

INFORMACIJSKA DRUŽBA

Zbornik 26. mednarodne multikonference

INFORMATION SOCIETY

Proceedings of the 26th International Multiconference

Slovenska konferenca o umetni inteligenci
Slovenian Conference on Artificial Intelligence

Kognitivna znanost
Cognitive Science

Odkrivanje znanja in podatkovna skladišča • SiKDD
Data Mining and Data Warehouses • SiKDD

Miti in resnice o varovanju okolja
Myths and Truths about Environmental Protection

16. Mednarodna konferenca o prenosu tehnologij
16th International Technology Transfer Conference

Demografske in družinske analize
Demographic and Family Analyses

Vzgoja in izobraževanje v informacijski družbi
Education in Information Society

Digitalna vključenost v informacijski družbi
Digital Inclusion in Information Society

Konferenca o zdravi dolgoživosti
Conference on Healthy Longevity

Legende računalništva in informatike
Legends of Computing and Informatics

Uredniki • Editors:

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IS2023

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PREDGOVOR MULTIKONFERENCI INFORMACIJSKA DRUŽBA 2023

Šestindvajseta multikonferenca Informacijska družba se odvija v obdobju izjemnega razvoja za umetno inteligenco, računalništvo in informatiko, za celotno informacijsko družbo. Generativna umetna inteligenca je s programi kot ChatGPT dosegla izjemen napredek na poti k superinteligenci, k singularnosti in razcvetu človeške civilizacije. Uresničujejo se napovedi strokovnjakov, da bodo omenjena področja ključna za obstoj in razvoj človeštva, zato moramo pozornost usmeriti na njih, jih hitro uvesti v osnovno in srednje šolstvo in vsakdan posameznika in skupnosti.

Po drugi strani se poleg lažnih novic pojavljajo tudi lažne enciklopedije, lažne znanosti ter »ploščate Zemlje«, nadaljuje se zapostavljanje znanstvenih spoznanj, metod, zmanjševanje človekovih pravic in družbenih vrednot. Na vseh nas je, da izzive današnjice primerno obravnavamo, predvsem pa pomagamo pri uvajanju znanstvenih spoznanj in razčiščevanju zmot. Ena pogosto omenjanih v zadnjem letu je eksistencialna nevarnost umetne inteligence, ki naj bi ogrožala človeštvo tako kot jedrske vojne. Hkrati pa nihče ne poda vsaj za silo smiselnega scenarija, kako naj bi se to zgodilo – recimo, kako naj bi 100x pametnejši GPT ogrozil ljudi.

Letošnja konferenca poleg čisto tehnoloških izpostavlja pomembne integralne teme, kot so okolje, zdravstvo, politika depopulacije, ter rešitve, ki jih za skoraj vse probleme prinaša umetna inteligenca. V takšnem okolju je ključnega pomena poglobljena analiza in diskurz, ki lahko oblikujeta najboljše pristope k upravljanju in izkoriščanju tehnologij. Imamo veliko srečo, da gostimo vrsto izjernih mislecev, znanstvenikov in strokovnjakov, ki skupaj v delovnem in akademsko odprtem okolju prinašajo bogastvo znanja in dialoga. Verjamemo, da je njihova prisotnost in udeležba ključna za oblikovanje bolj inkluzivne, varne in trajnostne informacijske družbe. Za razcvet.

Letos smo v multikonferenco povezali deset odličnih neodvisnih konferenc, med njimi »Legende računalništva«, s katero postavljamo nov mehanizem promocije informacijske družbe. IS 2023 zajema okoli 160 predstavitev, povzetkov in referatov v okviru samostojnih konferenc in delavnic, skupaj pa se je konference udeležilo okrog 500 udeležencev. Prireditve so 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 s 46-letno tradicijo odlične znanstvene revije. Multikonferenco Informacijska družba 2023 sestavljajo naslednje samostojne konference:

- Odkrivanje znanja in podatkovna središča
- Demografske in družinske analize
- Legende računalništva in informatike
- Konferenca o zdravi dolgoživosti
- Miti in resnice o varovanju okolja
- Mednarodna konferenca o prenosu tehnologij
- Digitalna vključenost v informacijski družbi – DIGIN 2023
- Slovenska konferenca o umetni inteligenci + DATASCIENCE
- Kognitivna znanost
- Vzgoja in izobraževanje v informacijski družbi
- Zaključna svečana prireditve konference

Soorganizatorji in podporniki konference so različne raziskovalne institucije in združenja, med njimi ACM Slovenija, SLAIS za umetno inteligenco, DKZ za kognitivno znanost in 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.

S podelitvijo nagrad, še posebej z nagrado Michie-Turing, se avtonomna stroka s področja opredeli do najbolj izstopajočih dosežkov. Nagrado Michie-Turing za izjemen življenjski prispevek k razvoju in promociji informacijske družbe je prejel prof. dr. Andrej Brodnik. Priznanje za dosežek leta pripada Benjaminu Bajdu za zlato medaljo na računalniški olimpijadi. »Informacijsko limono« za najmanj primerno informacijsko tematiko je prejela nekompatibilnost zdravstvenih sistemov v Sloveniji, »informacijsko jagodo« kot najboljšo potezo pa dobi ekipa RTV za portal dostopno.si. Čestitke nagrajencem!

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

FOREWORD - INFORMATION SOCIETY 2023

The twenty-sixth Information Society multi-conference is taking place during a period of exceptional development for artificial intelligence, computing, and informatics, encompassing the entire information society. Generative artificial intelligence has made significant progress towards superintelligence, towards singularity, and the flourishing of human civilization with programs like ChatGPT. Experts' predictions are coming true, asserting that the mentioned fields are crucial for humanity's existence and development. Hence, we must direct our attention to them, swiftly integrating them into primary, secondary education, and the daily lives of individuals and communities.

On the other hand, alongside fake news, we witness the emergence of false encyclopaedias, pseudo-sciences, and flat Earth theories, along with the continuing neglect of scientific insights and methods, the diminishing of human rights, and societal values. It is upon all of us to appropriately address today's challenges, mainly assisting in the introduction of scientific knowledge and clearing up misconceptions. A frequently mentioned concern over the past year is the existential threat posed by artificial intelligence, supposedly endangering humanity as nuclear wars do. Yet, nobody provides a reasonably coherent scenario of how this might happen, say, how a 100x smarter GPT could endanger people.

This year's conference, besides purely technological aspects, highlights important integral themes like the environment, healthcare, depopulation policies, and solutions brought by artificial intelligence to almost all problems. In such an environment, in-depth analysis and discourse are crucial, shaping the best approaches to managing and exploiting technologies. We are fortunate to host a series of exceptional thinkers, scientists, and experts who bring a wealth of knowledge and dialogue in a collaborative and academically open environment. We believe their presence and participation are key to shaping a more inclusive, safe, and sustainable information society. For flourishing.

