razgledanost, pomaga pa nam tudi pri poglobljenem razumevanju delovanja vsega, kar nas obdaja. Je kompleksen proces, ki zahteva dekodiranje simbolov, bralec pa mora poleg tega dobro obvladati jezik, v katerem bere. Žal branje samo po sebi večini učencev ni privlačno, sploh kadar gre za vsebine, ki posameznika ne zanimajo (dovolj), da bi se branja lotil poglobljeno. Tako učitelji pogosto iščemo načine, kako bi vsem, predvsem pa tistim, ki branja ne marajo, to kompleksno in nadvse koristno dejavnost približali in jim pomagali pri tem, da bi jo do neke mere vzljubili. To počnemo na različne načine: uporabljamo besedila, ki so učencem všeč, dejavnosti branja delimo na manjše enote, lahko pa uporabimo metode in oblike, ki učenca že same po sebi motivirajo. Ena od teh je uporaba IKT pri pouku, s katero spodbujamo dvig bralne pismenosti. Uporaba spletne platforme, ki je predstavljena v nadaljevanju, je uporabna pri vsakem šolskem predmetu in ni vezana samo na pouk slovenščine. Sama učencem večkrat pripravim tudi kvize pri ostalih predmetih, s katerimi ponavljajo in utrjujejo svoje znanje ter si hkrati dvigajo svojo bralno pismenost.

2. RAZISKAVE NA PODROČJU BRALNE PISMENOSTI

Slovenija je vključena v mednarodne raziskave bralne pismenosti pod okriljem IEA (Mednarodna zveza za evalvacijo dosežkov v izobraževanju) že od leta 1991, ko je bila izvedena prva raziskava, t.i. Reading Literacy 1991. Zajemala je učence 3. in 8. razreda takratne OŠ. Deset let kasneje, leta 2001, je bila poleg ponovljene raziskave iz leta 1991 izvedena na novo zasnovana Mednarodna raziskava bralne pismenosti za četrtošolke in četrtošolce PIRLS 2001. Od takrat dalje se podatke zajema na vsakih pet let (2006, 2011, 2016). Tako je bila v letu 2016 raziskava narejena že četrtič. Slovenski četrtošolci in četrtošolke so bili v raziskave vključeni vsakokrat. Naslednja raziskava PIRLS bo potekala v letu 2021. PIRLS definira bralno pismenost takole: »Bralna pismenost je sposobnost razumevanja in uporabe tistih pisnih jezikovnih oblik, ki jih zahteva družba in/ali jih vrednoti posameznik. Bralke in bralci ustvarjajo pomen iz besedil v različnih oblikah. Berejo za to, da se učijo, da z drugimi sodelujejo v skupnostih bralcev v šoli in vsakdanjem življenju, ter za veselje.« [1].

Raziskava PIRLS 2016 [2] se glede na namen branja osredotoča na dva namena branja, to sta branje za užitek (za namen literarne izkušnje) in branje za učenje (za pridobivanje in uporabo informacij). Zato so bila v raziskavo vključena tako literarna kot tudi informativna besedila. Rezultati kažejo, da so bili bralni dosežki četrtošolcev v Sloveniji nad mednarodnim povprečjem sodelujočih držav, saj je mednarodno povprečje izračunano na 500 točk (srednja vrednost lestvice PIRLS), Slovenija pa dosega povprečen bralni dosežek 542 točk. Deklice v povprečju dosegajo višje bralne dosežke kot dečki.

V okviru omenjene raziskave je bilo prvič izvedeno tudi preverjanje bralne pismenosti na računalniku – ePIRLS, ki je vsebovala le informativna besedila. Raziskava kaže, da so naši četrtošolci dosegali nižje rezultate bralne pismenosti na računalniku (povprečen dosežek Slovenije na lestvici ePIRLS je 525 točk).

Tabela 1: Doseganje mednarodnih mejnikov branja slovenskih četrtošolcev v raziskavi PIRLS 2016 in ePIRLS 2016 [2]

	PIRLS 2016	ePIRLS 2016
nižji mednarodni mejnik branja	96 %	95 %
srednji mednarodni mejnik branja	83 %	78 %
višji mednarodni mejnik branja	49 %	39 %
najvišji mednarodni mejnik branja	11 %	5 %

V PIRLS 2016 je sodelovalo 50 držav in 11 referenčnih udeleženk, v ePIRLS pa 12 držav in 2 dodatni referenčni udeleženki. V Sloveniji je bilo v raziskavo vključenih 160 šol (253 oddelkov oziroma 4499 učencev), v raziskavo ePIRLS pa 250 oddelkov, kar predstavlja 4303 učencev. V vzorcu sodelujočih je bila približno polovica dečkov in približno polovica deklic. [2] V izvedeni raziskavi je sodelovala tudi naša šola s takratnimi četrtošolci.

3. RAZVIJANJE SPORAZUMEVALNE ZMOŽNOSTI, BRALNA PISMENOST IN UPORABA INFORMACIJSKE TEHNOLOGIJE V UČNEM NAČRTU ZA SLOVENŠČINO

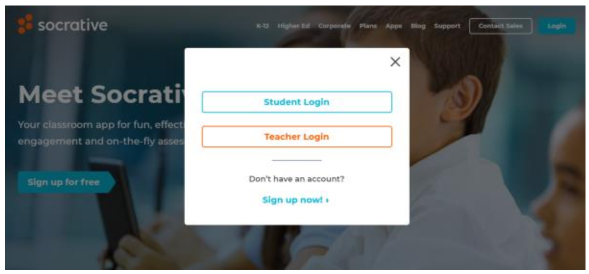
V trenutno veljavnem učnem načrtu za slovenščino [4] je med splošnimi cilji predmeta zapisano, da učenci »razvijajo sporazumevalno zmožnost v slovenskem (knjižnem) jeziku, torej zmožnost kritičnega sprejemanja in tvorjenja besedil različnih vrst«, pa tudi »razmišljujoče in kritično sprejemajo raznovrstna neumetnostna besedila, objavljena v raznih medijih – iz njih pridobivajo novo stvarno/enciklopedično znanje, tega pa uporabljajo v vsakdanjem življenju …« Poleg tega naj učenci razvijajo tudi digitalno zmožnost, ki se povezuje z razvijanjem sporazumevalne zmožnosti v slovenskem jeziku. Avtorji predlagajo, naj pouk slovenščine občasno kot nadgradnja klasičnega pouka v učilnici poteka v spletni učilnici, saj raba informacijskih tehnologij lahko pomembno pripomore h kakovostnejšemu pouku.

S posodobljeno izdajo učnega načrta za slovenščino [5], ki stopi v veljavo s 1. 9. 2019, se je vsebina poglavja o uporabi informacijske tehnologije pri pouku slovenščine kot logična posledica razvoja IKT povečala. Učitelj naj bi učence in učenke spodbujal k rabi računalnikov, pametnih telefonov ter tablic. Uporaba sodobne tehnologije pri pouku učence motivira ter jim omogoča hitrejše in kakovostnejše doseganje ciljev pouka slovenščine.

4. INFORMACIJSKA TEHNOLOGIJA KOT POMOČ PRI DOSEGANJU CILJEV

4.1 Učna platforma Socrative

Socrative je učna platforma, ki omogoča ustvarjanje spletnih kvizov in t.i. »izhodnih kartic«. Učitelj mora najprej na spletni strani https://socrative.com/ ustvariti račun. Slika 1 prikazuje, kako se učitelj prijavi v platformo.

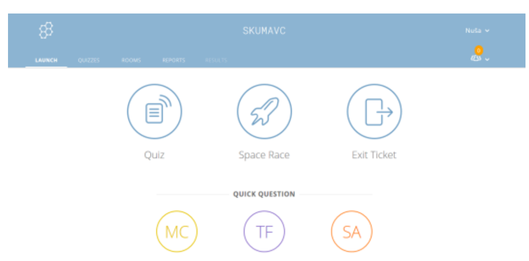


Slika 1: Učitelj se v platformo prijavi s klikom na »Teacher login« [3].

Po registraciji in prijavi lahko začne ustvarjati kvize. Spletna stran je sicer narejena v angleškem jeziku, vendar je zelo enostavna za uporabo. Obstajata brezplačna in plačljiva različica, vendar nam brezplačna omogoča dovolj za običajno uporabo pri pouku.

4.2 Ustvarjanje spletnih kvizov

Po uspešni prijavi v zgornjem delu zaslona izberemo »Quizzes« (slika 2). Z izbiro »Add quiz« in »Create new« v zgornjem desnem delu ustvarimo nov kviz. Nato ga poimenujemo ter začnemo z urejanjem vprašanj. Dodajamo lahko vprašanja oz. naloge treh tipov: naloge izbirnega tipa (z enim ali več pravilnimi odgovori), naloge tipa drži/ne drži ter naloge kratkih odgovorov. S klikom na ustrezno tipko vstavimo vprašanje oz. nalogo določenega tipa.



Slika 2: Po prijavi v Socrative najprej levo zgoraj izberemo »Quizzes«, da ustvarimo kviz [3].

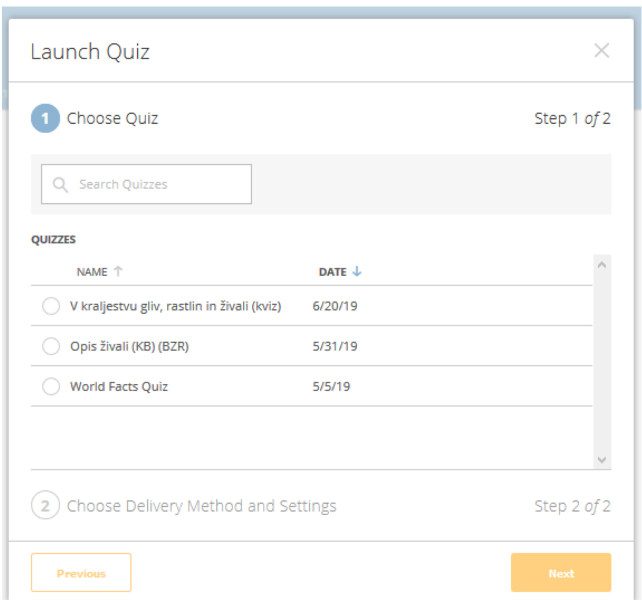
4.3 Zagon kviza, razredne tekme ali izhodnih kartic

Ko smo kviz ustvarili, ga moramo še zagnati. Najprej se odločimo, katero vrsto reševanja bomo izbrali (kviz, razredna tekma ali izhodna kartica).

Učitelj lahko medtem, ko učenci rešujejo kviz, rezultate reševanja učencev v realnem času projicira na tablo ali pa jih le spremlja na svojem računalniku. Pri tem lahko »skrije« določene podatke (npr. ime reševalca ali njegov odgovor). Rezultatov pri običajnem reševanju kviza običajno ne projicira na tablo, pač pa jih le spremlja in po potrebi posreduje (če npr. opazi, da gre kateri od učencev skozi vprašanja zelo hitro, pri tem pa se pogosto zmoti, torej so njegovi odgovori napačni, ga na to pravočasno opozori). Prav tako lahko takoj vidi, kateri učenci so pri reševanju hitri, kateri počasnejši, kdo je v odgovarjanju točen in kdo se moti. Nasprotno pa pri izbiri »razredne tekme« s projiciranjem napredka posamezne skupine, v katere so razvrščeni učenci, spodbudimo učence, da so pri odgovarjanju natančni ter se trudijo za skupni uspeh.

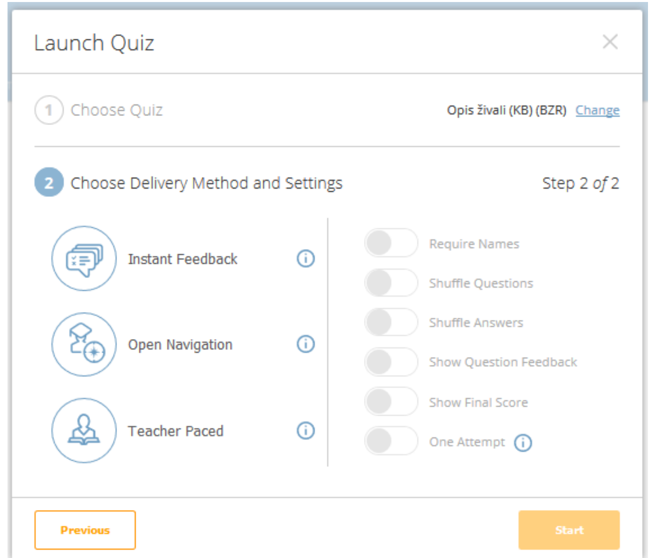
4.3.1 Kviz

Kadar želimo, da bo učenec samostojno in osredotočeno reševal naloge, izberemo način reševanja »kviz«. Nato s seznama izberemo kviz, ki ga bodo reševali učenci (slika 3).



Slika 3: V prvem koraku učitelj izbere kviz, ki ga bodo reševali učenci [3].

Učna platforma učitelju omogoča izbiro več načinov reševanja in povratne informacije. Slika 4 prikazuje te načine. Če izbere možnost »Instant Feedback«, bodo učenci odgovarjali na vprašanja po vrstnem redu in kasneje ne bodo mogli popravljati svojih odgovorov. Učenec takoj dobi povratno informacijo o tem, ali je na vprašanje odgovoril pravilno oz. kakšen je pravilen odgovor. Učitelj lahko v realnem času spremlja napredek in odgovore vseh učencev, ki rešujejo kviz. Druga možnost reševanja je »Open Navigation«, pri katerem učenci rešujejo naloge v poljubnem vrstnem redu. Učenec povratno informacijo dobi ob koncu reševanja celotnega kviza. Učitelj tudi pri tej možnosti vidi napredek vseh učencev v realnem času. Zadnja možnost pa je »Teacher Paced«, pri katerem učitelj nadzoruje hitrost reševanja posameznega kviza. Pri tem lahko določeno vprašanje preskoči ali pa se nanj tudi vrne.

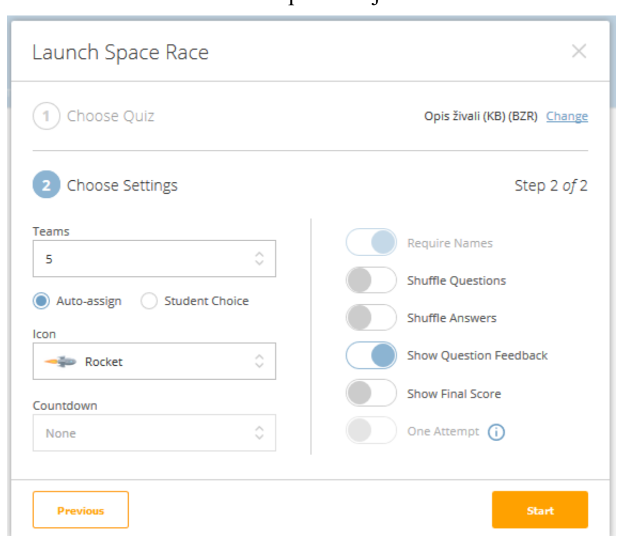


Slika 4: V drugem koraku učitelj izbere način reševanja [3].

V nastavitvah lahko nastavimo, ali morajo učenci vpisati svoje ime pred reševanjem kviza, ali se bodo vprašanja in odgovori učencem izpisovali mešano (s tem preprečimo, da bi učenci pri odgovarjanju »prepisovali« drug od drugega), ali naj učenci dobijo povratno informacijo po posameznem vprašanju ter ali naj se jim izpišejo končne točke.

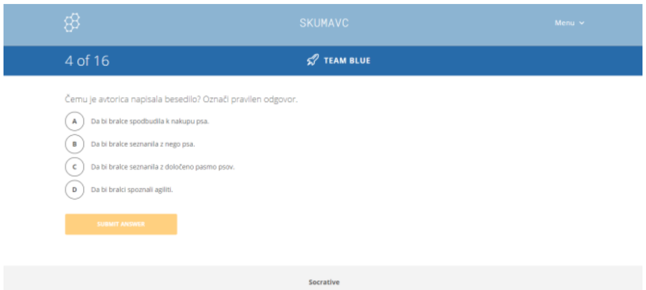
4.3.2 Razredna tekma

Kadar želimo nekoliko popestriti pouk, lahko izberemo način »Space Race« oz. tekmovanje (slika 5). Gre za zabavnejšo obliko kviza, pri čemer se učenci trudijo za skupni uspeh svoje ekipe. Pred začetkom razredne tekme učitelj izbere kviz, ki ga bodo reševali učenci, nato pa še število ekip (2-20) ter ikono, ki bo kazala napredek skupine. Učitelj lahko izbere, ali si bo posameznik sam izbral barvo ekipe, za katero bo tekmoval, ali pa bo v skupino samodejno dodeljen. Tudi pri tej obliki imamo možnost enakih nastavitev kot pri običajnem kvizu.

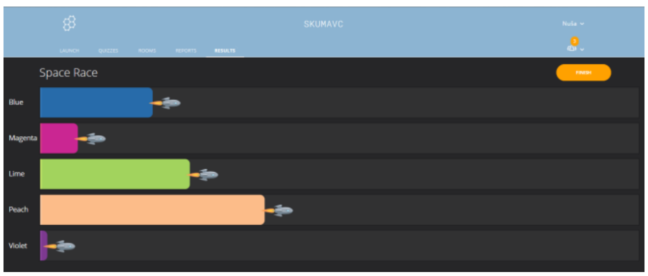


Slika 5: Za popestritev pouka uporabimo »Space Race«, kjer izberemo število ekip in ikono [3].

Velika prednost pri tej obliki je v tem, da učitelj kljub na videz skupinski dejavnosti, pri kateri se učenci zabavajo, ob tem pridobi dragocene informacije o posameznikovem znanju oz. o tem, kako je reševal kviz. Slika 6 prikazuje primer vprašanja, kot ga vidi učenec, član modre ekipe. Na sliki 7 pa vidimo, kako izgleda trenutni napredek posamezne ekipe.



Slika 6: Četrto vprašanje izbirnega tipa, na katerega odgovarja učenec, ki je član modre ekipe [3].



Slika 7: Prikaz napredka posamezne ekipe je ponazorjen z izbrano ikono [3].

4.3.3 *Izhodne kartice*

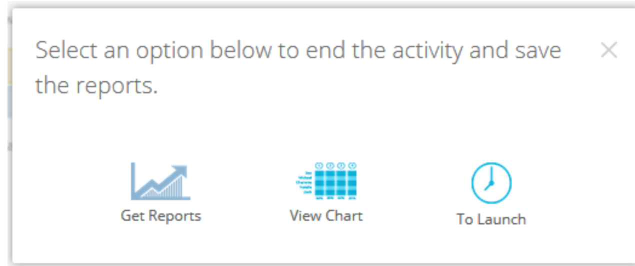
Učna platforma nam omogoča tudi ustvarjanje t.i. izhodnih kartic. To je ena od metod, kako lahko zaključimo z učno uro, pri tem pa dobimo dragocene informacije o tem, kako dobro je posameznik razumel vsebino, kaj se je novega naučil ter odgovor na učiteljevo vprašanje, ki jim ga ob zaključku ure zastavi ustno. Izhodna kartica je že vnaprej ustvarjena v angleščini, vendar nam, če jo uporabljamo redno in učence vodimo pri izpolnjevanju, omogoča samoevalvacijo ter načrtovanje še boljših učnih ur v prihodnosti.

4.4 Prijava učenca

Učenec se v učno platformo Socrative prijavi tako, da obišče spletno stran https://socrative.com/, nato pa klikne na gumb »Login« v desnem zgornjem kotu. Izbere »Student Login«. Nato vpiše ime sobe (običajno je to priimek učitelja, spletna stran sama generira ime sobe), za tem pa še svoje ime. Prednost te učne platforme je, da ne zahteva registracije učenca, prav tako pa se učenci lahko v platformo prijavijo z vzdevkom ali izmišljenim imenom. Nato se avtomatsko odpre aktivnost, ki jo je za učence predhodno zagnal učitelj (kviz, razredna tekma, izhodna kartica).

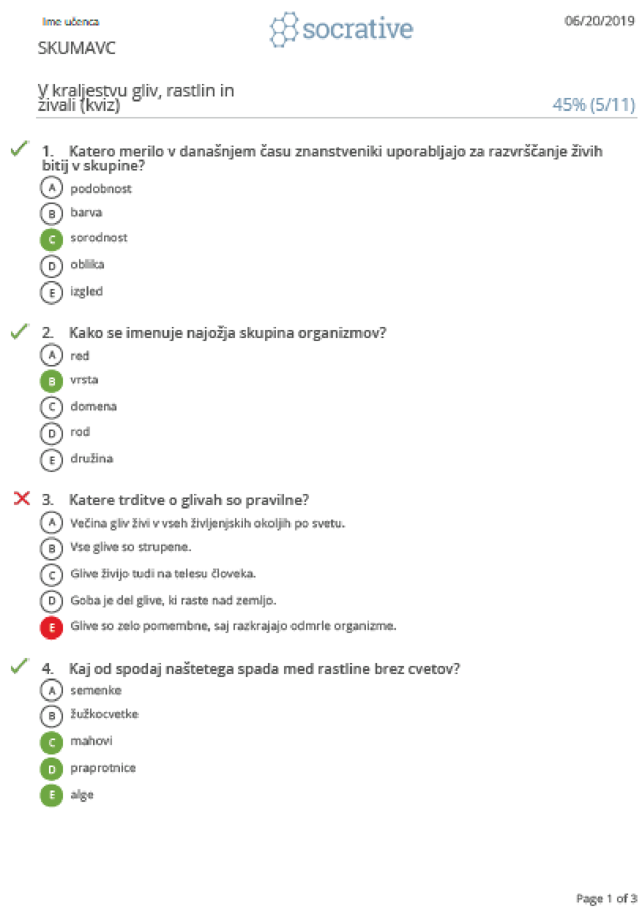
4.5 Pregled rezultatov

Ob koncu dejavnosti učitelj zaključi dejavnost s klikom na gumb »Finish«, ki se nahaja v desnem zgornjem kotu. Nato si lahko na svoj računalnik prenese rezultate s klikom na »Get Reports« ali pa si ogleda on-line tabelo s klikom na »View chart« (slika 8). Z izbiro »To Launch« se vrne na začetno stran.



Slika 8: Ob koncu aktivnosti izberemo, kako želimo prikazati rezultate [3].

Zbirnik odgovorov vseh učencev, ki so sodelovali v aktivnosti, lahko izvozimo v obliki excel tabele z izbiro »Whole Class Excel«. Shranimo si lahko tudi podatke za vsakega posameznega učenca v pdf obliki (če bi želeli npr. vsakemu posebej natisniti celoten kviz vključno z vsemi možnimi odgovori) s klikom na »Individual Student(s) PDF« (slika 9). Če želimo podatek o tem, koliko učencev je na posamezno vprašanje odgovorilo z določenim odgovorom, izberemo »Question Specific PDF«.



Slika 9: Podatki posameznega učenca, ki je reševal kviz [3].

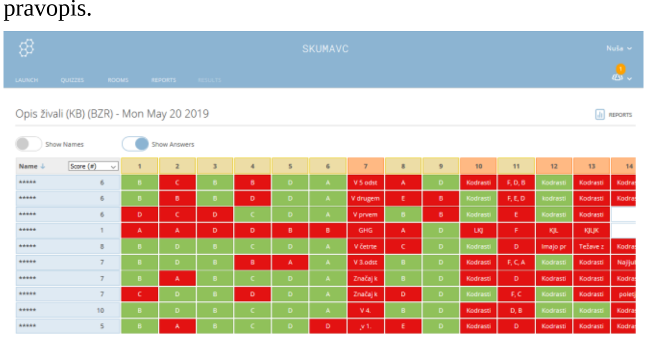
Na rezultate posamezne aktivnosti se lahko vrnemo tudi kadarkoli kasneje. To storimo tako, da po prijavi v učno platformo s seznama izberemo »Reports« ter aktivnost, za katero si želimo pogledati rezultate.

5. PRIMER DOBRE PRAKSE

Pri pouku slovenščine v 4. razredu sem se odločila, da bom utrjevanje znanja izvedla s pomočjo učne platforme Socrative. Poiskala sem neumetnostno besedilo, in sicer opis živali. Nato sem na podlagi besedila sestavila vprašanja, ki preverjajo učenčevo bralno razumevanje. Vprašanja so bila sestavljena na različnih taksonomskih stopnjah. Sestavila sem spletni kviz, ki pa je vseboval vse vrste vprašanj. Pri nalogah, kjer so morali učenci sami napisati odgovor, sem pri sestavljanju možnih rešitev morala paziti, da sem napisala vse možnosti, ki bi jih lahko napisali učenci. Pri tem pa je bilo učence potrebno opozoriti tudi na natančnost pri pisanju samostojnih odgovorov, saj bi vsaka na videz nepomembna napaka (npr. dva zaporedna presledka) označila odgovor kot nepravilen. Učenci so izhodiščno besedilo dobili v pisni obliki, tako da so ga imeli ves čas pred seboj, prav tako so ob sebi imeli svinčnik in so si določene podatke lahko podčrtovali ali kako drugače označevali. Ker sem želela, da učenci rešujejo vprašanja po vrsti, vendar pa se lahko nanje tudi vračajo in jih urejajo, hkrati pa nisem želela, da bi drug od drugega prepisovali, sem v nastavitvah kviza izbrala, da so bile naloge zastavljene po vrsti, odgovori pa so bili pri vsakem posamezniku premešani (slika 10).

Slika 10: Učenci so reševali vprašanja po vrsti, hkrati pa so se lahko premikali po navigaciji naprej in nazaj [3].

Ob koncu dejavnosti sem si ogledala rezultate dejavnosti (slika 11). Ugotovila sem, da imajo učenci veliko težav predvsem pri nalogah, kjer morajo izbrati več odgovorov (vendar ne vedo koliko) ter pri tvorjenju samostojnih odgovorov. Pri tvorjenju samostojnih odgovorov so bili odgovori učencev večkrat zavedeni kot napačni, čeprav je šlo le za pravopisne napake. Je pa ravno zaradi tega to dober način, da učence navajamo na natančnost in pravopis.



Slika 11: Odgovore učencev si ogledamo v tabeli, v kateri lahko tudi skrijemo identiteto posameznika [3].

6. ZAKLJUČEK

Uporaba informacijske tehnologije pri pouku nam lahko močno olajša doseganje ciljev iz učnega načrta. Deluje kot močno motivacijsko sredstvo. Učna platforma Socrative ima mnogo pozitivnih lastnosti: ustvarjanje kvizov je enostavno, v vprašanja oz. naloge lahko vstavljamo tudi slike, učitelju omogoča enostaven in pregleden vpogled v znanje vsakega posameznega učenca, rezultat in napredek reševanja posameznega učenca lahko spremlja v realnem času, od učenca ne zahteva nobene registracije, reševanje kvizov je enostavno … Kviz lahko ustvarimo tudi v excel obliki (najprej si s spletne strani pridobimo predlogo) in jo nato uvozimo v spletno obliko. Omogočeno je tudi deljenje kvizov z drugimi uporabniki platforme ter nalaganje kvizov, ki so jih ustvarili drugi.

Platforma Socrative pa ima tudi nekaj pomanjkljivosti. Ena od njih je ta, da morajo učenci pri nalogah, kjer je pravilnih več odgovorov, izbrati vse, če želijo, da je naloga točkovana kot pravilna. Prav tako morajo pri samostojnih odgovorih odgovarjati povsem natančno, da je naloga točkovana kot pravilna. Sicer je omogočeno vstaviti več možnih odgovorov, vendar pa ne moremo predvideti vseh možnih napak, ki jih lahko napravijo učenci. Sploh v nižjih razredih učenci, ki še niso vešči dela z računalnikom, napravijo veliko (predvsem pravopisnih) napak.

Učencem je bila izvedena učna ura slovenščine zelo všeč. Ker si današnje generacije otrok življenja brez računalnikov, telefonov in drugih interaktivnih naprav ne predstavljajo, je prav, da jih smiselno vključujemo tudi v pouk. Pri tem pa moramo seveda paziti, da jih vseskozi seznanjamo z varno rabo ter dejstvom, da so aplikacije in platforme le sredstvo za dosego cilja. Učenci pa so tisti, ki morajo biti pametni uporabniki le-teh.

7. VIRI

[1] Doupona, M. 2016. Mednarodna raziskava bralne pismenosti PIRLS 2016. Povzetek rezultatov raziskave. DOI: https://www.pei.si/wp-content/uploads/2018/12/PIRLS_povzetek.pdf (pridobljeno 29. 7. 2019)

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[3] Socrative https://socrative.com/

[4] Učni načrt, Slovenščina. 2011. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: DOI: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_slovenscina_OS.pdf (pridobljeno 2. 8. 2019)

[5] Učni načrt, Slovenščina (posodobljena izdaja). 2018. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: DOI: http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/podrocje/os/prenovljeni_UN/UN_slovenscina.pdf (pridobljeno 2. 8. 2019)

Za učence s posebnimi potrebami matematika postane igra

For students with special needs math becomes a game

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POVZETEK

V prispevku predstavljam, kako učenci s posebnimi potrebami uporabljajo svoje mobilne naprave pri pouku matematike in pri domačih nalogah. Mladostniki dnevno uporabljajo sodobno tehnologijo, predvsem telefone, ki pa še zdaleč niso namenjeni samo telefoniranju, temveč tudi drugim dejavnostim. Zaradi tega se mi je porodila ideja, da poskušam to njihovo navezanost izkoristiti in uporabiti mobilne naprave kot motivator in pripomoček. V ta namen v prilagojenem izobraževalnem programu osnovne šole z nižjim izobrazbenim standardom pri pouku matematike uporabljamo mobilne naprave kot glasovalne naprave za kviz Kahoot. S pomočjo aplikacije Kahoot izdelam kviz, učenci pa do kviza dostopajo le z vpisom PIN številke, ki jo vpišejo v Kahoot aplikaciji na mobilnih napravah. Ključni cilji takšnega načina poučevanja so preverjanje predznanja, utrjevanje snovi, soustvarjanje nalog ter nenazadnje zdrava tekmovalnost in izredna motiviranost pri izvedbi preverjanja doseženega znanja.

Pri raziskovanju razsežnosti spletnega kviza Kahoot sem ugotovila, da lahko kreiram izziv in s tem omogočim mladostnikom opravljanje domačih nalog na mobilnih napravah. Moram priznati, da so me presenetili njihovi odzivi, saj jih je domačo nalogo na mobilnih napravah opravilo več kot običajno. Tako se zaveš, da učenje na podlagi igre naredi razliko in tudi rezultat – znanje.

Ključne besede

Učenci s posebnimi potrebami, matematika, poučevanje, domače naloge, igra, kviz, Kahoot

ABSTRACT

In my article I present how young people with special needs use their mobile devices in mathematics classes and with their homework. Young people use modern technology every day, especially phones, but they are not meant just for telephoning, but also for other activities. That is why I got the idea, to try and use their attachment to mobile phones as a motivating tool. I have started to use mobile phones in my mathematics class in adapted educational program with lower education standards. We use mobile phones as voting devices in quiz Kahoot! I make a quiz by Kahoot application and students access the quiz only by entering a PIN number on their mobile devices. The main aims of this kind of teaching are verification of the students so far knowledge, revision of the material, co-creation tasks an final healthy competition during the actual verification of the achieved knowledge.

When researching the extent of online quiz Kahoot!, I found that I can create a challenge and thus enable adolescents to do their homework on mobile devices. I have to admit that I was surprised by their responses; more students finished their homework than usual. Thus, you realize that learning based on games makes a difference and also provides a result - knowledge.

Keywords

Students with special needs, mathematics, teaching, homework, game, quiz, Kahoot

1. UVOD

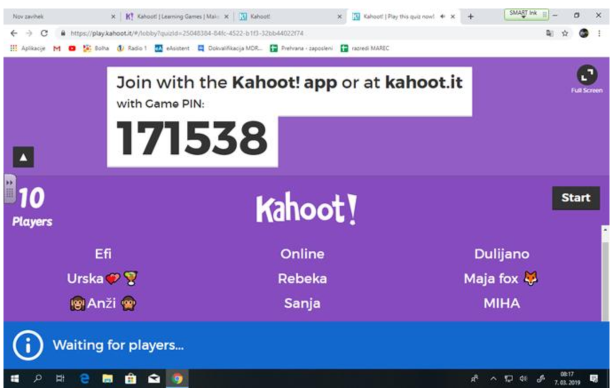
Informacijsko-komunikacijska tehnologija (v nadaljevanju IKT) je prisotna skoraj v vseh področjih človekovega delovanja. V slovenski šoli so se računalniki začeli množično pojavljati okoli leta 1992, ugotavlja Gerlič [2], kot razvedrilo učencem. Z uvedbo devetletne osnovne šole pa se računalnik uporablja tudi kot pedagoško–didaktični pripomoček, navaja Gerlič [2]. Razvoj pa gre neumorno dalje, pojavile so se i-table, glasovalne naprave itd. Mladostniki s posebnimi potrebami dnevno uporabljajo sodobno tehnologijo, predvsem telefone. Zelo so postali navezani na svoje naprave, saj jim le-te omogočajo dosegljivost in povezanost 24 ur na dan. Pametne telefone z izjemno multifunkcionalnostjo in neskončnimi možnosti uporabe vse težje odložijo. Pri pouku matematike v prilagojenem izobraževalnem programu osnovne šole z nižjim izobrazbenim standardom sem želela to njihovo navezanost izkoristiti za aktivnejši, njim bolj prijazen način učenja. V ta namen pri urah matematike mladostniki s posebnimi potrebami odgovarjajo na vprašanja na svojih lastnih mobilnih napravah. S pomočjo aplikacije Kahoot izdelam kviz.

2. UPORABA MOBILNIH NAPRAV PRI POUKU

Za uporabo mobilnih naprav pri pouku sem se odločila, ker sem želela pouk popestriti, dvigniti mladostnikom raven motivacije in jim pokazati, da se lahko mobilne naprave uporabljajo tudi v izobraževalne namene. S pomočjo spletnega kviza smo njihove mobilne naprave spremenili v glasovalne naprave. Pred leti je bilo potrebno učilnice opremiti z glasovalnimi napravami, če je želel učitelj pri pouku uporabljati kvize. To je za nekatere šole predstavljalo velik finančni zalogaj. Sedaj pa lahko glasovalne naprave nadomestijo mobilni telefoni. Večina mladostnikov ima svoje telefone. Tisti, ki ga nimajo, ga lahko nadomestijo s tabličnim računalnikom oziroma jim odstopim mojega. Aplikacija Kahoot se je izkazala za preprosto, uporabniku prijazno in najenostavnejšo aplikacijo. Hitro so jo usvojili tudi mladostniki s posebnimi potrebami.

2.1 Kahoot kviz

Gre za prosto dostopno in zelo preprosto spletno aplikacijo [3]. Pred prvo uporabo se je potrebno učiteljem na spletni strani https://create.kahoot.it/register registrirati in ustvariti svoj račun. Učitelj lahko izbira med že narejenimi javnimi kvizi ali pa naredi svoj kviz. Za ustvarjanje novega kviza izberemo opcijo »Create« [5] in nas spletna stran enostavno vodi skozi proces ustvarjanja kviza. Začnemo s poimenovanjem kviza in izbiranjem naslovne slike, nato pa začnemo s tvorjenjem vprašanj, ki morajo imeti vsaj dva in največ štiri možne odgovore. Pri vsakem vprašanju lahko nastavimo časovno omejitev ter točkovanje. Za izdelavo preprostega kviza, z nekaj vprašanji, potrebujemo le par minut. Ko imamo kviz pripravljen, lahko začnemo z igro. In tukaj pride na vrsto najboljši del, ki ta kviz loči od ostalih. Kot vemo, je danes pametni mobilni telefon zelo pomemben za večino mladostnikov in zakaj tega ne bi izkoristili? Vsak tekmovalec mora za sodelovanje v kvizu na svoj telefon naložiti aplikacijo Kahoot. Ta zavzame zanemarljivo količino prostora in je prenesena v trenutku. Za izvedbo kviza v frontalni obliki potrebuje učitelj projektor, da lahko učenci vidijo vprašanja in spremljajo vmesne rezultate. Ko pričnemo s kvizom, se na glavnem zaslonu računalnika oziroma na projecirani sliki (Slika 1) izpiše koda kviza (Game PIN), ki jo vsak od tekmovalcev vnese v aplikacijo. S tem se prijavi v igro, hkrati pa mora izbrati tudi ime oziroma vzdevek, po katerem ga bo program zaznal in točkoval glede na uspešnost. Tekmuje lahko vsak zase na svojem telefonu, lahko pa tekmujejo tudi skupine.



Slika 1. Prikaz projecirane slike učiteljevega računalnika, kjer je koda kviza za prijavo v aplikacijo

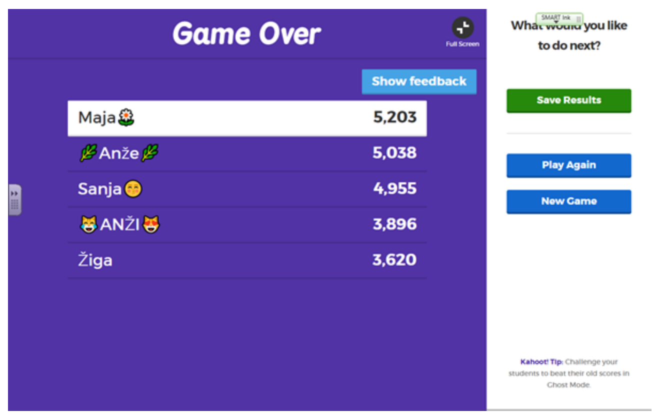
2.2 Kviz pri pouku

Učenci se s svojimi mobilnimi telefoni prijavijo v program ter odgovarjajo na vprašanja in s tem utrjujejo svoje znanje. Prednost uporabe programskega orodja Kahoot je predvsem pri preverjanju usvojenega znanja, ponovitvi snovi in utrjevanju. Malo manj je uporabno pri usvajanju novih učnih vsebin. Kot najbolj učinkovito se izkazalo, da sem kviz uporabila na začetku ure kot uvodno motivacijo ali pa na koncu ure za preverjanje znanja, a ne več kot 15 minut. Pripravila sem jim največ 10 vprašanj oziroma nalog. Kadar so bile matematične naloge kompleksnejše, so morali najprej nalogo rešiti v zvezek, šele potem so lahko izbrali pravi odgovor.

Slika 2. Učenec rešuje primer deljenja števil z enomestnim deliteljem v zvezek, na mobilni napravi bo izbral pravilni odgovor

Za vsako nalogo sestavljavec kviza določi časovni okvir, v katerem morajo udeleženci podati odgovor. Ko vsi odgovorijo oziroma poteče čas, dobijo udeleženci povratno informacijo o pravilnosti odgovora.

Učenci so razporejeni na lestvici ne le po pravilnosti odgovora, ampak šteje tudi hitrost, kar predstavlja še dodatno motivacijo.



Slika 3. Prikaz vrstnega reda udeležencev na projicirani sliki učiteljevega računalnika

3. DOMAČE NALOGE NA MOBILNIH NAPRAVAH

Zaradi pozitivnega odziva učencev in preproste uporabe sem vpeljala tudi domače naloge v obliki kviza, na katerega lahko odgovarjajo preko mobilnih naprav. Domače naloge v obliki kviza je opravilo bistveno več učencev, kakor bi jih sicer.

Zelo natančno je domača naloga opredeljena po B. Čagran [1], in sicer kot »pisna, ustna in praktična oblika učenčevega dela, ki jo posreduje učencem učitelj, in je neposredno povezana s poukom ter jo učenci opravljajo praviloma samostojno po rednem šolskem delu«. Domača naloga torej ni samo pisna, pač pa tudi ustna ali praktična.

Učencem redno dajem domačo nalogo. Z domačo nalogo učenci utrdijo snov, ki smo jo obravnavali pri pouku in pri samostojnemu delu ugotovijo, kaj znajo in česa ne. Pri matematiki se snov nadgrajuje in učenci ne morejo aktivno spremljati razlage, če predhodne snovi ne razumejo in je nimajo utrjene. Pri izbiri domačih nalog upoštevam, da učenci zanje potrebujejo 15 do največ 20 minut dnevno. V začetku šolskega leta, želim, da učenci 14 dni poleg opravljene domače naloge zapišejo, koliko časa so reševali naloge. S tem želim dobiti vpogled, koliko časa potrebuje določen učenec za domačo nalogo. Vemo, da so si učenci s posebnimi potrebami zelo različni. Zato domače naloge vedno individualiziram. Slabšim učencem dajem manj nalog, lažje naloge, boljšim pa ponudim dodatne oziroma težje naloge. Vsakodnevno pregledam, kdo ima opravljeno domačo nalogo. Učence, ki opravijo dodatne domače naloge oziroma tiste, ki domače naloge sploh niso opravili, si vedno zabeležim. Prav tako vedno frontalno preverimo pravilnost rešitev in se pogovorimo o postopkih reševanja. Opravljanje domačih nalog bistveno pripomore k uspešnosti pri predmetu in k boljšemu znanju.