This year, we connected ten excellent independent conferences into the multi-conference, including "Legends of Computing", which introduces a new mechanism for promoting the information society. IS 2023 encompasses around 160 presentations, abstracts, and papers within standalone conferences and workshops. In total about 500 participants attended the conference. The event was accompanied by panel discussions, debates, and special events like the award ceremony. Selected contributions will also be published in a special issue of the journal *Informatica* (<http://www.informatica.si/>), boasting a 46-year tradition of being an excellent scientific journal. The Information Society 2023 multi-conference consists of the following independent conferences:

- Data Mining and Data Warehouse - SIKDD
- Demographic and Family Analysis
- Legends of Computing and Informatics
- Healthy Longevity Conference
- Myths and Truths about Environmental Protection
- International Conference on Technology Transfer
- Digital Inclusion in the Information Society - DIGIN 2023
- Slovenian Conference on Artificial Intelligence + DATASCIENCE
- Cognitive Science
- Education and Training in the Information Society
- Closing Conference Ceremony

Co-organizers and supporters of the conference include various research institutions and associations, among them ACM Slovenia, SLAIS for Artificial Intelligence, DKZ for Cognitive Science, and the Engineering Academy of Slovenia (IAS). On behalf of the conference organizers, we thank the associations and institutions, and especially the participants for their valuable contributions and the opportunity to share their experiences about the information society with us. We also thank the reviewers for their assistance in reviewing.

With the awarding of prizes, especially the Michie-Turing Award, the autonomous profession from the field identifies the most outstanding achievements. Prof. Dr. Andrej Brodnik received the Michie-Turing Award for his exceptional lifetime contribution to the development and promotion of the information society. The Achievement of the Year award goes to Benjamin Bajd, gold medal winner at the Computer Olympiad. The "Information Lemon" for the least appropriate information move was awarded to the incompatibility of information systems in the Slovenian healthcare, while the "Information Strawberry" for the best move goes to the RTV SLO team for portal dostopno.si. Congratulations to the winners!

Mojca Ciglarič, Chair of the Program Committee
Matjaž Gams, Chair of the Organizing Committee

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PREDGOVOR

Kar se tiče umetne inteligence, živimo v vznemirljivih časih. V času Informacijske družbe 2022 ChatGPT še ni bil na voljo, ko se je pojavil, pa je bilo vse drugače – umetna inteligenca se je iz nečesa, o čemer so govorili predvsem strokovnjaki, prelevila v nekaj, o čemer govorijo vsi. Spremembe v dojemanju (generativne) umetne inteligence so še nekoliko večje kot napredek njenih dejanskih zmožnosti, a tudi slednji je velik: nesporno je postala zelo uporabno orodje za pisanje besedil in programske kode ter generiranje slik, uveljavlja se kot osebni pomočnik in še več. Če bo razvoj umetne inteligence še naprej tako hiter, kot je trenutno, si v prihodnosti zlahka predstavljamo dramatičen napredek v produktivnosti gospodarstva, raziskavah in vsakdanjem življenju. A marsikdo umetno inteligenco vidi tudi kot grožnjo: od tega, da bo generirala velike količine posamezniku prilagojenih škodljivih vsebin in ljudem prevzela delovna mesta, do tega, da nas bo vse pobila. Tehtanje, kaj od tega se res utegne zgoditi, je malo prehud zalogaj za tale predgovor, tako da si raje pogledjmo, kaj tak razvoj dogodkov pomeni za naše delo.

Dostopnost velikih jezikovnih modelov pomeni, da so naloge, ki zahtevajo razumevanje ali generiranje naravnega jezika, lažje izvedljive kot kdajkoli prej. To je odlično, nerodno pa je, da je gradnja tovrstnih modelov zaradi velike računske zahtevnosti izven dosega velike večine organizacij – tako raziskovalnih kot podjetij. A še vedno se lahko ukvarjamo z njihovim prilagajanjem, vključno z uporabo spodbujevanega učenja s človekovim povratnim odzivom (angl. reinforcement learning with human feedback), in tehnikami za tvorbo pozivov (angl. prompt engineering), ki dajo zelena izhodna besedila. Veliko raziskovalnih izzivov nudijo metode za zagotavljanje zaupanja v umetno inteligenco in njeno uravnavanje s cilji snovalcev (angl. alignment), za kar v splošnem še ni dobrih rešitev. Lahko pa se ukvarjamo tudi z vprašanji, kako umetno inteligenco regulirati, kako bo preobrazila (informacijsko) družbo in kaj storiti, da jo bo na bolje, kaj inteligenca sploh je in kdaj bo njena umetna različica dobila zavest.

Če se ozremo k Slovenski konferenci o umetni inteligenci, opazimo, da se velikih jezikovnih modelov dotika le en prispevek od 12, družbenih vidikov umetne inteligence pa nobeden. Da bi bolje naslovili vroče tematike zadnjega časa, smo povabili Mykolo Pechenizkiyja s Tehnične univerze v Eindhovnu, da nam predava o praktičnih problemih in metodah zaupanja vredne umetne inteligence. Po lanski uspešni izvedbi Data Science Meetupa v sklopu konference – dogodka, kjer imajo strokovnjaki iz industrije kratke predstavitve svojega dela – ga na podoben način organiziramo tudi letos. Povezovanje z industrijo je dandanes namreč bolj pomembno kot kdajkoli prej, saj se tam dogaja vedno več raziskav in razvoja umetne inteligence.

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predsedniki Slovenske konference o umetni inteligenci

FOREWORD

With regards to artificial intelligence, we live in exciting times. During Information Society 2022, ChatGPT was not yet available, but when it appeared, everything changed – artificial intelligence turned from a subject mainly discussed by experts to something everyone is talking about. The changes in the perception of (generative) artificial intelligence are somewhat greater than the changes in its actual capabilities, but the latter are also substantial: it has definitely become a highly useful tool for writing text and software code as well as for generating images, it is increasingly capable as a personal assistant, and more. If it continues to advance at the current pace, we can easily imagine the future to bring dramatic improvements in economic productivity, research and everyday life. But many also see it as a threat: it may generate personalised harmful content at scale and take away jobs from people, and some even believe it may kill us all. Considering which of these things are actually likely to happen is beyond the scope of this preface, so let us look instead at what these developments mean for our work.

The accessibility of large language models means that tasks requiring understanding or generating natural language are easier than ever. This is excellent, but on the other hand building such models is beyond the reach of the vast majority of organisations – both research and business – due to its huge computational cost. However, we can still engage in fine-tuning of such models, including with reinforcement learning with human feedback, and develop techniques for engineering prompts that yield desired outputs. A lot of research challenges can be found in developing methods to ensure trust in artificial intelligence and align it with the goals of the creators, for which there are no generally good solutions yet. We can also tackle questions of how to regulate artificial intelligence, how it will transform (information) society and how to ensure it will transform it for the better, what intelligence is, and when its artificial version will gain consciousness.

Looking at the Slovenian Conference on Artificial Intelligence, we notice that only one out of the 12 papers touches upon large language models, and none addresses the social aspects of artificial intelligence. To better address the hot topics of recent times, we invited Mykola Pechenizkiy from Eindhoven University of Technology to give a keynote on practical problems and methods of trustworthy artificial intelligence. Last year we successfully combined the conference with Data Science Meetup – an event where industry experts give short presentations of their work – so we are going to organise it in a similar manner this year. Connecting with the industry is more important than ever, as more and more research and development of artificial intelligence is happening there.

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Time-Series Cutmix Data Augmentation for Heart Sound Classification Using Neural Networks

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ABSTRACT

In cutmix augmentation, a synthetic data instance is created by mixing parts of a pair of original instances. In this paper, a domain-specific time-series cutmix approach was employed for a heart sound classification task. The approach utilized neural networks and was tested on a publicly available heart sound dataset. To assess the efficacy of generating realistic instances, we implemented three distinct constraints for pairing requirements. Our main focus of interest was evaluation of performance of the approaches on datasets of varying sizes, thus we performed the experiments using different fractions of the train set. Cutmix showed promising results as best improvements in accuracy over the no augmentation baseline reached 5.61% and 1.46% when 10% and 100% of the training data were used, respectively.

KEYWORDS

cutmix, synthetic data generation, time-series augmentation, phonocardiogram, heart sound classification, neural network

1 INTRODUCTION

The accurate classification of heart sounds plays a crucial role when it comes to early detection of cardiovascular diseases (CVDs). Although heart auscultation is a cost-effective and efficient diagnostic method, the accurate identification of heart abnormalities requires proficient auscultation skills. Auscultation, typically performed with a stethoscope, involves listening to the various sounds produced by the heart, such as heartbeats and murmurs, to detect any irregularities or issues. To reduce the burden on healthcare staff and to mitigate the medical costs of delayed CVDs detection, there is a growing demand for automated approaches for identification of heart sound abnormalities. The integration of cutting-edge machine learning (ML) and signal processing technologies has led to the widespread adoption of automated computer methods for tackling this challenge.

When it comes to heart sound classification from phonocardiograms (PCGs) using ML technologies, a variety of approaches have been tried and established, most of which draw inspiration from the broader domains of general audio and image data analysis. These encompass strategies such as utilizing features derived from time-series signals as inputs for classical ML models or neural networks (NNs). Additionally, techniques involving spectrograms as inputs for NNs, employing time-series directly as NN inputs, extracting deep features from NNs for use in ML models, and even applying wavelet analysis have all been experimented with.

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In alignment with this research landscape, our study revolves around utilizing time-series PCGs as inputs for a NN. This particular approach has been previously explored and reported in [11, 3, 13, 16, 5, 6, 17, 10, 1, 18, 12].

When it comes to time-series augmentation, the basic approaches include augmentations in time, frequency and time-frequency domains such as jittering, flipping, scaling, warping, cutout, cutmix and others [15, 7, 19]. To the best of our knowledge, the only works that specifically analyse augmentation methods for heart sound classification deal with spectral imaged based approaches [8, 2, 21]. In this paper, we present a cutmix approach that has been specifically adapted to time-series PCG domain. In a cutmix approach, a synthetic instance is created from two original PCGs. To assess the efficacy of generating realistic instances, we implemented three distinct constraints for pairing requirements. These constraints help limit the various ways in which the original PCGs can be distributed in pairs for the creation of the synthetic PCGs.

2 DATASET

In this study, we used heart sounds from the PhysioNet/CinC Challenge 2016 dataset [9, 4], which consists of six (a-f) distinct PCG databases. Recordings were labeled as either normal or abnormal heart sounds and were split into train and validation set by the competition organizers. For our experiments, we utilized the validation set as the test set, while adjusting the original train set to achieve class balance. To ensure fair evaluation, both the train and the test subsets were balanced with respect to the two classes. In total, we used 277 normal and abnormal train recordings and 145 normal and 151 abnormal test recordings as depicted in Figure 1. The total lengths of train and test recordings are 3h 18min and 1h 37min, respectively.

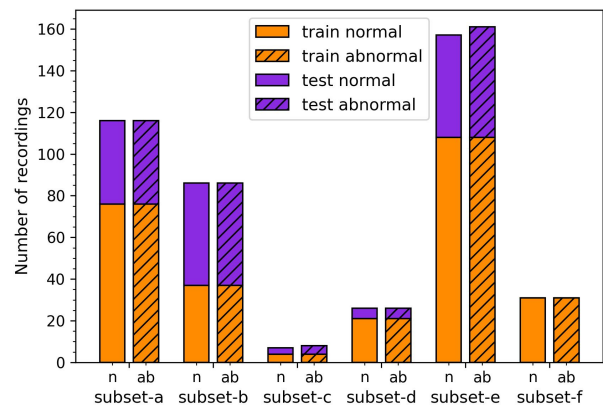


Figure 1: Data distribution used in our experiments.

The dataset also includes segmentation annotations denoting the locations of the fundamental heart states (S1, systole,

S2, and diastole) for each of the PCGs. They were computed using Springer’s segmentation algorithm [14] and additionally manually checked and corrected by the experts.

3 METHODOLOGY

The outcome of interest used to evaluate the cutmix approaches was a binary variable indicating whether a PCG represents a normal or abnormal heart. The methodology steps included pre-processing of the PCGs, selection of NN architecture and determination of cutmix augmentations techniques.

3.1 Preprocessing

The recordings were first down-sampled to 1000 Hz, filtered using Butterworth filter of order four to four frequency bands, 25-45Hz, 45Hz-80Hz, 80-200Hz, 200-400Hz, and finally normalized using root mean square normalization with the target amplitude of -20 dBFS. The recordings were then split into separate heart cycles (segments) according to segmentation annotations and zero-padded to 2.5s. Each instance was thus a time-series 2-D array of shape (4, 2500), with the first dimension denoting the number of frequency band channels and the second dimension denoting the segment length.

The goal of our study was to also find out how well the cutmix augmentation approaches perform on datasets of smaller sizes, therefore we split the training set into a variety of differently-sized smaller sets, specifically, 10%, 20%, 40%, 60%, and 80%. The selected smaller training sets were randomly selected and were stratified with respect to the data subsets and class labels within each subset. First, the smallest (10%) subset was created. Then, new subjects were added without reselection of the smaller set, meaning that the first next larger set (20%) included all of the subjects from the smaller set. This process was repeated until all of the subsets were created.

3.2 Convolutional Neural Network

The neural network structure used in our experiments was inspired by the one proposed in [11]. It consists of four convolutional neural networks (CNN) where each takes a different frequency band as the input. Besides the input layer, the CNNs consists of two additional layers, each including a convolution, ReLU activation and max-pooling. The last CNN layer also includes 25% dropout. The output of the four CNNs are flattened and input to a dense network with 20 hidden neurons with dropout of 50% and two output neurons.