Pri raziskovanju razsežnosti spletnega kviza Kahoot sem ugotovila, da lahko kreiram izziv in s tem omogočim mladostnikom opravljanje domačih nalog na mobilnih napravah. Obstaja možnost nastavitve časovnega okvira, kdaj se izziv konča. Pri kreiranju izziva se učitelju izpiše PIN številka. Učenci doma na svojih mobilnih napravah v aplikacijo Kahoot vnesejo zahtevno PIN številko in pričnejo reševati domačo nalogo.

Slika 4. Prikaz naloge na zaslonu mobilne naprave

Po končanem izzivu mladostnik dobi povratno informacijo o pravilnosti odgovorov in katero mesto med tekmovalci je zasedel.

Učitelj lahko doma med potekom izziva spremlja, koliko učencev je sodelovalo v izzivu in kolikšen delež pravilnih odgovor je dosegel posamezni učenec.

Ob koncu izziva se z mladostniki vedno pogovorimo o domači nalogi, naredimo analizo in jim podam povratno informacijo o njihovih dosežkih in katero mesto so dosegli.

Slika 5. Seznam sodelujočih učencev in njihovi rezultati

Slika 6. Prikaz analize uspešnosti učencev pri posamezni nalogi

4. ZAKLJUČEK

Moram priznati, da so me presenetili njihovi odzivi, saj jih je domačo nalogo na mobilnih napravah opravilo več kot običajno. Še več, želeli so si domačih nalog. Že zjutraj pred poukom so prihajali v učilnico in me spraševali, če bodo spet lahko dobili domačo nalogo na mobilnih napravah.

Zaradi pozitivnega odziva mladostnikov s posebnimi potrebami in preproste uporabe aplikacijo pri pouku uspešno uporabljam že kar nekaj časa. Ko ti predhodno nezainteresiran mladostnik po igri kviza dvigne roko in reče: »Učiteljica, hvala, da ste naredili matematiko zabavno.« ostaneš brez besed. Zaveš se, da lahko poučevanje pripelje
š do te točke, da ga dojemajo kot igro.

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Problemski pouk z uporabo IKT tehnologije

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POVZETEK

Sodobna družba ima vedno višje zahteve po razvijanju digitalnih kompetenc posameznika. Informacijsko-komunikacijska tehnologija je tako že dodobra vpeta v šolski sistem in nam nudi dobro izhodišče za razvijanje potencialov učencev za uspešno delovanje v družbi 21. stoletja. Vključevanje IKT tehnologije v pouk zahteva od učitelja zmožnost kritične presoje ustreznosti posameznih orodij, ki so na voljo. Zato mora učitelj pred samo implementacijo informacijsko-komunikacijske tehnologije razmisliti, kakšen doprinos bo le-ta imela na učno delo in v katero fazo pouka bi jo bilo smotrno umestiti. Med samim izvajanjem učnih dejavnosti pa je njegova vloga, da le spremlja in usmerja učence pri reševanju problemskih nalog. Pa je v praksi res tako? Rezultati Mednarodne raziskave poučevanja in učenja (TALIS 2018) kažejo, da v Sloveniji le malo učiteljev pričakuje, da učenci uporabijo IKT za projektno ali redno delo v razredu. Poleg tega pa je v primerjavi s povprečjem OECD v Sloveniji tudi drugače mnogo manj projektnega dela.

V nadaljevanju je predstavljen primer dobre prakse uporabe IKT tehnologije pri problemskem pouku učencev petega razreda. Učenci so po skupinah samostojno izpeljali projekt s področja trajnostnega razvoja, kjer je bila njihova naloga raziskati avtohtone slovenske rastline ter jih na zanimiv način predstaviti sošolcem. Poleg tega pa so ob pomoči digitalnih orodij ali spletnih aplikacij pripravili tudi utrjevanje in ponavljanje obravnavane snovi. Na ta način so ob pomoči sodelovalnega učenja krepili kompetence 21. stoletja, predvsem kritično mišljenje, socialne kompetence, učenje učenja ter digitalno pismenost.

Ključne besede

Informacijsko-komunikacijska tehnologija, razvoj digitalnih kompetenc, problemski pouk, učenec, učitelj

ABSTRACT

Contemporary society demands that an individual increasingly develop the digital competence. Information-communication technology is largely integrated in the school system and provides good basis for the development of pupils' potentials to incorporate successfully in the 21st century society. A teacher needs to be able to critically evaluate the tools available in order to include ICT in the learning process. Thus the ICT contribution to the teaching process as well as the most appropriate phase for its use need to be determined in advance. The role of the teacher in the learning activities is to monitor and guide pupils through problem-based tasks. Is it really so? The results of the Teaching and Learning International Survey (TALIS 2018) show that only a few teachers in Slovenia expect their children to use ICT for project or regular work in the class. Moreover, there is also much less project work in Slovenia than in the average OECD country.

Later on there is presented a good example of ICT use in the problem-based learning of the 5th class pupils. Pupils conducted independently in groups a project concerning sustainable development; their goal was to explore autochthonous Slovenian plants and to present them in an interesting way to their classmates. They use the digital tools and internet applications to revise and refresh the relevant subject matter. So they strengthen 21st century competencies through problem-based learning, especially critical thinking, social competence and digital literacy.

Keywords

Information-communication technology, digital competence development, problem-based learning, pupil, teacher

1. UVOD

V zadnjih desetletjih je slovensko šolstvo doživelo velik razmah. Sodobna šola mora poskrbeti, da posameznik od učnega procesa odnese kar največ, predvsem ob individualizaciji in diferenciaciji pouka. Zelo pomembno je, da se učitelj pri načrtovanju pouka usmeri na aktivno vlogo učenca. Tako učitelj vse bolj izgublja vlogo podajalca znanja, kar je značilno za tradicionalno šolstvo, in pouk vse bolj naravnava na učence ter pri tem sledi njihovi razvojni stopnji ter osebnim značilnostim. Postaja podpornik in usmerjevalec učnega procesa, pri čemer otroke vodi na poti k novim znanjem.

Ker živimo v družbi neprestanega spreminjanja in prilagajanja, je prav, da že od zgodnjega otroštva učimo učence tudi veščin dobre medsebojne komunikacije in sodelovanja. Ravno prednosti sodelovalnega učenja, kjer morajo učenci v manjših skupinah podrediti svoje osebne cilje in slediti nekemu skupnemu cilju ter kjer ima vsak svojo vlogo in odgovornost za končni rezultat, so po našem mnenju vse premalo izkoriščene v šolskem prostoru.

Na naši šoli smo problemski pouk zasnovali s pomočjo IKT tehnologije, ki je učencem vedno blizu in zanimiva, ob tem pa tudi krepi temeljne veščine, spodbuja mišljenje višjega reda in krepi motivacijo učencev [5]. Učenci so se učili reševati problemske situacije tako samostojno kot v manjših skupinah. Ob vsem tem pa smo jih želeli naučiti tudi kritične rabe IKT tehnologije in varnosti na spletu.

2. PROBLEMSKI POUK

Pri sodobnem pouku se fokus prenaša s poučevanja na učenje, saj je najvišja vrednota kakovostno in uporabno znanje.

Že 1999 je Brcko označil problemski pouk kot najvišjo obliko poučevanja in učenja. Tudi Cencič [5] meni, da je to ena izmed didaktičnih strategij aktivnega oz. odprtega pouka. V šolah ga poznamo kot metodo reševanja problemov, raziskovalno metodo in ustvarjalni pouk [2]. Tako se pouk iz tradicionalnega poučevanja spreminja v učenje, saj sta v ospredju učenčeva lastna aktivnost in samostojnost pri reševanju problemov, pri čemer mora biti posameznik sistematičen in natančen. Rešitve danih problemov so nemalokrat originalne [9]. Ravno lastna učna aktivnost učenca je najpomembnejši faktor uspešnega učenja. Rezultat takega aktivnega učenja je v prvi vrsti znanje ter spretnosti in navade, ki jih učenec usvoji [6].

Problemske naloge morajo biti otrokom blizu, vzete morajo biti torej iz njim bližnjih tematskih področij in življenjskih situacij, tj. avtentične. Učenci gredo tako skozi vse faze reševanja problema in pridejo do rešitev in znanja, ki je zanje uporabno. Izgrajeno znanje je v takem procesu njihov lastni konstrukt, ob vsem tem pa krepijo tudi številne kompetence, kot so (samo)kritičnost, vztrajnost, pozitivna samopodoba, motiviranost za delo.

Veliko vlogo ima pri zasnovi in izvedbi takega pouka učitelj. Ta mora zelo dobro poznati specifike posameznih otrok, da bi delo v skupinah lahko kvalitetno teklo. Ravno tako se mora vprašati, katere cilje želi z učenci zasledovati in kaj naj bi bil končni rezultat problemskega pouka. Predvsem pa je pomembno, da je fleksibilen. Tak pouk namreč lahko poteka strnjeno ali z različnimi premori več časa in tu se učitelj lahko poslužuje medpredmetnega povezovanja in fleksibilnosti urnika.

3. IKT TEHNOLOGIJA IN RAZVOJ DIGITALNIH KOMPETENC

Kot pravi Gerlič [4], sta ena ključnih problemov vzgoje in izobraževanja ustrezna motivacija učencev in doseganje aktivnega znanja. Navaja tudi, da učenci rešujejo probleme šablonsko in nemotivirano (prav tam). Vpeljevanje IKT tehnologije v pouk je tako lahko dober motivacijski faktor. Vse, kar se nanaša na računalnike, pametne telefone in druge e-pripomočke, deluje na učence motivacijsko. Učni proces postaja v njihovih očeh na tak način bolj zanimiv. Rebernak [8] meni, da učiteljevo vnašanje e-gradiv v pouk vpliva na višjo kakovost njegovega dela. Nikakor pa ne smemo IKT tehnologije vnašati v pouk kar tako, brez tehtnega premisleka in brez zasledovanja nekega vnaprej določenega cilja, saj se bistvo uporabe sredstva tako lahko izgubi. Za uspeh v sodobni družbi morajo biti učitelji in učenci zmožni tehnologijo premišljeno in učinkovito uporabljati, torej biti digitalno pismeni.

Digitalna zmožnost je opredeljena kot temeljno razumevanje in poznavanje narave, vloge ter zmožnosti informacijske družbe v našem vsakdanjem življenju [7]. Sem spada uporaba različnih programov in urejevalnikov besedil, aplikacij, elektronske pošte, spletnih mest za medsebojno komunikacijo ter tudi zavedanje o pasteh IKT tehnologije in spleta.

Vsem nam so različna IKT sredstva neprestano na dosegu roke. Posebej otroci si skoraj ne znajo prestavljati dneva brez telefona ali večera brez televizije in računalnika. Ravno zato menimo, da bi lahko prednosti IKT tehnologije v šoli bolj izkoristili. Ob tem velja poudariti tudi pomen varne rabe.

Pouk z elektronskimi prosojnicami in raznimi avdio-vizualnimi elementi je že dodobra implementiran v naš šolski sistem. Pri vsem naštetem ima bolj kot ne glavno funkcijo učitelj, učenci so samo opazovalci in so le malo aktivni. Aktivni pouk, kjer učenci sami izgrajujejo svoje znanje prek problemskih situacij, s sodelovanjem, posvetovanjem, iskanjem virov in usklajevanjem ter preverjanjem rešitev, ob pomoči motivacijskih IKT sredstev, pa je nekaj čisto drugega. Nikakor ne smemo pozabiti, kot navaja Ulvik [10], da IKT tehnologija daje učnemu procesu nekaj več, nikakor pa ne more v celoti nadomestiti ostalih oblik dela.

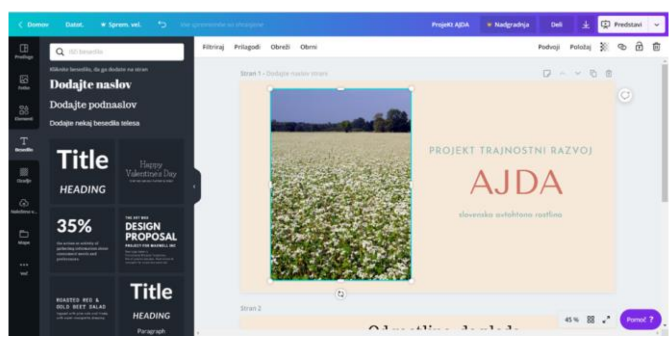
V mesecu juniju smo v medijih zasledili rezultate mednarodne primerjalne raziskave učenja in poučevanja TALIS 2018. V izsledkih je navedeno, da v Sloveniji le malo učiteljev pričakuje, da učenci uporabijo IKT za projektno ali redno delo v razredu.

4. PRIMER DOBRE PRAKSE

V petem razredu je veliko možnosti, da pouk zasnujemo tako, da spodbujamo aktivno učenje. V minulem šolskem letu smo pri obravnavi Slovenije pri družbi pogosto izvajali medpredmetne povezave s slovenščino. S tematiko Slovenije želimo pri učencih vzpostaviti neko splošno naravno in kulturno razgledanost o posameznih pokrajinah in državi kot celoti. Pri slovenščini se učenci v petem razredu učijo o jeziku in spoznajo besedilni vrsti opis rastline in predmeta.

Ob zaključku šolskega leta smo želeli z učenci pripraviti nekakšen pregled usvojenega znanja s teh področij. Tako se je jim porodila ideja, da bi po skupinah raziskali slovenske avtohtone rastline, ki rastejo po posameznih slovenskih pokrajinah, nato pa bi pripravili predstavitev za sošolce in ob koncu vseh predstavitev še interaktivne vaje za ponavljanje. Naša naloga je bila, da smo učencem pomagali problem preoblikovati v problemsko nalogo. Dali smo jim načrt s ključnimi napotki, kako se problemske situacije lotiti in kako ravnati, ko naletijo na težave.

Izvedbi omenjene dejavnosti smo namenili cel teden, sicer ne strnjeno, pač pa vsakodnevno dve uri. Učence smo najprej razdelili v manjše skupinice. Sledila je izbira teme, tj. avtohtone rastline, ki je značilna za določeno slovensko pokrajino. Učenci so si v skupinah nato razdelili zadolžitve in na spletu in v knjižnici iskali vire. Zbiranje virov je bilo prepuščeno njim samim. Ko so jih poiskali, so jih v skupinah preučili in na podlagi ugotovitev izdelali elektronsko predstavitev rastlin s programom Canva (Slika 1).

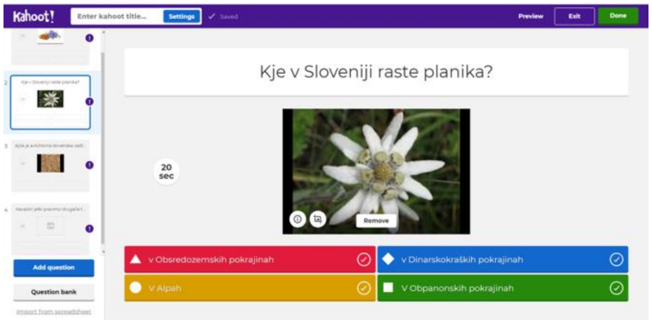


Slika 1. Elektronska predstavitev s programom Canva

Učencem je bilo delo s programom, ki je zelo preprost, vendar nekoliko drugačen od njim poznanega Microsoft Power Pointa, zelo zanimivo. Veliko so se igrali z dodajanjem različnih ozadij in izrezkov ter fotografij in napisov. Ko so nastopile težave pri izdelavi predstavitve, so člani skupine staknili glave in vztrajno in pogumno našli pot naprej. Tudi če kdo česa ni znal, se mu niso posmehovali, pač pa so ga usmerili na pravo pot. Med skupinami tako ni vladala tekmovalnost, pač pa spodbudna klima, ki vodi k napredku.

Vse skupine so uspešno izdelale in predstavile svoje e-predstavitve. Sledil je drugi del projekta, in sicer priprava vaj za utrjevanje snovi. Učencem smo predstavili orodje Kahoot! in vse funkcije, ki jih omogoča ta program za izdelovanje kvizov. Učenci so po skupinah pripravili vprašanja, ki so se nanašala na predelano snov. Vprašanja so bila izbirnega tipa, z možnostjo izbire med več odgovori. V izdelovanju nalog so zelo uživali, saj so bili pri celotni nalogi popolnoma samostojni. Lepo jim je bilo, da je delo potekalo ob pomoči računalnika, ki ima nanje močan motivacijski vpliv. Po spletu so iskali fotografije in jih vključevali v kviz. Ob tem so utrjevali pravilno navajanje virov in razmišljali o varni rabi spleta in pasteh, ki jih ta predstavlja.

Ko so vsi učenci zaključili s pripravo kviza, je sledilo preverjanje znanja. To je potekalo v dveh fazah. Vsaka skupina je sošolcem najprej predstavila svoj kviz in jim postavljala vprašanja, na katera so odgovarjali ob pomoči pametnega telefona. Za odgovor na vsako vprašanje je na voljo 20 sekund. Program Kahoot! je narejen tako, da upošteva pravilnost in hitrost odgovora, tako da je bilo treba na vprašanje kar se da hitro odgovoriti. V drugem delu pa smo združili določena vprašanja iz vseh kvizov in sestavili razredni kviz s ponovitvijo vseh raziskanih rastlin ter se po skupinah zopet preizkusili v reševanju (slika 2). Člani vseh skupin so bili med preverjanjem aktivni. Ko so na ekranu zagledali vprašanje, so staknili glave in skupaj odgovorili. Tako so na zabaven in dinamičen način, ob igri, utrjevali šolsko snov.



Slika 2. Izdelava kviza v programu Kahoot!

5. ZAKLJUČEK

Učenci digitalne medije uporabljajo dnevno. Brez njih si življenja ne znajo predstavljati. Ko smo petošolce povprašali, kaj počnejo na teh napravah, so povedali, da poslušajo glasbo, gledajo posnetke in igrajo igre ter predvsem brskajo po spletu. Ugotovili smo, da se sploh ne zavedajo uporabne vrednosti, ki jo ta tehnologija ima.

Učitelji se trudimo pouk narediti zanimiv in dejavnosti motivacijske, da bi spodbudili zanimanje in aktivnost otrok. Pogosto smo s tradicionalnimi oblikami in metodami dela pri tem neuspešni. Zato je dobro, da pogledamo izven okvirov ustaljenih šolskih praks in stopimo korak naproti učencem. Digitalni mediji so učencem blizu. Številne vsebine lahko obravnavamo in preverjamo ob njihovi pomoči. Za vse to potrebujemo učitelja, ki je digitalno pismen in bo tudi pri učencih razvijal digitalne kompetence in jim na ta način pomagal do boljšega delovanja v družbi 21. stoletja. Za kvalitetno udejstvovanje v tej družbi pa so nujno pomembne tudi sodelovalne kompetence. Razvoj teh lahko učinkovito spodbujamo s problemskim poukom in s skupinskim delom ter učence tako spodbudimo k aktivnosti.

Naloga učitelja ni, da digitalizira celoten učni proces, pač pa da premišljeno in smiselno v pouk vnaša digitalne medije in na tak način skrbi za razvoj digitalnih kompetenc. Ob tem učence tudi opozarja na nevarnosti spleta. Za učinkovito delovanje v družbi 21. stoletja pa so nujne tudi emocionalne kompetence in učenje učenja. Te pa prav tako učinkovito razvijamo s pomočjo sodelovanja v problemskih situacijah. Takšen način dela je za učitelja precej zahteven, saj je v vlogi opazovalca in usmerjevalca, ki s povratnimi informacijami in dodatnimi navodili učence usmerja na pot do cilja.

S problemskim poukom učenci pridobivajo znanja višjih taksonomskih ravni in se učijo za življenje. Zato je pomembno, da učence učimo učinkovitega reševanja problemov, tudi ob pomoči tehnologije, ki nam je na voljo, in predvsem s sodelovanjem in povezovanjem z ostalimi.

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Popestritev ponovitve celoletne snovi v 6. razredu pri matematiki

The enhancement to repetition of year-round content in 6th grade in mathematics

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POVZETEK

Konec vsakega šolskega leta iščemo zanimive načine, kako ponoviti celoletno snov. V prispevku predstavljam primer dobre prakse, kjer smo celoletno snov v 6. razredu pri matematiki ponovili tako, da so učenci za sošolce pripravili različne naloge. Te naloge (iskanje besed, metanje kock, igranje iger, reševanje križank, domine …) so učenci naredili pri neobveznem izbirnem predmetu računalništvo. Naloge skupaj z rešitvami smo natisnili ter jih razdelili med sošolce, ki so naloge rešili in podali povratno informacijo. Učencem je bil tak način ponovitve snovi prijetnejši, bili so visoko motivirani za delo, pridobljena matematična znanja so uporabili na zanimivejši način.

Ključne besede

6. razred, matematika, učenje z igro, Tools for Educators

ABSTRACT

At the end of each school year we look for interesting ways to replicate the year-round content. This article presents an example of good practice where the year-long content was repeated in 6th grade in mathematics by having students prepare different tasks for their classmates. Tasks (word search, dice throwing, playing games, solving crossword puzzles, dominoes, etc.) were made by students in the optional elective computer science course. The completed tasks together with the solutions were printed and distributed among classmates who solved the tasks and gave feedback. This kind of repetition was more enjoyable for the students, they were highly motivated for work, and they used their mathematical knowledge in a more interesting way.

Keyword

Sixth grade, mathematics, learning by playing, Tools for Educators

1. UVOD

V okviru vseživljenjskega učenja moramo učencem ne le predati bogato znanje in jih uriti v različnih spretnostih, temveč jih je treba usposobiti tudi ali pa predvsem za to, da se bodo v različnih učnih okoljih znali učiti. Da je učenje učenja postalo ena od ključnih kompetenc, namreč ni naključje ali nemara modna muha. Sestavljajo jo odnos do učenja, veščine učenja in znanje. Znanje zajema širno področje védenja o svetu okoli nas, učenje učenja pa poudarja tudi znanje o samem sebi kot učencu [1].

2. TEORETIČNA IZHODIŠČA

Matematika je predmet, pri katerem se vsebine vsako leto prepletajo in nadgrajujejo. Učenec vsako leto v proces učenja vnaša elemente ponavljanja predznanja ter obenem nadgrajevanje le-tega. Ker je napredek pogojen s sprotnim utrjevanjem in ponavljanjem snovi, je za učitelja zelo pomembno, da spremlja proces učenja in na podlagi povratnih informacij učencev spreminja proces poučevanja. Učitelj lahko pozitivno vpliva na proces učenja, če učencu zagotovi varno učno okolje in omogoči okoliščine, v katerih se bo lahko učeči optimalno razvijal. Marentič Požarnikova navaja, da ima vpliv okoliščin na učenje velik pomen. Učitelj na eni strani ustvarja učne okoliščine, učenec je v teh okoliščinah vpet v proces učenja. Vendar se proces še ne zaključi. Učitelj spremlja napredek učencev ter rezultate učenja, ki so kognitivne in socialno-emocionalne narave. Na podlagi povratne informacije se krog zaključi, saj učitelj tako evalvira lastno prakso in se uči oblikovati nove okoliščine za učenje ali spodbudno učno okolje [3].

V ta namen smo se na Osnovni šoli Antona Martina Slomška Vrhnika odločili, da bomo oblikovali interaktivno ter spodbudno učno okolje, v katerem bodo učenci šestih razredov lahko ponovili celoletno snov pri predmetu matematika. Vsako leto poskušamo najti nov, zanimiv, drugačen način ponovitve. Letos smo se odločili, da bodo učenci sami pripravili naloge za sošolce.

3. OPIS DELA

Z učenci 6. razredov smo se dogovorili, da bodo pri neobveznem izbirnem predmetu računalništvo, nekateri pa po pouku, pripravili zanimive matematične naloge za sošolce. Delo je potekalo s pomočjo brezplačnega programa Tools for Educators. Ustvarili so učni list, pri tem pa izbirali med orodji, kot so križanka, iskanje besed, izdelava kocke, izdelava igralnih podlog, bingo, labirint, domine ipd.

Učenci so se odločili, da bodo izdelane didaktične igre obsegale matematične sklope 6. razreda: naravna števila; enačbe in neenačbe; ulomki; decimalna števila; osnovni geometrijski pojmi; kot in krog; obseg, ploščina, površina in prostornina; obdelava podatkov.

Pred izvedbo učnih ur smo morali proučiti spletno stran Tools for Educators (https://www.toolsforeducators.com/); pripraviti kratka navodila za učence in rezervirati računalniško učilnico.

Po koncu dejavnostih v računalniški učilnici pa smo morali natisniti naloge – učni list za vsakega učenca ter pripraviti evalvacijske liste.

Z učenci smo v računalniški učilnici učne liste ustvarjali 2 uri. Učni list so učenci izdelali s pomočjo spletne strani Tools for Educators (slika 1), nato pa ga dokončali v Wordu. Uporabljali so tudi Orodje za izrezovanje, kadar je bilo to potrebno. Zahteva je bila tudi, da v glavo dokumenta napišejo avtorja in razred; datoteko ustrezno shranijo (ucni-list-ime-razred); ima učni list naslov; so na učnem listu navodila za reševanje in so priložene rešitve.

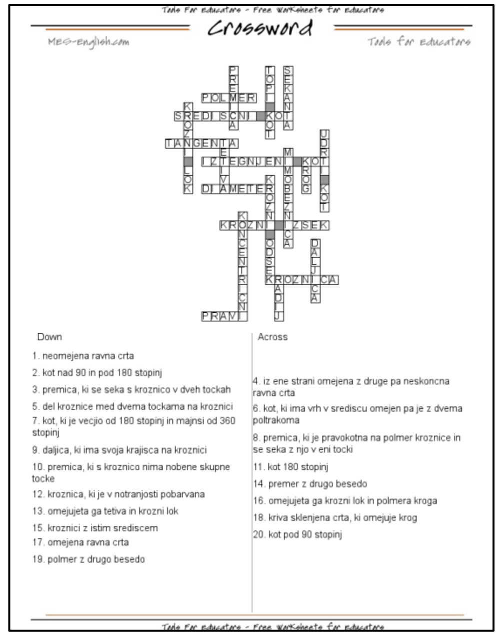
Slika 1. Tools for Educators

Učenci so najprej obiskali spletno stran Tools for Educators. Nato so izbrali dejavnost, ki jim je najbolj ustrezala. Predhodno so morali pripraviti naloge/vprašanja za sošolce. Ko so dejavnost ustvarili, so jo shranili na računalnik, nato pa jo vstavili v urejevalnik besedil in učni list obdelali do konca (slika 2). Prav tako so morali shraniti rešitve, ki so jih dodali v učni list (slika 3). Rešitev sošolcem nismo natisnili, te so bile zgolj za preverjanje pravilnosti rešitev.

UČNI LIST - utrjevanje znanja iz matematike, 6.R

Najdi si prijatelja s katerim se boš igral igro. Vzemita kocko. Vsak vrže enkrat in odgovori na vprašanje. Naj zmaga najboljši in najpametnejši in ne pozabita uživati.

Slika 2. Primer učnega lista



Crossword

Down

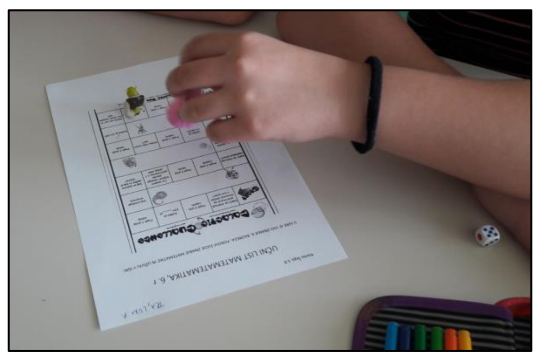
1. neomejena ravna crta
2. kot nad 90 in pod 180 stopinj
3. premica, ki se seka s kroznico v dveh tockah
5. del kroznice med dvema tockama na kroznici
7. kot, ki je vecjio od 180 stopinj in majnsi od 360 stopinj
9. daljica, ki ima svoja krajisca na kroznici
10. premica, ki s kroznico nima nobene skupne tocke
12. kroznica, ki je v notranjosti pobarvana
13. omejujeta ga tetiva in krozni lok
15. kroznici z istim srediscem
17. omejena ravna crta
19. polmer z drugo besedo

Across

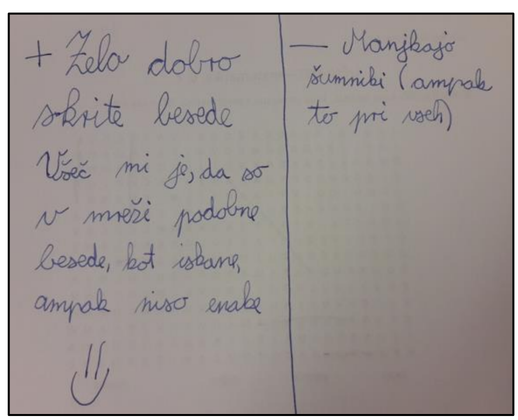
4. iz ene strani omejena z druge pa neskoncna ravna crta
6. kot, ki ima vrh v sredíscu omejen pa je z dvema poltrakoma
8. premica, ki je pravokotna na polmer kroznice in se seka z njo v eni tocki
11. kot 180 stopinj
14. premer z drugo besedo
16. omejujeta ga krozni lok in polmera kroga
18. kriva sklenjena crta, ki omejuje krog
20. kot pod 90 stopinj

Slika 3. Primer vstavljenih rešitev

Med uro matematike smo učne liste razdelili med sošolce, ki so jih reševali. Nekateri individualno, nekateri v parih, odvisno od tipa naloge, ki so jo izbrali (slika 4). Zadnjo stran lista so razdelili na dva dela. Na enega so zapisali, kaj jim je na učnem listu všeč, na drugega, kako naj učni list še izboljšamo (slika 5).



Slika 4. Reševanje učnih listov



Slika 5. Zadnja stran učnega lista

Učne liste smo ob koncu ure pobrali, jih pogledali in učencem podali povratno informacijo. Povratne informacije po Peršolji ne smejo biti prehitre. V nasprotnem primeru (preden se učenec ne dovolj posveti problemu) se nauči manj. Pomembno je, da povratne informacije pri učencu sprožijo razmislek, da se učenec trudi sam priti do pravilne rešitve. To sproži kognitivni konflikt. Učenec mora imeti možnost za izboljšanje, sicer je povratna informacija nekoristna, prav tako, če je učenec ne razume. Biti mora osredotočena, sicer ni učinka [4].

4. REZULTATI

Naslednjo šolsko uro so učenci učne liste popravili glede na pripombe sošolcev. Učne liste je izdelalo 22 učencev.

Prav tako so rešili kratke evalvacijske vprašalnike, kjer so odgovorili na 3 vprašanja:

- Ali ti je bila učna ura zanimiva? Zakaj da/ne?
- Kaj bi spremenil?
- Učiteljici bi sporočil še …

Prav vseh 22 učencev je povedalo, da so jim bile učne ure zelo zanimive in zelo všeč. 20 učencev je najbolj uživalo pri ustvarjanju učnih listov. 7 učencev je skrbelo, da bodo učni list zelo težko naredili. Prav vsem je bilo všeč, ker so lahko izbirali med različnimi dejavnostmi ter imeli dovolj časa. Vseh 22 učencev meni, da je to zelo dober način za ponavljanje snovi.

5 učencev bi spremenilo, da bi lahko ustvarili več učnih listov ter da bi bilo več nalog narejenih za delo v paru. Vseh 22 učencev meni, da bi program moral dovoliti šumnike (vendar program tega ni dopuščal). 12 učencev predlaga, da bi sošolci pisali bolj natančna navodila (v kateri smeri naj iščejo besede). 8 učencev meni, da je preveč nalog na učnem listu. 2 učencema je bil učni list prelahek (prehitro sta končala). 5 učencev je mnenja, da mora avtor svoj učni list obvezno rešiti in preveriti pravopis. 3 učence je motilo, ker učni list vsebuje tudi angleške črke.

Prav vsi učenci so zapisali, da si želijo še več takšnih ur in da je to odličen način za utrjevanje znanja (najprej so morali pogledati zvezke in učbenike, da so se spomnili celoletne snovi). 8 učencem so bile ure zabavne in devet učencev se je balo povratnih informacij sošolcev. Trije učenci menijo, da bi prihodnjič lahko ustvarjali učne liste v parih.

5. ZAKLJUČEK

Učna igra je odličen primer dinamične metode dela. Od nas zahteva vključitev preteklih izkušenj, torej posredovanega znanja, hkrati pa refleksija in vrednotenje učne igre naredita en korak več: udeležence spodbudita k razmišljanju, kaj novega so se pri tej igri naučili. Za učno igro potrebujemo konkretne učne cilje. Te lahko delimo na izobraževalne in vzgojne [2]. Kot odličen primer dobre prakse pri ponovitvi učne snovi v 6. razredu pri matematiki se je izkazala ponovitev v obliki didaktičnih iger, ki so jih učenci pripravili sami, pri čemer so si pomagali tudi z računalniškim programom Word in spletno stranjo Tools for Educators. To pa potrjujejo tudi povratne informacije učencev, ki so celoletno učno snov ponovili na inovativen, zanimiv in zabaven način. Hkrati pa smo izvedli tudi medpredmetno povezovanje, saj so učenci naloge za ponovitev učne snovi pripravili pri neobveznem izbirnem predmetu računalništvo.

6. LITERATURA IN VIRI

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Medijske vsebine skozi prizmo kritičnega očesa

Media content through the prism of the critical eye

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POVZETEK

V prispevku je predstavljeno delo v sklopu izbirnih vsebin vzgoja za medije. Opisane so aktivnosti, ki jih izvajamo z namenom, da bi učenci čim bolje spoznavali uporabo medijev. Ti pravzaprav prispevajo k oblikovanju predstav o svetu, pripomorejo pri iskanju življenjskih stilov, celo vedenjski vzorci se porajajo prek njih. V današnjem tehnološkem času je pomembno biti informacijsko in funkcionalno pismen, naučiti se je potrebno biti sposoben kritično analizirati, ocenjevati ter izdelovati medijske oblike. K uram pouka sem uvedla nove inovativne pristope in nove dejavnosti, da bi učenci znali analizirati lastne navade spremljanja medijev, prepoznati in odpraviti morebitno medijsko zasvojenost in ustvarjalno ter smotrno izbrati medijske vsebine. Eden izmed primerov je spoznavanje medijskih poklicev prek osebne ravni, učenci se torej v živo spoznajo z osebami, ki opravljajo tovrstne poklice, ne le prek teorije. Vsako obravnavano temo spremlja kritično motrenje, kjer učenci z lastnimi ugotovitvami prispevajo k širši sliki. V prispevku je podrobneje orisano, kako pravzaprav razvijajo lastnosti, ki botrujejo pozitivni samopodobi ter samostojnemu družbenemu delovanju.

Ključne besede

Uporaba medijev, kritična analiza, medijske oblike, inovativni pristopi

ABSTRACT

In this article I will present educational practice in the context of the elective subject of media education. I will describe the activities that I undertake in order to make the pupils more aware of the use of media. In fact, media contribute to formation of perception and ideas about the world, help pick lifestyles, and even behavioural patterns emerge through media. In today's information age it is important to be media literate and functional, it is necessary to learn how to analyze, critically assess and design various communication forms. At the lessons, I introduce innovative approaches and new activities so that the pupils can analyze their own media habits, recognize and eliminate possible media addiction, and choose media content creatively and wisely. As an example, pupils do not just theoretically, but personally experience different jobs in media industry by meeting people working in these professions. Each topic covered includes a critical observation, which allows pupils with their own findings to contribute to the bigger picture. In the article I will outline in more detail how they actually develop qualities which promote positive self-image and independent social functioning.

Keywords

Media use, critical analysis, communication forms, innovative approaches

1. UVOD

Vseobsegajoča prepletenost medijev v vsakdanjem življenju posameznika zelo zaznamuje človekov obstoj. Tako postane poznavanje medijev, njihovo delovanje, kritično motrenje vsebin še kako potrebno za zdrav razvoj slehernika, še posebej mladostnikov. Pri izbirnih vsebinah vzgoja za medije (televizija, radio, tisk) sem se odločila spremljati in ozavestiti učence, kako močan vpliv imajo mediji na slehernikovo presojanje realnosti: na vrednote, na stil življenja, na nakupe, na mnenje o kakovosti izdelkov, na medsebojne odnose … Kako vodljivi pravzaprav smo, da postane lahko hitro medijska realnost naša realnost. Že Manca Košir je v prejšnjem stoletju ugotovila, da je televizija izjemno učinkovit medij, saj gledalca pritegne v svojo navidezno resničnost, da z vidom in sluhom doživlja njene podobe, in ima občutek, kot da je tam, sredi dogodkov.

Z učenci motrimo vpliv medijev in njihovo uporabo, na primer družbenih omrežij, in vzpenjajoče se odvisnosti od raznovrstne novodobne tehnologije, celo zasvojenosti z računalniškimi igricami in socialnimi omrežji. Alarmantna je njihova dovzetnost in poistovetenje s samim domišljijskim svetom zaslonov. V prispevku opisane aktivnosti izvajamo v namen preprečitve prepogostega in vseobsegajočega bega iz vsakdana v virtualni svet. Seveda v ospredje postavimo tudi pozitivne strani. Potrebno je učence pripraviti, jih naučiti in razviti kritično presojanje vsega, s čimer so obdani. Jim ponuditi alternativne dejavnosti, ki bi jim nudile užitek in zadovoljstvo.

2. MOJI INOVATIVNI PRISTOPI

2.1 Izkustveno učenje

Sporazumevanje in komunikacija prek medijev je zelo pomemben del našega socialnega življenja. Poznavanje delovanja medijev, kritično analiziranje medijskih vsebin in celo ustvarjanje lastnih medijskih sporočil je ključno za kakovost bivanja. Z učenci prek izkustvenega učenja – osebne izkušnje ne le razmišljamo o obravnavani učni snovi, temveč to bolj izkusimo prek doživljanja. Učenje se prenese iz miselne tudi na akcijsko in čustveno raven. Učenci preizkušajo abstraktne definicije in pojme s konkretnimi situacijami. Uporabljajo osebne izkušnje kot vir učenja. Z aktivnim vključevanjem vsakdanjih situacij, na primer pri obisku različnih medijskih ustanov: televizije, radia, časopisne hiše pouk postane veliko bogatejši in zanimivejši. V obliki terenskega dela se učenci srečajo s konkretnimi situacijami, spoznajo konkretne osebe in lahko sami vpletejo svoje doživljanje. S takim načinom dela je učencem snov razumljivejša, veliko bolj jo pomnijo in se je tako veliko lažje naučijo.

2.2 Obiskovanje medijskih hiš in delo na terenu

Učenci pri izbirnem predmetu televizija spoznajo skupne značilnosti množičnih medijev, spoznajo nastanek in razvoj televizije, seznanijo se z osnovnimi značilnostmi televizije, odkrivajo podobnosti in razlike med televizijskimi postajami, spoznajo osnovne korake novinarskega dela. A vse to prenesemo iz šolskih klopi v samo središče dogajanja. Vsako šolsko leto namreč z učenci obiščemo snemanja najrazličnejših oddaj, kjer spoznavamo zaodrje in znane televizijske obraze. V praksi torej spoznajo delo – raznolikost in pestrost dela na televiziji. Nemalokrat se ponudi prilika kako znano osebnost spoznati v živo. Učenci iz prve roke vidijo delovno rutino novinarjev, se z njimi srečujejo na njihovem delovnem mestu. Učenci tako izkoristijo priložnost, da vzpostavijo stik, se domenijo za intervju in tako še na osebni ravni spoznajo morda celo svojega idola. Ob takem znanstvu se lahko njihova predstava o tem človeku in njegovem delu zamenja. Učijo se kritično presojati svoja doživetja in predstave. Z RTV Slovenija, oddajo Infodrom, že več let sodelujemo in novinarska ekipa večkrat obišče našo šolo. Posnamejo različne prispevke, ob novem letu so na primer poročali o našem božičnem bazarju, nekaj učencev je podalo tudi svoje mnenje o božični in novoletni nakupovalni mrzlici ter pomenu praznikov. Na svoje pojavljanje na televizijskih zaslonih so bili učenci še kako ponosni.

2.3 Sooblikovanje šolskega glasila, nagradna vprašanja

Pri izbirnem predmetu tisk učenci prispevajo svoje izdelke tudi za šolski časopis Vrtiljak pegic. Učenci se srečujejo z različnimi načini in oblikami sporočanja: novinarskimi, umetniškimi, publicističnimi besedili. Naučijo se v praksi, kako se oblikujejo novice in novinarski žanri v posameznih medijih. Podrobno proučijo različne besedilne in medijske vrste: intervju, reportaža, novica, poročilo, dokument, fotografijo, video, film, glasbo, internet. Vsako leto si zamislijo kako novo rubriko, na primer objavljajo nagradna vprašanja, kjer učenci odgovarjajo na vprašanja in svoje odgovore vržejo v nabiralnik, ki ga imajo na primer v knjižnici. Beležijo dogodke, kjer se pove vse o preteklih uspehih in tekmovanjih, ki so se dogodili na šoli. Ozirajo se v prihodnost, napovedujejo dogodke, ki se bodo odvijali na naši šoli. Kot eko poročevalci sodelujejo tudi pri projekt Ekošola. Na list papirja tako prelijejo kritične refleksije o ekološko prebranih vsebinah.

2.4 Oglaševanje in propaganda, lasten oglas

Z učenci se seznanimo, kako razlikovati oglaševanje in propagando od novinarskega sporočanja. Učenci postopoma ugotovijo in razumejo, da mediji sveta ne zrcalijo, ampak ga ustvarjajo. Prav tako namenimo prostor socialnim omrežjem, se zamislimo nad vseobsegajočim vplivom le teh na kakovost našega bivanja. Sprašujemo se in iščemo načine, kako najti ravnovesje in zdravo spremljanje neizogibnega sveta spleta.

Na ta način zaobjamemo in poglobimo priporočila učnega načrta. Prek značilnosti oglasov se učenci seznanjajo z bistvenimi značilnostmi oglaševanja, pri tem je poudarek na opozarjanju na prepričevalno naravo oglaševanja in propaganda. Zavedajo se lastne percepcije oglasnih sporočil. Diskutirajo o tem, kako razlikovati oglas od novinarskih besedil. Izpolnjujejo kodirni list o pogostosti in vsebini oglasov. Oblikujejo svoj oglas.[1]

2.5 Lastna radijska oddaja in tiskovna konferenca

Pri izbirnem predmetu radio učenci sami pripravljajo radijske oddaje prek računalnika, saj je šolski radio potreben obnove in žal ni funkcionalen. Zbirajo novice (tako o dogajanju na šoli kot tudi izven nje). Obiščejo tudi več radijskih postaj, da vidijo, kako to poteka profesionalno. Prijazni uslužbenci jim gostoljubno predstavijo prostore hiše, tehnične naprave, vse poklice in velikokrat se učenci tudi sami preizkusijo v vlogi radijskega voditelja ali snemalca. Zelo jim je v ponos, ko sebe slišijo v kaki izmed radijskih oddaj. Iznašli so rubriko Skriti gost, kjer učenci pripravijo intervju z določeno osebo in vnaprej posnamejo glas, nato pa spremenimo glas in učenci ugibajo, kdo je ta skriti gost, svoje odgovore pa ponovno oddajo v nabiralnik, srečni izžrebanec pa prejme nagrado. Občasno pripravijo tudi tiskovno konferenco in okroglo mizo z zanimivimi gosti in temami.

3. MEDIJSKI POKLICI PREK OSEBNE PLATI

Pri vseh izbirnih predmetih spoznavamo medijske poklice tudi v prerezu bolj osebnih plati. Učenci spoznavajo delovno rutino ljudi, ki opravljajo medijski poklic. Z njimi se srečujejo na njihovem delovnem mestu, saj večino teh učenci spoznajo v živo, jim zastavijo vprašanja v zvezi s področji, ki jih najbolj zanimajo. Vprašanja si vnaprej pripravijo, ko sami pregledajo obstoječo literaturo. Tako na primer pridejo v stik z novinarji vseh treh medijskih vej, moderatorji, napovedovalci, uredniki, s publicisti, oglaševalci, snemalci, tehnično službo in medijskimi tehniki. Zadnji jim na primer razkažejo delo na področju grafičnih, medijskih in avdovizualnih komunikacij.

3.1 Novinarska etika

Sledimo priporočilom učnega načrt Vzgoje za medije, da učenci opredeljujejo odgovornost novinarja po novinarskem kodeksu in prebujajo zavest ter oblikujejo merila o moralno nespornem novinarstvu. Pomagajo razviti strpen in spoštljiv odnos do drugih. Pogovarjajo se o tem, kako naj novinarji spoštujejo človekovo zasebnost. Osvajajo pojme: novinarska etika, novinarski kodeks, načelo podajanja resnice, nepristranskost svobode, humanost odgovornosti.[1]

4. KRITIČNO MOTRENJE

Poudarek pri izvajanju izbirnih vsebin je, da učenci izboljšajo svojo informacijsko in funkcionalno pismenost, so sposobni analizirati lastne navade spremljanja medijev, kritično izbirati medijska sporočila. Spoznavajo delovanje medijskih institucij (kdo sporoča in zakaj), medijskih kategorij (za kakšno vrsto besedila gre in podajajo ob njem objektivno oceno), medijskih tehnologij (kako se sporoča), medijskega jezika (kako vemo, kakšen je pomen medijskih sporočil), občinstev (kdo in kako sprejema medijska sporočila). V praksi učenci oblikujejo novice in novinarske žanre v mediju tako televizija, radio in tisk. Srečajo se z okoliščinami, prek katerih prihaja do konstrukcije pomena. Naletijo na delovno rutino novinarjev ...

4.1 Samorefleksija kakovosti učenčevega mišljenja

Izjava Johna Deweya, ameriškega filozofa, psihologa in pedagoga »Človek se ne uči iz izkušnje, pač pa iz refleksije izkušnje,« v začetku 19. stoletja je botrovala radikalni spremembi fokusa pozornosti učiteljev v procesu učenja iz učenčeve izkušnje same na refleksijo le-te. Ni dovolj, da ima učenec priložnost vaditi veščino, torej kritično misliti – raziskovati, argumentirati, sklepati, sodelovati, ustvarjati. Pomemben je predvsem poudarek, da proces uporabe veščine vedno znova, po vsaki aktivnosti, v kateri je veščino uporabil ozavešča in reflektira. Učence spodbujam, da

primerjajo svoj dosežek z želenim stanjem in skrbno načrtujejo nadaljnje korake, da bi dosegli želene spremembe v prihodnosti.[2]
Vse zgoraj opisane veščine skozi celo šolsko leto razvijamo pri pouku. Učenci se med drugim tudi zavedajo, da je jezik najpomembnejši del kulturne dediščine, raziskujejo zvrsti jezika (sleng, časopisni, radijski in televizijski jezik), na ta način si utrjujejo znanje knjižnega jezika (zbornega in pogovornega). Ozavestijo različne okoliščine rabe jezika, razvijajo zmožnosti za vse štiri sporazumevalne dejavnosti (poslušanje, govorjenje, branje, pisanje) in so sposobni izražanja v praktično-sporazumevalnem, strokovnem in publicističnem jeziku.

5. ZAKLJUČEK

Pri izbirnih vsebinah vzgoja za medije (televizija, radio, tisk) sem se odločila spremljati in ozavestiti učence, kako močan vpliv imajo mediji na slehernikovo presojanje realnosti: na vrednote, na stil življenja, na nakupe, na mnenje o kakovosti izdelkov, na medsebojne odnose … Kako vodljivi pravzaprav smo, da postane lahko hitro medijska realnost naša realnost. Z učenci motrimo vpliv medijev in njihovo uporabo, na primer družbenih omrežij, in vzpenjajoče se odvisnosti od raznovrstne novodobne tehnologije celo zasvojenosti z računalniškimi igricami in socialnimi omrežji. Alarmantna je njihova dovzetnost in poistovetenje s samim domišljijskim svetom zaslonov. V prispevku opisane aktivnosti izvajamo z učenci, da bi preprečili prepogost in vseobsegajoč beg iz vsakdana v virtualni svet. Seveda v ospredje postavimo tudi pozitivne strani. Potrebno je učence pripraviti, jih naučiti in razviti kritično presojati vse, s čimer so obdani. Jim ponuditi alternativne dejavnosti, ki bi jim nudile užitek in zadovoljstvo.

6. VIRI IN LITERATURA

[1] Učni načrt, Vzgoja za medije. Ljubljana: Ministrstvo za šolstvo in šport, Zavod Republike Slovenije za šolstvo: Dostopno na naslovu: http://www.mizs.gov.si/fileadmin /mizs.gov.si/pageuploads/podrocje/os/devetletka/predmeti_izbirni/Vzgoja_za_medije_izbirni.pdf (pridobljeno 15. 8. 2019)

[2] Drnovšek, M., Rupnic, V. T., Mikeln, P, and Gros, V. 2018. Zavod Republike Slovenije za šolstvo. https://www.zrss.si/pd f/vescine-kriticnega-misljenja.pdf. (pridobljeno 15.8.2019)

[3] Košir, M., Ranfl, R., 1996. *Vzoja za medije*. DZS Ljubljana.

Delovni zvezek v oblaku

Workbook in cloud

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POVZETEK

Prispevek predstavi uporabo programa OneNote pri pouku strokovnega modula Preoblikovanje nekovinskih materialov v srednjem strokovnem izobraževanju, smer tehnik mehatronike. Naloga dijakov je bila, da naložijo program na svoje mobilne telefone in prenesejo dokumente z nalogami v ustrezne mape. Nato vse naloge uspešno izpolnijo. Cilj naloge je bil, da se dijaki naučijo uporabo programa OneNote in soustvarijo tri poglavja delovnega zvezka za strokovni modul. Dijaki so uspešno ustvarili izvirne izdelke v programu OneNote.

Ključne besede

Delovni zvezek, OneNote, preoblikovanje nekovinskih materialov, sodobna tehnologija

ABSTRACT

This article demonstrates the OneNote program which is used when teaching the secondary level mechatronics technicians about the transformation of non-metallic materials. The students' task was to download the program onto their mobile phones, transfer the documents with tasks to the appropriate folders and complete all the tasks successfully. The goal of the assignment was to teach students how to use OneNote program and create three chapters for professional module workbook. Students had successfully created original products in OneNote.

Keywords

Workbook, OneNote, Transformation of Non-Metallic Materials, contemporary technology

1. UVOD

Zaradi hitrega razvoja tehnologije je potrebno tudi v šoli pouk prilagoditi tempu razvoja gospodarstva. S sodobno tehnologijo smo se na Šolskem centru Kranj, enota Srednja tehniška šola, vključili v projekt Inovativna pedagogika 1:1. Projekt spodbuja razvoj digitalne pismenosti pri dijakih in učiteljih in večjo uporabo sodobne tehnologije, to je tabličnega računalnika in pametnih telefonov. V projekt smo vključili dijake prvega letnika, smer tehnik mehatronike.

Dijaki veliko uporabljalo mobilne telefone za različne dejavnosti. Ena izmed dejavnosti, ki smo jo vpeljali, je ustvariti delovni zvezek s programom OneNote. Pri modulu Preoblikovanje nekovinskih materialov dijaki nimajo učbenika, zato je bila idealna priložnost, da sami sodelujejo pri nastanku treh poglavij delovnega zvezka v elektronski obliki.

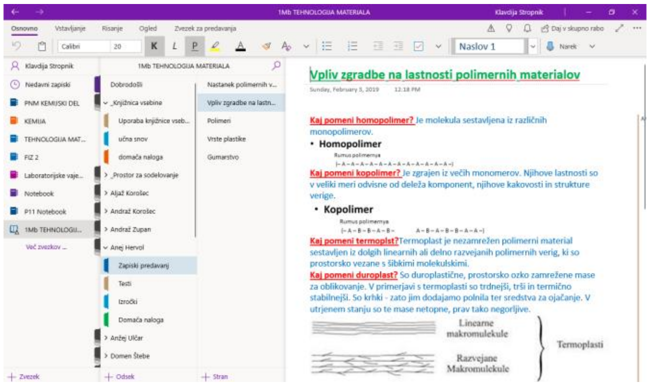
Naloga dijakov je bila namestiti aplikacijo OneNote na mobilni telefon in iz knjižnice v aplikaciji namestiti naloge v ustrezne mape ter naloge uspešno rešiti. Poleg tega so morali tudi sami sestaviti naloge in besedilo s kriteriji uspešnosti in namenom učenja. Za reševanje in sestavljanje nalog so imeli na voljo različne priročnike, učbenike in spletno iskanje informacij.

2. NASTANEK DELOVNEGA ZVEZKA

Delovni zvezek v aplikaciji OneNote sestavlja pet razdelkov. Prvi razdelek je knjižnica vsebine, drugi je zapiski učne ure, tretji izročki, četrti razdelek domača naloga in peti preizkus znanja [1] in [3].

V razdelku knjižnica vsebine so imeli pripravljene dokumente z vsebino učne snovi in naloge. Vse dokumente so morali prenesti v ustrezne razdelke. V razdelku zapiski učne snovi so imeli zapisano učno snov in naložen dokument iz knjižnice. V izročkih so imeli povzetke celotnih učnih ur in nalog. V razdelku domača naloga so imeli naložene učne liste z nalogami in vprašanji za ponovitev snovi. Pri preizkusu znanja so preverili usvojeno in utrjeno znanje.

Slika 1 prikazuje primer delovnega zvezka z razdelki in učno snovjo.



Slika 1: Primer delovnega zvezka z razdelki

3. PROGRAM ONENOTE

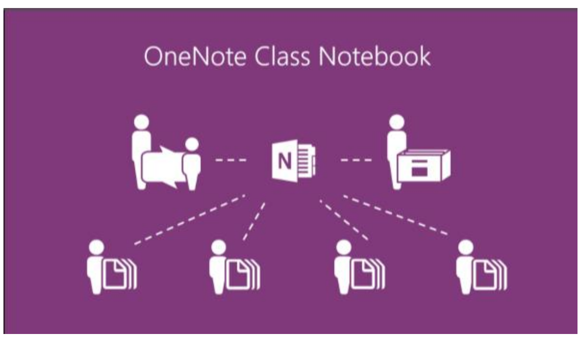
OneNote je zelo priročen program, ki je vključen v zbirko aplikacij sistema Windows za Windows, s katero lahko ustvarite sistem beležk za shranjevanje potrebnih informacij. V bistvu je OneNote elektronski prenosnik, ki lahko vsebuje kakršne koli osebne beležke [5].

Slika 2: Ikona OneNote

Program OneNote omogoča vnašanje opomb ali snemanje zvoka na prenosni računalnik. S pomočjo tabličnega računalnika se lahko besedilo skicira ali zapiše zamisli. Slike se lahko dodaja tudi iz telefona. Omogočeno je tudi takojšnje iskanje zapiskov, prosto premikanje zapiskov na strani in organizacijo strani v odseke. Omogočeno je ustvarjanje več zvezkov in skupna rabo zvezkov z drugimi, tako da si lahko vsi ogledajo in dodajajo besedilo [4].

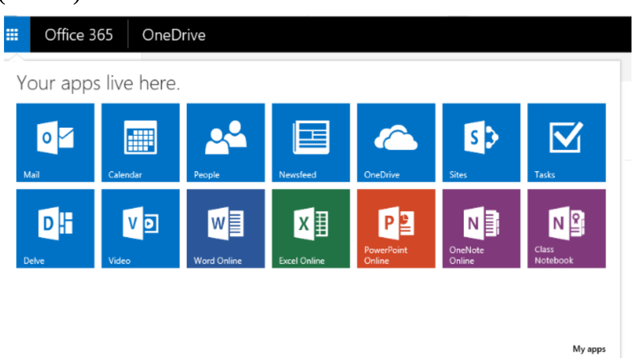
4. DELO Z APLIKACIJO

Uporaba aplikacije OneNote (Slika 3) je zelo enostavna. Učitelj v razredu lahko deli naloge in podaja povratno informacijo dijakom za opravljeno nalogo.



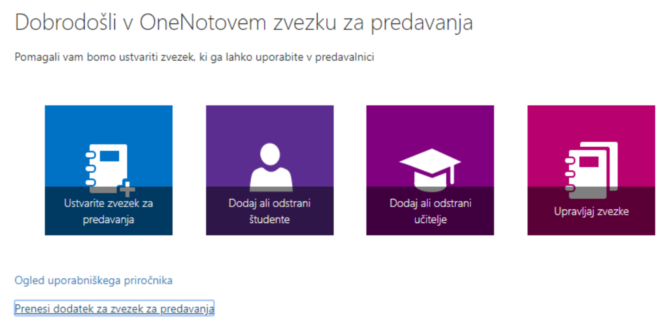
Slika 3: Uporaba OneNote v razredu

Aplikacija se lahko odpre preko spleta ali na računalniku. Za odpiranje preko spleta se lahko uporablja povezavo OneDrive. Na OneDrive se nahaja aplikacija OneNote v zaganjalniku aplikacij (Slika 4).



Slika 4: Zaganjalnik aplikacij

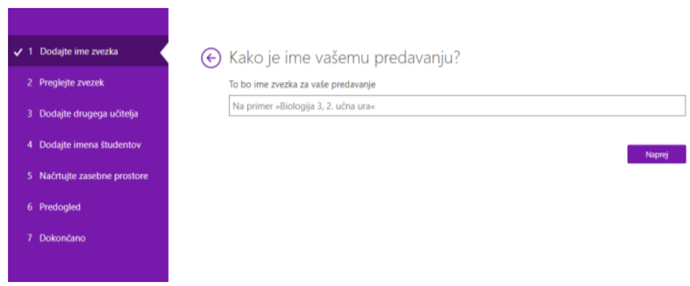
S klikom na aplikacijo Class Notebook (Slika 5) se odpre uvodna stran, na kateri se ustvari nov zvezek za nadaljnje delo. Pojavijo se štiri ikone. S prvo ikono se ustvari nov zvezek, z drugo se doda ali odstrani učence, s tretjo se doda ali odstrani učitelje, pri zadnji ikoni pa se ureja zvezek [2].



Slika 5: Uvodna stran za delo v OneNote

Pod ikono Ustvari zvezek za predavanje (Slika 6) se nahajajo naslednji koraki:

- poimenovanje zvezka,
- pregled zvezka,
- dodajanje vloge drugemu učitelji,
- dodajanje učencev,
- načrtovanje zasebnih prostorov,
- predogled in dokončanje zvezka.



Slika 6: Koraki za ustvarjanje zvezka

5. ANALIZA

Ustvarjanje delovnega zvezka skupaj z dijaki se je izkazalo za zelo uporabno. Dijaki so z velikim veseljem pristopili k delu. Težave so bile povezane s hitrostjo prenosov podatkov v program, kajti program OneNote potrebuje veliko prostora na katerikoli napravi. Izpolnjevanje in reševanje nalog pa dijakom ni povzročalo težav. Vsi dijaki so uspešno opravili vse zastavljene naloge. Dijaki, ki so naloge opravili hitreje, so pomagali reševati še ostalim.

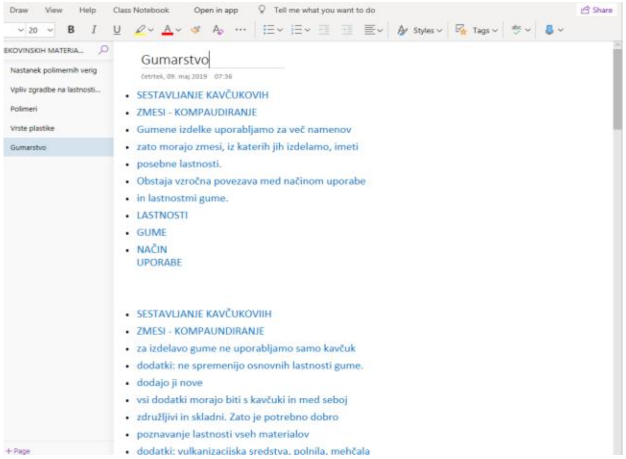
Iz Tabele 1 je razvidno, da dijaki zelo radi uporabljalo mobilne telefone, tablice ali računalnike kot pripomočke za učenje. Težave vidijo v hitrosti interneta.

Tabela 1: Anketa zadovoljstva

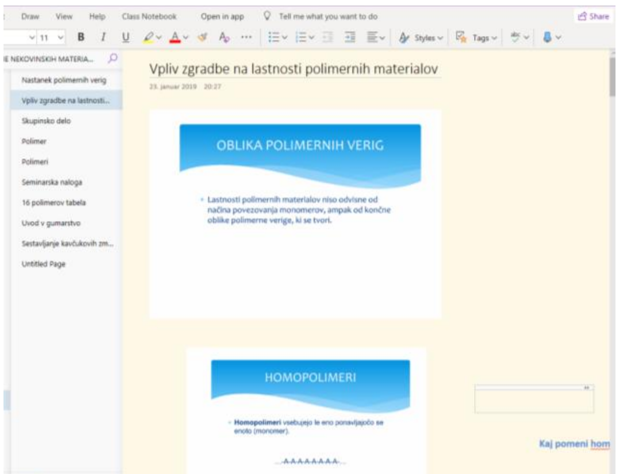
Ali pri učenju uporabljaš mobilni telefon, tablico ali računalnik?	mobilni telefon 65% tablica 18% računalnik 17%
Ali ste imeli pri izvajanju programa OneNote kakšno težavo?	počasen prenos podatkov 70% dostop do povezave s spletom 22% nisem imel težav 8%
Ali bi si želel pri pouku redno uporabljati sodobno tehnologijo?	Da 80% Ne 20%

6. REZULTAT

Vsi dijaki so uspešno ustvarili delovni zvezek s tremi poglavji. Poglavja so si uredili po straneh. Vsebino poglavij so opremili z različnimi nalogami in dodali povezave na video posnetke. Sliki 7 in 8 prikazujeta primera delovnega zvezka dijakov.



Slika 7: Delovni zvezek dijaka in poglavje Gumarstvo



Slika 8: Delovni zvezek dijaka in poglavje Vpliv zgradbe na lastnosti polimerov

7. ZAKLJUČEK

Ob vstopu v novo tisočletje se je z uporabo nove, napredne tehnologije spremenil način podajanja učne snovi v šoli. Tempo življenja je prispeval k temu, da tudi učitelji v šoli bolj vključujejo učence ali dijake v soustvarjanje učnih ur, kar omogoča, da veliko več znanja usvojijo v šoli. Anketa je pokazala, da si dijaki želijo uporabljati napredno tehnologijo tudi za učenje, ne pa samo za igranje igric ali za komunikacijo preko družbenih omrežij. Učitelji so pa tisti, ki morajo biti več kot en korak pred svojimi učenci ali dijaki, da lahko kvalitetno vključijo uporabo sodobne tehnologije pri svojem pouku.

8. VIRI

[1] Rehberger, R. 2018. *Onenote*. Interna dokumentacija. Šolski center Kranj.

[2] Baloh, P., Vrečar, P. in Woods, P. 2015. *Ob praktičnih primerih skozi Microsoft Office 365: vodnik za preživetje na delovnem mestu*. Ujemi Znanje, Ljubljana.

[3] *Create a notebook in OneNote.* https://support.office.com/en-us/article/create-a-notebook-in-onenote-6be33cf9-f7c3-4421-9d74-469a259952d3?wt.mc_id=otc_onenote pridobljeno na spletu 20. 8. 2019

[4] *Osnovna opravila v programu OneNote 2010.* https://support.office.com/sl-si/article/osnovna-opravila-v-programu-onenote-2010-29a50122-eb92-4eaf-8a39-ae5f01094ddc pridobljeno na spletu 20. 8. 2019

[5] *Kaj je OneNote in kako ga poganjati: navodilo.* https://flipperworld.org/pc/kaj-je-onenote-in-kako-ga-poganjati-navodilo pridobljeno na spletu 20. 8. 2019

Galvanizacija z Vernierjem

Electroplating with Vernier

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POVZETEK

Prispevek predstavi laboratorijsko vajo galvanizacije z uporabo Vernierjevih pripomočkov, ki jo dijaki srednje tehniške usmeritve na Srednji tehniški šoli v Kranju izvedejo v prvem letniku. Naloga laboratorijske vaje je razdeljena na dva dela. V prvem delu se dijaki seznanijo s priključitvijo senzorja merjenja električnega toka na računalnik. V drugem delu pa zbirajo podatke za izračun električnega naboja in mase atomov bakra. Cilj laboratorijske vaje je, da se dijaki seznanijo s pojmom galvanizacije. Ob zaključku laboratorijske vaje dijaki predstavijo svoje rezultate sošolcem. Rezultat laboratorijske vaje je bil pri vseh dijakih dosežen z uspešnimi meritvami. Dijaki so tako utrdili teoretično znanje o galvanizaciji.

Ključne besede

Galvanizacija, laboratorijska vaja, merilnik električnega toka, Vernier

ABSTRACT

The article presents the laboratory electroplating exercise using Vernier gadgets performed in the first year by the students of technical orientation at the Secondary Technical School in Kranj. The lab work is divided into two parts. In the first part, students learn how to connect an electrical current sensor to a computer. In the second part, they collect data to calculate the electric charge and mass of copper atoms. The goal of lab work is to familiarize students with the concept of electroplating. At the conclusion of the lab work, students present their work to classmates. The result of the laboratory exercise was achieved in all students with successful measurements. The students thus consolidated their theoretical knowledge of electroplating.

Keywords

Electroplating, laboratory exercise, electrical current sensor, Vernier

1. UVOD

Po učnem načrtu dijaki v srednjem strokovnem izobraževanju pri kemiji opravijo devet laboratorijskih vaj. Laboratorijske vaje so za dijake obvezne. Ena od devetih vaj je galvaniziranje in uporaba računalnika. Pri izvajanju vaj so dijaki razdeljeni v skupine po dva do trije člani. Za vsako laboratorijsko vajo je namenjena ena šolska ura.

Dijaki prvih letnikov tehniških smeri (elektrotehnik, tehnik mehatronike in računalniški tehnik) so imeli nalogo, da opravijo meritve s pomočjo programa Logger Pro.

V prvem delu laboratorijske vaje so dijaki, s pomočjo navodil, priključili senzor električnega toka na analogni vhod vmesnika. Nato so vmesnik z USB ključem povezali z računalnikom.

V drugem delu vaje so zbirali podatke s pomočjo programa Logger Pro. Te podatke so uporabili pri nalogah za izračune. Izračunati so morali pretečen električni naboj, teoretično število molov bakrovih atomov in dejansko število molov bakrovih atomov. Podati so moralo tudi možen vir napak pri eksperimentu.

Po končani vaji je sledila analiza rezultatov. Dijaki so sošolcem predstavili rezultate in napake, ki so se pojavile pri izvedbi vaje. Predlagali so tudi izboljšave pri izvedbi vaje, da bi tako dosegli boljše rezultate.

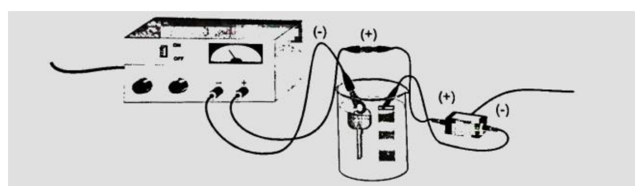
2. NAVODILA LABORATORIJSKE VAJE

2.1 Priprava elektrod

Dijaki z žično krtačo očistijo kovinski elektrodi, ki sta medeninast obesek za ključe in bakrena ploščica. Obe elektrodi operejo s kislo raztopino natrijevega klorida in destilirano vodo. Na koncu ju še osušijo. Ko sta elektrodi suhi, ju stehtajo na analitski tehtnici.

2.2 Priključitev senzorja na računalnik

Dijaki s pomočjo navodil (Slika 1 in Slika 2) priključijo senzor električnega toka.



Slika 1: Priključitev elektrod

Iz bakrene žice oblikujejo držalo za medeninast obesek. Obesek povežejo na negativni pol. Bakreno ploščico priključijo preko senzorja na pozitivni pol napajalnika. Pri priključitvi morajo paziti, da elektrod ne potopijo v elektrolit. Elektrolit je kisla raztopina bakrovega sulfata penta hidrata.

Na analogni vhod vmesnika priključijo senzor električnega toka. Vmesnik z USB ključem povežejo z računalnikom. Na računalniku vključijo program Logger Pro, odprejo mapo z imenom Advanced Chemistry with Vernier in poiščejo dokument z imenom »21 Electroplating«.

Ko imajo pripravljen program za zbiranje podatkov, lahko potopijo elektrodi v elektrolit. Upoštevati je tudi potrebno, da je napetost skozi meritve konstanta. To je 1,5 V. Izmeriti je potrebno električni tok. Območje meritev naj se giblje od 0,2 do 0,6 A. S pomočjo programa opazujejo potek elektrolize in odlaganje bakra na površino medeninastega obeska. Podatke zbirajo 30 minut [3].

KEMIJA – vaje 1. letnik

Ime in priimek, razred : ______________________ datum:____________

GALVANIZIRANJE - vaja z VERNIERJEM

V tem eksperimentu boste izvedli meritve galvanizacije. Galvaniziranje je nanašanje plasti kovin, kot so krom, baker ali zlato na drugo kovino. V komercialne namene galvanizirane prevleke uporabljamo za lepši izgled, odpornost kovine pred korozijo ali za izboljšanje trdote površine kovine. Ta eksperiment opisuje enega od načinov izdelave bakrene prevleke na medeninast ključ ali kak drug primeren kovinski predmet.

Pripravili boste elektrokemijsko celico z uporabo bakrene ploščice, katode (pozitivni pol) in medeninast ključ, anode (negativni pol). Elektrode potopite v raztopino zakisanega bakrovega sulfata – $Cu\ SO_4 + H_2SO_4$. Za uspešen prenos Cu atomov z anode (Cu ploščice) na površino medeninastega ključa priklopite elektrode na enosmerno el. napetost.

Pri tem eksperimentu boste uporabili Faradayev zakon, razviden iz spodnje enačbe:

Masa odložene snovi na elektrodi $m(Cu) = \frac{I \cdot t \cdot M}{z \cdot F}$

I = tok v amperih (A) povprečni izmerjeni tok

t = čas dovajanja toka (s) = 1800 s

M = molska masa elementa, ki se nalaga (Cu) = 63.54 g/mol

z = število molov snovi (elektroni/mol) = 2

F = Faradayeva konstanta 96500 As/mol

CILJI (V tem eksperimentu boste):

- pripravili elektrokemijsko celico za prekrivanje medeninastega ključa z bakrom,
- izmerili količino Cu, ki smo ga nanesli med galvanizacijo
- izračunali količino energije, ki je potrebna za postopek galvanizacije

MATERIAL ZA VAJO:

- Vernierov vmesnik Lab Pro
- računalnik
- senzor električnega toka raztopina
- izvor enosmerne napetosti, 1,5 V DC
- vezne žice s krokodilčki, 4x
- čaša, 250 ml, 2x
- bakrena ploščica 10 cm x 1 cm
- medeninast obesek
- tehtnica, 0.001 g natančna
- bakrena žica, nelakirana, premer 0.64 – 0. 8 mm (za držalo)

KEMIKALIJE:

- destilirana voda
- elektrolit: $Cu\ SO_4 + H_2SO_4$
- vinski kis
- trden natrijev klorid $NaCl_{(s)}$

Slika 2: Učni list z navodili

3. MERILNIK ELEKTRIČNEGA TOKA

Merilnik električnega toka (Slika 3) deluje in meri tokove v razponu od -10 A do +10 A. Pri meritvah se uporablja tehnologija, pri kateri ni potrebno dodatno priključiti upornika. Merilnik je opremljen z zamenljivo varovalko, ki varuje, da v vezju ne pride do previsokih tokov. (v gradivu za interna navodila)

Slika 3: Merilnik električnega toka

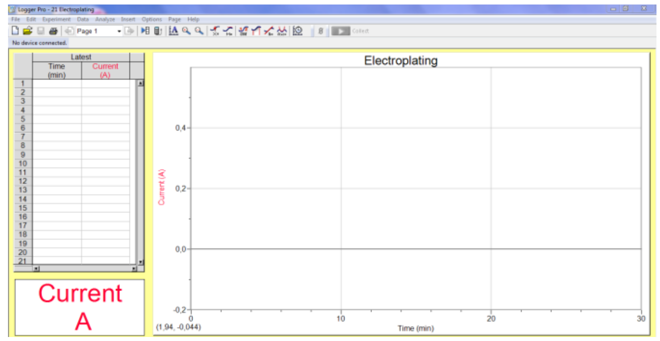
Merilnik se poveže na analogni vhod vmesnika [4]. Vmesnik pa povežemo z računalnikom z USB ključem. Na računalniku je program Logger Pro, s katerim zbiramo podatke [2].

4. PROGRAM LOGGER PRO

Program Logger Pro omogoča računalniško zajemanje meritev, uporaben je za učitelje in učence v osnovni in srednji šoli. Ima enostaven uporabniški vmesnik, ki pripomore k boljši vizualizaciji, saj uporabniki v realnem času vidijo izris grafov s fizikalnimi količinami. (povzeto s spletne strani z naslovom Logger Lite) [1]. Program nudi še:

- enostavno zajemanje podatkov,
- več možnosti za obdelavo podatkov in poglobljeno analizo le-teh,
- ročni vnos in izvoz podatkov,
- video analizo.

Slika 4 prikazuje izpis meritev v programu Logger Pro. Meritve se izrisujejo na grafu in izpisujejo v tabeli [5].



Slika 4: Program Logger Pro

Program žal ni preveden v slovenski jezik.

5. ANALIZA PODATKOV

S pomočjo Tabele 1 so dijaki analizirali vse naloge za pridobitev pravilnih rezultatov. Največ težav so imeli pri pridobitvi podatka o povprečnem električnem toku. Ta podatek so morali odčitati iz grafa električni tok v odvisnosti od časa.

Tabela 1: Podatki za izračun

začetna masa bakrene ploščice	3,04g	0,28g
končna masa bakrene ploščice	2,76g	
začetna masa medeninastega obeska	5,72g	0,20g
končna masa medeninastega obeska	5,92g	
povprečen električni tok	0,3835A	/
čas meritve	1800s	/

Pri izračunu teoretične in dejanske vrednosti števila molov bakrovih atomov dijaki niso imeli težav. Napake so se pojavile, ker so uporabili napačne vrednosti pri pretvorbi enot. Do odstopanja pri izračunu je prihajalo tudi pri molski masi, kjer so uporabljali različne periodne sisteme.

Dijaki so bili zelo kritični pri navajanju možnih virov napak pri izvajanju eksperimenta. Večina jih je opozarjala na človeško napako. Priznali so, da so nenatančno prebrali navodila. Naslednja najbolj pogosta napaka, ki so jo omenili, je bila odpoved računalnika, ker je odpovedala baterija ali pa je prišlo do prekinitve električnega toka. Dijaki so opazili, da se je tretja napaka lahko pojavila pri elektrolitu in elektrodah: elektrolit je lahko nepravilno pripravljen in ima omejen rok uporabe; pri elektrodah pa so omenili poškodbe in nepravilno čiščenje.

6. ZAKLJUČEK

Samostojne laboratorijske vaje dijaki zelo radi izvajajo. Pri tem utrdijo večino teoretičnega znanja in spoznajo rokovanje z različnimi eksperimentalnimi instrumenti.

Čeprav je eksperimentalna naloga dokaj zahtevna za dijake prvih letnikov, so navodila pripravljena dokaj enostavno. Znanje, ki ga pridobijo pri tej vaji, uporabijo ne samo pri predmetu kemija, ampak tudi pri strokovnih modulih.

Pridobljeno znanje s praktičnim izvajanje je zelo pomembno, kajti tisto, kar dijaki naredijo samostojno, si bolje zapomnijo in usvojijo.

7. VIRI

[1] *Logger Pro.* https://www.vernier.com/products/software/lp/ pridobljeno s spleta 20. 8. 2019

[2] Interna navodila za uporabo programske opreme LabPro in vmesnikov Vernier LabPro.

[3] Randall, J. 2007. *Advanced chemistry with Vernier : experiments for AP, IB, and college general chemistry*. Vernier Software & Technology. Beaverton.

[4] *Go Direct sensor za tok*. https://www.ucila.eu/izdelek/go-direct-senzor-za-tok/ pridobljeno s spleta 20. 8. 2019

[5] *Logger Lite.* https://podpora.sio.si/logger-lite/ pridobljeno s spleta 20. 8. 2019

Učenje plesa z uporabo IKT

Teaching dancing with the use of ICT

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POVZETEK

V prispevku je predstavljeno projektno delo spoznavanja plesa s pomočjo IKT-tehnologije v vrtčevski skupini štiriletnikov. Z otroki smo se pogovarjali o pingvinih (njihovem izgledu, gibanju) in se odločili, da se naučimo ples pingvinov. Kot didaktični pripomoček smo pri dejavnosti uporabili računalnik, s pomočjo katerega smo na spletni strani YouTube najprej poslušali pesem, nato pa si ogledali še posnetek plesa. Omenjeni didaktični pristop je otroke motiviral, bili so bolj zbrani. Predstavljal jim je nov način učenja. Pokazali so izjemno vztrajnost, saj smo gibe večkrat ponovili, dokler ni bila sestavljena celotna koreografija. Nekatere gibe smo, na željo otrok, tudi spremenili. Otroci so med dejavnostjo aktivno sodelovali in si pomagali. Drug drugega so dopolnjevali. Njihova vztrajnost je bila nagrajena z uspehom, kar so lahko ob koncu dejavnosti videli tudi mali plesalci − sledil je namreč ogled posnetka njihovega plesa, ki je bil posnet s kamero na mobilnem telefonu. Z zadovoljstvom so si ogledali samega sebe, svoj nastop so komentirali in sklenili, da so pripravljeni to izkušnjo deliti tudi s svojimi starši. Povabili so jih na plesni nastop in zadovoljstvo je bilo obojestransko. Česa podobnega se bomo nedvomno še kdaj lotili, saj se je učenje plesa s pomočjo IKT-tehnologije izkazalo kot uspešen primer prakse, kjer je bilo prisotnega veliko smeha, sproščenosti, poglobljenega sodelovanja in uspešne komunikacije.

Ključne besede

Ples, IKT, sodelovanje, sprostitev, predšolsko obdobje

ABSTRACT

In the paper, we present our project work that dealt with teaching a kindergarten group of four-year-olds how to dance, with the use of information and communications technology (ICT). With the children, we talked about penguins (about their appearance and movement) and decided to learn the penguin dance. As a didactic aid, we used a computer to first listen to the song on Youtube and then see the video of the dance. This didactic approach motivated the children and made them more concentrated; what is more, for them, this was a new learning method. The children showed a great perseverance as we kept repeating the moves until we mastered the entire choreography. Some moves were changed upon the children's request. They participated actively and helped each other. Furthermore, they complemented each other. Their perseverance was awarded; the young dancers saw the video of their dance that was recorded with a mobile camera. They were pleased to see themselves; they even commented on their performance and decided to share this experience with their parents, whom they invited to a dance performance. The satisfaction was mutual. Without doubt, we will try something similar in the future as teaching dancing with the use of ICT proved successful; what is more, there was plenty of laughter, relaxation, deepened cooperation and effective communication.

Keywords

Dancing, ICT, cooperation, relaxation, pre-school period

1. UVOD

Sodobna tehnologija na vsakem koraku kroji naš vsakdan, tako v naših službenih okoljih kot zasebnem življenju. Posledično je tudi vsaka generacija naših najmlajših, ki jih vleče zgled staršev, starejših sorojencev, vzgojiteljev, vse bolj spretna pri rokovanju s t. i. pametnimi napravami. Za uporabo moderne tehnologije so zelo motivirani, saj jih privlačijo številni multisenzorični dražljaji.

Kot vzgojiteljica predšolske vzgoje sem si zadala cilj, da izkoristim pozitivne lastnosti moderne tehnologije (večja motivacija otrok za izvajanje dejavnosti, dejavnosti so bolj razgibane, delovno okolje v igralnici je bolj dinamično) in elemente le-te vključila v plesno vzgojo, ki je v Kurikulumu za vrtce [2] uvrščena v področje umetnosti.