3.3 PCG Cutmix Augmentation

We tested different cutmix approaches of data augmentation for classification of the PCGs. A cutmix data augmentation technique is originally an image data augmentation strategy that replaces a patch of pixels from one image with a patch from another image [20]. In our case, a section of one PCG was replaced by a section of another PCG. A synthetic instance is generated from a pair of original instances, input 1 and input 2.

In the cutmix technique presented in this study, a synthetic instance was generated using the following steps. Firstly, a pair of input instances with the same class label was selected. Secondly, both input instances were cut at the same point within the four heart beat stages (S1, systole, S2, diastole). Subsequently, the first part of input 1 was mixed with the second part of input 2. This process resulted in a new synthetic instance encompassing all four heart beat stages that had the same class label as the inputs.

Note that only one synthetic instance was generated per input instance. Cutmix scheme is shown in Figure 2.

Two cutting variations were considered, deterministic and random. In a deterministic variation, the cutting point was always right after systole, as depicted with red dashed line in Figure 2, while in random variation, a cutting point was randomly chosen to be either right after S1, systole, or S2 as depicted with dashed black lines.

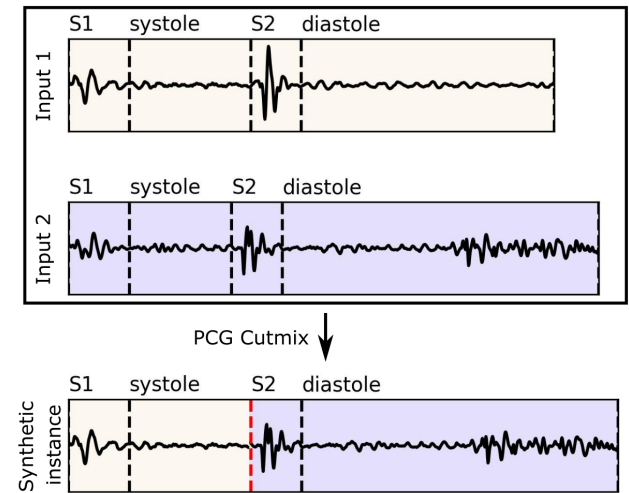


Figure 2: Visualization of PCG cutmix. Inputs 1 and 2 have the same class label. The black dashed lines denote possible cutting points, while the red dashed line denotes the selected cutting point. Note that only one synthetic instance is generated per input pair.

Data augmentation was performed during the model training. If a batch underwent augmentation (this was determined by the cutmix probability parameter for each batch separately at random), then the whole batch was replaced with the synthetic batch. The synthetic batch was created in such a way, that each instance of the original batch played a role of input 1 and input 2 exactly once, which results in the synthetic batch having the same size as the original and no original instance being over- or under-represented. In all of the cases, the synthetic instances were generated using PCGs of the same class label, thus eliminating any uncertainties regarding the labeling of the generated instance. Furthermore, we implemented some additional pairing requirements. In the Subset cutmix, the input pairs were constrained to be drawn from the same data subset, while in the Subject cutmix, the input pairs had to belong to the same subject (same PCG). In the Length cutmix, the instances in the batch were sorted into 10 bins based on their heart beat length, and each pair was drawn from the same bin. The unconstrained cutmix methodology is referred to as Basic cutmix. The idea behind the limitations was to check if creating more realistic synthetic PCGs by forcing the input PCGs of each synthetic instance to have the same recording settings, come from the same subject and/or be of similar length improves the model performance.

3.4 Hyperparameter Finetuning

In our experiments, there were four parameters to be tuned. Three hyperparameters, e.g., batch size, epoch number and learning rate, as well as the augmentation probability parameter. The latter denotes the probability of applying augmentation to a batch during

training. To optimize these parameters, we employed a grid-search methodology, which involved evaluating performance on the training set through three-fold cross-validation. To reduce search time, batch size was fixed to 512, which demonstrated effectiveness across all scenarios. Meanwhile, we explored epoch numbers within the range of 50 to 100, learning rates ranging from 10^{-4} and 10^{-1} , and cutmix probabilities spanning 0.1 to 1.0.

In order to minimize the number of experiments required for identifying the optimal configurations, we divided the fine-tuning process into stages. Initially, we determined the best combination of epoch number and learning rate for the baseline scenario without augmentation. Subsequently, utilizing these identified settings, we fine-tuned the augmentation probability for each specific augmentation technique. Ultimately, the chosen parameters were utilized to train the model using the complete training set, with final evaluation carried out on the test set.

It is important to note that additional improvement of both baseline and the methods' accuracies could be achieved by expanding the hyperparameter search grid. Although we fixed the batch sized at 512 due to computational constraints, our experimentation revealed that smaller batch sizes tend to yield slightly improved outcomes.

4 RESULTS

To explore the impact of generating synthetic data on datasets of varying sizes, we assessed the effectiveness of cutmix augmentation technique across various proportions of the training data: 10% (56 PCGs), 20% (112 PCGs), 40% (222 PCGs), 60% (334 PCGs), 80% (444 PCGs), and 100% (554 PCGs). Alongside the cutmix approaches, we present results for the no augmentation baseline scenario as well. Accuracy served as the key performance evaluation metric, with findings based on the mean and standard deviation (SD) derived from three runs. The results are shown in Figure 3 and are given in Table 1.

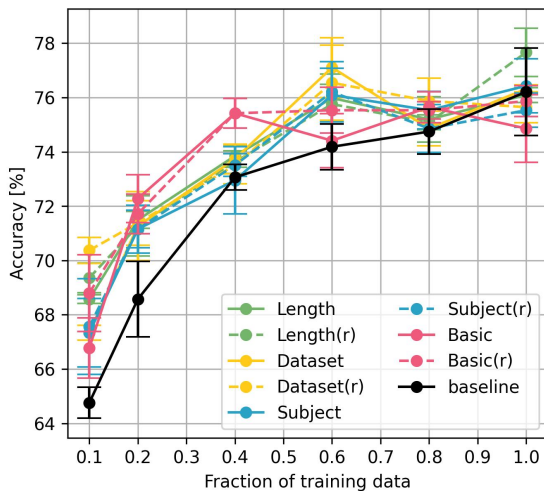


Figure 3: Accuracy vs. training data fraction of the cutmix approaches and the baseline.

We see that all of the methods work decently with some of the methods providing big improvements in accuracy over the baseline. At 10% and 100% of the train data, accuracy improvements over the baseline are 5.61% and 1.46%, respectively. To

check the statistical significance of the results, we included accuracy SD derived from a set of three experiment runs. In scenarios involving 10% and 20% of the training data, all cutmix approaches demonstrated statistically significant improvements compared to the baseline approach. However, for higher percentages of training data, not all of the approaches showed statistically significant improvements. The augmentation techniques seem to have insignificant effect when the whole train data is used.

When comparing deterministic and random cutting variations, the outcomes show that in the majority of the cases there are no statistically significant differences between the two.

In terms of the pairing requirements constraints, the most constrained method, Subject, performs the worst. Conversely, the least constrained method, Subject and unconstrained Basic approach, perform the best, whereas the moderately constrained Length method shows intermediate performances. Consequently, we deduce that the pairing diversity holds substantial significance, whereas the strategy of how the pair instances are mixed together holds lesser importance. Comparing the Dataset and Basic approaches does not give a straightforward answer on which one works better.

Interesting view of performance of the synthetic data generation is also measuring how much the dataset size appears to expand due to synthetic data generation technique relative to the initial dataset size. For this purpose, we first linearly extrapolated the baseline method above the 100% of the training data as well as interpolated the values below 100%. After that, the accuracy of each method at given fraction of training data was compared to the baseline to see at which data fraction the (inter/extrapolated) baseline achieves the same performance. The expansion percentages were then calculated by dividing the two data fractions. For example, the Dataset approach at 10% of training data achieves the same accuracy as the (interpolated) baseline at 28% of the training data, thus the apparent data size expansion due to synthetic data generation equals to 280%. Complete results are given in Figure 4.

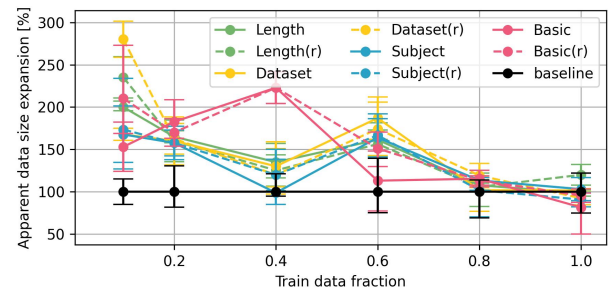


Figure 4: Apparent data size expansion vs. training data fraction.

5 DISCUSSION AND CONCLUSIONS

Our analysis indicates that the proposed cutmix augmentations substantially improve the no augmentation baseline when it comes to heart sound classification tasks using variously-sized training datasets. The results also show that there is no statistically significant difference between the random and deterministic cutting variations of the approaches. In terms of the pairing requirements constraints, the methods with no or very little constraints, Basic and Dataset, show superior performance.

Table 1: Methods' accuracies for different percentages of the training set. The numbers are given as mean (SD) derived from three runs. The best results for each considered percentage of training data are written in bold.

Method	Percentage of training data					
	10% (N=56)	20% (N=112)	40% (N=222)	60% (N=334)	80% (N=444)	100% (N=554)
Basic	66.78±1.11	72.28±0.88	75.42±0.55	74.41±0.99	75.65±0.57	74.86±1.24
Basic(r)	68.8±1.41	71.72±0.73	75.42±0.55	75.53±0.84	75.53±0.32	75.87±0.57
Length	68.57±0.16	71.49±0.32	73.85±0.42	75.98±0.88	75.2±0.84	76.09±0.27
Length(r)	69.36±0.55	71.27±1.11	73.63±0.42	75.76±0.73	75.08±0.27	77.67±0.88
Dataset	67.34±0.27	71.27±1.27	73.74±0.55	77.1±1.1	74.86±0.63	76.32±0.16
Dataset(r)	70.37±0.48	71.38±0.82	73.51±0.69	76.54±1.38	75.87±0.84	75.65±0.57
Subject	67.34±1.26	71.16±0.88	72.95±1.24	76.09±0.99	75.53±0.69	76.43±0.99
Subject(r)	67.56±1.77	71.16±0.69	73.51±0.42	76.21±1.11	74.86±0.88	75.53±0.63
baseline	64.76±0.57	68.57±1.38	73.06±0.48	74.19±0.84	74.75±0.82	76.21±1.61

Conversely, the most constrained method, Subject, performs the worst, whereas the moderately constrained Length method shows intermediate performances. As a result, we deduce that the variability in pairings carries considerable importance, whereas the cutting approach, whether deterministic or random, holds comparatively less importance.

Although the results of the best augmentation methods look promising, further experimentation is essential. These experiments should include various selections of fractions of the training data. This is important due to intrinsically stochastic nature of selecting a fraction of the training dataset. This influence of randomness becomes stronger as the fraction size decreases. For instance, if we repeatedly choose 10% of the training set at random, the resulting subsets will exhibit significantly less overlap compared to the scenario where we repeatedly select 80% of the training set randomly.

The cutmix augmentation methods have demonstrated their ability to yield superior results compared to the baseline. Nevertheless, further experiments are needed to compare these methods with standard time-series augmentations, including techniques such as cutout, manifold mixup, noise induction, polarity flip, gain adjustment, and more.

ACKNOWLEDGMENTS

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Social Interaction Prediction from Smart-Phone Sensor Data

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ABSTRACT

Occupational stress is often associated with social interactions. We used data collected as a part of the larger study to predict whether a person is interacting with another while at work and at home. The dataset consisted of three weeks of data of 55 participants and included information on application and screen usage, calls, location, and Bluetooth and Wi-Fi data. We exploited a question about work activities to obtain approximate labels of social interactions. Additionally, we derived a feature indicating indoor location, which did not turn out to be useful in our case. In a binary classification problem tackled with a random forest model, we achieved an F_1 score of about 0.57.

KEYWORDS

social interactions, mobile sensing, indoor localization, stress detection

1 INTRODUCTION

The relationship between stress and social interactions is a complex one. Social interactions can both offer relief from psychological distress and be influenced by stressors [18]. For instance, distress can trigger support from empathetic individuals, but persistent distress can erode such support over time. Interpersonal encounters, especially instrumental support (e.g., help with tasks), can act as a protective factor against occupational stress [16] and burnout [4], but they can also be sources of conflict.

In the field of artificial intelligence, researchers have recognized the significance of social interactions, often using smartphones for monitoring due to their widespread use. Various smartphone sensors, including GPS, Bluetooth, Wi-Fi, accelerometer, microphone, and on-device analytics like call and message monitoring, application usage, screen activity, and battery status, have been employed for this purpose [20].

This paper outlines a method for detecting a person's involvement in a social interaction. We utilize a dataset of smartphone

sensor data labelled with the number of people a person interacted with in the last ten minutes. Importantly, unlike many studies that focus on remote social interactions (e.g., [2]), controlled settings (e.g., [13, 8]), or use dedicated hardware (e.g., [7, 14]), we predict everyday face-to-face interactions using personal smartphone data. Our focus is solely on predicting the number of people present during interactions. We intend to use this as a feature to predict social support quality and aspects of occupational stress.

2 DATA COLLECTION

We obtained this dataset as a part of a larger study called *Stress at work* (STRAW; [1]), where we developed an Android application [12] based on the AWARE framework [6]. This app collected participants' self-reports and smartphone data, including screen and application use, GPS location, calls, and Bluetooth and Wi-Fi access points. Participants completed short questionnaires approximately every 90 minutes, which included questions from psychometrically validated scales. They also contained questions about work activities from the previous 10 minutes.