Otroci stari štiri leta so pri plesni vzgoji največkrat deležni dela po učnem pristopu ustvarjalni gib, za katerega je značilno, da jim vzgojiteljica zastavi gibalno-plesne izzive oz. naloge, pri katerih otroci sami iščejo izrazne forme v okviru lastnega raziskovanja in ustvarjanja. Vključevanje ustvarjalnega giba omogoča aktivno učenje in spodbuja učne potenciale, doprinese k intelektualni rasti pri različnih področjih, krepi neverbalno komunikacijo, ustvarjalnost, spomin ter združuje kognitivne ter čustveno-socialne sposobnosti tako pri mlajšem otroku kot pri starejšem študentu [1]. Za popestritev plesne vzgoje v skupini je bilo tokrat plesno-gibalna naloga sestavljena drugače. Poslužili smo se posnetka obstoječe plesne koreografije in se preko projeciranja le-te poskusili naučiti nov ples. Zanimalo nas je namreč, v kolikšni meri so štiriletniki zmožni procesnega učenja v skupini (ogled plesa, zaznavanje ritma, opazovanje in posnemanje gibov, pomnjenje zaporedja gibov, vztrajanje pri utrjevanju in nadgrajevanju naučenega, izpeljava celotne koreografije, izvedba plesnega nastopa), ali jih bo učenje ob posnetku dodatno notranje motiviralo in povečalo njihovo vztrajnost ter v kolikšni meri je razvita njihova zmožnost samorefleksije, ko si bodo ogledali posnetek svojega plesnega nastopa, ki ga bo posnela vzgojiteljica.

2. POTEK DELA V SKUPINI

2. 1 Uvodna motivacija

Z otroki, ki so bili zbrani v jutranjem kotičku, smo se pogovarjali o pingvinih. Ugotovili so, kje pingvini živijo, kakšni so, kaj radi jedo in kako se premikajo. Ena izmed deklic je vstala in pokazala vsem otrokom, kako pingvini hodijo. Tudi ostali so posnemali njeno gibanje po sobi in zdelo se jim je zabavno. Predlagali so, da prižgemo računalnik in si poiščemo kakšno sliko ali posnetek pingvinov. S premori smo si ogledali krajši posnetek v angleščini, besedilo katerega sem otrokom počasi prevajala [3].

2. 2 Ali pingvini tudi plešejo?

Ker so bili otroci navdušeni nad videzom in vedenjem pingvinov, smo jih vprašali, ali poznajo kakšno pesem o pingvinih. Kar nekaj otrok je povedalo, da poznajo pesem Alenke Kolman, Ples pingvinov [4]. Pesem jim je bila v nadaljevanju predvajana. Otrokom se je dopadlo besedilo pesmi (Na ledenem polju južnega tečaja, / v črno-belih srajcah sto pingvinov raja. / Dva koraka desno, enega nazaj, / copa cop na mestu, / v prvi položaj. / Dva koraka levo, enega naprej, / copa cop na mestu, gneča je precej. / Ko so črno-bele srajce prepotene, / se plesoča družba v ocean požene. / Najmanj sto pingvinov ob obali plava / in v penečem morju hrbte pozibava…) in že med prvim poslušanjem so nakazovali gibe, ki jih narekuje besedilo – ali premikamo roke, noge ali celo telo. Po posnetku smo skupaj obnovili besedilo, razložili težje besede oz. besedne zveze (ocean, ledeno polje, plesoča družba, peneče morje, pozibavati, kaj pomeni, da pingvini nosijo črno-bele srajce …) in nakazali posamezen gib. Z navdušenjem so poslušali in želeli, da zavrtimo še enkrat. Ponovili smo in predlagala sem, da se naučimo tudi celotno koreografijo plesa pingvinov.

2.3 Od posnemanja do lastne koreografije

Posnetek plesa smo našli na YouTubu in ga predvajali. Potem smo se lotili koreografije »na suho«. To pomeni, da smo gibe ponovili brez glasbe in predvajanja. Medtem smo se tudi pogovarjali in otroci so predlagali, da nekatere gibe spremenimo. Bili so polni domišljije. Upoštevali smo različne ideje gibov in jih vpletli v koreografijo. Pri plesu so bili uspešni in natančni. Pozorni so bili tudi na ritem. Posnetek smo si ogledali še nekajkrat. Malo zaradi gibov, malo pa tudi zaradi veselja do tehnologije, saj je le-ta zanimiva za predšolske otroke. Računalniška projekcija jim je predstavljala dobro motivacijo in vzpodbudila tudi bolj zadržane otroke, da so se pridružili skupinski plesni dejavnosti. Po nekaj dnevih smo koreografijo dobro izpilili in stopnja njihove zainteresiranosti je bila vseskozi visoka, kar je razvidno s slik. Njihova vztrajnost se je najbolje izrazila, ko sem s pomočjo telefona posnela njihov nastop. Bili so navdušeni, da bodo tudi oni soustvarili plesni posnetek, tako kot otroci na prvotnem posnetku, ob katerem so se učili plesa.

Slika 1 in 2 in 3. Otroci med utrjevanjem plesne koreografije.

2. 4 Samoevalvacija in plesni nastop

Posnetek plesa so si otroci ogledali nekega pomladnega dopoldneva, po zajtrku. Ker je bilo zunaj svetlo, smo zatemnili okna in »pričarali« slavnostno premierno vzdušje. Otroci so si z zanimanjem ogledali posnetek plesa in takoj prosili za ponovno predvajanje. Pogledali so ga še trikrat in vsakokrat so glasneje komentirali svoje gibe in gibe ostalih otrok. Zanimivo je bilo, da so se štiri leta stari otroci izkazali za stroge kritike, še posebej do plesa drugih, pri katerem so našli nemalo »napak«. Po ogledu posnetka so bili otroci motivirani, da svoje znanje plesa pokažejo tudi izven svoje igralnice, zato smo se odločili, da bomo ples odplesali za ostale vrtčevske skupine in za starše na zaključni prireditvi. Njihov nastop je vsakokrat požel glasen aplavz, še posebej starši niso skrivali ponosa in navdušenja.

3. ZAKLJUČEK

Projektno delo spoznavanja plesa preko IKT-tehnologije se je izkazalo kot nadvse uspešen primer prakse. Vsekakor je omenjen didaktični pristop popestril plesno vzgojo, pri kateri otroci najpogosteje sami ustvarjajo plesne figure. Otrokom je bilo všeč procesno učenje ob učnem pripomočku, ki je multisenzoričen. Ob tem so tudi spoznali, da se računalnik ne uporablja le za kratkočasenje, temveč se lahko ob njem tudi učimo. Uživali so ob ogledu poučnega posnetka o pingvinih, navdušeni so bili nad glasnim predvajanjem pesmi ter ogledu posnetka plesa, ki jih je za plesno izražanje nedvomno bolj motiviral, kot pa če bi jim gibe pokazala vzgojiteljica. Najbolj pa so bili navdušeni in ponosni, ko so si ogledali posnetek svoje plesne točke. Počutili so se kot pravi »junaki«. Veselje do plesnega izražanja so jim vlili tudi glasni aplavzi po njihovih plesnih nastopih. Zadovoljna pa sem bila tudi sama, saj so otroci pokazali veliko volje, vztrajnosti, kreativnosti, kritičnega mišljenja ter sposobnosti povezovanja in sodelovanja v skupini – tako so bili doseženi vsi predvideni vzgojni in učni cilji projektne dejavnosti.

4. VIRI IN LITERATURA

[1] Geršak, V. (2014). Primeri vključevanja ustvarjalnega giba v učenje od vrtca do univerze. V: Geršak, V. Meško, N. (ur). *Konferenca plesne pedagogike.* Velenje, JSKD, str. 17.

[2] Kurikulum za vrtce. (2009). Ljubljana: Ministrstvo za šolstvo in šport, Urad Republike Slovenije za Šolstvo.

[3] All About Penguins for Kids: Penguins of the World for Children − FreeSchool https://www.youtube.com/watch?v=O8qilxaBR20 (Dostopno 4. 4. 2019).

[4] Alenka Kolman − Ples Pingvinov https://www.youtube.com/watch?v=PYsQHkYSlTI&t=64s (Dostopno 4. 4. 2019).

[5] Plesna šola Step by step − Ples pingvinov https://www.youtube.com/watch?v=xIHbNNcXC2U (Dostopno 5. 4. 2019).

Razvoj digitalnih kompetenc učiteljev slovenščine

Development of Slovene language teachers' digital competences

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POVZETEK

Sodoben pouk od učitelja slovenščine zahteva ustrezno usposobljenost na področju digitalnih kompetenc. Te vključujejo zlasti varno in kritično uporabo informacijsko-komunikacijske tehnologije. Teoretično se učitelji slovenščine s temi vsebinami seznanijo že na fakultetah, praktično pa jih poglabljajo ob vstopu v pedagoški poklic. V prispevku se osredotočamo na razvoj digitalnih kompetenc učiteljev začetnikov in prikazujemo rezultate empirične raziskave o (digitalnih) kompetencah učitelja za poučevanje slovenščine. Rezultati kažejo, da so učitelji začetniki dobro usposobljeni na področju digitalnih kompetenc, celo bolje kot njihovi starejši kolegi (mentorji), vendar kljub temu še ostaja nekaj neizkoriščenih priložnosti, ki bi jih bilo smiselno ob vstopu v pedagoški poklic upoštevati.

Ključne besede

Digitalne kompetence, učitelj slovenščine, empirična raziskava

ABSTRACT

Modern teaching requires Slovene language teachers to train in digital competences, which include safe and critical use of IT technology. Slovene language teachers learn theory about these contents at the faculties, but they deepened their digital competences upon entering the teaching profession. This article focus on development of beginning teachers' digital competences and presents the results of empirical research on Slovene language teachers (digital) competences. The results show that beginning teachers are well trained in digital competences, even better than their older colleagues (mentors), but there are some missed opportunities.

Keywords

Digital competences, Slovene language teacher, empirical research

1. UVOD

Globalizacija prinaša vedno nove izzive, s katerimi se tudi/zlasti soočamo na področju vzgoje in izobraževanja. Tako postaja vedno bolj pomemben cilj opremljanje mladih s kompetencami, potrebnimi za soočanje s vsakodnevnimi izzivi, ki jih globalizacija prinaša. Gre za t. i. ključne kompetence za vseživljensko učenje, med katere med drugim spada tudi digitalna kompetenca/pismenost.

Digitalna kompetenca/pismenost vključuje varno in kritično uporabo sodobne informacijsko-komunikacijske tehnologije (IKT) ter "sposobnost iskanja, zbiranja in obdelave informacij ter njihovo uporabo na kritičen in sistematičen način" [10].

Tovrstne spremembe zahtevajo od učitelja, da je ustrezno usposobljen za uporabo sodobne IKT, saj si brez nje dandanes težko predstavljamo sodoben pouk. Tudi učitelj mora imeti torej (poleg ostalih) razvite digitalne kompetence.

2. KOMPETENCE UČITELJA ZAČETNIKA

Po zaključenem izobraževanju na dodiplomski ravni se bodoči učitelji pod vodstvom starejšega kolega (mentorja) usposabljajo za samostojno poučevanje. To obdobje imenujemo uvajalno obdobje v pedagoški poklic, učitelje pa učitelji začetniki. Kot tako ima to obdobje več pomembnih ciljev [17]: (a) začetniku nudi podporo na strokovni (razvijanje strokovnih kompetenc) ter osebnostni in socialni ravni; (b) prispeva h kakovostnejši profesionalni usposobljenosti; (c) prispeva k zmanjšanju izstopanja iz pedagoškega poklica; (č) spodbuja izobraževalno kulturo v institucijah; (d) omogoča in zagotavlja povratne informacije institucijam, ki usposabljajo pedagoške delavce (pri nas torej fakultetam).

2.1 Opredelitev kompetence

V času uvajanja v pedagoški poklic je eden od pomembnih ciljev poglobitev kompetenc, pridobljenih v času dodiplomskega izobraževanja, in pridobivanje kompetenc, potrebnih za začetek dela v šoli in delo v učiteljskem poklicu nasploh. Kompetenca je pojem, ki ga je mogoče opredeliti na različne načine, odvisno od področja, znotraj katerega ga uporabljamo. Na področju vzgoje in izobraževanja in zlasti učiteljskega poklica ter učiteljeve vloge v razredu je, kot pravi in povzema B. Marentič Požarnik [7], "posebno primerna opredelitev, da gre za zmožnost posameznika, da aktivira, uporabi in poveže pridobljeno znanje v kompleksnih, raznovrstnih in nepredvidljivih situacijah."

Koncept kompetence v poučevanju tako zajema naslednje značilnosti kompetence [13]: (a) zajema tako skrito in eksplicitno znanje, spoznavne in praktične spretnosti kot tudi stališčne in odnosne kompetence (motivacijo, prepričanja, vrednote in čustva); (b) omogoča učiteljem soočanje s kompleksnimi zahtevami; (c) daje učiteljem moč, da ravnajo profesionalno (strokovno) in ustrezno situaciji; (č) pomaga učitelju, lotevati se nalog uspešno (doseganje želenih rezultatov) in učinkovito; (d) lahko se dokaže oz. izkaže do določene ravni dosežka.

2.2 Pridobivanje kompetenc za poučevanje

Pravilnik o pripravništvu, kakor se je v slovenskem prostoru imenovalo do leta 2014, ko je do takrat uveljavljeno pripravništvo zamenjala t. i. prva zaposlitev v vzgoji in izobraževanju, v svojem 17. členu opredeljuje področja kompetenc, ki naj jih učitelj začetnik v obdobju uvajanja v poklic usvaja. Gre za kompetence na naslednjih področjih: (a) znanja in razumevanja; (b) spretnosti učinkovitega poučevanja; (c) sodelovanje z delovnim in družbenim okoljem; (č) prepričanja, vrednote in stališča; ter (d) organizacija in vodenje. Poleg teh splošnih področij kompetenc priročnik o organizaciji pripravništva [2] za obdobje uvajanja kompetence in njihove vsebine, ki naj bi jih učitelj začetnik pridobil za uspešno delo v pedagoškem poklicu, razčlenjuje nekoliko podrobneje. Te kompetence in njihove dimenzije, na katere smo se za učitelje slovenščine oprli tudi v našem prispevku, so: (a) strokovno obvladovanje predmeta; (b) načrtovanje in vodenje pouka; (c) organizacija dela v razredu; (č) ocenjevanje in beleženje napredka učencev; (d) kritična samorefleksija; in (e) nadaljni strokovni razvoj.

Na podlagi strokovne literature s področja didatkike slovenščine in omenjenega priročnika smo za učitelje slovenščine, ki vstopajo v pedagoški poklic, oblikovali naslednje štiri kategorije strokovnih kompetenc,[1] potrebnih za poučevanje slovenščine [14]: (a) temeljne strokovne kompetence (literarnostrokovne in jezikoslovne); (b) splošne pedagoške kompetence; (c) specialnodidaktične kompetence (književno- in jezikovnodidaktične); in (č) kompetence za razvijanje čezpredmetnih ciljev oz. ključnih zmožnosti učencev. Digitalne kompetence učitelja začetnika smo zajeli znotraj splošnih pedagoških kompetenc, specialnodidaktičnih kompetenc in kompetenc za razvijanje ključnih zmožnosti učencev.

2.3 Opredelitev digitalnih kompetenc učitelja

Digitalne kompetence učitelja bi lahko opredelili kot učiteljevo zmožnost uporabe informacijsko-komunikacijske tehnologije v poklicnem kontekstu z dobro pedagoško-didaktično presojo ter zavedanje o vplivih njene uporabe na učne oblike in na učenčeve učne strategije [11].

Učiteljeva profesionalna digitalna kompetenca sestoji iz treh delnih zmožnosti/kompetenc: (a) splošne digitalne kompetence (splošno znanje in spretnosti, ki jih morajo učitelji pridobiti, da bi bili digitalni izobraževalci); (b) didaktične digitalne kompetence (predmetnospecifične zmožnosti, ki so pomembne za posamezno predmetno področje); in (c) profesionalne digitalne kompetence (digitalne zmožnosti učiteljskega poklica, ki jih potrebujejo pri svojem delu, npr. ob načrtovanju pouka, pri zbiranju in obdelavi podatkov, dokumentacije, pri komunikaciji s starši in drugimi deležniki). Učitelji začetniki se morajo zato v obdobju uvajanja v pedagoški poklic naučiti, kako svoje teoretično znanje prenesti v predmetnospecifično izvedbo pouka, vodenje razreda in vrednotenje učenčeve učinkovite rabe digitalne tehnologije [8].

2.3.1 Digitalne kompetence učiteljev slovenščine

V slovenskem prostoru je uveljavljena opredelitev digitalne kompetence oz. pismenosti po evropski definiciji. Vključuje varno in kritično uporabo informacijsko-komunikacijske tehnologije pri delu, v prostem času in pri sporazumevanju, in sicer z uporabo računalnikov za iskanje, ocenjevanje, shranjevanje, proizvodnjo, predstavitev in izmenjavo informacij ter za sporazumevanje in sodelovanje v skupnih omrežjih po internetu. Informacijsko-komunikacijska tehnologija močno vpliva "tudi na kulturo učenja v sodobni šoli, saj si danes težko predstavljamo sodoben pouk brez uporabe informacijske tehnologije. S spreminjanjem učenja in poučevanja informacijsko-komunikacijska tehnologija prispeva k usvajanju ostalih ključnih zmožnosti, zato je naloga šole, da z različnimi dejavnostmi spodbuja kritično rabo interneta in drugih informacijskih sistemov v vzgojne in izobraževalne namene" [4].

Pri pouku književnosti lahko učitelj učence usmerja v raziskovanje učnih vsebin s pomočjo spleta in jih usmerja v sprejemanje – poslušanje oz. gledanje posnetkov literarnih in kulturnih vsebin na spletu [6]. Pri pouku jezika pa morajo e-besedila postati tudi osnovni vir, saj zaradi svojih specifik (npr. večpredstavnost, hipertekst in odpiranje povezav, prepletanje oz. "motnje" z drugimi besedili, kot so oglasi in podobno, interaktivnost oz. možnost neposrednega besednega odziva) zahtevajo drugačno branje (prim. [3]). "[P]ojmovanje branja elektronskih besedil izhaja iz nasprotja osnovnemu linearnemu branju tiskanih besedil, ki jih beremo od besede do besede, od povedi do povedi, od vrstice do vrstice in od prve do zadnje strani ter v slovenščini z levega roba strani proti desnemu" [3].

Učiteljeva kompetenca za razvijanje digitalne zmožnosti učencev zajema (prirejeno in nadgrajeno po [4]) kompetence za rabo sodobne učne/informacijske tehnologije, in sicer: (a) poznavanje sodobne tehnologije in možnosti uporabe le-te pri načrtovanju pouka, učenju in poučevanju; (b) iskanje podatkov; (c) priprava domačih in seminarskih nalog; (č) izmenjava informacij (d) raziskovanje učnih vsebin s pomočjo spleta ipd.; (e) varna in kritična raba informacijskih sistemov; (f) kritično dojemanje spletnih strani z "učno snovjo za učence".

3. DIGITALNE KOMPETENCE PRI POUKU SLOVENŠČINE

Da mora imeti učitelj slovenščine za uspešno uresničevanje ciljev predmeta razvite tudi ustrezne digitalne kompetence, je razvidno iz učnih načrtov (prim. [15] in [16]).

Učni načrt opredeljuje digitalne kompetence po *Priporočilih Evropskega parlamenta in Sveta Evrope o ključnih zmožnostih za vseživljenjsko učenje/izobraževanje* iz leta 2006. Digitalna zmožnost tako "vključuje zavestno in kritično rabo informacijske tehnologije pri opravljanju šolskih in zunajšolskih obveznosti in dejavnosti" [15].

3.1 Predmetni cilji

Oba dokumenta že v splošnih ciljih predmeta predvidevata razvijanje digitalne zmožnosti učencev.[2] Učenci namreč pri slovenščini "[i]z digitalnih besedil varno, ustvarjalno in kritično pridobivajo informacije, jih ustrezno uporabljajo in po potrebi tudi dopolnjujejo. Ozaveščajo in presojajo tako svojo kot tudi širšo uporabo digitalne in druge tehnologije ter prek nje pridobljenih informacij – ob tem razvijajo svojo digitalno zmožnost." [15] Tudi temeljni cilj slovenščine, tj. razvijanje sporazumevalne zmožnosti,[3] "se povezuje z uporabo IKT; tako se

[1] V didaktiki slovenščine se za pojem 'kompetenca' pogosto uporablja sinonimni izraz 'zmožnost', zato v prispevku uporabljamo oba izraza enakovredno.

[2] Izraz 'učenci' uporabljamo tako za osnovnošolske učence in učenke kot tudi za dijake in dijakinje.

[3] Podrobneje o sporazumevalni zmožnosti na tem mestu ne bomo razpravljali, saj bi s tem presegali namene pričujočega članka.

razvija posameznikova digitalna zmožnost" [16]. Ob tem je potrebno dodati, da učitelj lahko uspešno uresničuje te cilje le, če je sam na teh področjih ustrezno usposobljen.

3.2 Medpredmetne povezave

Razvitost učiteljevih digitalnih kompetenc učna načrta predvidevata tudi v nadaljevanju, in sicer pri smernicah izvajanja pouka oz. didaktičnih priporočilih. Tako na ravni vključevanja kroskurikularnih vsebin učna načrta posebno pozornost namenjata razvijanju digitalnih zmožnosti (digitalne pismenosti) učencev, ki je ena izmed ključnih kompetenc vseživljenjskega učenja. Učenci naj tako pri razvijanju sporazumevalne zmožnosti in pri dejavnem stiku (komunikaciji) z besedili uporabljajo digitalno tehnologijo za naslednje dejavnosti [15], [16]: (a) sprejemanje, razčlenjevanje in tvorjenje umetnostnih in neumetnostnih besedil; (b) kritično mišljenje, ustvarjalnost in inovativnost; (c) iskanje, zbiranje, izmenjavo in obdelavo podatkov ter njihovo sistematično rabo pri tvorjenju informacij. "Za izdelavo, predstavitev in razumevanje kompleksnih informacij uporabljajo tudi primerno strojno in programsko opremo; samostojno uporabljajo primerne didaktične računalniške programe in medmrežje/splet kot vir podatkov in komunikacijsko orodje." [15], [16]

3.3 Uporaba informacijske tehnologije

Razvijanje digitalnih kompetenc učencev poteka ob delu s pomočjo informacijske tehnologije, tj. z rabo računalnika in druge razpoložljive tehnologije. Namen uporabe je, da bi učenci "pridobili, ovrednotili, shranili, tvorili oz. oblikovali, predstavljali informacije in si jih izmenjevali ter da bi se sporazumevali in bi sodelovali na spletu" [15].

Z rabo informacijske tehnologije lahko učitelj pripomore k uresničuju učnih ciljev predmeta, z njeno pomočjo spodbuja aktivnost učencev, jih motivira in učence posledično digitalno opismenjuje. Pri tem pa naj učitelj učence spodbuja k rabi računalnikov, pametnih telefonov, tablic ipd. tudi pri domačem delu [15].

Poleg tega sodobna informacijska tehnologija omogoča rabo raznih oblik in metod dela ter učitelju omogoča "pripravo in prilagoditev besedil, nalog in drugega gradiva za doseganje raznih ciljev" [15] iz učnega načrta. Omogoča mu tudi delo z različnimi e-vsebinami (e-gradiva, e-knjige, e-učbeniki, spletni slovarji in drugi jezikovni priročniki …) in e-storitvami, kar pa omogoča večjo stopnjo diferenciacije in individualizacije pri pouku in učenju ter uporabo drugačnih oblik pouka, kot je npr. sodelovalno učenje [15].

Pri vsem tem je pomembno, da je učitelj ustrezno strokovno usposobljen, da zna poiskati in presoditi kakovost spletnih vsebin in storitev, in tega naučiti tudi učence, ter omenjene vidike ustrezno (primerno) vključiti v pouk.

Se pa lahko bralec o tem pouči v slovenistični strokovni literaturi, prim. [1], [5] in [18], sinteza opredelitev pa je dostopna tudi v [14].

4. RAZISKAVA O DIGITALNIH KOMPETENCAH UČITELJEV SLOVEŠČINE

4.1 Ozadje in namen raziskave

V proučevanje usposobljenosti učiteljev začetnikov na področju digitalnih kompetenc je bil usmerjen del raziskave o razvijanju kompetenc za poučevanje slovenščine, in sicer v okviru doktorskega študija na temo *Vloga obdobja pripravništva pri pridobivanju kompetenc za poučevanje slovenščine* [14].

S pomočjo anketnih vprašalnikov za učitelje začetnike in za njihove mentorje smo želeli ugotoviti: (a) s katerimi težavami so se v času uvajanja v pedagoški poklic soočali učitelji začetniki; (b) v kolikšni meri so bili začetniki pri načrtovanju in izvedbi pouka pozorni na vključevanje sestavin za razvijanje ključnih zmožnosti oz. digitalnih kompetenc učencev ter po čigavem nasvetu; (c) kako mentorji ocenjujejo usposobljenost začetnikov za razvijanje ključnih zmožnosti pri slovenščini in kakšno je njihovo mnenje glede usposobljenosti učiteljev začetnikov za razvijanje posameznih ključnih zmožnosti pri slovenščini.

Ob tem smo predpostavljali, da: (a) se učitelji začetniki ob vstopu v pedagoški poklic najpogosteje soočajo z delovno preobremenjenostjo, ne soočajo pa se s težavami nepoznavanja sodobne informacijsko-komunikacijske tehnologije; (b) so pri pouku včasih pozorni na razvijanje ključnih zmožnosti, in še to po opozorilu mentorja; (c) mentorji usposobljenost začetnikov za razvijanje ključnih zmožnosti pri slovenščini ocenjujejo kot neustrezno, glede usposobljenosti začetnikov za razvijanje posameznih sestavin ključnih zmožnosti pri slovenščini pa menijo, da nimajo dovolj znanja o ključnih kompetencah.

4.2 Metodologija

Opravljena raziskava je bila zasnovana iz dveh delov. Teoretični del raziskave je zajemal analizo strokovne literature s področja kompetenc učitelja in analizo dokumentacije, ki opredeljuje organizacijo in potek uvajanja začetnikov v pedagoški poklic. Analiza je služila kot osnova za oblikovanje anketnih vprašalnikov za empirični del. V empiričnem delu je bila raziskava kvantitativna, zato smo uporabili kvantitativne metode raziskovanja. Uporabili smo kavzalno neeksperimentalno metodo, s pomočjo katere smo skušali iskati vzročno-posledične povezave in proučevane pojave vzročno pojasnjevati [12].

Osnovni množici raziskave sta bili dve: eno so predstavljali učitelji začetniki, drugo pa učitelji mentorji začetnikom. Vzorca za raziskavo sta bila neslučajnostna, namenska, izbrana z namenskim izborom glede na njune lastnosti, pomembne za našo raziskavo. To je bila izobrazba, saj smo vključili le učitelje slovenščine.

V raziskavi je skupno sodelovalo 72 učiteljev začetnikov,[4] od tega 44 osnovnošolskih, 20 gimnazijskih ter po štirje iz poklicne ali strokovne šole in srednje tehniške šole. Poleg tega je v raziskavi sodelovalo še 60 mentorjev učiteljem začetnikom.

[4] V naši raziskavi smo jih imenovali 'pripravniki', saj je bilo v času priprave in izvedbe raziskave uvajanje v učiteljski poklic urejeno v obliki pripravništva.

4.3 Rezultati in ugotovitve raziskave

4.3.1 *Težave, s katerimi se učitelji začetniki soočajo*

Z raziskavo smo ugotovili, da se je le majhen delež učiteljev začetnikov (4 anketirani učitelji začetniki oz. 2,4 %) pri uvajanju v pedagoški poklic soočal z nepoznavanjem sodobne informacijsko-komunikacijske tehnologije. Kot največjo težavo so navedli nepoznavanje izobraževalnega sistema, in sicer kurikula, zakonodaje, predpisov ipd. (22 začetnikov oz. 13,3 %), ter nepoznavanje učencev – njihovega razvoja, socialnega statusa (21 učiteljev začetnikov oz. 12,7 %). Naša predpostavka, da učitelji začetniki nimajo težav z nepoznavanjem sodobne IKT tehnologije, se je izkazala kot pravilna.

Za razliko od slovenskih učiteljev začetnikov, ki svoje znanje in spretnosti na področju digitalnih kompetenc ocenjujejo kot dobre, pa norveški učitelji začetniki s svojim znanjem o tem, kako v razredu delati z digitalnim orodjem, niso zadovoljni (prim. [8]). Prav tako nekatere raziskave kažejo, da imajo učitelji na splošno slabo znanje o tem, kako uporabljati informacijsko-komunikacijsko tehnologijo v pedagoške/didaktične namene [11].

4.3.2 *Učitelji začetniki o digitalnih kompetencah*

V nadaljevanju raziskave smo ugotovili tudi, da so učitelji začetniki večinoma pri načrtovanju in izvedbi pouka včasih pozornost namenili razvijanju digitalnih zmožnosti učencev. Tako se je izkazalo pri usmerjanju učencev v raziskovanje učnih vsebin s pomočjo spleta (60,0 % začetnikov je pozornost namenilo včasih, 33,3 % vedno in 6,7 % nikoli), usmerjanju v sprejemanje (poslušanje/gledanje) posnetkov literarnih in kulturnih vsebin na spletu (56,7 % anketiranih včasih, 36,7 % vedno in 6,7 % nikoli) ter kritičnem dojemanju spletnih strani z "učno snovjo" za učence (50,0 % učiteljev začetnikov včasih, 30,0 % včasih in 20,0 % nikoli). Na vse omenjene vidike digitalne zmožnosti učitelji začetniki pravijo, da so bili pozorni na lastno pobudo. Naša predpostavka se je torej deloma izkazala kot pravilna (da učitelji začetniki včasih namenijo pozornost razvijanju digitalnih zmožnosti učencev) in deloma kot nepravilna (začetniki so na omenjene vidike pozorni na lastno pobudo, ne pa na pobudo mentorja).

4.3.3 *Mentorji o digitalnih kompetencah učiteljev začetnikov*

Mentorji so usposobljenost učiteljev začetnikov na področju digitalnih kompetenc (za razliko od ostalih ključnih zmožnosti[5]) ocenili kot zelo ustrezno. Tako je ocenila več kot polovica (52,6 %) anketiranih mentorjev. Nekoliko manj (47,7 %) mentorjev ocenjuje usposobljenost začetnikov na področju digitalnih kompetenc kot srednje ustrezno, noben mentor pa je ni ocenil kot neustrezno. O digitalnih kompetencah učiteljev začetnikov mentorji menijo, da so veliko bolje podkovani kot njihovi starejši mentorji, da se zavedajo prednosti in pasti uporabe spleta ter da imajo občasno še nekoliko težav pri posredovanju teh vsebin učencem in da za to potrebujejo še nekoliko več izkušenj. Na podlagi razultatov raziskave smo ugotovili, da se naša predpostavka glede ocene in mnenja mentorjev o usposobljenosti začetnikov na področju digitalnih kompetenc ni izkazala kot pravilna.

[5] Kulturne zavesti, socialnih in osebnostnih zmožnosti, sporazumevalne zmožnosti in kompetence učenje učenja. Usposobljenost učiteljev začetnikov na področju teh kompetenc so ocenili kot srednje ustrezno.

5. SKLEP

Raziskava je pokazala, da so učitelji začetniki dobro usposobljeni na področju digitalnih kompetenc, vendar bi bilo kljub temu zaradi razmaha sodobne tehnologije (tudi učne) in razširjenosti njene uporabe smotrno posvetiti še večjo pozornost nekaterim vidikom digitalne zmožnosti.

Nekoliko več pozornosti bi bilo tako potrebno nameniti raziskovanju učnih vsebin s pomočjo spleta, varni in kritični rabi informacijskih sistemov, kritičnemu dojemanju spletnih strani z "učno snovjo za učence", vključevanju e-vsebin in e-storitev ipd. Glede na tempo razvoja informacijske tehnologije pa je nujen predpogoj za (kakovostno) digitalno opismenjevanje učencev učiteljevo nenehno izobraževanje in izpopolnjevanje svojih digitalnih kompetenc.

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Katera učna gradiva bi izbrali na poklicnih in strokovnih šolah

Which learning materials to choose in vocational and technical schools

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POVZETEK

Izbira učnega gradiva za pouk je odvisna tako od nabora razpoložljivih gradiv kot tudi od situacije, v kateri pouk poteka.

V prispevku predstavljamo raziskave o uporabi učnih gradiv in potrebah po novih gradivih v poklicnem in strokovnem izobraževanju. Ugotavljamo, da zaradi pomanjkanja kakovostnih učnih gradiv za strokovne module učitelji iščejo različne vire in pripravljajo interna gradiva vseh vrst. Na splošno si učitelji želijo bolj poenotena gradiva, predvsem učbenike, močno pa je izražena tudi potreba po raznovrstnih e-gradivih. Dijaki prav tako izražajo, da želijo uporabljati več e-gradiv, zato bi veljalo pri izbiri učnega gradiva upoštevati tudi njihovo mnenje.

Glede na to, da so digitalne spretnosti na trgu dela postale že skoraj nujni pogoj za zaposlitev, je pomembno, da postanejo sestavni del kurikula ter da se odražajo tudi v razvoju in uporabi kakovostnih e-gradiv.

Ključne besede

Poklicno in strokovno izobraževanje, učna gradiva, potrebe po učnih gradivih, e-gradiva

ABSTRACT

The choice of learning material depends on the set of materials available and the situation in which the instruction takes place.

This paper presents research on the use of learning materials and the need for new materials in vocational education and training. We find that because of the lack of quality learning materials for the vocational modules, teachers are looking for different resources and preparing internal materials of all kinds. In general, teachers want more unified materials, especially textbooks, and the need for a variety of e-materials is strongly expressed. Students also want to use e-learning materials, so their opinion should be taken into consideration when choosing teaching materials.

Given that digital skills in the labor market have become a prerequisite for employment, it is important that they become an integral part of the curriculum and that they are also reflected in the development and use of quality e-learning materials.

Keywords

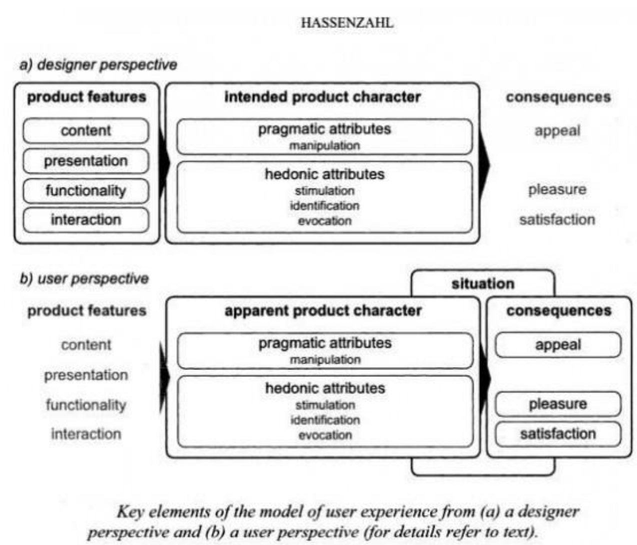
Vocational education and training, learning materials, needs for learning materials, e-learning materials

1. UVOD

Učitelji v Sloveniji imajo avtonomijo pri izbiri učnih gradiv, s pomočjo katerih bodo učenci dosegali predvidene učne izide. Pri načrtovanju pouka se tako znajdejo pred odločitvijo, kaj bodo svojim učencem ponudili za učenje. Njihova odločitev je lažja, če imajo na voljo kakovosten nabor tiskanih in e-gradiv. Če tega nimajo, morajo gradivo zbrati iz različnih virov, ga prilagoditi potrebam pouka, pri tem pa paziti na ustrezno raven strokovnosti.

Izbor učnih gradiv je seveda tudi stvar situacije, v kateri se nahaja učitelj. Lahko ima na voljo zelo kakovostno novo interaktivno gradivo, podprto z multimedijskimi vsebinami, pa ga ne bo uporabil – morda zato, ker s pridom uporablja že neko drugo gradivo, morda zato, ker se novo gradivo ne sklada z njegovim pedagoškim konceptom, morda misli, da za njegove učence ni primerno, morda novega gradiva sploh ne pozna ipd.

Odnos med produktom, v našem primeru učnim gradivom, in uporabnikom dobro pojasnjuje Hassenzahlov model (Slika 1). Model prikazuje, da je neko gradivo lahko zasnovano ob upoštevanju uporabniške izkušnje, vendar uporabniška izkušnja ni odvisna le od značilnosti, ki jih uporabnik prepozna v gradivu, ampak tudi od vsakokratne situacije, v kateri se uporabnik nahaja.



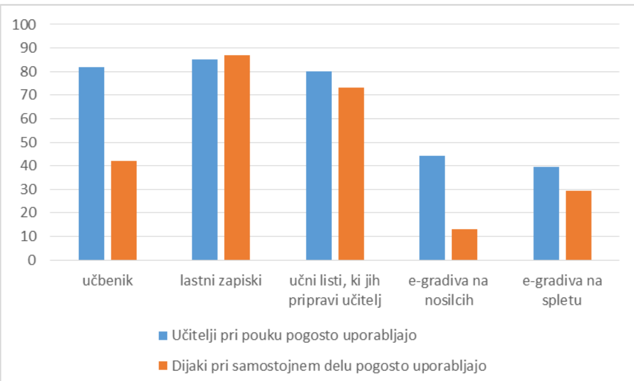
Slika 1: Hassenzahlov model [1]

V nadaljevanju bomo prikazali, v kakšni situaciji se nahajajo učitelji strokovnih modulov v programih poklicnega in strokovnega izobraževanja, ko (i)zbirajo učna gradiva za svoje dijake.

2. Z UČNIMI GRADIVI DO KAKOVOSTNEGA ZNANJA

Leta 2011 je na Centru RS za poklicno izobraževanje izšlo poročilo o prvi raziskavi o značilnostih in uporabi učnih gradiv v srednjem poklicnem in strokovnem izobraževanju. V raziskavo je bilo vključenih 370 učiteljev v programih Strojni tehnik, Zdravstvena nega in Ekonomski tehnik ter 552 njihovih dijakov, večinoma iz višjih letnikov. [2]

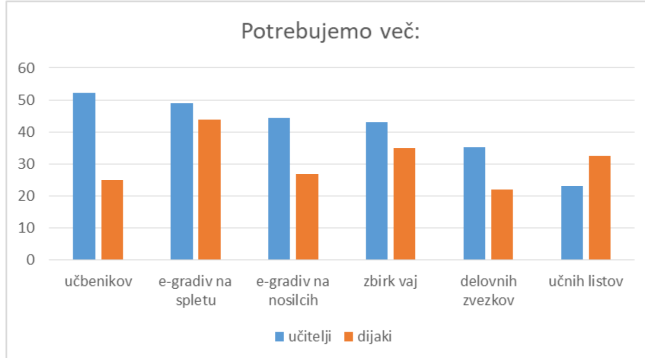
Na vprašanje, kaj uporabljajo pri pouku, so učitelji odgovorili, da najpogosteje uporabljajo lastne zapiske, učbenike ter učne liste, ki jih pripravijo sami. Manj uporabljajo e-gradiva na spletu oz. na digitalnih nosilcih. Če njihove odgovore primerjamo z odgovori dijakov, kaj oni uporabljajo za učenje, se odgovori ujemajo pri uporabi lastnih zapiskov in delovnih listov, ki jih pripravijo učitelji. Učbenike dijaki manj pogosto uporabljajo, še manj pa e-gradiva, posebej tista na digitalnih nosilcih. Gradiva na spletu uporabljajo bolj pogosto, in to več pri samostojnem učenju doma kot v šoli.



Sika 2: Vrste gradiv, ki jih učitelji in dijaki najpogosteje uporabljajo

Če pogledamo uporabo lastnih zapiskov in učnih listov, lahko ugotovimo, da se dijaki največ učijo iz tistih gradiv, ki jih za njih pripravijo učitelji. Učbenike dijaki pri samostojnem delu uporabljajo bistveno manj, vendar je treba upoštevati, da v poklicnem in strokovnem izobraževanju izredno primanjkuje kakovostnih učbenikov. Na tem področju bi bilo treba resno razmisliti o pedagoško-didaktičnih in tudi o sistemskih rešitvah na nacionalni ravni, ki bi bolj spodbujale tako pripravo kot tudi uporabo učbenikov, v tiskani ali e-obliki. Učbeniki so za dijake prva strokovna literatura, prek katere spoznavajo osnovne zakonitosti nekega strokovnega področja, strokovno terminologijo, osnovno znanje in veščine s tega področja. Prilagojeni so za raven srednješolcev, ki niso strokovnjaki na teh področjih, ampak to šele postajajo. S pomočjo kakovostnih učbenikov bodo lahko razvili spretnosti za razumevanje zahtevnejše strokovne literature.