Participants reported diverse work activities, including breaks, transit, individual work, and working with others. In the case of working with others, they specified in-person, telecommunication-based, lecture, or other interactions, also indicating the number of people involved as one, two, or more than two.

In the primary study, we collected data from 55 participants employed at research organizations in Belgium and Slovenia, with diverse genders (26 women) and ages (mean age 34.9 years, ranging from 24 to 63 years). Each participant provided data for 15 working days, responding to the questionnaires roughly every 90 min as designed [11].

3 TARGET AND FEATURE EXTRACTION

To create a predictive model for social interactions, we first defined the target variable by processing answers to the question work activity questions and then selected the most informative features. With these labelled data and the chosen features at hand, we trained a supervised random forest model, as elaborated in Section 5.

3.1 Label Extraction

We processed answers to the question about work activity in the last ten minutes and extracted the following attributes for these 10-minute segments of collected data:

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- `n_others`: Number of interactions with others in last 10-minutes (-1: exact number unknown, 0: alone, 1: one additional person, 2: two additional people, 3: more than two additional people).
- `inperson`: Interaction in person (True/False).
- `formal`: Formality of interaction (True/False)

Due to question interdependence some attribute values were impossible to determine, resulting in missing values. For instance, participants mentioned activities like “coffee, lunch or toilet break” for which we didn’t collect the number of people present.

These attributes served two purposes: data filtering (`inperson` and `formal`) and segment labelling (`n_others`), resulting in a labelled dataset of 3371 10-minute segments with features listed in the next section. The target variable distribution was highly imbalanced (see Table 1).

Label	Examples Count	Binary Merged Count
3	479	1157
2	179	
1	390	
-1	109	
0	2214	2214

Table 1: Class distributions of extracted and merged labels.

To simplify the problem, we merged labels into a binary representation, indicating whether the number of people involved was greater than 0 (True) or not (False).

3.2 Features

3.2.1 Initial Feature Set. Following the literature referenced in Section 1, we selected sensors from the collected data that could be informative in predicting interactions. We computed first and second-order features from these sensors during the 10-minute segments. Below are the sensors we utilized, along with brief descriptions and feature counts in parentheses:

- Activity_recognition (1): Physical activity (walking, running, cycling).
- Applications_foreground (99): Use of various categories of phone applications.
- Bluetooth (30): Count and variance of visible Bluetooth devices (own and foreign).
- Calls (29): Call duration, quantity, and entropy of duration.
- Locations (21): GPS location features like variance and average speed.
- Messages (10): Number of sent/received messages.
- Screen (7): Screen details, such as unlock duration.
- Speech (5): Detection of human speech via microphone input.
- Wi-Fi (8): Visible Wi-Fi access point count, Wi-Fi localization (see Section 4).

Here, the speech sensor was a custom-implemented method that was running on the device and classified audio data online (see our previous work, [9], for more details)

3.2.2 Feature selection. In previous work [12, 11], we implemented numerous features from the sensors mentioned earlier. To address high feature correlation, we reduced them to a smaller subset before classification. We applied a threshold of $r = 0.8$ and retained only one feature from each highly correlated group.

In cases where features were highly similar and had correlations close to 1, the selection was arbitrary. We chose the feature based on its simplicity and ease of interpretation. Figures 1 and 2 depict correlation matrices before and after this feature selection step.

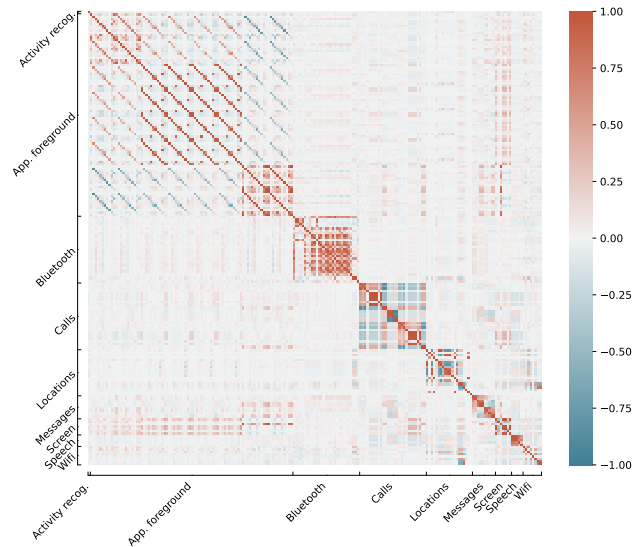


Figure 1: Correlation matrix of all features grouped by sensor, excluding categorical features

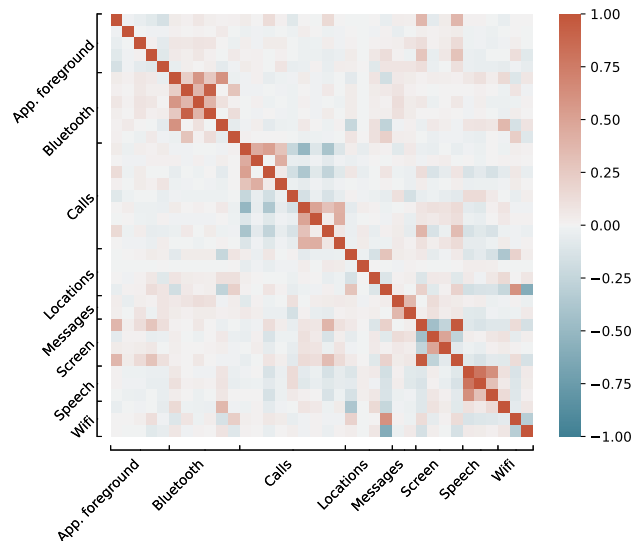


Figure 2: Correlation matrix after manual elimination of highly correlated features.

We utilized sklearn’s [15] random forest (RF) implementation to reduce the dimensionality of feature space, employing the Gini impurity metric. We explored various RF hyperparameters (`max_depth`: 10, 20, 30 and 40; `n_estimators`: 100, 500 and 1000) to observe feature selection and their impact on Gini impurity. Some features were infrequently chosen, and some of the selected ones had minimal impact (less than 0.02 reduction) on Gini impurity. We performed 10-fold cross-validation to assess the selected feature set’s predictive quality using the F_1 metric. By evaluating how features influenced the F_1 score and retaining those significantly impacting it while removing others with minor effects on Gini impurity, we derived the final feature set:

- `phone_screen`: Screen unlocks and total screen unlocked time.
- `phone_speech`: Mean and standard deviation of human voice proportion in audio.
- `phone_applications_foreground`: Duration of communication and tools app usage.
- `phone_locations`: Average speed, time in significant locations, location variance logarithm, and time at the most visited location.
- `phone_bluetooth`: Number of unique devices, total scans of others' devices, and their mean.
- `phone_wifi_visible`: Number of unique sensed Wi-Fi access points.
- `phone_calls`: Mean call duration (outgoing and incoming).

Most of the features used were included in RAPIDS [19] with implementation of Doryab's [5, 3] Bluetooth and location features.

4 WI-FI LOCALIZATION

In addition to the simple features described in the previous section, we aimed to incorporate indoor location data into our models, focusing on a subject's home and work settings based on GPS location. We identified these settings by distinguishing between the two most frequented locations within each setting.

4.1 Rough GPS location

For rough GPS location determination, we utilized GPS cluster labels provided by Doryab [5]. We employed a simple heuristic, considering the most common cluster label between 00:00 and 6:00 as home and between 6:00 and 20:00 as work. Subsequently, we segregated each subject's Wi-Fi scan data into home and work categories, excluding data recorded outside of these time segments. This allowed us to analyze each setting independently.

4.2 Indoor Wi-Fi location

We adapted Wi-Fi localization from a supervised to an unsupervised learning approach due to a lack of calibration steps during data collection. This adjustment was made individually for each subject's data, given the differences in their environments.

The Wi-Fi sensor data included three key variables: timestamp, detected device's media access control (MAC) address, and received signal strength indicator (RSSI). We filtered out entries with uncommon MAC addresses (appearing fewer than 100 times) and grouped the remaining entries into 1-minute segments to create Wi-Fi fingerprints. Each fingerprint, specific to a subject and setting, comprised a combination of MAC addresses and corresponding RSSI values recorded during that minute. This often resulted in 70 or more unique values, presenting a high-dimensional clustering challenge.

4.3 Clustering

We applied k -means clustering with the silhouette measure to determine the optimal value of k . Given the uncertainty about the number of significant locations per subject, we started with $k = 12$ and reduced it, ultimately stopping at a minimum of $k = 4$, as we expected at least four significant locations (e.g., desk, lunch, meeting room, other).

For each clustering result, we computed the silhouette measure [17] and selected the k value yielding the highest silhouette score. Additionally, we manually assessed the clustering results

by visualizing the relationship between different combinations of principal components (see Fig. 3).

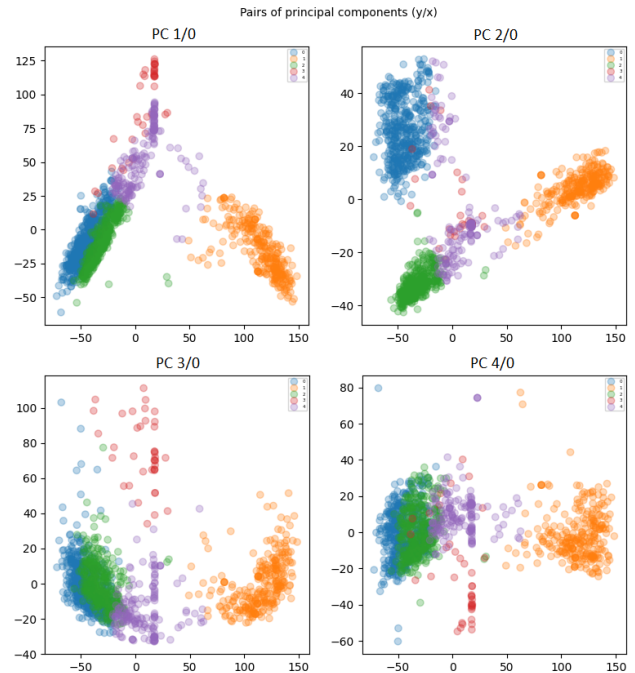


Figure 3: Visualization of a subject's Wi-Fi fingerprint clustering results using principal component pairs as returned by principle component analysis with colours representing different clusters.

After clustering individual-specific data, we assigned an indicator label unique to each person, which couldn't be generalized. For each location, we determined whether it represented the most or second-most frequent location in a given setting. We split the data into home and work subsets, performing separate Wi-Fi data clustering for each, resulting in four localization features.

- **Scope:** General location classification as most common (1), second most common (2), or neither (0), alongside personal cluster labels.
- **Setting:** Home or work (determined by rough GPS location). If outside these settings, corresponding features were set to -1.

Ultimately, these features proved uninformative for our use case and were removed during feature selection in Section 3.2.2. This may be attributed to limitations in our modified clustering approach without initial calibration steps during data collection.

5 INTERACTION CLASSIFICATION

We selected the random forest model for its versatility in handling both categorical and numerical data, capturing complex, non-linear feature-target relationships through ensemble techniques. To tackle dataset imbalance, we initially used imblearn's [10] random oversampling and undersampling, with undersampling proving superior in our F_1 score evaluation. Additionally, we imputed missing values with zeros when it logically represented the intended feature content, e.g., missing duration values indicating non-usage of specific applications.

Table 2 presents LOSO and 10-fold cross-validation results for models, comparing undersampling, oversampling, and the

original class distribution. We explored various random forest configurations by adjusting maximum tree depth (Max_d) and the number of trees (N_estim).

Dataset imbalance posed challenges; oversampling and the base approach led to numerous false classifications in the majority class, while undersampling misclassified more majority class examples as the minority. A more balanced class distribution yielded a less biased model and a slight increase in the average F_1 score with undersampling. LOSO was notably affected by sampling methods, with undersampling performing better due to the problem's subject-dependent nature and overlap in examples between train and test splits in 10-fold CV.

Hyperparameters		LOSO			10-Fold		
Max_d	N_estim	Under	Over	Base	Under	Over	Base
40	100	0.573	0.504	0.471	0.553	0.530	0.471
40	500	0.562	0.508	0.482	0.549	0.551	0.476
40	1000	0.557	0.512	0.481	0.556	0.556	0.479
30	1000	0.555	0.513	0.483	0.542	0.551	0.480
20	1000	0.561	0.519	0.477	0.547	0.556	0.482
10	1000	0.558	0.524	0.462	0.559	0.552	0.447

Table 2: Table displaying F_1 scores for the model with various hyperparameter combinations. It presents results for both CV and LOSO approaches using undersampling (Under), oversampling (Over), and no class imbalance mitigation (Base).

6 CONCLUSIONS

In this paper, we developed an RF model to detect personal interactions using various phone sensors, achieving an F_1 score of 0.57 after feature filtering. The most informative features included the speech sensor and the subject's application usage statistics. Surprisingly, the indoor location did not improve results, possibly due to the COVID-19 pandemic's remote work context. Despite social interactions not being the focus of the primary study, we achieved a moderate F_1 value. We anticipate that with a more focused data collection approach and a balanced dataset, further improvements can be made, potentially enabling accurate estimation of the number of people in social interactions.