V raziskavi nas je nadalje zanimalo tudi mnenje o razpoložljivosti različnih vrst učnih gradiv. Učitelji so na vprašanje, katerih gradiv je premalo, izpostavili učbenike, e-gradiva na spletu in digitalnih nosilcih, zbirke vaj, nekoliko manj delovne zvezke, najmanj pa učne liste. Dijaki pa so najbolj izpostavili e-gradiva na spletu, nekoliko manj zbirke vaj, delovne zvezke in učne liste.



Slika 3: Vrste gradiv, ki jih po mnenju učiteljev in dijakov primanjkuje

Mnenja učiteljev in dijakov o tem, katerih vrst gradiv najbolj primanjkuje, so usklajena glede tega, da potrebujejo več e-gradiv na spletu. Njihovo mnenje o potrebnosti učbenikov se razlikuje, vendar je treba tudi ta podatek postaviti v kontekst pomanjkanja kakovostnih učbenikov, ki je značilen za programe poklicnega in strokovnega izobraževanja. Tudi tukaj se torej pokaže, da bi bilo smiselno spodbuditi pripravo kakovostnih e-gradiv. Ta med drugim omogočajo tudi individualne prilagoditve in s tem podpirajo fleksibilno, na dijaka osredinjeno izobraževanje. [4] E-gradiva bi lahko nadomestila tudi učne liste, edino kategorijo, pri kateri so dijaki izkazali večjo potrebo kot učitelji.

Poglejmo zdaj, kakšna je situacija po posameznih strokovnih področjih.

3. ANALIZE STANJA PO POSAMEZNIH STROKOVNIH PODROČJIH

Od leta 2013 na Centru RS za poklicno izobraževanje sistematično analiziramo stanje učnih gradiv po posameznih strokovnih področjih s pomočjo kombinacije spletne ankete med vsemi učitelji strokovnih modulov in pogovorov s predstavniki šol, da ugotovimo čim bolj realno stanje vseh obstoječih učnih gradiv, določimo prioritete pri pripravi novih gradiv ter pridobimo nabor potencialnih avtorjev za analizirano strokovno področje.

V analizi smo med drugim zajeli tudi mnenje učiteljev o tem, katere vrste gradiv bi bile za posamezne strokovne module najprimernejše. [3]

3.1 Gradbeništvo

Analiza stanja na področju gradbeništva je bila izvedena leta 2013. Spletno anketo je izpolnilo 51 učiteljev iz vseh gradbenih šol v Sloveniji. Pri vprašanju, katero vrsto gradiva bi pri pouku najbolj potrebovali, so učitelji največkrat omenili e-gradiva. Eden od učiteljev je celo komentiral: »Knjig je dovolj, manjka e-gradivo.« Potrebe po e-gradivih se vsekakor skladajo s trendom digitalizacije šolstva, vprašanje pa je, kaj učitelji razumejo pod oznako e-gradivo. Pravo e-gradivo je namreč interaktivno, vsebuje multimedijske elemente in deluje samo na elektronskem mediju.

V letih po analizi stanja so na področju gradbeništva nastali 4 učbeniki, vsi v tiskani obliki. Eden ima dodano aplikacijo za izračunavanje elementov za projektiranje cest. Treba pa je dodati, da je razvoj digitalnih spretnosti do neke mere že vključen v kurikul, saj dijaki pri strokovnih modulih uporabljajo računalniška orodja, ki so sicer v rabi v gradbeni stroki.

3.2 Elektrotehnika in računalništvo

Leta 2016 je anketo o učnih gradivih izpolnilo 188 učiteljev iz vseh elektro-računalniških šol v Sloveniji. Med potrebami so največkrat izpostavili učbenike, sledili so e-učbeniki, omenjali pa so tudi potrebo po drugih vrstah digitalnih gradiv, kot so spletni vodiči, aplikacije ipd. Seveda za področje elektrotehnike in računalništva velja še veliko bolj kot za druga strokovna področja, da sam pouk poteka ob uporabi različnih računalniških orodij, tako da potreba po klasičnih učbenikih morda ni tako presenetljiva.

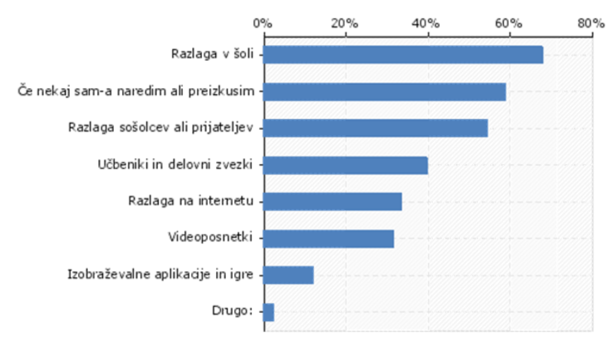
V sodelovanju s slovenskimi založbami je v naslednjih letih nastalo 8 novih učbenikov, ki so vsi v tiskani obliki, nekateri imajo dodatne vsebine v e-obliki. Pri izbiri oblike je vsekakor pomembna vloga založb, ki večinoma raje izdajajo tiskane učbenike, predvsem zaradi (za zdaj) bolj jasne distribucije. Trend pa je, da založbe poleg tiskane izdaje ponujajo še nadgradnjo z e-gradivi na spletu.

3.3 Medijski tehnik

Na področju medijev smo leta 2017 anketo poslali tako učiteljem kot dijakom programa Medijski tehnik. Izpolnilo jo je 43 učiteljev in 282 dijakov.

Medijski tehnik je relativno nov izobraževalni program, ki sploh nikoli ni bil sistematično pokrit z učnimi gradivi. Učitelji uporabljajo kombinacijo različnih objavljenih in neobjavljenih gradiv ter tudi orodij, v anketi so jih navedli več kot 70 – od tiskanih virov v različnih jezikih, strokovnih revij, spletnih strani, programskih orodij ipd. Učitelji so poleg potrebe po učbenikih, delovnih gradivih in e-gradivih posebej navedli tudi potrebo po AV gradivih, kar je glede na specifiko programa Medijski tehnik razumljivo.

Dijake smo vprašali, kaj jim najbolj pomaga, da se lažje in bolj učinkovito učijo. Možnih je bilo več odgovorov.



Slika 4: Delež dijakov glede na vire in pripomočke pri učenju

Poleg razlage v šoli, ki je med viri običajno na prvem mestu, dijakom v programu Medijski tehnik najbolj pomaga, če nekaj sami naredijo ali preizkusijo. Tudi sicer dijaki sporočajo, da bi si želeli več praktičnega dela. 14 dijakov je to eksplicitno navedlo v odgovoru na odprto vprašanje, ali želijo še kaj sporočiti v zvezi z učnimi gradivi v programu Medijski tehnik. Eden je zapisal, da si želijo »mogoče manj poudarka na "piflanju\" postopkov, ki jih je treba znati za pozitivno oceno in več dejanske razlage, za kaj in kako se kaj uporablja, kje nam kaj utegne priti prav – da dobimo v glavo malce večjo sliko in jo tudi v praksi uporabimo za kakšen povsem svoj in drugačen projekt kot v šoli.«

Takoj za učbeniki dijaki kot koristen vir navajajo internet in videoposnetke, kar se sklada z navedbami učiteljev, da bi potrebovali več elektronskih in prav posebej AV gradiv.

Dijaki so lahko navedli gradiva (učbenike, knjige, spletne strani, revije, aplikacije ...), ki jih uporabljajo oz. so jih uporabljali pri pouku strokovnih modulov in iz katerih so se res veliko naučili.

Največ dijakov je navedlo enega od obstoječih učbenikov oz. gradiv, ki so jih navedli tudi učitelji. Omenili so tudi spletne učilnice svojih učiteljev. Precej dijakov je navedlo splošne spletne vire, kot so Youtube, Wikipedia in Google, nekaj pa jih je navedlo tudi bolj specifične vire, kot so digital-photography-school.com, camerasim.com, instructables.com, blockly games ipd. Nekaj dijakov je navedlo, da kot vir uporabljajo samo zapiske, nekateri pa so zatrdili, da ne uporabljajo nič.

Pomanjkanje učnih gradiv v programu Medijski tehnik je prav gotovo spodbudilo iskanje in uporabo pisanega nabora različnih virov, hkrati pa je ta primanjkljaj poglobil razlike med šolami in tudi posameznimi dijaki, ki različno dostopajo do razpoložljivih virov.

3.4 Gostinstvo in turizem

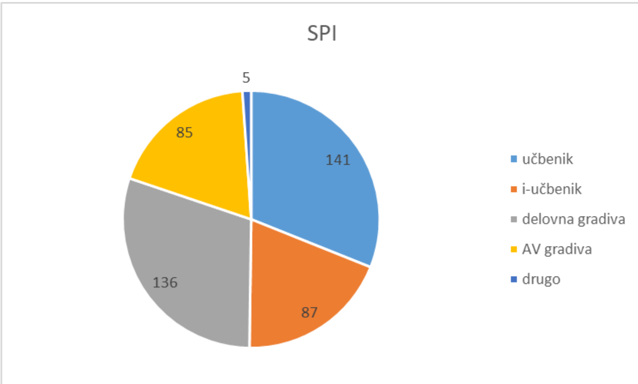
Učitelji s področja gostinstva in turizma (sodelovalo je 45 učiteljev) so bili glede na odgovore v anketi, ki smo jo izvedli leta 2018, odprti za vse vrste učnih gradiv. Ko smo z avtorji načrtovali enega od predvidenih učbenikov in se pogovarjali o potencialni elektronski obliki, so se odločili za tiskan učbenik, ker se jim je e-učbenik glede na strukturo njihovih dijakov – namenjen je v prvi vrsti dijakom 3-letnega programa Gastronomske in hotelske storitve – zdel manj primeren. Zelo pa bi si želeli, če bi lahko tiskan učbenik nadgradili z multimedijskimi elementi, predvsem videoposnetki, ki so po njihovem mnenju v gostinstvu in turizmu zelo uporabna gradiva.

3.5 Strojništvo

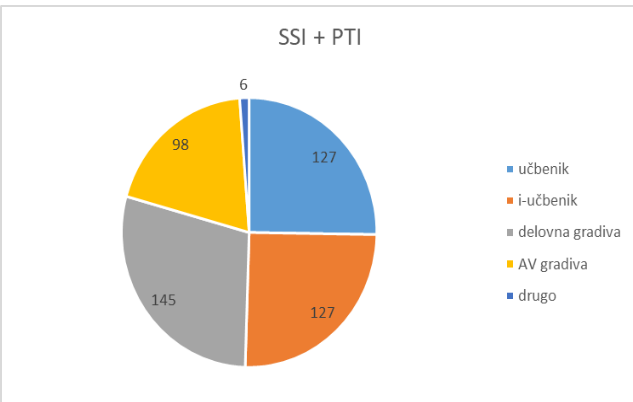
Anketo med učitelji strojništva smo izvedli v letu 2019 in podatki še niso v celoti obdelani. Anketo je izpolnilo 141 učiteljev, ki poučujejo v izobraževanih programih na področju strojništva in avtoservisne dejavnosti. Največ odgovorov je prišlo od učiteljev v programih Strojni tehnik, Strojni tehnik PTI, Avtoserviser in Oblikovalec kovin-orodjar, ki so tudi programi z največ vpisanimi dijaki na tem področju.

Za potrebe tega prispevka smo pregledali potrebe po novih učnih gradivih, ki so jih anketirani učitelji navedli v svojih odgovorih. Pri tem se je pokazala razlika med potrebami po učbenikih in i-učbenikih med 3-letnimi programi srednjega poklicnega izobraževanja (SPI) ter 4-letnimi programi srednjega strokovnega (SSI) in poklicno-tehniškega izobraževanja (PTI).

V programih SSI in PTI se kažejo približno enake potrebe po učbenikih in i-učbenikih, v programih SPI pa so izražene potrebe po klasičnih učbenikih bistveno večje kot po i-učbenikih. Le pri dveh modulih v programih SPI so učitelji dali prednost i-učbenikom pred klasičnimi gradivi. Zanimiva je tudi velika potreba po delovnih gradivih za dopolnjevanje, ki je izražena tako pri 3- kot tudi pri 4-letnih programih. Prav tako je visok delež odgovorov, ki sporočajo, da bi učitelji potrebovali več AV gradiv.



Slika 5: Razmerje med potrebami po različnih vrstah učnih gradiv v programih srednjega poklicnega izobraževanja



Slika 6: Razmerje med potrebami po različnih vrstah učnih gradiv v programih srednjega strokovnega in poklicno-tehniškega izobraževanja

3.6 Glavna sporočila analiz stanja učnih gradiv

Pri interpretaciji podatkov, pridobljenih z anketami, je potrebno upoštevati, da ni jasno, kaj učitelji razumejo pod navedenimi kategorijami učnih gradiv. Pa vendar lahko na podlagi analiz povzamemo nekaj sporočil, ki so pomembna za nadaljnji razvoj učnih gradiv v poklicnem in strokovnem izobraževanju.

Prvo sporočilo – kakovostnih učnih gradiv za strokovne module v izobraževanih programih poklicnega in strokovnega izobraževanja primanjkuje, zato učitelji iščejo različne vire in pripravljajo interna gradiva, kar v pouk vnaša določeno pozitivno dinamiko, vendar ustvarja razlike med šolami in dijaki.

Drugo sporočilo – učitelji med potrebami največ navajajo učbenike. Želijo pa tudi drugačne vrste gradiv. Smiselno bi bilo narediti nadaljnjo raziskavo, kaj o tem menijo dijaki, ki po naših podatkih na prvo mesto ne postavljajo potrebe po učbenikih, ampak po e-gradivih in učnih gradivih »po meri«, ter ugotovitve povezati s siceršnjo kakovostjo razpoložljivih učnih gradiv.

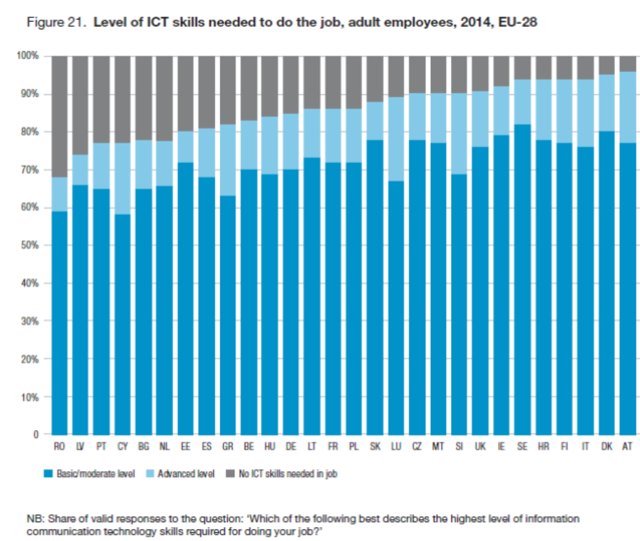
Tretje sporočilo – za nekatere vsebine oz. tudi za nekatere programe se e-gradiva kažejo kot manj primerna izbira. Toda – ali je za modul Strežba e-gradivo manj smiselno kot za modul Računalniško podprte proizvodnje? Ali so za dijake 3-letnega srednjega poklicnega izobraževanja e-gradiva res manj primerna kot za dijake 4-letnih programov?

4. ZAKLJUČEK

Ob načrtovanju učnih gradiv za nek strokovni modul je treba vsekakor pretehtati, za kakšne oblike učnih gradiv se bomo odločili. Tudi npr. za modul Strežba se da narediti uporabno e-gradivo. V proces načrtovanja učnih gradiv je smiselno vključiti tudi dijake, saj so prav oni njihovi končni uporabniki in je njihova uporabniška izkušnja najpomembnejša. Poleg tega bodo učna gradiva, pri katerih bodo sodelovali, vzeli bolj "za svoja".

O tem, da bi bila e-gradiva bolj primerna za izobraževalne programe na višji zahtevnostni ravni, lahko že zaradi premalo podatkov resno podvomimo. E-gradiva vsebujejo manj besedila in dolge opise postopkov nadomeščajo z videoposnetki ali animacijami, tako da tehnologija v tem primeru na nek način "osvobodi" učence intenzivne uporabe pisnega sporočanja, s katerim imajo prav dijaki v srednjem poklicnem izobraževanju največ težav. [4]

Dejstvo je, da je določena raven digitalnih spretnosti za opravljanje dela potrebna po vsej Evropi in da se ta raven zaradi avtomatizacije delovnih procesov viša. [5]



Slika 7: Raven IKT spretnosti, potrebnih za opravljanje dela, pri odraslih delavcih v letu 2014, EU-28

Cedefop, Evropski center z razvoj poklicnega usposabljanja, je v svoji prvi raziskavi o spretnostih in delovnih mestih v Evropi (*European skills and jobs survey*) v letu 2014 ugotovil, da je 43 %delavcev po vsej Evropi v zadnjih 5 letih pri svojem delu soočilo s spremembami v tehnologijah, 47 % delavcev pa je izkusilo spremembe delovnih metod ali praks. [6]

Poklicno in strokovno izobraževanje mora na vse te izzive odgovoriti, tudi s pomočjo sodobno zasnovanih učnih gradiv. Če želimo, da na šolah učitelji in dijaki izbirajo med kakovostnimi gradivi, je treba izbiro takšnih gradiv tudi ponuditi. Skozi učbeniško politiko v državi bi morali poskrbeti za to, da bi z raznolikimi gradivi, ki vključujejo tudi e-gradiva, sistematično pokrili vsa strokovna področja poklicnega in strokovnega izobraževanja.

Vprašanje je, ali je popoln prehod na e-gradiva mogoč. Pa tudi, ali je smiseln? Bolj bistveno je vprašanje, kako vključiti utemeljena znanja IKT v redni del kurikula poklicnih in strokovnih šol. Da ne bodo naši dijaki zgolj uporabniki računalniških orodij, temveč tudi »snovalci digitalne prihodnosti«. [7]

5. ZAHVALA

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[7] Snovalci digitalne prihodnosti ali le uporabniki? Poročilo strokovne delovne skupine za analizo prisotnosti vsebin računalništva in informatike v programih osnovnih in srednjih šol ter za pripravo študije o možnih spremembah (RINOS). Ljubljana, 2018 (pridobljeno 26. 08. 19 na http://www.mizs.gov.si/fileadmin/mizs.gov.si/pageuploads/Aktualno/Porocilo_RINOS_30_5_18.pdf)

Podcast – pouk na drugačen način

Podcast – different kind of teaching

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POVZETEK

Pri predmetu državljanska in domovinska vzgoja smo se odločili, da bomo naredili podcaste na učno temo človekovih pravic. Najprej smo spoznali kaj so podcasti, kako so narejeni ter se seznanili s programsko opremo, ki je potrebna za njihovo izdelavo.
Učenci so si izbrali vsak svojo človekovo pravico. Po navodilih so raziskali temo in napisali scenarij za izdelavo podcastov. Nato so se posneli, ter vse skupaj zmontirali v končni izdelek. Te so skupaj z učiteljico poslušali ter jih ocenili. Dosegli smo vse zastavljene cilje - poleg znanja o izbrani temi, so nadgradili tudi svoje digitalne kompetence.

Ključne besede

Podcast, človekove pravice, digitalne kompetence

ABSTRACT

We decided to make podcasts dealing with human rights for the school subject Patriotic and Citizenship Culture and Ethics.
Firstly, the pupils got to know what podcasts are, how they are made and what kind of software is needed for making them.
Secondly, different categories of human rights were chosen by the pupils. They had to explore the given topic and write a screenplay for podcasts according to instructions, followed by recording and editing the podcasts. The pupils and the teacher listened to the final products and graded them together. All the aims were achieved – including the acquired knowledge on the chosen topic, as well as digital competence.

Keywords

Podcast, Human Rights, Digital Competences

1. UVOD

Pri predmetu državljanska in domovinska vzgoja smo se pri temi človekove pravice odločili, da bomo naredili podcaste. Učenci naj bi najprej raziskali vsak svojo temo in nato napisali scenarij po katerem bi posneli in izdelali podcast, ki bi ga javno objavili. Poleg tega, da bi se seznanili z izbrano temo, bi se tudi naučili iskanja informacij, povzemanje in na koncu izdelave podcasta. Skladno z okvirjem digitalnih kompetenc za državljane[1] smo želeli spodbuditi področje informacijske pismenosti, komuniciranja in sodelovanje ter izdelovanja digitalnih vsebin.

2. Državljanska in domovinska vzgoja ter etika

Učni načrt za državljansko in domovinsko vzgojo ter etiko je zasnovan na učno ciljnem in procesno razvojnem modelu, ki temelji na celostnem pristopu k učenju in poučevanju. Ključni pogoj za izvedbo celostnega pristopa je usmerjenost učiteljev v medpredmetne povezave.

Z raznovrstnimi sodobnimi metodami in učnimi pristopi naj učitelj usmerja učence v kritično samostojno raziskovalno delo. Učitelj naj spodbuja uporabo sodobne informacijsko−komunikacijske tehnologije. Učenci razvijajo kompetence z neposrednimi učnimi dejavnostmi, kot med drugim so: primerjanje, analiziranje, kritično izražanje stališč, priprava referatov, predstavitve vsebin z uporabo IT, raziskovanje. [1]

3. PODCASTI

3.1 Kaj so podcasti

Podcasting ali pododajanje je metoda za distribucijo digitalnih video in avdio vsebine preko interneta. Vsaka od teh digitalnih datotek se imenuje podcast, ki se ponavadi redno objavlja kot serija epizod. Vsak del spremlja posebna datoteka, tako imenovani vir (RSS), ki opisuje lokacijo podcasta in omogoča uporabnikom, da se naročijo na serijo in samodejno prejemajo nove epizode. Poslušamo jih z telefonom ali katerim koli prenosnim MP3 predvajalnikom ali računalnikom. Podcasti so bili prvotno samo zvočni, sedaj lahko vsebujejo tudi slike in videoposnetke. [2]

3.2 Strategije za dober izobraževalni podcast

Da je podcast dober, je pomembno upoštevati nekaj priporočil.
Pomembno je, da poslušalcu približamo vsebino o kateri govorimo. Besedilo mora vključevati primere, ki so blizu poslušalcu in v katerih se lahko najdejo.
Dober podcast je jasno strukturiran z uvodom, ki predstavlja vsebino in cilje, temu sledi glavni del. Zaključek mora poudariti ključne točke in predstaviti glavni cilj naslednjega dela podcasta.
Uporabljamo moramo premore pri razmišljanju v podcastu, kjer avtor prosi poslušalca, naj se ustavi in premisli o določeni točki. Temu omogoči, da razmišljajo o vsebini, ki se predvaja.
Na koncu podcasta uporabimo vprašanja, na katerega lahko poslušalec odgovori. S tem spodbujamo veščine refleksivnega in kritičnega načina razmišljanja.
Podcasti so bolje sprejet, če so narejeni v bolj osebnem in neformalnem načinu.
Avtor lahko vsebino razložiti z monologom, dialogom ali intervjujem.
Monolog zahteva raznolikost v višini in tempu zvoka. Poslušalec bi moral dobiti občutek, da se mu govori neposredno.
Oblika dialoga lahko vključuje dve ali več osebi v razpravi, ki v primerjavi z enim samim glasom, ponuja poslušalcu raznolikost. Intervju je sestavljen iz vprašanj in odgovorov in ponuja priložnost

[1] DigiComp 2.1 https://www.zrss.si/pdf/digcomp-2-1-okvir-digitalnih-kompetenc.pdf

za pogovor s strokovnjaki z različnih področij. Lahko bi tudi učenci avtorji si med sabo postavljali vprašanja o določeni temi, ki so jo spoznali. [3]

3.3 Zakaj podcasti pri pouku

Obstaja več načinov za spodbujanje vključenosti učencev v izobraževanje. Šolski projekti, z uporabo tehnologije učencem zagotavljajo, da lahko nadgradijo svoje znanje z analizo informacij in komuniciranjem idej. Učenci pripravijo skupinsko raziskovalno predstavitev učne temo, ki vključuje izdelava podcasta.

Naloga spodbuja kreativno reševanje problem, učenci širijo informacije in zagotavljajo razvoj svojih sposobnosti komuniciranja in pismenosti. Ko študenti izdelajo podcast, razvijajo svoje sposobnosti skupinskega dela, komunikacije, organizacije, tehnične pismenost in načrtovanje, poleg tega pa tudi sposobnost raziskovanja in zapisanja teme in scenarija podcasta. [4]

4. Postopek izdelave in objave podcasta

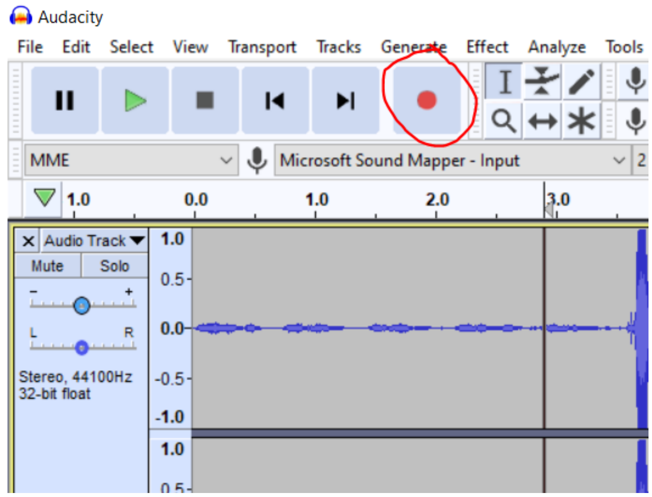
Postopek je sestavljen iz treh faz: izdelava datotek, objava podcastov in dostava ter predvajanje. Izdelava datotek vključuje načrtovanje, pisanje scenarija, snemanje vsebin ter urejanje in stiskanje datotek. Za izdelava potrebujemo strojno opremo za snemanje, kot so digitalni mikrofoni in programska opremo za urejanje zvoka. Poleg ustreznih zvočnih datotek, moramo ustvariti vir RSS. To je povezava, ki navaja lokacijo epizod podcasta. Vključuje tudi podatke o njem, kot so: datumi objav, naslovi in opisi za vsako epizodo.
Zvočno datoteko naložimo na strežnik na katerem ustvarimo vir RSS (soundcloud.com), tega nato dodamo v podcast imenik (itunes connect). Poslušalec se lahko naroči na podcast serije z uporabo podcast aplikacije. Ta prenese vse epizode, na katere se nanaša trenutni RSS vir. Aplikacija nato v imeniku v rednih presledkih preverja vir za posodobitve in naloži vse nove epizode, ki so se pojavile od zadnjega preverjanja. Poslušalci lahko dostopajo do podcastov neposredno na telefonih ali na svojem osebnem računalniku.

4.1 Opis dela

Učenci so se naprej seznanili z snemanjem in obdelavo zvoka. Za snemanje smo uporabljali prosto dostopni program Audacity, ki poleg snemanja omogoča tudi obdelavo zvoka in montažo podcasta. Program lahko uporabljamo tudi za izdelavo zvoka za druge predstavitve ali za zvokovno podlago filmov.

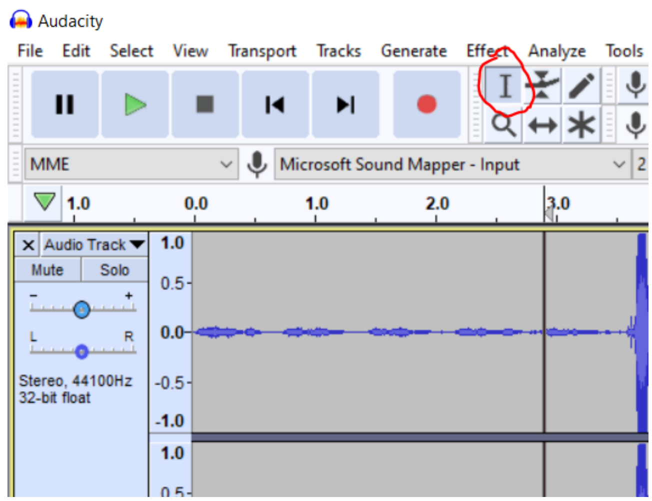
Z mikrofoni so se posneli in se preposlušali, tako so dobili prvo izkušnjo o tem, kako je njihov glas na posnetku drugače od tega, ki ga poznajo. Za snemanje smo uporabili slušalke z naglavnim mikrofonom. Tako smo lahko vsi naenkrat delali z zvokom. Ne glede na kvaliteto slušalk, je v tej fazi bilo največ težav z nedelovanjem mikrofona. Ta ni bil pravilno priklopljen pred zagonom programa za urejanje zvoka ali pa so bile težave z nastavitvami mikrofona v računalniku.

Po priklopu mikrofona, odpremo program Audacity. Z klikom na rdeči gumb začnemo s snemanjem (slika 1).



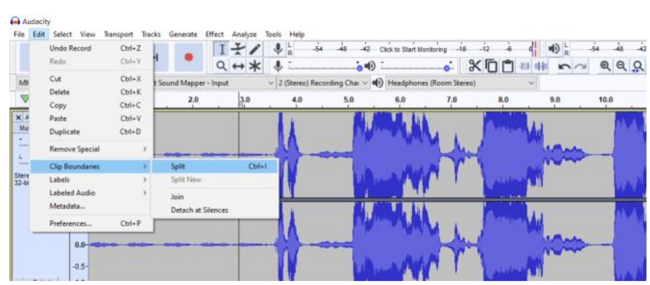
Slika 1 Gumb za snemanje

Po tem ko smo posneli zvok, ga želimo tudi urediti. Z klikom na gumb za označevanje zvoka, lahko označimo neželene dele in jih z pritiskom na gumb delete na tipkovnici zbrišemo (slika 2).



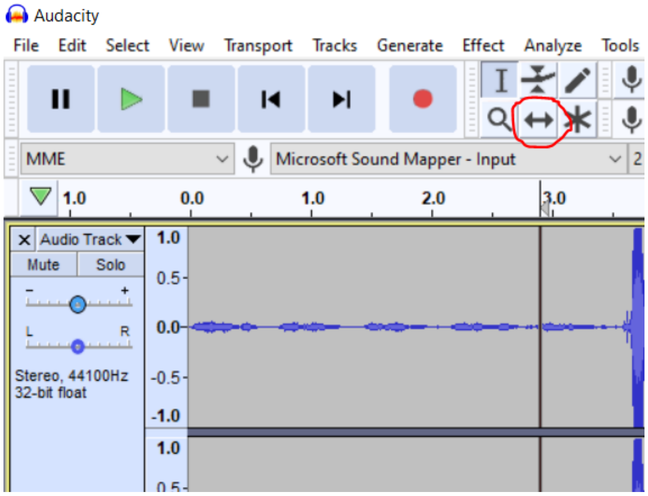
Slika 2 Gumb za označenje dela zvoka

Zvočne posnetke lahko razdelimo na posamezne dele. To naredimo, tako, da se postavimo na želeno točko prereza in v meniju poiščemo možnost za razrez »split«, kot je razvidno na sliki 5.



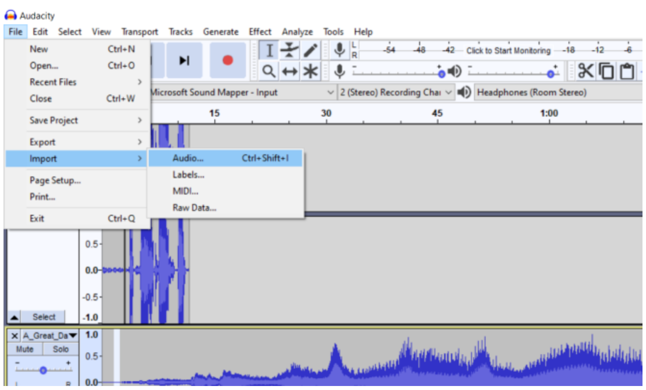
Slika 3 Razrez zvoka na dva dela

Ko želimo posamezne dele zvoka premakniti po časovni osi, izberemo orodje za premik (slika 3).



Slika 4 Gumb za premikanje delov zvoka

Za dodajanje glasbene podlage, uporabimo možnost v meniju »Import« kot je razvidno iz slike 4.



Slika 5 Vnos dodatne glasbe v projekt

Glasbene podlage smo dobili prosto dostopne z možnostjo ponovne uporabe na www.youtube.com/audiolibrary/music.

Med samim projektom smo shranjevali izdelek kot projektno datoteko. Šele na koncu smo, ko smo bili zadovoljni z izdelkom, izvozili.

Ko smo se seznanili z delovanjem programa, so učenci naredili poskusni izdelek, da so ponovili pridobljeno znanje. Končni izdelek, se je zaradi boljše kvalitete posnetka in manj šumov snemal v posebnem prostoru z samostoječim mikrofonom.

Učenci so se v naslednjem koraku lotili izdelave scenarija svojega podcasta. Vsak je dobil naslov svoje teme in na katere vsebine naj bo pozoren. Dobili so seznam ključnih točke katere mora njihov izdelek vsebovati. Izdelek so delali učenci v dvojici. Začeli so z raziskovanjem svojih tem. Dobili so uvodne usmeritve in namig kje si lahko več preberejo o človekovih pravicah. Z nekaj pomoči so vsi našli več kot dovolj materiala o svoji temi na internetu. Sedaj so morali izluščiti bistvo in zapisati besedilo o izbrani človekovi pravici. Ko so bila besedila pripravljena, so bila pregledana, če so dovolj izdelana, da se lahko nadaljuje z delom.

Učenci so najprej besedilo večkrat prebrali, da so dobili občutek za svoje besedilo. Nato so ga v dvojicah posneli v posebnem prostoru, z prostostoječim mikrofonom. Želeli smo, da je bil posnetek čimbolj kvaliteten z čim manj hrupa v ozadju. Večinoma so se snemali v enem kosu. Če se jim je zataknilo, so se ustavili in nadaljevali z snemanjem.

Po končanem snemanju so začeli z obdelavo zvoka. V program so naložili svoj posnetek in nato pobrisali odvečno tišino, napačne dele posnetka. Končne izdelke so shranili in izvozili v zaključno mapo.

Te so potem skupaj z učiteljico za predmet preposlušali in skladno z kriteriji ocenili. Do izdelkov so bili zelo samokritični.

Naš namen je sicer bil, da izdelane podcaste naložimo v spletno aplikacijo Soundcloud. Ta lahko omogoča preprosto direktno objavo izdelka. Omogoča pa tudi RSS povezavo, ki jo potrebujemo za objavo v podcast imenikih.

Z učenci smo se na koncu strinjali, da izdelkov ne objavimo javno.

4.1.1 Izzivi pri delu z podcasti

Izkazalo se je, da so učenci kljub predhodnim znanjem obdelave zvoka, potrebovali kar nekaj pomoči. Niso bili dovolj samostojni pri organizaciji imenovanja posnetkov in projekta. Težave so imeli pri natančnem pregledu svojih posnetkov. Težko so razbrali, katera verzija posnetka je prava in katera ne. Bili so sicer zelo motivirani, ker so želeli, objave svojega izdelka. Zato naključno rezanje in obdelava v tem primeru za njih ni bila dovolj. Sami so želeli biti natančni, da bi njihov izdelek bil dober.

Največ težav pa smo imeli z kvaliteto branja besedila. Besedilo je bilo prebrano nerazločno, prehitro, zatikajoče ali pa monotono. Sami so bili v večini razočarani, nad seboj. Izdelki so večinoma dosegli zastavljene cilje, vendar si učenci, zaradi vsega naštetega, niso želeli objave.

5. ZAKLJUČEK

Učenci so dobili odlično izkušnjo. S tem, ko so se zavedali, da bodo njihovi izdelki javno objavljeni, so drugače pristopili delu. Z veliko resnostjo so se lotili raziskovanja svoje teme. Ves čas, med vsemi fazami dela, je bilo čutiti vznemirjenje. Na koncu so bili kljub vsemu trudu razočarani na svojimi izdelki. Ti niso bili tako kvalitetni kot so oddaje, ki jih poznajo sami. Večinoma zaradi slabo prebranih besedil in tehničnih težavah z montažo. Klub vsemu je bil cilj dosežen. Učenci so pridobili nove kompetence, pri tem pa so se podrobno spoznali z vsebino predmeta, ki je določena v učnem načrtu.

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COBISS+ v šolski knjižnici Osnovne šole Prule

COBISS+ at the school library of Primary school Prule

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POVZETEK

Prispevek predstavlja šolsko knjižnico osnovne šole ter pomen urejenega knjižničnega kataloga COBISS+, njegove prednosti in iskalne možnosti. Podrobneje je predstavljena in opisana ura pouka s petošolci, kako se naučijo iskanja gradiva po spletnem katalogu s pomočjo kviza v spletni učilnici.

Ključne besede

Šolska knjižnica, knjižnični katalog, COBISS+, učenje

ABSTRACT

This paper presents the definition of a school library at a primary school and the well-organised library catalogue COBISS+, its advantages and search possibilities. The author describes library lesson with online quiz catalogue searching for the fifth grade pupils in a e-classroom.

Keywords

School library, library catalogue, COBISS+, learning

1. UVOD

Šolska knjižnica je sestavni del osnovne šole in s svojimi storitvami, ki jih nudi, dopolnjuje in bogati cilje vzgojno-izobraževalnih procesov, ki potekajo skladno s predpisi. »Tradicionalno pojmovanje šolske knjižnice se je spremenilo: knjižnica ni skladišče knjig, ampak središče, kjer se znanje, zapisano na različnih nosilcih, razpršuje, knjižnica je torej bolj križišče poti, po katerih se pretaka znanje« [3]. Obstoj in delovanje šolske knjižnice je zakonodajno urejeno (upoštevajoč zakonodajo s področja vzgoje in izobraževanje ter knjižničarstva). Zelo pomembna prelomnica za šolske knjižnice je bil sprejem novega Zakona o knjižničarstvu leta 2015, ki je v 39. č členu predpisal vključitev šolskih knjižnic v nacionalni bibliografski sistem, kar je pomenilo, da so se morale šolske knjižnice, za namene obdelave in izposoje knjižničnega gradiva, vključiti v nacionalni bibliografski sistem COBISS. Za našo šolo to ni predstavljalo nič novega, saj smo se za vključitev v nacionalni sistem, po navodilu ravnatelja, samoiniciativno odločili že leta 2008. Vsa leta smo učencem predstavljali sistem COBISS in vse novosti ter posodobitve tako v okviru pouka knjižnično-informacijskega znanja (dalje KIZ), kot med referenčnim pogovorom ali ob kakšnih drugih priložnostih (interesne dejavnosti, dnevi dejavnosti, dan odprtih vrat ipd.). V nadaljevanju bo predstavljen knjižnični katalog, COBISS+ in potek pouka.

2. KAJ JE KNJIŽNIČNI KATALOG

Knjižnični katalogi oziroma različne oblike popisov gradiva so obstajale že skozi zgodovino in so predstavljale neke vrste urejeno bibliografijo naroda oziroma posamezne države (v primeru katalogov nacionalnih knjižnic). Od začetka so bili katalogi v fizični obliki (v knjižni obliki, omari, predalniku, kasneje na posebnih lističih). Sodobni razvoj in IKT sta prinesla spremembe v knjižničarstvu, tako da se je fizična oblika kataloga, s pomočjo računalnikov in svetovnega spleta, postopoma preselila v virtualno okolje. Knjižničarska terminologija opredeljuje knjižnični katalog kot »po abecedi ali po kakem drugem sistemu urejen popis knjižničnega gradiva, npr. abecedni imenski katalog« [1]. Bistveno je, da katalog omogoča iskanje informacij o gradivu (bibliografski podatki) in ali je gradivo na voljo, kje v knjižnici se nahaja, ali je prosto za izposojo ali gre le za čitalniški izvod in tako dalje. Da pa učenci znajo izkoristiti možnosti, ki jih katalog ponuja in najti gradivo, jih mora knjižničar znati usposobiti ter podučiti. V nadaljevanju bo podrobneje predstavljen sistem COBISS+ in napotki, ki so na voljo uporabnikom šolske knjižnice OŠ Prule.

COBISS+ je namenjen vsem uporabnikom, ki iščejo določene informacije ali gradivo. Vsem vključenim knjižnicam in njenim uporabnikom omogoča spletni dostop do baz podatkov. Največja baza, tako imenovana COBIB baza, je vzajemna bibliografsko-katoložna baza podatkov (to je skupni katalog vseh slovenskih knjižnic, ki delujejo v nacionalnem sistemu). Nato je možno iskati po posameznih lokalnih bazah (med njimi je tudi šolska knjižnica OŠ Prule, z akronimom OSPRU) ter druge specializirane baze podatkov in informacijski viri, ki delujejo oziroma se povezujejo s sistemom COBISS. Iskanje po katalogu COBISS+ je omogočeno preko javno dostopne spletne strani, ki jo vzdržuje Institut informacijskih znanosti v Mariboru (IZUM). Do lokalnega kataloga šolske knjižnice OŠ Prule in iskanja je možno dostopati na več načinov (del navodil za učence prikazuje slika 1). Razlago in navodila dobijo individualno v knjižnici (v IKT kotičku), pri skupinskem delu (pouk), datoteke pa so objavljene tudi v spletni učilnici šolske knjižnice.

Slika 1: Eno izmed slikovnih napotil za iskanje po katalogu.

Skozi šolanje učencem omogočamo učenje iskanja gradiva od kataloga do police in tudi obratno. Spoznavajo se s postavitvijo knjižničnega gradiva, ki je prilagojeno stopnji naše šole. Spoznajo pojem signature, ki je »številska, črkovna ali kombinirana oznaka mesta, na katerem je shranjen kos knjižničnega gradiva v knjižnici« [1]. Zbirka v knjižnici je ločena na leposlovje in poučno gradivo. Leposlovno gradivo je urejeno po starostnih stopnjah, poučno po mednarodnem UDK klasifikacijskem sistemu (številčne oznake, npr. 59 - živalstvo, 796 - šport). »Z organizacijo knjižnične zbirke torej dosežemo, da ta deluje kot smiselna celota, ki se zlije s knjižnično dejavnostjo določene knjižnice, in omogoča svojim uporabnikom iskanje informacij in poizvedovanje ter uporabo gradiv« [2]. V nadaljevanju bom podrobneje opisal učenje uporabe COBISS+ v sklopu pouka v knjižnici.

3. POUK V ŠOLSKI KNJIŽNICI

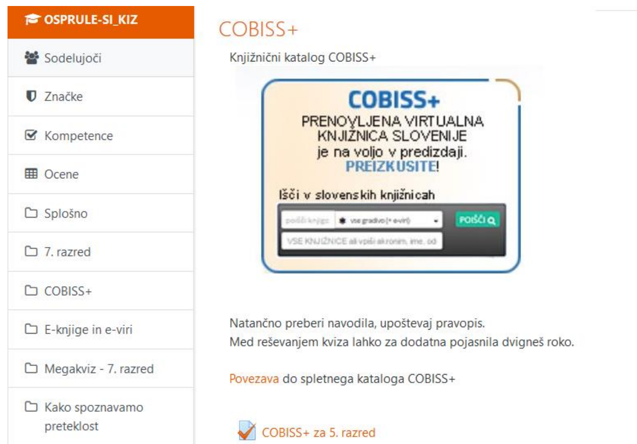
Osnovnošolska knjižnica, skladno s svojim poslanstvom in letnim delovnim načrtom, učencem v okviru pouka KIZ, omogoča doseganje določenih ciljev. »Knjižnična informacijska znanja zajemajo vse prvine informacijske pismenosti s poudarkom na uporabi knjižnice in z njeno pomočjo dosegljivih informacij. Informacijska pismenost je sposobnost pridobiti, vrednotiti in uporabiti informacije iz različnih virov. Je razširjen koncept tradicionalne pismenosti, ker se veže na uporabo kateregakoli sistema znakov in vključuje razumevanje in ustvarjalno rabo informacij, posredovanih tudi s sodobno tehnologijo, sodobnimi računalniškimi in komunikacijskimi viri« [4]. Knjižničar, v sodelovanju z učitelji posameznih predmetov (po razredih), za vsako šolsko leto načrtuje ure KIZ-a (opora za načrtovanje je program Knjižničnega informacijskega znanja, ki ga je izdalo pristojno ministrstvo za šolstvo in kjer so zapisani cilji ter vsebine). Ker se mi zdi zelo pomembno, da učenci postanejo samozavestni in samostojni uporabniki knjižnice, jim predstavim COBISS+ in jih naučim iskanja knjižničnega gradiva po spletnem katalogu knjižnice in na policah v knjižnici.

Učenci pri pouku določenih predmetov pripravljajo govorne nastope že v nižjih razredih (opis živali, predmeta, osebe), zato se mi je zdelo smiselno, da jih naučim iskanja vsaj knjižnih virov, prilagojeno njihovi starostni stopnji (najprej knjižnih, kasneje tudi neknjižnih in spletnih virov). Učenci v prvem in drugem vzgojno-izobraževalnem obdobju spoznajo katalog šolske knjižnice kot vir informacij, seznanijo se s COBISS+, spoznajo osnovne elemente bibliografskega zapisa s poudarkom na avtorju, naslovu in letnici ter znajo iskati gradivo v katalogu.

Uvodoma jim pojasnim, da imamo vse knjige naše knjižnice urejene v knjižničnem katalogu. Ob tem jim razložim primerjavo na urejenost priimkov v redovalnici (ob tem ponovimo abecedo in tako dobijo še boljšo predstavo), zatem naredimo vajo s priimki avtorjev v knjižnici. Avtorske knjige so razvrščene po prvi črki priimka (npr. MUCK, Desa ali MAKAROVIČ, Svetlana). Nato se obrnemo k polici z ljudskimi pravljicami (avtor ni znan – ponovimo značilnosti ljudskih pravljic), kjer razložim urejenost (knjige so urejeno po prvi črki prve besede v naslovu, npr. HVALEŽNI medved). Pridobljeno znanje gradimo in utrjujemo tudi v drugem triletju. Od šolskega leta in predznanja učencev je pomembno ali gredo prvič organizirano na pouk v računalniško učilnico kot četrtošolci ali petošolci. Izvedemo učno uro KIZ z naslovom Knjižnični katalog COBISS+. Več v nadaljevanju.

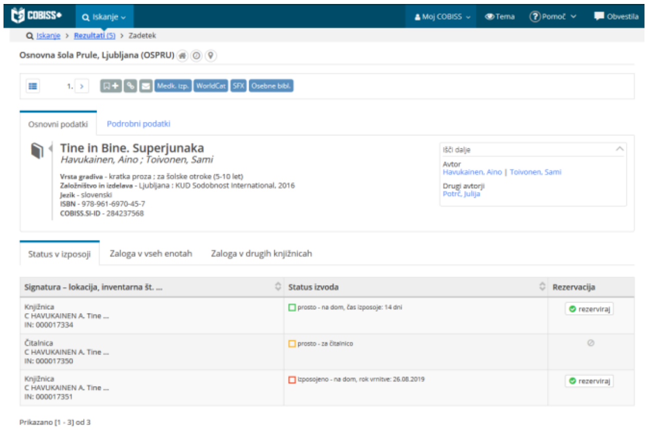
3.1 Pouk v računalniški učilnici

Kljub temu, da bi bilo pouk dobro izvajati v knjižnici (zaradi učnega okolja in dostopnosti do knjižnih polic) to na naši šoli ni možno, saj je računalniška učilnica na čisto drugem delu šole in je ločena od knjižnice. Prostor knjižnice pa ne omogoča, da bi imeli vsi učenci hkrati na voljo svoj računalnik (pomembno je, da se učijo najprej iskanja s pomočjo računalnika in COBISS+, saj je oblika kataloga na tablicah ali telefonih popolnoma drugačna). Ura pouka KIZ se vsako šolsko leto medpredmetno poveže z drugim predmetom (slovenščina, družba, angleščina, matematika), saj je od načrtovanja in predmeta odvisna vsebina in gradivo, ki ga bodo učenci iskali v COBISS+. Za pouk o iskanju gradiva po katalogu COBISS+ uporabljam namensko spletno učilnico (slika 2), do katere učenci dostopajo s svojim AAI računom. Vse potrebno za uspešno izvedbo ure vnaprej pripravim v namenski spletni. Poleg pisnih sem pripravil tudi prilagojena video navodila, ki so v pomoč tistim učencem, ki so bolj vizualni.



Slika 2: Pripravljeno poglavje v spletni učilnici, za izvedbo pouka s 5. razredom.

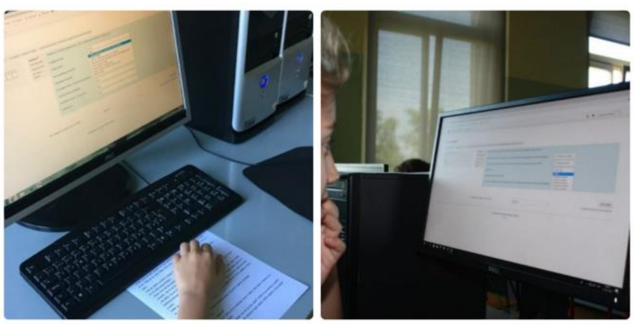
Uvodoma na projekciji prikažem spletno učilnico ter osvežim način vpisa (učenci morajo poznati podatke svojega AAI računa), nato predstavim poglavje za delo ter povezave. V spletni učilnici za vsak razred pripravim interaktivni kviz (izdelavo omogoča sama spletna učilnica), v katerega vključim različne tipe vprašanj (vprašanja, ki vključujejo več možnih odgovorov; vprašanja zaprtega tipa z v naprej določenimi odgovori itd.) v povezavi z vsebinami in predmetom. Do rešitev izhodiščnih nalog v kvizu pridejo učenci z enostavnim iskanjem po COBISS+ in ugotovijo ali je v knjižnici dostopno gradivo določenega avtorja (npr. David Walliams), z določenim naslovom (npr. Babica barabica) ali kdo je ilustrator določene knjige (npr. Tony Ross), katere izdaje tega dela so v knjižnici (npr. 3. ponatis) in ali ima knjižnica knjige o iskani temi (npr. knjige o konjih). Za rešitve temeljnih nalog pa je potrebno malo bolj podrobno iskanje s pomočjo izbirnega iskanja, kjer lahko učenci iščejo s pomočjo ključnih besed ali po avtorju, naslovu, letnicah idr. Učenci izvedejo iskalno zahtevo in na zaslonu dobijo rezultate iskanja. Naslednja slika prikazuje izbrani bibliografski zapis iskanega gradiva z vsemi elementi. Našli so tri izvode knjige z naslovom Tine in Bine, s podnaslovom Superjunaka. Na podlagi tega zapisa učenci izvedo na kateri polici pri kateri črki se gradivo nahaja in ali je gradivo v danem trenutku prosto za izposojo (status izposoje) ali je namenjeno uporabi v čitalnici.



Slika 3: Prikazan je izbrani bibliografski zapis iskanega gradiva (podatki o knjigi ter lokalni signaturni podatki - status izposoje).

Primer bibliografskega zapisa prikazuje slika 3, kjer vidimo, da je en izvod na polici v knjižnici, med leposlovnimi knjigami za 1. triletje (C), pri črki H (HAVUKAINEN), drug izvod je na voljo za čitalniško uporabo, tretji izvod pa je izposojen. Hkrati pa se na tej stopnji lahko preveri stanje zaloge v drugih knjižnicah).

Učenci s pomočjo iskanja rešitev po COBISS+ dobijo odgovore na zastavljena vprašanja. Če pa so njihovi odgovori pravilni, preverijo po zaključenem in oddanem kvizu (rešitve so vpisane, tako da vsak dobi povratno informacijo od pregledu svojega oddanega kviza). Fotografiji sta prikazani na sliki 4.



Slika 4: Prikaz dveh učencev med samostojnim reševanjem kviza v spletni učilnici.

4. ZAKLJUČEK

V prispevku sem želel osvetlili pomen šolske knjižnice, ki podpira cilje svoje šole z urejeno in organizirano zbirko knjižničnega gradiva, ki ga skrbno vodi s pomočjo kataloga. Da pa tak katalog služi namenu, je potrebno uporabnike izobraziti za uporabo iskalnih zahtev.

Skozi vsa leta se je spletni katalog, ki ga trenutno poznamo kot COBISS+, spreminjal. Pred leti sem učence začel seznanjati s katalogom COBISS2, ki je preko spleta omogočal iskanje preko COBISS/OPAC-a. Z napredkom se je tudi katalog posodobil in dobil obliko nove generacije, sedaj poznan kot COBISS+, ki hkrati deluje tudi na mobilnih napravah kot mCOBISS. Med bistvenimi cilji KIZ-a je zapisano, da učenci samostojno poiščejo gradivo v katalogu COBISS+, da znajo razbrati signaturo in dostopnost gradiva in da znajo s pomočjo elementov locirati knjižnično gradivo ter h gradivu prosto pristopijo. Zelo pomembno je, da učenci znajo uporabiti orodje (katalog) za doseganje svojih iskalnih zahtev (poiskati ali knjižnica ima določeno knjigo in kje se ta knjiga nahaja ter ali je prosta za izposojo). Zato poučevanje iskanja gradiva po katalogu in med knjižnimi policami poteka skozi posameznikovo celotno šolanje, kot tudi spoznavanje in uporaba informacijske tehnologije, ki krepi ter razvija posameznikovo digitalno pismenost.

5. LITERATURA

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Challenges in listening: Do we have two mouths and one ear?

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ABSTRACT
Listening is a primary human activity and effective listening skills, if developed properly, are the foundation for the development of other language skills. The definition of listening and the practice of listening comprehension have seen numerous changes and modifications in foreign language education. With the use of modern technology, listening is reinforced with various visual inputs that, depending on the students' language proficiency, can have a positive impact on the learning outcome. However, there is an abundance of physical and people-related barriers impeding the listening process. Nevertheless, developing effective listening skills should be paramount not only in language teaching but also for the benefit of better communication. Although modern technologies can be applied in developing better listening skills, they include a great many pitfalls, which can be overcome if those involved in the listening process are aware of them and develop strategies to eliminate them.

Keywords
Effective listening, skills, modern technologies, barriers

1. DEFINING LISTENING
Listening is the first and most important language skill, and the foundation for developing other skills. Its significance is frequently neglected, as listening itself is occasionally mistaken for simply hearing things, although listening involves much more than a mere perception or reception of sounds and noises.

There are many misconceptions about listening. One of such misconceptions is that it is a rather passive activity, which is obviously far from being true. Listening is frequently mistaken for hearing. Whereas hearing is a physiological process, listening is a psychological activity. Both are interconnected, yet one does not have to be most sharp-eared to be a competent listener.

Even before birth, human beings are able to hear sounds and react to what they hear even while still in their mothers' womb. We are constantly exposed to all kinds of sounds whether we are aware of them or not. Naturally, we can tune-out the noise we believe to be irrelevant, boring or causing discomfort. Instead, we direct our attention to those sounds and noises we want to hear. In simple terms, hearing is the reception and perception of sounds, which the brain associates with known concepts.

Listening is the ability to recognise and understand the spoken language. It is a complex process during which the listeners interpret what they hear using their prior knowledge. Numerous linguists attempted to develop comprehensive definitions of listening, all of which include the following four elements: reception, construction of meaning, interpretation and response.

According to Rost (2009), listening is an active and important mental ability. It aids us to understand the world around us and is one of the necessary elements in creating successful communication.

Purdy (1997) defines listening as the process of receiving, making meaning of and answering to spoken and/or nonverbal messages.

During the listening process, meaning is constructed via communicative exchanges between the speaker and the listener. These exchanges include linguistic, paralinguistic and nonverbal means. Listening proceeds through four interconnected activities (sensing, interpreting, evaluating and responding), three of which occur in the listener's mind and, therefore, cannot be determined or measured to what extent they are "achieved". It is only the last activity which proves and ensures that the speaker's goal has been achieved.

Rost (2002) Hamouda (2013) define listening as an interactive process involving listeners in the construction of meaning. Sound discrimination, previous knowledge, grammatical structures, stress, intonation and other linguistic and non-linguistic clues assist the listener in making sense of what they heard.

Listening strategies have been defined by Vandergrift (1999) and Ak (2012) as metacognitive, cognitive and socio-affective strategies. Metacognitive and cognitive strategies are both mental activities with a single difference; metacognitive strategies involve managing language learning, whereas cognitive strategies are aimed at using the language. Socio-affective strategies are based on cooperation with other learners or teachers using different techniques. Naturally, more proficient and skilful listeners are able to simultaneously use many strategies and their existing linguistic knowledge, which enables them to understand better and thus makes them better listeners.

2. CHARACTERISTICS OF EFFECTIVE LISTENERS
Good listeners are crucial for the process of communication and play an equally important role as the speakers. There are a great many "requirements" they have to fulfil in order to be considered good listeners. Some characteristics can be acquired through practice and listeners can aim their efforts in the right direction, if they are aware of that.

Effective listening is an active, engaging and critical process. Without active listeners, speakers' activities become meaningless. Their words have to be paid attention to, understood and interpreted by the listener in order to convey a message.

Effective listening can be judged by the socially appropriate response of the listener. This can vary across individuals and cultures but can be learned, although the acquired response behaviour should be within the behavioural range comfortable for the listener (Mercadal-Sabbagh, Purdy).

Recent studies of the listening process have shown that effective listeners are by nature open-minded, like people and have a positive attitude. They are also interested in a variety of subjects. However, their most significant characteristic is their willingness to listen (Bromwell, 2006).

Other essential components that play a significant role in the effective listening process include attention, mindfulness and a sincere interest in what is being said. Attention is a conscious, voluntary direction to and concentration on the process of listening. It requires a great deal of effort and focus. Mindfulness, a state of being wholly present in the moment, is not just an important strategy, which enhances attention and listening skills, but also helps individuals to stay open-minded, listen for ideas and distinguish facts from opinions.

3. REASONS FOR LISTENING

Listening is the most widely used language skill in everyday life. Apart from having a positive influence on learning a foreign language, listening represents forty-five per cent of our everyday communication. Thirty per cent is spent speaking, 16 reading and only 9 writing (Hedge, 2000). Therefore, learning to listen effectively is vital for one's communication and the learning process.

One of the best reasons for listening has been formulated by the Dalai Lama: "When you talk, you are only repeating what you already know. But if you listen, you may learn something new."

Therefore, the ability to use listening as an instrument of learning makes a difference between more and less successful learners. Listening is the means of learning, as it is the tool of language input without which the learning does not take place. However, there has to be a sufficient amount of it. Furthermore, listening comprehension paves the way for the acquisition and expansion of other language skills. It has a particularly significant impact on developing speaking.

Wilson (2008) claims that when learning English as a foreign language, listening not only helps students to get to know the pitch of English, its intonation, stress, redundancy and vocabulary clusters, but also shows them how to gather information, enjoy, accept and agree, evaluate and criticise. Moreover, frequent active listening improves students' pronunciation.

Needless to say, listening is an activity that should be developed consciously not only in the mother tongue but also in the foreign language. Through diligent practice, learners can become better listeners and consequently better learners.

4. BARRIERS TO EFFECTIVE LISTENING

Generally, the barriers or impediments to effective listening can be divided into two major categories: physical barriers, and people-related barriers. The latter are further divided into physiological and psychological barriers. Those involved in the communication process should be able to recognise them and strive to eliminate the barriers they have the power to influence.

All extraneous noise that hinders the hearing process falls into the category of physical barriers. All background noise, frequent interruptions (by other people or telephone), poor acoustics, message overload, speed of speech and any kind of discomfort or the malfunctioning of the devices used to amplify speech, such as microphones or loudspeakers, etc., belong in the same group (Kukreja, 2013).

At first, noise or, to be more exact, the situational noise from the background and our environment, needs to be considered since, as studies show, information overload or excessive sensory input works against effective listening. Being constantly exposed to all kinds of audio signals, it is vital for our brain to be able to filter those that are important from those that are not. Selective attention is developed due to the overload of sensory information. In other words, we choose what we want to hear. This in itself would not be worrying were it not for the fact that in our desire to deal with many things at the same time we fail to process the messages fully and accurately and thus do not hear the really important messages. This can lead to serious misunderstandings (Mercadal-Sabbagh, Purdy).

People-related barriers involve physiological and psychological barriers of both parties involved in the communication process, i.e. the speaker and the listener. Physiological barriers include the individual's state of health, which can affect the listener's attention span, or the speaker's ability to clearly convey their message. The second physiological barrier involves various disabilities, such as hearing deficiency and speech disorders. The third and extremely important physiological barrier is the wandering attention, which is often the result of the difference between the speech rate and the rate with which the human mind processes words. The brain can process 500 words a minute, whereas a speaker can utter only about 150 words in a minute. The difference of 350 words per minute allows the listener sufficient time for letting the mind wander. Hence, the concentration on the message and its analysis is the key to a more successful communication (Kukreja, 2013, Fox).

Psychological barriers refer to processes that occur within a person and include a host of attitudes and behaviours. Among these, the most important ones involve being unsure of the speaker's ability, personal anxiety, personal attitudes and impatience. If the listener is highly egocentric, has a "know-it-all attitude" or a too casual attitude, the listening process will be heavily impeded. Impatience combined with intolerance and the over eagerness to share their own ideas and opinions can also result in the breaking down of the listening process (Kukreja, 2013, Fox).

Some behaviours and attitudes, which are learned from social or cultural associations and influences include reactions to stereotypical labels, ethnocentric rituals and mindlessness, which is defined as a state of relying heavily on preconceived notions, can seriously interfere with the listening process.

Two types of noise, the semantic and intrapersonal noise, are particularly noteworthy in the framework of psychological barriers to effective listening. The term semantic noise refers to the state of mind caused by trigger words or emotionally loaded words that provoke an emotional response, thus making the listener "drop their guard" or stop paying attention. Semantic noise is defined as anything that impairs our attention to the listening content, such as daydreaming or letting your mind wonder (Mercadal-Sabbagh, Purdy).

Self-perceptions and personal bias can also impede the listening process and consist of anything that functions as a barrier or gets in the way of understanding the speaker's message. Some typical examples include egocentrism, personal interests, biases or dogmatism, defensiveness and apprehension, and a know-it-all attitude (Mercadal-Sabbagh, Purdy).

Egocentrism, as can be inferred from the name, stands for self-centeredness, an interest in only what is relevant to and concerns oneself. It was already suggested as a barrier to comprehension by Carl Rogers in 1962. Carolyn Gwynn Coakley coined the term negative listening as a form of listening egocentrically or from a self-centred perspective.

To a certain extent, egocentrism is necessary for and is an essential part of a healthy personality. Nevertheless, egocentrism is limiting if developed to an excessive degree. By being limited to merely personal likes and preferences, egocentrics are deprived of learning to appreciate new experiences, will also not do well in college, nor will they be good citizens. Doing well in college requires students to listen beyond their interests driven by the desire to learn. For any kind of learning, advancement or expansion of tastes in topics, speakers and preferences, it is necessary to keep an open mind and really listen (Mercadal-Sabbagh, Purdy).

The listening process is also limited and impeded by ethnocentrism, which is similar to egocentrism, however, ethnocentric individuals limit themselves to the interests of their ethnic or cultural group. Rejecting someone's views and ideas on the basis of prejudice robs the individual of appreciating someone or something new, of learning something new and of getting to know someone new. To avoid that from happening, they need to listen long enough to reach the state when they can form an opinion (Mercadal-Sabbagh, Purdy).

Another problematic personal bias is dogmatism, which is a set of opinions an individual holds without questioning. Not knowing one's own position or not being aware of one's own dogmatic opinions makes it difficult to understand and compare own ideas to other speakers' opinions. This leads to defensiveness, which is a negative reaction to another speaker's ideas. As a result, this can cause listening apprehension – a fear or concern about receiving the speaker's message. This heavily impairs the willingness to listen or to use effective listening skills. The research presented by Roberts & Vinson (1998) in the International Journal of Listening indicates that worrying about accurately understanding the points of a lecture because we know we will be tested on the information or being concerned about a job interview have a negative impact on the listening outcome.

Most people have formed different types of bias and prejudice based on their life experiences – what they have lived, learned and listened to. All personal biases are egocentric, yet they are not problematic unless they prevent or impede the ability to listen, to learn or to accept something new. The situation becomes even more complex when personal biases are mixed with stereotypical perceptions of speakers and their topics.

In addition, the lack of knowledge of the subject matter and a know-it-all attitude are not conducive to being an open, aware and effective listener. Therefore, for the listening and learning process to be effective, it is necessary that people are aware of their personal biases and prejudices, so that they can compensate or even overcompensate when forming their opinions and beliefs.

5. IMPACT OF TECHNOLOGY

Even though the unavoidable use of electronic devices in the classroom can enhance the learning process in numerous ways, it can become problematic, particularly when practicing active and effective listening skills. These are important for all those whose goal is to communicate in whatever way work with people. They will need effective listening skills if they want to become good professionals. The excuse that one is able to listen while looking at something on a mobile device will be completely inappropriate. Looking at one's phone will not create the impression that one is paying attention. Thus, paying attention to the speaker, to their body language, intensity and intonation will be extremely important for successful communication (Ericksen, Beathea, 2019).

Although many studies show the benefits of introducing electronic devices in classrooms, there are some concerns. Firstly, students feel discomfort if they cannot check their phone for some time, which sometimes borders on the compulsive use of the mobile phone. Secondly, studies show that the use of electronic devices in the classroom increases students' intrusive thoughts, has negative effects on learning and may lead to distraction. They may hear the presenter or speaker, however, they do not really listen (Ericksen, Beathea, 2019).

According to a research study conducted by Goh (2012), the occurrence of "mind-wandering", "multitasking" and "thinking ahead" were the result of the use of electronic devices in the classroom. This also raises the question of how much human sensitivity has been lost as a result of merely hearing things and not properly listening to them. Devices can neither replace the individual's intuition, good judgement or problem-solving abilities nor substitute uniquely human characteristics, such as empathy, creativity and critical thinking. Half of the problem is solved if students learn to be aware of their shifting thoughts and are able to prevent them.

Another point in favour of omitting the use of mobile devices in classrooms stems from the fact that non-texting students score significantly higher on quizzes.

Therefore, clear guidelines regarding the use of electronic devices in the classroom should be set for the sake of both parties – the students and educators. They should all get familiar with the applications that are acceptable and may be used for educational purposes. Clear instructions for the use of such devices when performing the set tasks should also be agreed upon.

CALL (Computer-Aided Language Learning) has inevitably had a significant influence on practicing listening skills. As one of the crucial language skills, it is interwoven with other language skills, which means that without listening skills, the development of other language skills is impaired. Listening is the foundation for all language acquisition and learning, as well as an essential factor in the communication process (Sejdiu, 2013).

There is some controversy among researchers whether listening materials should be supported by visual input, arguing that the video input may distract the listener's attention. Nevertheles, it is clear that technology-based materials are not effective per se, but have to be adapted or modified using appropriate pedagogical strategies.

When a listening comprehension text is accompanied by transcript or subtitles, the latter prove to be more effective.

Studies conducted in European contexts have shown that digital stories tend to be stimulating, effective in language acquisition and help students achieve higher scores. They are the most effective in groups of small children, because they are not only visually supported but also interactive, which ensures the children's active involvement in decoding and understanding them (Sejdiu, 2013).

A study carried out in Turkey proved that computer-assisted listening instruction to a listening comprehension test had a significant impact on the students' scores.

Multimedia-based listening comprehension tools alone do not guarantee the best learning and testing results. Studies show that different types of media should be incorporated in the process of acquiring language and developing listening skills. They should also be combined with face-to-face teaching, in order to ensure the best results (Sejdiu, 2013).

Interactivity, authenticity and the integration of text, sound and visual input are the most significant advantages arising from the integration of technology in language instruction.

Nevertheless, some barriers, such as the lack of adequate skills on the educators' part, cultural resistance, inflexible teaching styles or even structural barriers, still exist. However, they can be overcome by determination, constant training and persistence.

Educators have to be careful of how they use technology, as there is a danger that students will become passive and inactive lest the teacher provides them with detailed instructions and tasks that have to be done while using such technology.

In most listening situations, the listener is able to see the speaker, which means that there is a risk that situations, in which the speaker is obstructed from the student's view, will be neglected. This is why situations, such as talking on the phone, listening to the radio and the like, should be incorporated when developing listening skills.

Today, educators are faced with the challenge of how to identify the appropriate accessible multimedia resources that can be incorporated in learning programmes.

Students demonstrating high listening skills in a foreign language have the ability of demonstrating proficiency in other language skills.

According to a study released by Microsoft, the omnipresent mobile phones have an enormous impact on the human attention span. From 2008 to 2013, the attention span has dropped from 12 to 8 seconds. Furthermore, mobile phones have an enormous impact on social interactions and the level of empathy (Hong, 2015).

Another study revealed that 62 per cent of students use their phone, tablet or computer while in the company of other students. This results in diminished listening skills, as well as lower ability to empathise and interact with others. Thus, the virtual world can lead to social isolation. Listening is by far the most affected by such phenomena. The little screen in our hand attracts all the attention and shuts out the world beyond it. Out of all of our senses, listening is essential for our survival, as it makes us react to the environment quicker than any other sense. In New York, people are advised not to use headphones while walking around the city, as this reduces their ability to stay safe (Drago, 2015).

6. CONCLUSION

Effective listening is indisputably the key to successful communication. There is no doubt that modern technology can assist in developing successful and effective listening strategies. However, technology itself will have no impact, if it is not supported by the appropriate learning materials that are relevant to students' needs, their learning styles, language (English) proficiency and socio-cultural background. This is undoubtedly a complex and challenging task for the educators, particularly as there are a host of possible impediments involved when technology is used in classrooms. There is also some evidence indicating that modern technologies can affect the degree of egocentricity in young and teenage learners, which can produce devastating consequences for the learning process. These most likely include the lack of students' motivation, short attention span and intrusive thoughts, particularly when combined with the teachers' inability to monitor the activities and processes the students' minds. Therefore, it is vital that all involved in the educational process are aware of the dangers and able to counter act.

A certain degree of listening practice without any visual stimulants should be "reintroduced" not only because it is the underlying activity for reading and, consequently, writing, but also to sensitise the students to the speakers' mood by hearing the stress and intonation of their speech.

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IKT opismenjevanje pri pouku angleščine

ICT literacy in English classes

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POVZETEK

Otroci zlahka sledijo hitremu razvoju informacijske tehnologije, vendar so dobri na tistem področju, ki je njim zanimivo (socialna omrežja, igrice ipd.). Povsem enostavne zadeve kot npr. vpis v elektronsko pošto, kakšno mora biti geslo ipd. pa jim predstavlja težavo.

Nameni razvoja digitalnega opismenjevanja pri mojih urah angleščine so: nadgrajevanje znanja s področja IKT, pomoč pri učenju, učenje varne uporabe spleta, spodbujanje k uporabi angleščine kot najbolj pogostega jezika na spletu ter iskanje močnih področij posameznika. Z aplikacijami in pripomočki, opisanimi v tem članku, želim doseči vse zgoraj navedeno.

Izkazalo se je, da pazljivo izbrana, osmišljena aplikacija ali pripomoček ne le nadgradi otrokovo znanje na področju digitalne pismenosti, v otroku vzbudi tudi zavedanje, da mu koristi, pripomore k boljšemu uspehu. Tako jo otrok uporablja tudi doma, daljše časovno obdobje.

Ključne besede

IKT opismenjevanje, elektronska sporočila, funkcija preverjanja črkovanja, grafikoni, program Microsoft Excel, varnost na internetu

ABSTRACT

Children easily keep up with the rapid evolution of information technology. However, they are good in the area of interest to them (social networks, games, etc.). Quite simple matters, such as email signup, what the password should be etc., is a problem for them.

The purposes of developing digital literacy in my English classes are: to upgrade ICT skills, to get help with learning, to learn how to use the web safely, to encourage the usage of English as the most common language on the web, and to find individual's strong areas of knowledge. With the applications and other computer programs described in this article, I want to achieve all of the above.

It turned out that a carefully selected application or computer program not only enhances the child's digital literacy skills, it also raises awareness in the child that it benefits him, contributes to better success. Therefore, children use it at home for a longer period of time.

Keywords

ICT literacy, emails, spell checker, graph, Microsoft Excell programme, internet security

1. UVOD

Trditev, da so današnji otroci veliko boljši v uporabi informacijske tehnologije od odraslih le delno drži. Dobri so na tistem področju, ki je njim zanimivo, kot so socialna omrežja, igrice ipd. Z vsako novo generacijo, ki jo sprejmem v 6. razredu, vedno znova ugotavljam, da učencem predstavljajo težavo povsem enostavne zadeve, npr.: vpis v elektronsko pošto, kakšno mora biti geslo, kako si ga zapomniti, s kom ga lahko delijo ipd., kako sestaviti vljudno elektronsko sporočilo s priponko. Ne vejo, da obstaja t. i. »preverjanje črkovanja« v programu Microsoft Word ali čarovnik za izdelavo grafikona ipd.

Na podlagi zgoraj navedenih ugotovitev v pouk prvega tujega jezika redno vključujem eno izmed ključnih zmožnosti za vseživljenjsko učenje – digitalno pismenost([1]). V namen razvoja IKT izberem tiste dejavnosti, ki se navezujejo na trenutno učno snov, prav tako zberem povratne informacije otrok, tako ugotovim potrebe (in/ali želje) in tej podlagi načrtujem pouk([2]).

2. OSNOVE UPORABE ELEKTRONSKE POŠTE IN UPORABA FUNKCIJE PREVERJANJA ČRKOVANJA

Šestošolce pri pouku angleščine najprej naučim osnove uporabe elektronske pošte.

Delo poteka po naslednjih korakih:
Ponovimo razliko formalnega in neformalnega sporočanja.
Pokažem nekaj primerov dobro in slabo napisanih elektronskih sporočil.

Naloga učencev je, da pojasnijo, zakaj je sporočilo dobro oziroma slabo napisano.

Za domačo nalogo napišejo krajše besedilo v angleščini na dano temo. Temo shranijo v programu za pisanje besedil, Word, Beležnica ali podobno. Besedilo mi pošljejo kot priponko, dodati pa morajo še sporočilo, ki mora vsebovati vljudno ogovorno vrstico, jedro sporočila in zaključno vrstico. Iz besedila mora biti razvidno kdo pošilja in kaj pošilja. Ta zapis je lahko v angleščini ali slovenščini (Slika 1).

Ko prejmem vse domače naloge, gremo z učenci v računalniško učilnico. Vsak učenec se prijavi v svojo elektronsko pošto in odpre priponko svoje domače naloge. Učencem razložim in prikažem uporabo preverjanja črkovanja. Vsak učenec s pomočjo te funkcije preveri svoj zapis. Popravljeno domačo nalogo mi ponovno pošljejo. Vsakemu učencu posredujem povratno informacijo o domači nalogi v elektronski obliki, bodisi kot opombe v samem dokumentu ali kot odgovor na njegovo sporočilo (Slika 2). Vsem učencem seveda ne pošljem enake povratne informacije, nekaterim je dovolj le namig, druge bolj natančno usmerim. Nekateri pa seveda potrebujejo natančno vodenje s konkretno prikazanimi primeri([2]).

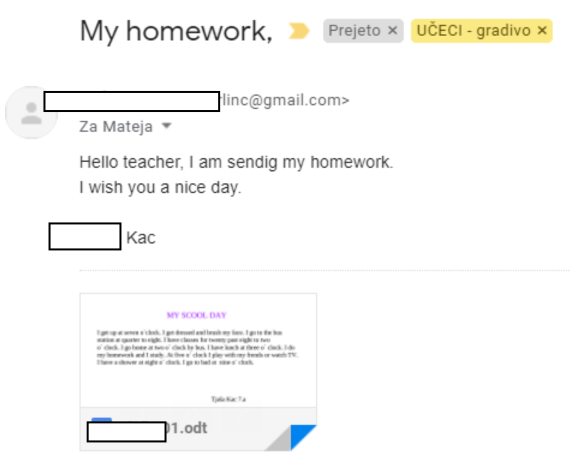
2.1 Namen te vaje

Zaradi interneta učenci seveda zelo hitro obvladajo tuj jezik, ker jim je v interesu raziskovati igrice ali določene aplikacije. Njihov primarni cilj je govoriti ali peti v tujem jeziku, zapis besed pa jim predstavlja težavo. Zato jih naučim uporabiti funkcijo preverjanja črkovanja. Namen te funkcije ni podpirati neznanje, ampak navajanje na samostojno delo, saj najprej besedilo napišejo po svojih najboljših močeh, preverijo s pomočjo katerekoli oblike slovarja, nato uporabijo možnost preverjanja črkovanja, šele v zadnji fazi pridem na vrsto jaz, učiteljica.

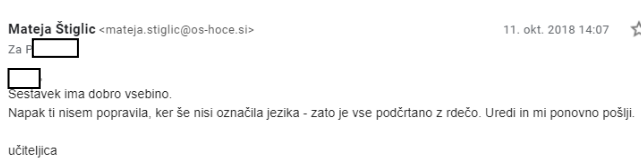
Naučijo se oblike uradnega sporočanja. Tako se kasneje, v višjem razredu, zelo redko zgodi, da mi kdo pošlje elektronsko sporočilo brez vsebine (le priponko) ali da se na koncu sporočila ne podpiše ipd.

Otroke prav tako opozorim na pasti interneta. Prepogosto se zgodi, da se v računalniški učilnici učenci ne odjavijo iz svoje elektronske pošte. Opozorim jih, da morajo biti zelo pazljivi, s kom delijo svoje osebne podatke, pa naj si bodo to slike, geslo itn..

Učencem je všeč, da mi lahko pošljejo zahtevano domačo nalogo kot elektronsko sporočilo.



Slika 1: Primer elektronskega sporočila učenca



Slika 2: Primer mojega odgovora na poslano domačo nalogo

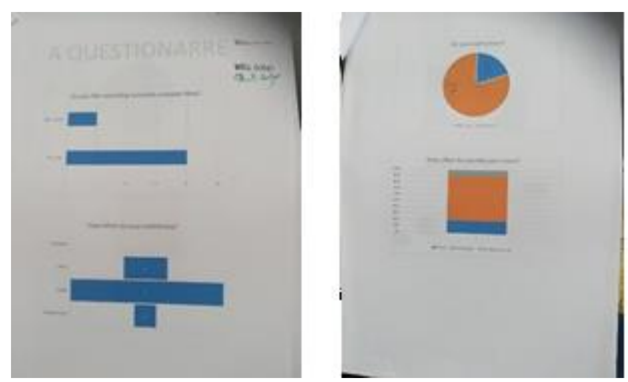
3. UPORABA FUNKCIJE ČAROVNIK ZA IZDELAVO GRAFIKONA

V 6. razredu učence prav tako učim uporabe čarovnika za izdelavo grafikonov/diagramov.

Potek dela:
Učenci so v prejšnji uri že spoznali glavne značilnosti vprašalnika s pomočjo predloge iz učbenika. Vprašalnik so tudi rešili. Samostojno zapišejo deset vprašanj, ki jih bodo zastavili sovrstnikom ali drugim učencem na šoli. Tema ankete je široka: dobre ali slabe navade, hrana, povprečni dan, kaj imaš rad in česa ne in podobno. Vsi preberejo vsa vprašanja. Presojajo o ustreznosti vprašanj, iščejo in popravljajo morebitne napake. Razmislijo o odgovorih, ki jih bodo v anketi ponudili (obkroževanje odgovorov, možnost dopolnjevanja…). Vsi učenci presojajo o ustreznosti odgovorov, iščejo in popravljajo morebitne napake. Vsak učenec izbere pet sošolk ali sošolcev in jih anketira. Zabeleži si odgovore. Preostalih pet oseb anketirajo do naslednje ure in si zabeležijo odgovore.

Pri uri nekateri učenci predstavijo ugotovitve: na primer: 3 učenci nikoli ne zajtrkujejo, 4 včasih, preostali pa vedno. Odziv učencev je lahko ali v slovenskem ali angleškem jeziku.

Pri matematiki so učenci že spoznali prikaz podatkov v obliki grafa. Naštejejo vrste diagramov: linijski diagram, stolpični diagram, tortni diagram, … Prikažem še način oblikovanja grafikonov in vnos podatkov v programu Microsoft Excel. V računalniški učilnici učenci poizkusijo narediti grafikon v poljubni obliki. Za ta del potrebujemo približno 30 minut. Učenci sami presojajo o najboljši obliki prikaza. Grafikon še ubesedijo. V pomoč jim je primer iz učbenika. Skupaj pregledamo končne izdelke (slika 3).



Slika 3: Primeri končnih izdelkov - grafikonov

3.1 Namen dejavnosti

Namen dejavnosti je, da :

- učenci spoznajo pojem anketa oziroma vprašalnik, raziskava (oblika neumetnostnega besedila),
- učenci znajo sestaviti krajšo anketo v tujem jeziku (s pomočjo primerov v učbeniku ali samostojno).
- si učenci medsebojno zastavljajo vprašanja v tujem jeziku in odgovarjajo nanje.
- učenci znajo anketo upovediti, pri tem uporabljajo čas present simple.
- se učenci učijo narediti grafikon v programu Microsoft Excel.

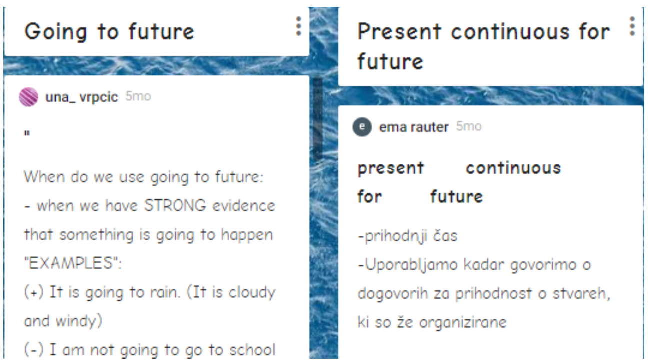
Kljub prvotni zadržanosti, je večina učencev naredila svoje grafikone v programu Microsoft Excel. Doma so z veseljem popravili napake in dopolnili pomanjkljivosti. Redki so ročno narisali svoj grafikon, kar pa nisem kaznovala ali grajala.

Vztrajala pa sem, da mora biti natančno narisan in pravilno označen. Vsem sem podala povratno informacijo končnega izdelka.

4. DRUGI NAČINI ZA RAZVIJANJE DIGITALNE PISMENOSTI

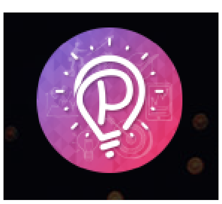
Pri pouku angleščine uporabljam še veliko drugih »pripomočkov«, na primer:

- Padlet
  - To aplikacijo sem uporabila v 8. razredu, v zahtevnejši skupini, kjer je delo potekalo v skupinah. Vsaka skupina je morala zapisati vse o zahtevanem času (sedanji, pretekli, prihodnji čas). Skupine so se morale medsebojno ovrednotiti, dodati pohvale ali spoštljivo izražene kritike([4]).



Slika 4: Primer dela v aplikaciji Padlet

- Personality test trait([5])
  - To aplikacijo sem uporabila v že zgoraj navedenem razredu. Učencem sem ponudila nekaj tem. Ena izmed skupin si je izbrala temo *Osebnostni tipi* in jo raziskovala. Skupina je uporabila navedeno aplikacijo, si jo naložila na telefon in jo pri pouku tudi uporabila – tako pri raziskovanju kot tudi pri kasnejši predstavitvi ostalim učencem oziroma skupinam.



Slika 5: Logotip aplikacijepersonality test trait

- Memrise([6]), Pictoword([7]), Kahoot([8])…
  - Te aplikacije otrokom ponudim, pokažem namen. Uporaba le-teh je odvisna od razpoložljivega časa ter znanja in želja otrok.

Nekatere aplikacije si otroci pri pouku naložijo na svoj telefon. Uporaba telefonov je na naši šoli prepovedana, razen kadar učitelj presodi, da je uporaba smiselna. Zlorabe se zgodijo, vendar izjemno redko.

5. ZAKLJUČEK

Učenci razvijajo različna področja digitalnih kompetenc, na različnih ravneh: brskajo po spletu, zbirajo informacije, na podlagi zbranega ustvarijo novo besedilo, ki ga predstavijo grafično, slikovno, pisno ali zvočno. Izdelek znajo deliti v elektronski obliki, uporabljajo spletne slovarje, učijo se spletne etike, kako ostati varen na internetu itn.([3]).

V tem članku navedene aplikacije otroci z veseljem in z veliko delovno vnemo uporabljajo tudi doma, v prostem času.

Uporabo katerihkoli aplikacij prilagodim glede na znanje, starost in želje otrok. Nemalokrat se izkaže, da imajo otroci, ki sicer niso odlični v znanju angleščine, dobro znanje na področju IKT. Tako imajo slednji odlično priložnost, da se izkažejo in postanejo samozavestnejši. Vsi otroci pa spoznajo, da smo si različni, da ima vsak svoje močno področje in kako je pomembna medvrstniška pomoč.

Zagotovo je ogromno drugih, morda celo boljših aplikacij, ki jih še nisem odkrila. Najpomembnejše si mi zdi, da uporabo vsake aplikacije osmislim in uporabim v pravi meri.

6. VIRI IN LITERATURA

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[6] https://www.memrise.com/

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Primer uporabe aplikacije Class Dojo v praksi

An example of using the Class Dojo application in practice

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POVZETEK

Eno izmed ključnih zmožnosti za vseživljenjsko učenje, ki se razvijajo v osnovni šoli, je digitalna pismenost ([1]). IKT je vključen v vsakdanjike naših otrok. Nobena izjema niso niti ure razredne skupnosti. Aplikacija Class Dojo deluje v operacijskih sistemih iOS, Android tako na računalniku kot na pametnih mobilnih telefonih. Class Dojo je aplikacija, ki poveže starše, otroke in učitelje. Razredniku nudi veliko možnosti za izvedbo vzgojnih ur, saj vsebuje že pripravljene vzgojne ure z vsemi potrebni elementi: motivacijo, natančno razloženo in z video vsebino podprto temo ure ter iztočnice za razpravo. Aplikacija vsebuje še veliko pripomočkov, ki so učitelju kateregakoli predmeta v veliko pomoč: časovnik, merilec glasnosti, pripomoček za oblikovanje naključnih skupin, možnost zapisa navodil za uro in predvajanja pomirjajoče glasbe, oblikovanje individualnega portfelja. Aplikacija je le delno prevedena v slovenski jezik, kar predstavlja njeno edino pomanjkljivost.

Ključne besede

Class Dojo, IKT v šoli, razredne ure, medsebojna povezanost

ABSTRACT

Digital literacy ([1]) is one of the key lifelong learning skills that are being developed in primary school. ICT is embedded in the everyday lives of our children. Class lessons are no exception. The Class Dojo app runs on iOS, Android, both on your PC and on smartphones. It is an application that connects parents, children and teachers. It offers many opportunities for teaching lessons, as it contains already prepared teaching hours with all the necessary elements: motivation, a thoroughly explained and video-supported topic of the lesson, and points for further discussion. It also contains many tools that are of great help to the teacher of any subject: timer, noise meter, random group maker, individual portfolios. It also contains an option of playing calming music and displaying instructions for students. The application is only partially translated into Slovenian, which is the only drawback.

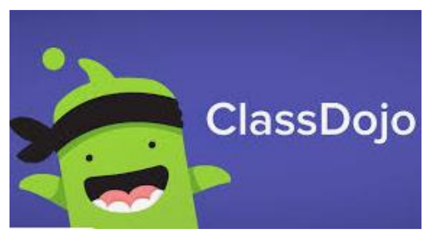
Keywords

Class Dojo, ICT at school, classroom lessons, inter-connectedness

1. UVOD

IKT predstavlja eno izmed ključnih kompetenc vseživljenjskega učenja in je nujna za vključenost v naši vse bolj digitalizirani družbi ([3]).

Razredništvo predstavlja precejšnjo dodatno obremenitev učitelja. Ur oddelčnih skupnosti je premalo, zato je toliko težje vključiti informacijsko komunikacijsko tehnologijo. Imam srečo, da kot razredničarka in učiteljica angleščine, otroke vidim najmanj štirikrat na teden, v šestem in sedmem razredu, v osmem in devetem razredu pa vidim cel razred, na žalost, le enkrat vsakih štirinajst dni. Moje razredne ure niso namenjene gledanju filmčkov, YouTube-a, opravičevanju izostankov v e-asistentu ipd. Beremo zgodbice, pripravim delavnice/delo v skupinah, ki otroke učijo socialnih veščin, učijo, kako postati samozavestnejši, kakšne so dobre učne navade, kakšne so vrednote, ki jih cenimo. Z namenom nadgrajevanja razrednih ur, v iskanju novega, sem pred leti odkrila aplikacijo Class Dojo. Intenzivneje jo uporabljam s sedanjo generacijo otrok, letos so v osmem razredu.



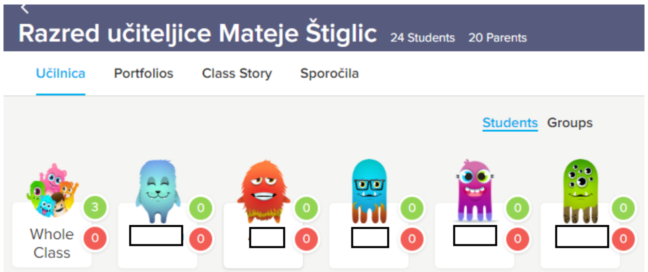
Slika 1. Logotip aplikacije ([2])

Po mojem mnenju je aplikacija idealna za nižjo stopnjo, prvo in drugo triado, jaz pa jo kot razredničarka uporabljam od 6. do 9. razreda.

2. ZAKAJ CLASS DOJO?

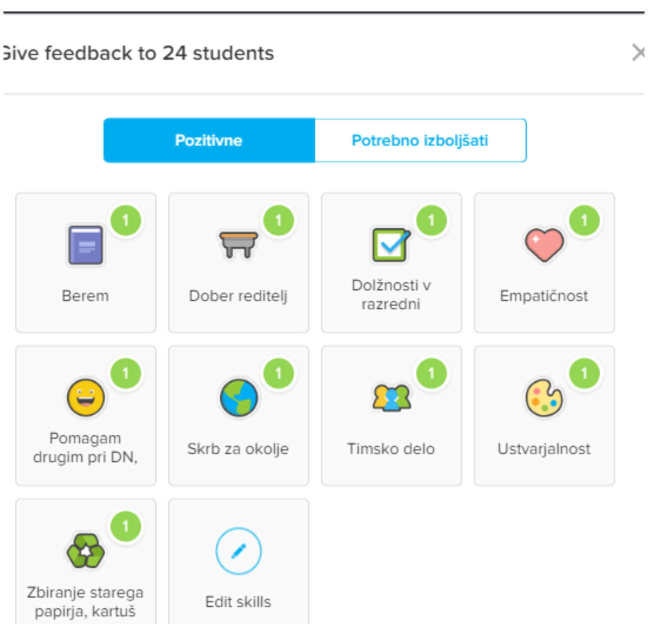
V šestem razredu otroci vzljubijo to aplikacijo. Sami si oblikujejo avatarja, ki jih predstavlja. Otroci se registrirajo, naložijo aplikacijo na svoj telefon. V tem letu mi je zelo pomembno, da jo čim bolj redno uporabljamo. Tako kasneje, ko so starejši, ne dajejo pripomb, da je aplikacija otročja.

Kodo za vpis v aplikacijo dobijo tudi starši. Aplikacijo uporabljam za neformalno dopisovanje z njimi. Na primer v času šole v naravi sem fotografije in besedila pošiljala staršem ravno s pomočjo te aplikacije. Ko smo se vračali iz šole v naravi, sem prav tako delila našo lokacijo, da so vedeli, kdaj bomo na cilju. Na razrednih urah otroci velikokrat delajo v skupinah, igrajo igre vlog, oblikujejo plakate, miselne vzorce – tudi takrat staršem, kar med poukom, pošljem slike z aktualnim dogajanjem. V preteklem letu je to aplikacijo uporabljalo 20 od 23 staršev, kar je 87% staršev in vsi otroci.



Slika 2. Primeri avatarjev ([2])

Kot dodatnega administratorja lahko dodam sorazrednika. Ta učitelj jih prav tako poučuje, zato ima enako pomembno vlogo. Aplikacija omogoča nagrajevanja v obliki točkovanja, plus in minus točke. Kot administrator imam možnost, da v slovenskem jeziku zapišem dejanja, ki jih bomo nagrajevali in tista, za katera si bodo otroci prislužili minus točke. Na začetku šolskega leta zberem ideje, želje otrok, kritično presodimo, katere so najboljše in jih zapišemo. Ovrednotimo jih s točkami, na primer: medsebojna pomoč +1 točka, za vsakih 15 kg papirja je 1 točka ipd. Običajno te točke podeljujemo vsak teden, in sicer tako, da otroci na list zapišejo, komu bi dodelili točko in zakaj, sledi še kratka razprava ali kritična presoja in na koncu podeljevanje točk. Otroci so se s pomočjo te aplikacije in z mojim vodenjem veliko bolj osredotočili na pozitivna dejanja, ki jih je bilo sprva zelo težko poiskati. Naučili so se pohvaliti drug drugega, četudi za malenkosti. Prav tako so se naučili izraziti kritiko neprimernega obnašanja oziroma dejanj na primeren način. Kot administrator imam možnost, da lahko staršem omogočim ali vidijo negativne točke svojega otroka ali ne. Vedno se odločim, da starš tega ne vidi. Otrok je z odvzemom točke kaznovan, ker je npr. na športnem dnevu metal papirčke v gozd, torej gre za manjše »prekrške«. Takšne primere razrešim sama. S »kaznovanim« otrokom se pogovorim tako, da sam uvidi, kaj je naredil narobe.

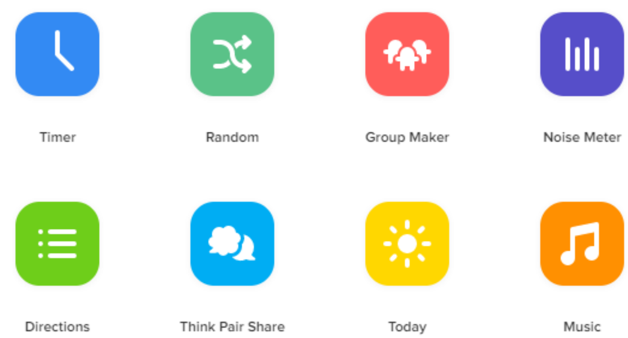


Slika 3: Dejanja, ki jih nagrajujemo ([2])

Aplikacija omogoča, da si lahko določimo cilj, koliko pozitivnih točk želimo zbrati v določenem obdobju, kar vzpodbuja osredotočenje na pozitivno, prepoznavanje negativnih dejanj, pravočasno reševanje težav. Učence z največ točkami nagradim: izrečem sprotne ustne pohvale, podelim priznanja, delim uspeh oz. pohvalo v razredni zgodbi aplikacije (»Class story«), kjer jo vidijo vsi vpisani.

V aplikaciji najdemo tudi risanke. S pomočjo le-teh učence učim obvladovanja in prepoznavanja čustev, kako se umiriti, koncentracije, spoznali so, kaj pomeni njim zelo abstrakten pojem empatija ipd. Najprej si ogledamo video, nato sledi pogovor. Aplikacija ponuja vse: video – risanko in zapisna vprašanja za nadaljnji pogovor. Video lahko delimo tudi s starši, tako da se otroci tudi doma lahko o določeni zadevi pogovarjajo. Pogosto uporabim priročnik Čudo na razrednih urah, ker odlično dopolnjuje v tej aplikaciji obravnavane teme ([4]).

Veliko delamo v skupinah, tako pri razrednih urah, kot pri urah angleščine. Aplikacija ponuja možnost naključnega razdeljevanja v pare ali skupine. Ponuja tudi merilec glasnosti, časovnik, možnost zapisa navodil za uro in predvajanja pomirjajoče glasbe. Novost prejšnjega šolskega leta je možnost oblikovanja učenčevega portfelja. Učencem dam skupno navodilo, vsak učenec pa posebej odda svojo nalogo. Kot učiteljica ali kot razredničarka jo pregledam in delim z drugimi, če se tako odločim, ali pa učenca obvestim o morebitnih napakah.



Slika 4. Pripomočki, ki jih aplikacija ponuja ([2])

Aplikacija nudi natančna in nazorna navodila, ki jih potrebujemo pri uporabi ne glede na vlogo (učitelj, učenec, starš). Prav tako nudi možnost, da si natisnemo posterje in druge pripomočke pri delu s to aplikacijo, kot so koledar, pohvale, pobarvanke itd.

Poskrbljeno je tudi za varnost, in sicer s certifikati: CAPP, FERPA, upoštevajo določila GDPR.

Slaba stran aplikacije je, da je le delno prevedena, ne ponuja podnapisov v slovenskem jeziku, sem pa jim že ponudila, da bi prevedla risanke in navodila.

3. ZAKLJUČEK

Aplikacija razrednikom prihrani veliko časa pri načrtovanju vzgojnih ur, prav tako je učitelju v pomoč pri učnih urah ostalih predmetov. S pomočjo aplikacije sem dosegla večjo povezanost staršev, otrok in mene kot razredničarke. Kljub vsem plusom, ki jih ima, pa je seveda vodenje in bližina odraslega nezamenljiva. Aplikacija predstavlja le delček v mozaiku doprinosa k otrokovi vzgoji. Za vzgojo poskrbijo starši, učitelji jim pomagamo, aplikacija Class Dojo pa pomaga nam vsem.

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Utrjevanje matematike s pomočjo IKT

Consolidating mathematics with ICT

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POVZETEK

Sodobna družba je vpeta med računalnike, pametne telefone, virtualne svetove. Brez tako imenovane informacijsko komunikacijske tehnologije skoraj ne moremo funkcionirati. Ta tehnologija vpliva na naše odnose, komunikacijo, mišljenje. Otroci imajo v domačem okolju dostop do mobitelov in računalnikov še preden gredo v vrtec, kasneje v osnovni šoli se pri pouku srečajo z uporabo računalnikov, nato nadgradijo svoje znanje pri pouku informatike v srednji šoli.

V prispevku je predstavljena uporaba matematičnega programa Symbolab, s katerim so dijaki pri pouku matematike utrdili in ponovili snov iz poglavja linearne funkcije. Pri tem sem matematiko povezala z angleščino in fiziko ter spodbudila medsebojno pomoč.

Ključne besede

Linearna funkcija, Symbolab, učitelj mentor

ABSTRACT

Modern society is embedded in computers, smartphones, virtual worlds. Without information communication technology, we almost cannot work. This technology affects on our relationships, communication, thinking.

Children access smartphones and computers at home before they go to kindergarten, later in elementary school they are using computers at lessons and then upgrade their skills in IT lessons in high school.

This paper introduces the use of the Symbolab mathematical program for consolidation and deepening of knowledge of the learning lessons from the linear function. During the lessons there was cross-curricular integration with English and physics. With this kind of work I encouraged peer help so the students were help to each other.

Keywords

Linear function, Symbolab, teacher mentor

1. UVOD

Uporaba informacijsko komunikacijske tehnologije (IKT) je v življenju posameznika neizogibna. Služi mu za komunikacijo, iskanje informacij, zabavo. Z ustreznim znanjem si z njo olajša delo. Vedno večji pomen dobiva tudi v izobraževalnem procesu. Pri dijakih poveča motivacijo za učenje, raziskovanje, izboljša prostorsko predstavo. Učitelj lahko nadgradi izvedbo tradicionalne učne ure. Pristop z uporabo IKT pri uri je inovativen, kar dijake pritegne. Pri tem mora učitelj skrbno preučiti cilje učne ure in kako bo s tehnologijo določene cilje osvojil.

2. SODOBNA TEHNOLOGIJA PRI POUKU

Tako imenovana informacijska doba je vplivala na vseživljenjsko učenje in delo. Znanje in izobraževanje sta glavna dejavnika preživetja, hkrati pa sta dostopna vedno večjim množicam posameznikov, kar je pripomogel razvoj informacijske tehnologije. Tako izobraževanje dobiva nove razsežnosti: prehaja od formalnega k neformalnemu, od skupinskega k individualnemu ter prehaja od poudarka na znanju k poudarku na osebnostnem razvoju [4]. Tehnologija in virtualna okolja pripomorejo, da je učenje aktivno, učitelj pa ima vlogo mentorja [6]. Učenje v parih in izobraževanje s pomočjo mentorja je individualizirana pot do znanja. Je najučinkovitejša, saj mentor skrajša pot do znanja in pomaga učencu pri težavah [4].

Naloge mentorjev so lahko usmerjene k

posameznikovem osebnostnem razvoju: vpliva na dijakovo mišljenje, odgovornost, motivacijo, poklicni razvoj. Naloge temeljijo tudi na stroki. Mentor vpelje dijaka v delo organizacije in mu razloži pravila na katerih temelji organizacija. Tretji sklop nalog, ki so informativne narave, pa temeljijo na tem, da zna posameznik povezati obstoječe znanje z novim ter pri tem znanje poveže s prakso in izkušnjami, ki jih dobi v organizaciji [3].

IKT se pri pouku matematike uporablja za usvajanje novih matematičnih pojmov, izvajanju matematičnih postopkov, reševanje matematičnih problemov. Pri tem je na voljo različna tehnologija: grafična in numerična računala, prenosni ali tablični računalnik, računalniški programi, internet, interaktivna tabla, e - gradiva, spletne učilnice. Pri tem dijaki: razvijajo informacijsko pismenost, raziskujejo in modelirajo probleme, avtomatizirajo postopke, preverjajo znanje, sodelujejo s sošolci, znajo zbrati in selekcionirati informacije [5]. IKT nudi dostop do množice informacij in različnih virov, zapletene procese poenostavi ali približa dijaku s pomočjo simulacij. Služi kot orodje za prilagajanje, izboljšanje, nadgradnjo učnih vsebin za vsakega dijaka, tako nadarjenega kot tudi dijaka s posebnimi potrebami [7]. Za dijake s posebnimi potrebami so primerni tudi ustrezni računalniški programi, ki lahko preučijo stopnjo znanja, identificirajo šibka in močna področja posameznika in s tem prilagodijo naloge. Hkrati tudi spremljajo napredek dijaka [6].

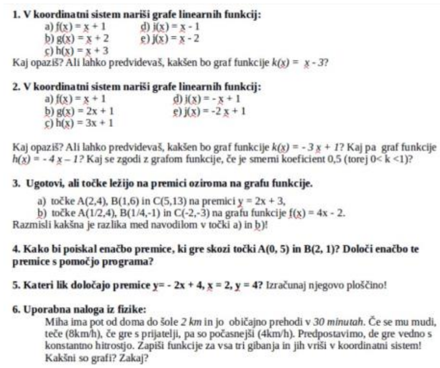
3. POTEK URE

Vključevanje IKT v izobraževalni sistem se je pričelo leta 1994 s šestletnim izvajanjem programa Računalniško opismenjevanje. S tem programom se je izobrazilo učitelje in ravnatelje, šole se je opremilo z ustrezno strojno in programsko opremo. Sledil je program informatizacije šolstva z e - gradivi. V zadnjem času pa se to nadgrajuje s povezavo vseh osnovnih in srednjih šol v eno mrežo (SIO 2020) [1].

Pri pripravi učne ure z uporabo IKT sem si zastavila osnovna vprašanja: kako bo uporaba pripomogla k uresničevanju ciljev, kakšno programsko in strojno opremo imam na voljo, kako dijake spremljati, kako jih aktivno vključiti v uro, kako spremljati njihov napredek, kakšni so interesi dijakov in kako prilagoditi naloge [2].

Bližal se je konec šolskega leta, zato sem se odločila, da učno uro matematike za dijake prvega letnika poklicnega izobraževanja izpeljem malo drugače. Pri redni učni uri smo obdelali risanje grafa linearne funkcije. Za ponavljanje in utrjevanje te snovi pa sem se odločila, da uro izpeljem z uporabo računalnikov in programov v računalniški učilnici. Delo sem organizirala tako, da so reševali v parih in sicer so boljši dijaki sedeli z učno šibkejšimi. Pri tem so raziskovali tudi premik, razteg, zrcaljenje grafov funkcije in točke na premici.

Na spletno učilnico sem jim pripela učni list, ki ga prikazuje Slika 1.



1. V koordinatni sistem nariši grafe linearnih funkcij:

a) f(x) = x + 1 d) i(x) = x - 1
b) g(x) = x + 2 e) j(x) = x - 2
c) h(x) = x + 3

Kaj opaziš? Ali lahko predvidevaš, kakšen bo graf funkcije *k(x) = x - 3?*

2. V koordinatni sistem nariši grafe linearnih funkcij:

a) f(x) = x + 1 d) i(x) = - x + 1
b) g(x) = 2x + 1 e) j(x) = -2 x + 1
c) h(x) = 3x + 1

Kaj opaziš? Ali lahko predvidevaš, kakšen bo graf funkcije *k(x) = - 3 x + 1?* Kaj pa graf funkcije *h(x) = - 4 x – 1?* Kaj se zgodi z grafom funkcije, če je smerni koeficient 0,5 (torej 0< k <1)?

3. Ugotovi, ali točke ležijo na premici oziroma na grafu funkcije.

a) točke A(2,4), B(1,6) in C(5,13) na premici y = 2x + 3,
b) točke A(1/2,4), B(1/4,-1) in C(-2,-3) na grafu funkcije f(x) = 4x - 2.

Razmisli kakšna je razlika med navodilom v točki a) in b)!

4. Kako bi poiskal enačbo premice, ki gre skozi točki A(0, 5) in B(2, 1)? Določi enačbo te premice s pomočjo programa?

5. Kateri lik določajo premice y= - 2x + 4, x = 2, y = 4? Izračunaj njegovo ploščino!

6. Uporabna naloga iz fizike:

Miha ima pot od doma do šole *2 km* in jo običajno prehodi v *30 minutah*. Če se mu mudi, teče (8km/h), če gre s prijatelji, pa so počasnejši (4km/h). Predpostavimo, de gre vedno s konstantno hitrostjo. Zapiši funkcije za vsa tri gibanja in jih vriši v koordinatni sistem! Kakšni so grafi? Zakaj?

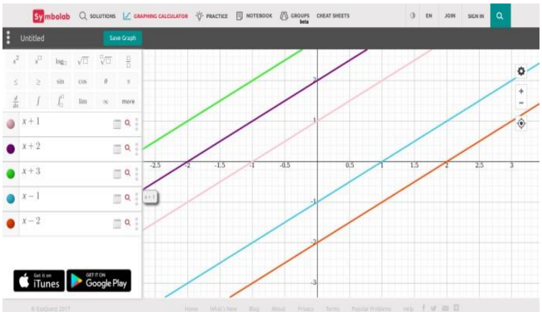
Slika 1: Naloge iz spletne učilnice

Nato so preko spleta poiskali program Symbolab. To je prostodostopen program, ki omogoča matematično računaje, risanje grafov funkcij, nudi tudi nekaj razlag iz določenih matematičnih poglavij v angleškem jeziku. Ponuja računanje tako preprostih računskih operacij kot tudi računanje odvodov, integralov … Dostopa se lahko tudi preko Office 365. S tem pridobiš dostop do različnih nalog, ki jih rešiš za vajo, program pa preveri rešitev. Če želiš celoten postopek reševanja naloge, program ni več brezplačen, kar je slabost tega programa.

Najprej smo pregledali, kaj program ponuja: razlaga snovi, računanje matematičnih problemov, fizikalnih problemov … Ugotovili so, da ga lahko uporabijo za reševanje nalog pri drugih predmeti (fizika) in tudi v višjih letnikih.

Za reševanje učnega lista so uporabili funkcijo za risanje grafov, kar prikazuje Slika 2.

Program za risanje je enostaven, zato so ga hitro osvojili. Naloge so reševali postopoma in sicer tako, da sem jim nekaj časa pustila, da so sami uporabili program, se med seboj posvetovali in si pomagali z internetom. Po nekaj minutah smo pregledali in se pogovarjali o rešitvi naloge.



Slika 2: Reševanje prve naloge v programu Symbolab

Dijake sem tudi sproti preverjala ali rešujejo naloge in jim po potrebi tudi kaj svetovala.

Zadnja naloga je bila uporabna naloga iz fizike, pri kateri so potrebovali več časa za razmislek. Ker je bilo ure že konec, sem jim dala izziv, naj jo poskušajo rešiti doma. Rešitev naloge smo preverili pri naslednji učni uri.

4. ZAKLJUČEK

Učna ura je bila dijakom zelo zanimiva, saj ni potekala tradicionalno. Veliko so pridobili dijaki, ki so imeli težave z učenjem matematike in predstavo pojma linearna funkcija. Pri tem so z matematiko povezali še druge predmete (fizika, angleščina), si medsebojno pomagali in sodelovali, uporabljali svetovni splet za iskanje določenih informacij o linearni funkciji.

Ure z uporabo IKT so zelo dinamične, dijaki nadgrajujejo znanje informacijske pismenosti, odkrivajo nove informacije, jih povezujejo z že znanimi dejstvi pri tem pa znajo informacije ločiti glede na uporabnost in veljavnost. Dijaki z učnimi težavami izboljšajo predstavo. Zato sem mnenja, da je uporaba te tehnologije na primeren način in v določenem časovnem okvirju priporočljiva in ustrezna.

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Razvijanje digitalne pismenosti pri angleščini s pomočjo Amazonovega pametnega zvočnika Echo in virtualnega pomočnika Alexa

Developing digital literacy during English lessons with the help of the Amazon smart speaker Echo and its virtual assistant Alexa

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POVZETEK

Prispevek opisuje rabo IKT pri pouku angleščine. S pomočjo Amazonovega pametnega zvočnika Echo in virtualnega pomočnika Alexe učenci razvijajo digitalno pismenost. V prispevku je podan opis učnega sklopa, v katerem so učenci spoznali napravo, o njej iskali informacije, se načrtno pripravljali za delo z njo in nato aktivno sodelovali pri interakciji. Izpostavljeni so pozitivni učinki, ki so se pokazali med in po učnem sklopu, kot so zmanjšanje treme učencev, razvijanje govorne in slušne spretnosti, avtentičnost in komunikativna narava dejavnosti same. Na koncu so predlagane še možnosti za delo v prihodnje.

Ključne besede

Pametni zvočnik, Amazon, Alexa, digitalna pismenost, pouk angleščine

ABSTRACT

The article describes the use of ICT during English lessons. Students develop their digital literacy with the help of the Amazon smart speaker Echo and its virtual assistant Alexa. The article provides the description of the lessons in which the students familiarized themselves with the device, searched for information about it, systematically prepared for work and then actively participated in interaction with it. Positive effects which emerged during and after the lessons are put forward, among them being reduction of stage fright, the developing of speaking and listening skills as well as the authentic and communicative nature of the activity itself. The article closes with suggestions and options for work in the future.

Keywords

Smart speaker, Amazon, Alexa, digital literacy, English lessons

1. UVOD

Digitalna pismenost je ena izmed ključnih zmožnosti za vseživljenjsko učenje, ki je eno izmed treh področji, ki sestavljajo medkulturno in medjezikovno komunikacijo. Tako je tudi definirana v Učnem načrtu za angleščino [1]. Le-ta tudi izpostavlja, da učenci pri pouku angleščine kritično uporabljajo informacijsko-komunikacijsko tehnologijo za pridobivanje, vrednotenje in shranjevanje informacij, za njihovo tvorjenje, predstavitev in izmenjavo ter za sporazumevanje. Glede na to, da je IKT vse bolj prisoten v vsakdanjem življenju, se zdi smiselno tudi vključevanje le-tega v poučenje tujih jezikov, še posebej angleščine, ki je na področju IKT dejansko najbolj razširjen jezik v uporabi. Prav tako učenje s pomočjo sodobne tehnologije učence zelo motivira, izjemno popestri pouk in usmerja delo v hitrejše in kakovostnejše doseganje ciljev.

2. PAMETNI ZVOČNIK *ECHO*

Pri pouku se digitalna pismenost velikokrat razvija s pomočjo računalnikov, tabličnih računalnikov ali telefonov. Redkeje se uporabljajo druge naprave, pa čeprav se v zadnjem času na tržišču pojavljajo najrazličnejše. S temi so učenci običajno manj seznanjeni, a jim, vsaj po lastnih izkušnjah, praktična aplikacija ne povzroča težav. V prispevku bom predstavil uporabo in delo z Amazonovim pametnim zvočnikom Echo in na njem nameščenim virtualnim pomočnikom Alexo pri pouku angleščine ter podal nekaj opažanj in predlogov za delo v prihodnje.

Preden sem Echo prinesel v razred (9. razred), sem se temeljito pripravil in razmislil, kako naj bi potekalo delo z napravo. Predvideval sem, da velika večina učencev ne pozna zvočnika Echo, niti kako izgleda (slika 1). To se je kasneje izkazalo za točno, čeprav je peščica učencev že slišala za napravo in nekateri posamezniki so jo tudi prepoznali, ko so jo videli. Predvsem so prepoznali virtualnega pomočnika Alexo in to poimenovanje posplošili na celotno napravo. Zato je v pričujočem prispevku z imenom Alexa mišljena naprava kot celota.

Slika 1: Pametni zvočnik Echo z virtualnim pomočnikom Alexo. [2]

Ker predstavitev Alexe in delo z njo ne bi bila možna v sklopu ene šolske ure, sem se odločil, da temi namenim dve šolski uri. Žal ni bilo možnosti po t. i. blok oz. dvojni uri, zato se je zadeva odvila v dveh zaporednih dnevih oz. urah. Na prvi uri sem Alexo prinesel v razred in jo učencem predstavil tako, da sem jim povedal nekaj osnovnih stvari o njej – da je to virtualni pomočnik, ki se uporablja na Amazonovih pametnih zvočnikih, ter da se upravlja z glasovnimi ukazi. Povedal in demonstriral sem jim tudi, kaj vse Alexa zmore (slika 2), t. j. odgovoriti na vprašanja, predvajati glasbo (vzorce ali v celoti, kar je plačljivo), ustvariti sezname »to do«, nastaviti alarme, predvajati poddaje oz. podcaste, predvajati avdio knjige, zagotavljati realne podatke o vremenu, prometu in športu, upravljati druge pametne naprave doma (luči, pečico, ogrevanje …). Vse to in še več zmore v angleščini, nemščini, francoščini, italijanščini, japonščini, portugalščini, španščini in hindiju.

Slika 2: Nekaj možnosti, ki jih Alexa ponuja. [3]

Predvideval sem, da bodo pri pouku učenci v največji meri postavljali vprašanja Alexi, zato smo največ časa namenili temu, kakšna vprašanja lahko postavljamo in kako. Tako smo demonstrirali, da se Alexa po pričakovanjih najbolje odreže pri vprašanjih zaprtega tipa, recimo *Alexa, what's two plus two?* ali *Alexa, who is the president of Slovenia?* Tudi pri vprašanjih bolj odprtega tipa se Alexa dobro odreže, še posebej, če »zadenemo« eno od vprašanj, ki jih je proizvajalec predvidel, in teh je resnično dosti, npr. *Alexa, give me a gardening tip.* ali *Alexa, which football team do you support?* ali *Alexa, what happens if you step on a LEGO brick?* Pri vprašanjih, ki so zelo odprtega tipa ali pa zahtevajo mnenje, analizo oz. interpretacijo, pa Alexa ponavadi odgovori z *Sorry, I don't know that one.* ali *I don't have an opinion on that.* Proizvajalec je predvidel tudi manj vljudne oblika diskurza s strani uporabnikov. Tako se Alexa na kletvice ali vulgarizme odzove s prehodom v stanje pripravljenosti.

Če Alexa ne razume vprašanja oz. sogovornikovega govornega dejanja, le-tega pozove, da to ponovi ali željeno pove kako drugače. Prva ura druženja z Alexo se je končala s frontalnim postavljanjem vprašanja s strani učencev. Tako je bil prebit led, učenci so se sprostili in se preizkusili v postavljanju vprašanj. Čisto za konec sem učencem še razložil, kako bo izgledala naslednja učna ura, tako da ne bomo po nepotrebnem izgubljali dragocenega časa in da bomo lahko v celoti izkoristili uro, od česar bodo seveda imeli največ učenci sami.

2.1 Izpeljava učne ure z Alexo

Drugo učno uro so učenci nestrpno pričakovali. Kot sem jim že sporočil na prejšnji uri, sem učence razdelil v tri skupine po 5 učencev. Vsaka skupina je imela določeno nalogo, ki jo je opravljala 15 minut. Po tem času je vsaka skupina dobila še drugo in nato še tretjo nalogo, tako da so vse skupine v eni šolski uri opravile vse tri naloge.

Prva naloga je bila, da so s pomočjo tabličnih računalnikov pobrskali po spletni strani amazon.com in poiskali čim več informacij o Alexi. Najpomembnejše so si izpisali v zvezek v obliki miselnega vzorca. Druga naloga je bila, da so si pripravili in zapisali v zvezek čim več vprašanj, ki so jih želeli postaviti Alexi. Najprej so v skupini s pomočjo tehnike brainstorming – viharjenje možganov – dobili nekaj idej. Potem je vsak član skupine zapisal vsaj deset vprašanj v zvezek. V skupini so vsa vprašanja pregledali in povedali, ali se jim zdijo primerna in ugibali, ali bodo od Alexe dobili zadovoljiv odgovor. Tretja naloga je bila dejansko delo z Alexo. Učenci so se posedli okoli Alexe in se pogovarjali z njo oz. ji postavljali vprašanja, ki so si jih pripravili. Cilj je bil, da vsi učenci izkusijo pogovor z Alexo in da se izkoristi ves čas, ki je na voljo, tako da lahko vsi učenci kar največ urijo govorno in slušno spretnost.

2.2 Opažanja in pozitivni učinki

Učenci so se odlično odzvali na delo z Alexo. Težav pri posameznih nalogah ni bilo. Z veseljem so s tablicami iskali informacije in bili pri tem uspešni in učinkoviti. Znali so razločiti, kaj so bistveni podatki in te tudi zapisati. Prav tako so učenci imeli veliko idej oz. vprašanj kaj želijo Alexo vprašati. Sam pogovor z njo je tekel brez težav, brez oz. z izredno malo treme, z veliko zanimanja, dobre volje, smeha in novih informacij o najrazličnejših stvareh.

Pri delu z Alexo je absolutno potrebno izpostaviti pozitivne učinke in prednosti. Med slednjimi je zagotovo potrpežljivost Alexe, saj le-ta neštetokrat ponovi vprašanje ali odgovor, kadar je to potrebno. To vedno stori s prijaznim glasom, tudi ko nečesa ne razume. Ker je Alexa virtualen pomočnik, je seveda ni moč razjeziti, spraviti v slabo voljo oz. s tira. Kot zelo pomemben pozitiven učinek dela z Alexo in takšen, ki je nemudoma opazen, je izguba treme. Učenci premagajo nelagodje pred govorom, saj vedo, da jih ne bo nihče popravljal ali kritiziral zaradi njihove izgovorjave, slovnične (ne)pravilnosti in skladenjske ali leksikalne (ne)smiselnosti. Učenci najdejo pomiritev in varnost v dejstvu, da bo Alexa v najhujšem primeru prijazno odvrnila *Sorry, I'm having trouble understanding you right now.*

Prav tako pouk z Alexo pripomore k razvijanju digitalne kompetence učencev. Le-to je seveda možno pri vseh šolskih predmetih. Čeprav v svetu ITK-ja angleščina kot jezik dominira, pa razvijanje digitalne spretnosti običajno prvenstveno ne asociiramo z učenjem in poučevanjem angleščine. Navkljub temu ali pa ravno zaradi tega je uvajanje rabe IKT-ja v pouk angleščine toliko bolj pomembno, saj se učenci med delom z IKT-jem posredno oz. celo nezavedno učijo angleščine, torej jo usvajajo. Pri tem informacijsko-komunikacijsko tehnologijo uporabljajo za pridobivanje, vrednotenje in shranjevanje informacij, za njihovo tvorjenje, predstavitev in izmenjavo ter za sporazumevanje. Seveda je moč zagovarjati tudi obratno smer, t. j., da se med učenjem angleščine s pomočjo IKT-ja posredno oz. nezavedno urijo v rabi le-tega. Kakorkoli gledamo na zadevo, dejstvo ostaja, da se širijo in poglabljajo zmožnosti na obeh področjih – jezika in rabe digitalne tehnologije. O pomenu novih tehnologij pri učenju jezika pišeta tudi Kervin in Derewianka, ki še posebej izpostavljata interakcijo z »non-human partners«, saj ti zagotavljajo »the kind of intensive, sustained practice needed to consolidate learning« [4].

Pri delu z Alexo nikakor ne moremo mimo razvijanja slušne in predvsem govorne spretnosti. Slednji je zaradi narave dela v razredu, predvsem pa zaradi številčnosti učencev v razredu, težko posvetiti toliko časa, kot bi ga bilo dobro oz. zaželeno. Če bi izmerili, koliko učenec znotraj ene šolske ure govori, bi ugotovili, da zelo malo, saj je pouk zapolnjen z dajanjem navodil, branjem besedil, pisanjem, razlago itd. Pri vaji z Alexo pa učenec aktivno komunicira 3 minute in to vsak učenec v razredu. Nadalje je potrebno izpostaviti, da je sporazumevanje z Alexo prava komunikativna dejavnost v didaktičnem smislu, saj izhaja iz dejanskih potreb in želje učenca po sporazumevanju. Tudi Cunningsworth zagovarja isto načelo, t. j. da »students need to … communicate their needs, ideas and opinions. Motivation comes from real-life communication« [5].

Naslednji izredno pomemben vidik je, da je komunikacija avtentična, saj je Alexa materni govorec, pa čeprav digitalni oz. virtualni. Posledično je govor takšen kot se v angleščini dejansko pojavlja in ne takšen kot v nekaterih gradivih, kjer je lahko tudi prirejen oz. napisan z namenom, da prikaže določeno jezikovno prvino oz. značilnost.

Pri komunikaciji prav tako ne gre zanemariti jasnosti izražanja in pravilne oz. sprejemljive izgovorjave. Pri delu z Alexo učenci razvijajo tudi ta dva sporazumevalna aspekta, saj jih ob neadekvatni izreki Alexa pozove, da le-to ponovijo oz. jim sporoči, da ni razumela, kar je bilo povedano. Včasih se tudi zgodi, da Alexa »sprejme« sogovornikov govor, vendar ga narobe razume. V tem primeru, je potrebna parafraza, kar je z vidika učenja angleščine zelo dobrodošlo, saj utrjuje in poglablja leksikalno ter sintaktično širino govorca, v našem primeru seveda učenca.

2.3 Možnosti za delo v prihodnje

Po uspešni izpeljavi učnega sklopa se postavlja vprašanje, kako naprej oz. kako bi bilo možno delo nadgraditi. Izvedba še ene učne ure v istem razredu z istim formatom verjetno ni smiselna, saj bi verjetno bila učinkovita samo tretjina ure, t. j. postavljanje vprašanj oz. pogovor z Alexo. Bolj smiselno bi bilo učence razdeliti v samo dve skupini in jim zadati mini projektno delo, ki ga morajo opraviti v eni šolski uri (recimo opis znane stavbe ali življenjepis znane osebe). Ena skupina bi izdelovala projektno delo s pomočjo tabličnih računalnikov, medtem ko druga s pomočjo Alexe. Na koncu bi izdelka lahko primerjali, izbrali boljšega in se nato pogovarjali o vlogi in pomoči, ki so jo bili učenci deležni s strani Alexe oz. tabličnih računalnikov. Ob naslednji priložnosti bi lahko digitalne pripomočke skupini zamenjali.

Kot zelo interesantna se ponuja možnost, da bi bila Alexa bila prisotna v razredu ves čas, tako da bi lahko učenci z njo komunicirali med poukom (ob dovoljenju oz. spodbudi učitelja) ali pa med odmorom, ko se učenci že zadržujejo v razredu in čakajo na pouk. Mislim, da bi to vodilo še k večji sproščenosti pri govoru in boljši sporazumevalni možnosti učencev. Prav tako bi zelo zanimivo videli, kakšna izreka nastaja takrat, ko učitelja ni zraven. To se namreč da enostavno preveriti, saj Alexa zapisuje vso komunikacijo, do zapisa le-te pa je moč hitro in preprosto dostopati preko administratorske strani na spletu.

3. ZAKLJUČEK

Uvajanje ali preizkušanje novih načinov in pristopov dela pri pouku vedno prinaša s seboj določeno mero negotovosti. Kljub temu pa je ob dobrem in premišljenem načrtovanju rezultat skoraj vedno zelo pozitiven. Tako je bilo tudi v predstavljenem primeru dela z Alexo. Učenci so ne samo spoznali novo IK tehnologijo, ampak so se v interakciji z njo tudi veliko naučili. Urili so svoje slušne in govorne spretnosti, širili jezikovno znanje, pridobivali novo faktografsko znanje in razvijali digitalno pismenost. Ob tem so pokazali veliko dobre volje in zanimanja oz. motivacije za delo, kar se je posledično izražalo v večji sproščenosti in zmanjšanju treme pri govoru. Delo z Alexo se je izkazalo za uspešno, dinamično in z možnostjo za nadaljnji razvoj.

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Učbenik,
nepogrešljivo učno sredstvo pri pridobivanju znanja

Textbook,
An indispensable learning tool in the acquisition of knowledge

Rado Wechtersbach
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POVZETEK
Učbenik je kot najpomembnejše učno sredstvo v učnem procesu vsakega izobraževanja gotovo eden najbolj zgovornih kazalcev stanja in razvoja učnega procesa v vsaki državi. Njegovo snovanje je zahtevno delo, ki temelji na matični stroki, upošteva pa spoznanja drugih ved (pedagogike, didaktike, psihologije idr.). V prispevku so predstavljene zahteve, ki jih mora izpolnjevati učbenik v Sloveniji, in opisane njegove želene lastnosti ter opredeljene didaktične funkcije učbenikov v socio-konstruktivističnem pojmovanju učenja.

Ključne besede
Učbenik, učni proces, socio-konstruktivizem

ABSTRACT
The textbook, as the most important learning tool in the learning process of any education, is certainly one of the most telling indicators of the state and development of the learning process in each country. Its design is a demanding work based on the parental profession, and considers the knowledge of other sciences (pedagogy, didactics, psychology, etc.). The paper presents the requirements that a textbook in Slovenia must meet, describes its desirable characteristics, and defines the didactic functions of textbooks in the socio-constructivist conception of learning.

Keywords
Textbook, learning process, socio-constructivism

1. UVOD
Ko v pogovoru besedo zanese na učbenik, vsi bolj ali manj vemo o čem je govor. Vprašanje je le, če povedano vsi dojemamo enako in je naše razumevanje ustrezno. Problem ustreznega dojemanja, kot izpostavljata Platon in Aristotel, je dana po postavi oziroma temelji na poznavanju in pravilnem razumevanju uporabljenih besed in njihovem zlaganju v besedne zveze, vse drugo je le nepotrebno zganjanje hrupa; premikanje bakrene posode s tolčenjem po njej.

Učbenik lahko opredelimo kot posebno zvrst strokovne literature, ki jo določata vsebina in ciljna publika. [22]. Slovar slovenskega jezika opredeljuje učbenik kot »*knjigo s predpisano snovjo za učenje*« [15]. Podobno opredeljuje učbenik tudi Britanska enciklopedija [11] kot knjigo, ki se uporablja pri učenju določene teme, zlasti v šoli. Tem razlagam bi težko nasprotovali, so pa uporabne v približno tolikšni meri, kot če vodo opišemo kot tekočino; opis je popolnoma pravilen, kaj dosti pa si z njim ne moremo pomagati.

Zavod Republike Slovenije za Šolstvo [23] opredeljuje učbenik kot osnovno učno sredstvo. Namenjen je učencem in dijakom, ki z njegovo rabo pridobivajo, utrjujejo ter preverjajo znanje o posameznih predmetnih področjih. Vsebinski okvir učbeniku določa učni načrt. V Sloveniji status učbenika pridobijo tista učna gradiva, ki jih potrdi pristojni strokovni svet (npr. SS za splošno izobraževanje).

Učbenik v Sloveniji ima torej sledeče lastnosti:

- namenjen je pridobivanju znanja,
- vsebinski okvir določi država z učnim načrtom,
- primernost potrdi ustrezni strokovni svet,
- izbere ga učitelj in z njimi organizira svoj učni proces.

2. UČBENIK V DIDAKTIČNI TEORIJI
V našem prostoru se teoretična didaktika s problematiko učbenikov ne ukvarja prav veliko. Didaktiki se jih v svojih delih dotikajo bolj mimogrede in običajno na ravni praktičnih napotkov bodisi avtorjem, kako naj učbenik napišejo, bodisi učiteljem, kako naj ga uporabljajo. [9]

Manko ustreznih didaktičnih raziskav učbenikov ugotavlja tudi Johnsen [6] v verjetno najobsežnejšem pregledu mednarodnih raziskav učbenikov do tistega časa. Njena analiza razdeli raziskave učbenike v tri področja: ideološko, produktno in uporabniško usmerjene raziskave, pri čemer je prvemu namenjeno daleč največ raziskav, še posebej tiste, ki analizirajo učbenike za zgodovino in družboslovje, slednjemu, torej področju vpliva učbenikov na kakovost učenja, pa najmanj.

Opredelitev in umestitev učbenika v didaktični teoriji je nujno povezana z njegovimi funkcijami v učnem procesu, te pa seveda niso enoznačne. Učbenik uvrščamo med učna sredstva, to je med predmete, ki so izdelani za uporabo pri pouku. Gre za širok pojem, ki obsega učila in učne pripomočke. Nekateri avtorji uvrščajo učbenik med učila (nosilec podatkov, s katerim učenci pridobivajo znanje), drugi ga smatrajo kot učni pripomoček (sam po sebi ni objekt učenja, ampak je to znanje, ki je zapisano v njem).

Učbenika v didaktični teoriji torej ne moremo preprosto in enoznačno definirati. Zato se pogosto zadovoljimo z aplikativno opredelitvijo: učbenik je učni medij, ki kot del izobraževalne tehnologije nenadomestljivo pripomore k uspešnemu in učinkovitemu pridobivanju znanja. Kot tak je vključen v učenčevo pridobivanje znanja, učitelj pa ga lahko vključi v vse etape svojega učnega procesa. [9]

3. VSEBINA UČBENIKA

V časih, ko sta bila učni proces in njegova vsebina skoraj do podrobnosti vnaprej definirane, vsebina učbenika ni bila vprašljiva, snovanje učbenika pa je bilo prej tehnično kot strokovno ali celo znanstveno vprašanje. Ob koncu prejšnjega stoletja pa je kurikulum našega izobraževanja doživel več sprememb. Za učbenike je bila verjetno najpomembnejša učno-ciljna naravnanost učnih načrtov in prehod iz standardov znanja na pričakovane rezultate.

Učni cilji v učnem načrtu so stanja, ki jih želimo doseči z učnim procesom, in so torej njegova normativna komponenta. So kazalniki, kaj naj učenci po končanem učnem procesu znajo oziroma so sposobni narediti, kako se vesti, misliti in čutiti. [20] V učnem načrtu predmeta Informatika je cilj npr. »D*ijak ima razvito znanje, veščine, spretnosti, osebnostne in vedenjske značilnosti, prepričanja in vrednote, ki omogočajo učinkovito uporabo informacijskih virov, odgovorno izbiro digitalne tehnologije in njeno kakovostno uporabo v vsakdanjem življenju in pri nadaljnjem izobraževanju*«. Namen predmeta informatika je torej spodbujati dijaka k sistematičnemu pridobivanju znanja, spretnosti in odnosov, ki so potrebni za razumevanje informacijske tehnologije in njeno kakovostno uporabo v vsakdanjem življenju, v nadaljnjem izobraževanju in za kasnejšo zaposljivost. [24]

Čeprav cilji v učnem načrtu niso vzgojno-izobraževalne odločitve, ki naj bi jih učitelji in učenci izvajali med poukom, le-te usmerjajo. V njih so enakovredno izraženi vzgojni in izobraževalni nameni, ko pa se učenci premikajo skozi učni proces, na koncu dosežejo pričakovane rezultate. Po učnem načrtu predmeta Informatika zna npr. *vsak dijak, ki je uspešno zaključil predmet, ovrednoti zbrane podatke, ki jih potrebuje za rešitev danega problema, jih z digitalno tehnologijo obdelati in urediti na določenem mediju v učinkovito predstavitev rešitve*. Pričakovani rezultati torej operativno opredeljujejo, kaj učenci, ki so pri predmetu dosegli pozitivno oceno, znajo oziroma so sposobni narediti. [21]

Ker so pričakovani rezultati vezani na povsem določeno učno situacijo, jih v bistvu lahko poistovetimo s konkretnimi učnimi nalogami. [13] Gre za naloge, ki ne usmerjajo le konkretne aktivnosti učitelja in učencev v učnem procesu, ampak predstavljajo tudi nekakšen spisek najbolj elementarnih smernic avtorjem pri snovanju učbenika. Pri njihovem udejanjanju pa mora imeti sestavljavec učbenika pri svojem delu vseskozi v glavi tudi nadrejene splošne cilje. Čeprav teh v celoti ni mogoče pripeljati do pričakovanih rezultatov, jih je pa potrebno v učbeniku čutiti. [17] Sestavljavec učbenika mora imeti torej v mislih splošne cilje, učbenik pa pripravlja predvsem na osnovi pričakovanih rezultatov.

4. KAKOVOST UČBENIKA

Nedvomno je težko ali celo nemogoče govoriti o absolutnih in vselej veljavnih kriterijih didaktične ustreznosti učbenika, saj so kazalci, s katerimi presojamo njegovo kakovost, vpeti v dinamičen ter ideološko prežet pedagoški prostor. To seveda ni razlog, da bi se odrekli poskusu opredelitve takšnih kriterijev. Eden od možnih okvirov, ki bi lahko odigrali to vlogo, so t. i. didaktična načela. [9]

Didaktična načela so splošne smernice in pogoji za uspešno in učinkovito ciljno, vsebinsko ter organizacijsko metodično vodenje učnega procesa pri vseh učnih predmetih ter bolj ali manj na vseh šolskih stopnjah. [17] Učbenik je seveda integralni del učnega procesa, zato jih je mogoče, vsaj kot dobro podlago za presojo njegove kakovosti, aplicirati tudi nanj. Načela so namreč po eni strani dovolj normativna, da se je po njih mogoče ravnati, po drugi strani pa tudi dovolj prilagodljiva, da s svojo togostjo ne ovirajo legitimnega pluralizma pedagoških pristopov pri iskanju konkretnih vsebinskih, oblikovnih in drugih rešitev. [9]

Avtorji navajajo različno število didaktičnih načel in jih tudi različno imenujejo, zato izpostavimo zgolj štiri, po mojem mnenju najpomembnejša, izhodišča [17]:

- vsebina: načela nazornosti, stvarno-logične pravilnosti ter strukturnosti in sistematičnosti;
- odnos do učenca: načela razvojne bližine, individualizacije, vzgojnosti;
- aktivnost učencev: načeli aktivnosti in problemskosti;
- organizacija učnega procesa: načelo ekonomičnosti in racionalnosti.

Kakšen pomen ima nazornost in sistematičnost učbenikov je v svoji raziskavi pokazal Justin. [7] Ugotovil je, da so besedila v slovenskih učbenikih pogosto slabo berljiva, vsebujejo preveč strokovnih izrazov in so napisana nesistematično. Učenci, ki so brali popravljena besedila, so dosegli bistveno boljše rezultate pri preverjanju znanja, kot njihovi vrstniki, ki so se učili iz nepopravljenih učbenikov.

Bistvo načela razvojne bližine je, da mora učbenik izhajati iz življenja, izkušenj in neposrednih življenjskih situacij učencev, katerim je namenjen. Če izhajamo iz resničnega življenja in učenčeve bližine, je učenec sposoben pridobljeno znanje razumno vgrajevati v svojo znanje in ga tudi ustrezno uporabiti [25]

Problemskost od avtorja zahteva, da za doseganje ciljev vključi v učbenik didaktične mehanizme, ki bodo učenca spodbujali k dejavnosti in reševanju problemskih situacij. Zasnovan naj bo torej tako, da učencu ne prinese »vsega znanja na pladnju«, ampak ga postavlja pred problem, učenec pa poišče njegovo rešitev, pri čemer mora do nekaterih znanj, potrebnih za rešitev, priti s samostojnim delom, uporabo različnih virov in s svojo iniciativo. [9] V ozadju te zahteve je predpostavka, da bo znanje, do katerega bodo učenci prišli sami, s svojo raziskovalno dejavnostjo, tudi trajnejše in stabilnejše, kot je golo pomnjenje vnaprej posredovanih podatkov. [13]

Didaktično načelo ekonomičnosti in racionalnosti zahteva, da učenci v optimalnih učnih okoliščinah z minimalnimi močmi, sredstvi in časom optimalno dosežejo postavljene učne cilje. [9]

Ne gre torej za vprašanje, v kolikšni meri upoštevati eno ali drugo načelo, ampak za smiselno aplikacijo vseh za učbenik relevantnih načel in izogibanje okoliščinam, v katerih bi navdušenje nad enim pedagoškim konceptom pomenilo zanemarjanje drugih, prav tako pomembnih razsežnosti didaktične konceptualizacije učbenika [9]

5. DIDAKTIČNE FUNKCIJE UČBENIKA

Za učitelja je učbenik učno sredstvo, s katerim lahko dosega optimalne učne rezultate. Vsekakor to ne pomeni, da je zanj edini vir snovnih ali didaktičnih priprav, ampak le orientacija za obseg in globino pouka [16]. Od učitelja se namreč pričakuje, da ima veliko globlji in temeljitejši uvid v vsebino svojega učnega predmeta, kot je predstavljena v učbeniku. Dejstvo, da učitelj obvladuje učbenik in ne narobe, je nujen pogoj, da ga bo lahko učinkovito vključil v svoj učni proces. [9] Ker je učbenikov za posamezni predmet običajno več, je od učiteljeve strokovne in didaktične usposobljenosti odvisna njegova strokovna presoja, kateri učbenik je za izpeljavo njegovega pouka najustreznejši.

Bolj kot učitelju je seveda učbenik kot učni vir namenjen učencu. O tem, da ga učenci uporabljajo za pridobivanje kakovostnega znanja, verjetno ni dileme. Stvari se zapletejo, ko skušamo to »kakovostno« znanje opredeliti, pogosto pa že takrat, ko ugotavljamo, kaj znanje sploh je in na kakšen način ga je možno pridobiti.

Klasično izobraževanje temelji na snovno-ciljnem pristopu. Njegovo bistvo je vsebinska zasnovanost in jasno predpisan način izvajanja, pri čemer so poudarjeni predvsem vsebinski cilji, ki so pogosto ločeni od zanimanja učencev. Posledice se kažejo v majhni uporabnosti znanja, v nizki motivaciji in posledično slabih učnih rezultatih. Naloga učitelja v takšnem izobraževanju je, da učno vsebino, bolj ali manj prilagojeno razvojni stopnji učencev, didaktično ustrezno posreduje, učenci pa jo sprejemajo in si jo zapomnijo. Glavna dejavnost učnega procesa je torej prenos (transmisija) znanja. Kaj je bit in bajt, katere so zunanje enote računalnika in kdaj je neka vrednost resnična (TRUE) so dejstva in tu res ni kaj spreminjati. Kakovost takšnega znanja je opredeljena v glavnem s količino in z natančnostjo ponovitve. [24] Odločujočo vlogo v učnem procesu ima učitelj, učenci pa so le pasivnimi udeleženci. Ker je učiteljevo mesto v sredini, med učno vsebino in učenci, govorimo o na učitelja osredinjenem pouku.

Temu primerna je tudi vloga učbenika, ki je operacionalizacija predpisanih učnih vsebin in ne omogoča odmikov in različnih pristopov na poti doseganja ciljev. Učenci ga uporabijo, če nečesa pri šolski razlagi niso razumeli ali so pozabili, oziroma za utrjevanje in preverjanje svojega znanja.

V sredini prejšnjega stoletja pa se je koncept učenja bistveno spremenil. Šlo je za premik od behaviorizma h kognitivni psihologiji, ki je znan kot kognitivna revolucija. [4] Behavioristično teorijo o učenju kot krepitvi odzivov je nadomestila teorija o izgrajevanju oziroma konstruiranju znanja. Proti koncu stoletja je temeljno teorijo nekoliko dopolnilo spoznanje, da na znanje, ki ga gradi učenec, pomembno vpliva tudi socialno okolje, v katerem poteka učenje. Takšno socio-konstruktivistično pojmovanje učenja je trenutno prevladujoč pogled na učenje. [1]

Znanje, ki naj ga učenci pridobijo v učnem procesu, sedaj ni več pojmovano kot zbirka vsebin, ampak kot poglobljeno razumevanje teh vsebin, njihove uporabe in povezovanja. Odraža se kot zmožnost reševanja različnih problemov in kritične nadgradnje pridobljenega znanja za reševanje podobnih problemov, ter kot nabor spretnosti in odnosov, ki jih posamezniki pri tem izkazujejo. Gre torej za premik pozornosti od vsebin k procesom. Učenje se v večji meri personalizira oziroma prilagoditi različnim interesom, kognitivnim značilnostim in učnim stilom posameznega učenca. Govorimo o na učenca osredinjenem pouku, ki poleg širših vzgojno-izobraževalnih nalog enakovredno upošteva tudi učenčeve subjektivne potrebe.

Takšno znanje se seveda ne da preprosto prenesti, ampak ga mora vsak učenec zgraditi v svoji glavi sam. Učence se uči pravilnih strategij reševanja problemov. Pri tem spoznavajo realne probleme, ki so jim blizu, razpravljajo o njih, oblikujejo vprašanja in jih samostojno ali v skupini rešujejo. Pomembne niso le rešitve, ampak predvsem način, kako so se učenci dokopali do njih. Učenci se učijo iskati in vrednotiti podatke, komunicirati, primerjati in vrednotiti različne rešitve. S prikazom rešitve izkažejo svoje dosežke, ti pa se, po diskusiji v razredu, primerjajo in vrednotijo s tistimi, ki so opredeljeni v učnem načrtu.

Spremenjena je tudi vloga učitelja. Poudarjena je njegova vloga kot strokovnjaka, ki vodi učence pri iskanju in izgrajevanju novega znanja, jih opozarja na stranpoti in jih usmerja na dodatne vire, sooča z nasprotnimi dokazi ipd. [5] Pri tem mora učno vsebino in učence pripeljati v čim bolj neposreden učni kontakt, če je le mogoče, pa se celo umakniti iz te linije in učence motivirati za samostojno pridobivanje znanja.

To pa je zapleten proces, ki zahteva drugačne vsebine, metode in oblike dela v razredu ter omogoča bistveno razširitev učnih virov in medijev. S tem se spremeni tudi vloga učbenika, ki je precej drugačna od prejšnjih.

Uvodoma naj bi učbenik opravil motivacijsko funkcijo, torej učence motiviral za spoznavanje in učenje. Običajno se v tej fazi predstavi problem, ki ga učenci poznajo, se z njim soočajo oziroma jim je blizu. V fazi uvajanja v novo učno snov, naj bi pripomogel k priklicu in refleksiji njihovega predznanja, ki je podlaga za dobro razumevanje vsebin in razumno vgrajevanje novega znanja v obstoječi sistem znanja. Učni cilji pri tem ne smejo biti dani le od zunaj, ampak jih je treba odpreti z notranjimi učnim potrebami učencev. Podobno velja tudi za učne vsebine, ki jih ni mogoče ustrezno izbrati in uporabiti brez upoštevanja učencev. [17] Na koncu naj bi učbenik omogočal tudi učenčevo samopreverjanje pridobljenega znanja in informiranje učitelja z napredovanjem učencev.

Po tej razlagi učbenik ni več knjiga s določeno snovjo, ampak so v njem navedena le bistvena področja, nekakšni otočki znanja. Iz njih učenci samostojno razberejo potrebno učno vsebino, pridobijo in preverjajo pa jo iz drugih virov. To omogoča, da vsak učenec pridobiva različno raven in vrsto znanja. Tako ni potrebno, da vsi sprogramirajo nek informacijski sistem, dovolj je, če znajo za dani algoritem izdelati računalniški program. Pri tem sicer obstaja nevarnost, da avtor vključi v učbenik prevelik korpus znanosti, oziroma na drugi strani, jo iz njega izpusti preveč. V obeh primerih postane učbenik za učence težko razumljiv in pogosto celo nefunkcionalen. [16]

Poleg tega potrebujejo nekateri učenci pri učenju sistematično predstavljene informacije in se učijo korak za korakom, drugi pa imajo raje celosten pristop in lahko iz množice raznovrstnih podatkov izluščijo bistvo ter si pri tem ustvarijo celosten okvir, v katerega potem vnašajo podrobnosti. Medtem ko potrebujejo prvi pregledno organizacijo učbenika in razumljivo zgradbo poglavij ter jasne naloge, naj bi učbenik drugim omogočal odkrivanje in raziskovanje ter usmerjanje k drugim virom. [20] Gre za kvalitativne razlike v tem, v kakšnih okoliščinah posamezni učenec bolje deluje. Te razlike morajo avtorji učbenikov seveda upoštevati in vključevati elemente za ene in druge.

Spremembe prinašajo obrat tudi v mišljenju in delovanju učitelja. Od njega zadevajo uvajanje aktivnih metod in oblik dela, npr. projektno reševanje problemov, sodelovalno učenje, timsko delo ipd. Tovrstno spreminjanje pa je zahtevno in dolgotrajno. Zahteva veliko učiteljeve motivacije, takta in potrpežljivosti ter nikakor ne more biti rutinsko in mehanično početje, ki se zgodi na ukaz. Gre namreč za skrajno občutljivo poseganje v šolski kolektiv in njegovo dinamiko ter posameznikova prepričanja in vrednote. [21]

6. ZAKLJUČEK

Če sedaj, na koncu, pogledamo, koliko učbenikov v Sloveniji sledi opisanim lastnostim, smo hitro razočarani. To je po eni strani razumljivo, saj je uvajanje sprememb v izobraževanje počasno. Šolski sistem je namreč eden izmed večjih sistemov, ki ga je nemogoče hitro in v kratkem času spremeniti. Pomembno pa je, da se učitelji zavedajo novosti, zahtevajo od založb drugačne učbenike in jih pri svojem pouku tudi uporabljajo.

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Digitalne kompetence v izobraževalnem sistemu

Digital Competences in the Education System

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POVZETEK

Digitalne kompetence sodijo med najpomembnejše kompetence državljanov v sodobnem svetu, obvezne so za uspešno poslovno kariero in so vedno bolj nepogrešljive tudi v vsakdanjem življenju. Izobraževalni sistem pa je ključen za pridobivanje in uporabo digitalnih kompetenc. V prispevku je predstavljeno stanje na področju razvoja meril in orodij za oceno in razvoj digitalnih kompetenc na različnih področjih in ravneh. Razvit je digitalni referenčni okvir za državljane, ki predstavlja izhodišče za vsa druga področja in izobraževalce (DigCompEdu), ki bo omogočil izobraževanje in usposabljanje učiteljev, kar je predpogoj za uvajanje pridobivanja digitalnih kompetenc v izobraževanje. Prikazane so zahteve za slovenski izobraževalni sistem, obenem pa tudi podpore EU-institucij pri izboljšanju stanja.

Ključne besede

Digitalne kompetence, izobraževanje, DigCompEdu

ABSTRACT

Digital competences are among the most important civilian competences in the modern world; they are instrumental for a successful business career and are increasingly indispensable in everyday life. The education system plays a key role in the acquisition and use of digital consequences. This paper presents the current state of the field of developing the measures and tools for the evaluation and development of digital competences in various fields and on different levels. A digital framework for civilians has been developed that represents the starting point for all other fields and educators (DigCompEdu) and that will facilitate the education and training of teachers as the prerequisite for implementing digital competences into education. The requirements for the Slovenian education system are presented, along with the support of EU institutions in improving the current state.

Keywords

Digital competences, education, DigCompEdu

1. UVOD

Na splošno lahko digitalne kompetence opredelimo kot zmožnost ali sposobnost posameznika, ki ima dovolj znanja in veščin, da opravi neko nalogo v digitalnem okolju pravilno in učinkovito.

EU se že od leta 2005 sistematično ukvarja z digitalnimi kompetencami, kot enim od ključnih vzvodov za sodobno evropsko družbo. Evropska komisija vsako leto objavi poročilo »Education and Training Monitor« (1), v katerem posamezne države opišejo tudi stanje na področju digitalnih kompetenc in vizije razvoja.

Evropski okvir digitalnih kompetenc za državljane 1, poznan tudi kot DigComp, nudi orodje za izboljšanje digitalnih kompetenc državljanov. Leta 2017 so pripravili Evropski digitalni kompetenčni okvir za državljane (DigComp 2.1) (2), ki uvaja podrobnejši opis osmih stopenj strokovnosti in primerov.

Osnova za posamezno raven so učni dosežki, upoštevana sta tudi Bloomova taksonomija in Evropski okvir kvalifikacij, saj želijo pripraviti za različna področja teste, s katerimi bi lahko realno izmerili digitalne kompetence ter jih univerzalno uporabili za vsa področja in ravni v družbi. Ker je 21 vrst digitalnih kompetenc in 8 ravni kompetenc, je treba za vsako konkretno področje ali proces pripraviti 168 opisnikov, po katerih se lahko določijo posameznikove digitalne kompetence.

Na podlagi tega okvira razvijajo okvire digitalnih kompetenc za različna strokovna področja in razvili so ga tudi za izobraževalce (3). Publikacija je tudi v slovenskem jeziku (4).

Kompetence izobraževalcev so razdeljene na šest ravni – od začetnika (A1), prek raziskovalca (A2), vključevalca (B1), strokovnjaka (B2), voditelja (C1) do najvišje stopnje – pobudnika (C2), ki naj bi preizkušal visoko inovativne in zahtevne digitalne tehnologije ter razvijal nove pedagoške pristope. Prikazane so v preglednici 1.

Preglednica 1. Kompetence izobraževalcev po ravneh v DigCompEdu

Ozn.	Poimenovanje	Zahteve
A1	Začetnik	Zaveda se pomena, ima malo znanja, potrebuje precej pomoči in spodbude. DK uporablja pri pripravi učnih ur, za administracijo in komunikacijo. **Obvlada samo osnove.**
A2	Raziskovalec	Zaveda se pomena, ima določena znanja, želi napredovati, potrebuje vodenje, zglede in pomoč. DK uporablja na nekaterih področjih, vendar ne sistematično in celovito Išče, raziskuje primerne strategije. **Spodbuja dijake k uporabi digitalnih tehnologij.**
B1	Vključevalec	Osredotočen je na opolnomočenje dijakov. **Vpeljuje dejavnosti za spodbujanje digitalnih kompetenc dijakov.**
B2	Strokovnjak	**Strateško spodbuja digitalne kompetence dijakov.**
C1	Voditelj	**Celovito in kritično spodbuja pridobivanje in uporabo digitalnih kompetenc dijakov.**
C2	Pobudnik	**Uporablja inovativne oblike za spodbujanje digitalnih kompetenc dijakov.**

2. TRENDI NA PODROČJU DIGITALNIH KOMPETENC V IZOBRAŽEVANJU V EU

Maja 2018 so v Evropskem parlamentu predstavili poročilo o modernizaciji izobraževanja v EU. V njem so digitalizacija in digitalne kompetence prepoznane kot ključne za razvoj Evrope in pri tem naj bi imelo izobraževanje najpomembnejšo vlogo. Država članice bi morale zagotoviti, da nihče ne bo končal šolanja brez osnovnih veščin in kompetenc, med katere sodijo tudi digitalne (str. 14). (5)

Podrobno so naloge za posodabljanje izobraževanja predstavljene v dokumentu Digital Education Action Plan (6). Predvidenih je enajst ukrepov, ki so razdeljeni v sklope A, B in C, in sicer:

A) Boljša uporaba digitalne tehnologije za poučevanje in učenje vsebuje tri ukrepe:

- Povezljivost šol s širokopasovnim dostopom, kar omogoča dostop do sodobnih virov in specializiranih gradiv, uporabo platform za sodelovanje in podporo aktivnemu učenju in projektnemu delu.
- Širitev orodja za samorefleksijo SELFIE (https://ec.europa.eu/education/schools-go-digital/how-selfie-works_en) do konca leta 2020, s katerim bodo vzpostavili mentorsko vključujočo in trajnostno mrežo, prek katere se bodo lahko učitelji in šole medsebojno podpirali ter izmenjevali izkušnje o uporabi digitalnih tehnologij za poučevanje in učenje.
- Digitalno podpisane kvalifikacije, to so elektronski dokumenti, ki jih izdajo ustanove za izobraževanje in usposabljanje, s katerimi potrjujejo dodelitev kvalifikacije osebi. Pristop bo temeljil na odprtih standardih in bo do konca leta 2019 vključen v novo platformo Europass (https://europass.cedefop.europa.eu/sl/resources/digital-competences), kjer se lahko shranjujejo in izmenjujejo digitalno podpisane kvalifikacije.

B) Razvijanje digitalnih kompetenc in veščin vsebuje pet ukrepov:

- Pripravljena bo spletna platforma za celotno EU, ki bo podpirala visokošolske ustanove pri uporabi digitalnih tehnologij za:
  - izboljšanje kakovosti in ustreznosti učenja in poučevanja,
  - pospeševanje internacionalizacije,
  - podpiranje sodelovanja med visokošolskimi zavodi po Evropi.

  Platforma bo delovala kot središče obstoječih evropskih, nacionalnih in regionalnih platform, ki se ukvarjajo s spletnim učenjem, kombinirano/virtualno mobilnostjo, spletnimi kampusi in izmenjavo najboljših praks.
- Pripravljenih bo več projektov, s katerimi bodo spodbujali digitalne kompetenc in odprte znanstvene veščine v visokem šolstvu. Cilj je vključevanje, informiranje in usposabljanje študentov, učiteljev, raziskovalcev in osebja na področju visokošolskega izobraževanja. To jim bo omogočilo sooblikovanje in soustvarjanje programov, ki obravnavajo družbene in tehnološke izzive.
- Do leta 2020 naj bi se vsaj 50 % šol priključilo projektu EU Code Week (https://codeweek.si/), v okviru katerega promovirajo in spodbujajo programiranje in računalniško razmišljanje.
- Povečati želijo kibernetsko varnost v izobraževanju, in to z ozaveščanjem učiteljev in študentov. Opravili bodo več tečajev za učitelje.
- Poseben poudarek bo na digitalnih in podjetniških spretnostih za dekleta, za kar bodo izvedli vrsto delavnic.

C) Izboljšanje izobraževanja z boljšo analizo podatkov in predvidevanjem vsebuje tri ukrepe:

- Študije o IKT v izobraževanju, ker so na voljo le starejši podatki, ki niso dovolj ustrezna podlaga za spremembe. Zelo pomembna bo raziskava PISA, ki bo potekala leta 2021 in bodo zanjo pripravili posodobljeni vprašalnik PISA IKT.
- Začeli se bodo pilotni projekti za umetno inteligenco in analitiko, ki bodo lahko predvideli prihodnje pomanjkanje spretnosti in znanj ter s tem pomagali posodabljati učne programe. Za leto 2020 je predvidena vzpostavitev zbirke učnih dejavnosti in učnih elementov za profile znanja, ki so bili uporabljeni v pilotnih projektih.

- Pripravili bodo vrsto političnih, raziskovalnih in usmeritvenih dokumentov o vplivu in potencialu digitalnih tehnologij v primarnem, srednješolskem in visokošolskem izobraževanju. Organizirano bo vseevropsko izobraževalno srečanje s sodelovanjem držav članic EU in partnerskih držav za prepoznavanje inovativnih rešitev za izzive, s katerimi se danes srečujejo izobraževalne ustanove.

3. STANJE IN NALOGE NA PODROČJU DIGITALNIH KOMPETENC V IZOBRAŽEVANJU V SLOVENIJI

V Sloveniji nismo opravili sistematičnih raziskav o digitalnih kompetencah v izobraževanju, nekaj parcialnih raziskav pa kaže, da stanje ni najustreznejše. O tem priča tudi Poročilo (The objective, 2019) (7), v katerem so prikazani rezultati raziskave, s katero so primerjali IKT v izobraževanju v 28 državah EU, na Norveškem, Islandiji in v Turčiji. V Sloveniji so skupaj opravili intervju (test) z 172 učitelji OŠ in 44 učitelji SŠ, skupaj s 410 starši ter 1143 učenci in dijaki.

S stališča digitalnih kompetenc so pomembni naslednji podatki:

Slovenija ima v osnovnem šolstvu 55 % dobro opremljenih in povezanih šol, kar je malo več, kot je povprečje EU (52 %). V srednjem šolstvu Slovenija zelo pozitivno odstopa pri opremljenosti in povezanosti šol z 89 %, saj je v EU povprečje le 72 %. Slovenija je zelo napredna pri povezavah šol s svetovnim spletom, pri čemer ima hitrost spleta več kot 100 mb/s 29 % osnovnih šol (v EU le 17 %) in 70 % srednjih šol (v EU pa je poprečje 18 %).

Je pa delež osnovnošolcev, ki redno tedensko uporabljajo računalnik v šoli, v Sloveniji 32 %, kar je precej manj kot v EU (52 %). V Sloveniji 52 % dijakov redno uporablja računalnik v šoli, kar je pod poprečjem EU (59 %).

Slovenski osnovnošolci imajo precej manj lastne opreme (2- do 4-krat) kot njihovi vrstniki v EU, srednješolci pa približno 30 do 50 % manj kot njihovi vrstniki. Imajo pa slovenski srednješolci v povprečju več telefonov kot njihovi vrstniki v EU.

Zelo pa je Slovenija slaba v digitalni kakovostni podpori šol, ki jo ima 8 % osnovnih šol (33 % v EU) in 11 % srednjih šol (51 % v EU).

Slabši od poprečja EU smo v Sloveniji pri digitalnih kompetencah učiteljev (razen v osnovnih šolah pri pripravi vsebin), in to v srednjih šolah še slabši kot v osnovnih šolah. Primerjava digitalnih kompetenc učiteljev v osnovni in srednji šoli v Sloveniji in EU je prikazana v preglednici 2.

Preglednica 2: Digitalne kompetence učiteljev v osnovnih in srednjih šolah v Sloveniji in EU

Digitalne competence po skupinah	Osnovnošolski učitelji		Srednješolski učitelji	
	Slovenija	EU	Slovenija	EU
Varnost	2,83	3,04	2,59	3,00
Komunikacija	2,87	3,03	2,32	3,05
Informacijska pismenost	2,85	3,06	2,68	3,17
Reševanje problemov	2,64	2,28	2,49	2,80
Ustvarjanje vsebin	2,66	2,60	2,32	2,67

Verjetno zaostanek lahko pripišemo tudi dejstvu, da v Sloveniji bistveno zaostajamo za povprečjem EU pri usposabljanju za uporabo sodobnih tehnologij za pedagoško delo in za konkretne predmete, medtem ko smo pri usposabljanju za uporabo opreme pri podobnih rezultatih kot v EU, kar kaže preglednica 3.

Preglednica 3: Odstotek usposabljanja učiteljev osnovnih in srednjih šol za digitalne kompetence po vrsti tečajev – primerjava tečajev za učitelje v Sloveniji in povprečje EU

	Osnovna šola		Srednja šola	
Vrsta tečajev	Slovenija	EU	Slovenija	EU
Tečaji za pedagoško rabo	28	45	22	50
Tečaji za predmete	28	49	21	48
Tečaji za uporabo opreme	44	45	38	43

Slovenske izobraževalce čakajo zahtevne naloge, če želimo slediti trendom v EU, obenem pa imamo na voljo veliko pomoči EU-institucij.

Kot konkreten primer pomoči, poleg obsežne literature in nekaterih že omenjenih projektov, omenjamo projekt CRISS (8) (https://www.crissh2020.eu/), s katerim želijo ustvariti razširljive in stroškovno učinkovite oblike digitalne učne infrastrukture prek certificiranja digitalnih kompetenc v osnovnih in srednjih šolah EU. Projekt CRISS predlaga skupni okvir za evropske učence in dijake ter podporo učiteljem v procesu poučevanja in učenja, ki bo temeljil na okvirih DigComp.

4. ZAKLJUČEK

Digitalne kompetence sodijo med najpomembnejše kompetence državljanov v sodobnem svetu, izobraževalni sistem pa ima pri pridobivanju in razvoju le-teh zelo pomembno vlogo. V EU so pripravili konkreten izvedbeni načrt in vrsto ukrepov, s katerimi bodo pomagali državam in izobraževalnim institucijam internacionalizirati delo, posodobiti njihove programe in omogočiti dostop do kakovostnih gradiv in projektov.

Stanje na področju digitalnih kompetenc v izobraževanju v Sloveniji je na večini področij slabše, kot je povprečje v EU, imamo pa prednost v opremi, interesu mladih in pričakovanjih staršev. Obstaja tudi nekaj šol, ki zelo dobro vključujejo pridobivanje digitalnih kompetenc mladih, in vrsta učiteljev, ki se samoiniciativno usposabljajo in vključujejo v mednarodne projekte. Nujno bo treba posodobiti izobraževalne cilje, izobraziti in usposobiti vodstva šol in učitelje ter naprednejše šole še bolj spodbujati k sodelovanju pri EU-projektih.

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