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Comparison of Advanced Processing Methods for PPG Denoising using a Novel Signal Quality Metric

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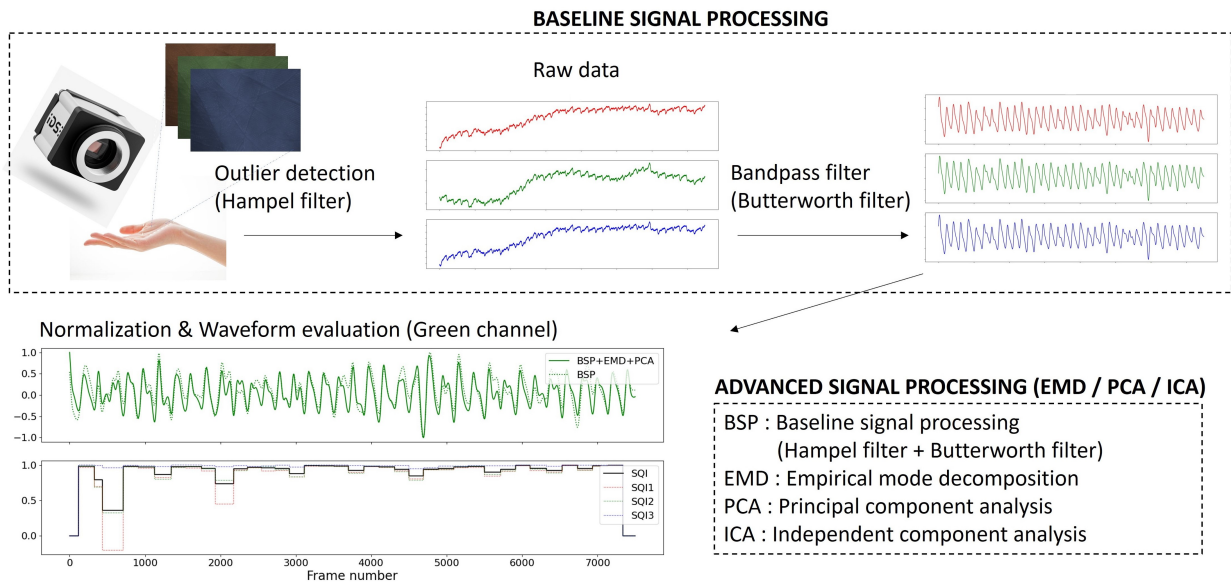


Figure 1: The top dashed box is baseline signal processing, the bottom right is advanced signal processing. The Upper left subplot is the raw recording of RGB channels. Both baseline and advanced signal processing were applied, and the lower subplot shows the denoised signal and its waveform evaluation.

ABSTRACT

Photoplethysmography (PPG) is a non-invasive method measuring blood volume changes using light. By illuminating tissue and observing light variations, PPG captures blood flow fluctuations. Vital physiological parameters can be obtained by analyzing the PPG signals, such as heart rate and oxygen saturation. In this study, we acquired PPG signals from the palm of a hand using camera-based remote sensing. However, this approach is especially sensitive to noise due to contact-free nature. We propose novel metrics for waveform evaluation of PPG signals and a unique pipeline combining several advanced methods for PPG

denoising. Applying our state-of-the-art pipeline to our dataset demonstrated a 5-12% improvement in the resting state and a 27-28% improvement in the active state in terms of our proposed Signal Quality Index metric. This was compared to the baseline denoising which employed only outlier removal and bandpass filtering.

KEYWORDS

photoplethysmography, noise removal, empirical mode decomposition, principal component analysis, independent component analysis, signal quality assessment

1 INTRODUCTION

Non-invasive physiological monitoring has grown essential in healthcare. Photoplethysmography (PPG) uses light to track blood volume changes. PPG often employs contact sensors, capturing light variations through the skin, which unveil blood flow characteristics and allow the extraction of metrics like heart rate (HR)

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and oxygen saturation. However, obtaining such parameters is not straightforward due to PPG being susceptible to noise such as motion artifacts.

Remote PPG (rPPG) acquires PPG signals without direct contact, avoiding the discomfort of attached devices. However, rPPG signals are more vulnerable to noise, especially from unintended movements. This leads to degradation of the PPG signal. When estimating blood pressure using PPG, accurate detection of systolic peaks is crucial [12]. Motion artifacts, however, can induce problematic peak shifts in the PPG signal.

The aim of this study was to refine the rPPG signal and assess its waveform with our proposed Signal Quality Index (SQI) detailed in Section 3.3. By examining different processing techniques for noisy rPPG signals, we wanted to enhance PPG technology and improve physiological monitoring reliability.

2 RELATED WORK

Several methods have been proposed to remove motion artifacts from PPG signals, with statistical approaches like Principal component analysis (PCA), Independent component analysis (ICA), and Empirical mode decomposition (EMD) [3, 9, 6]. In estimating the PPG-derived respiratory rate, separate utilization of PCA and EMD has demonstrated errors of 1.48 and 0.07 breaths/min, respectively, suggesting their efficacy in noise removal. However, the performance without any filter remained unassessed, so it is difficult to evaluate its performance. In another study, Motin et al. integrated EMD and PCA for PPG-based breath rate estimation. They reported absolute errors of 0.9 breaths and 9.9 breaths in 5-minute recordings, depending on the dataset [6]. In contrast, the exclusive use of a bandpass filter resulted in errors of 5.4 and 10.5 breaths in 5-minute respectively [8], indicating that combining different processing methods might be effective in improving robustness. In these studies, the PPG signal was not evaluated directly but rather through the quality of variables extracted from it. In contrast, Slapničar et al. focused on the waveform of the PPG signal itself and evaluate the signal in a data-driven manner [11]. In their study, a metric called Signal Quality Indices (SQIs) was defined and a threshold was set to extract only good waveforms.

3 METHODOLOGY

Our methodology for processing PPG data was divided into two stages: baseline signal processing (BSP) and advanced signal processing. In the BSP stage, we first applied the Hampel filter followed by the Butterworth filter to detect outliers and extract specific frequency components. In the advanced signal processing stage, additional noise removal was accomplished using either EMD, PCA, ICA, or a combination of these methods.

We then assessed the performance of previously described PPG processing methods using custom SQIs, which we describe in detail in Section 3.3. In this study, it was assumed that the HR was between 50 and 140 beats per minute ($50 \leq \text{HR} \leq 140$) as the HR of the subjects in our experiment ranged from about 60 to 130.

3.1 Baseline Signal Processing

We first used the Hampel filter to detect outliers. Afterwards, since the PPG data was expected to have some frequency range, a Butterworth filter was employed to extract specific frequency components. Based on the data obtained from these processes, we detected peaks using peak detection algorithm detailed by

Lazaro et al. [4] and if the number of peaks did not correspond to the HR specified previously, the data was discarded as too noisy during recording. For peak detection, we set a window (the size of which was based on HR), identified the highest gradient within, and marked the subsequent local maxima as the systolic peak. To isolate a PPG signal cycle, we also discerned the valley points, taken as the minimum between two systolic peaks [11].

3.1.1 Hampel Filter. The Hampel filter identifies outliers in time-series data through the following procedures.

- Take three points before and after the target data point and calculate the median within this window.
- Compute the median absolute deviation (MAD) by determining the median of the absolute differences between each data point in the window and the window's median.
- Multiply the MAD by a constant to estimate the standard deviation under the assumption that the data follows a normal distribution.
- If the absolute difference between a data point and the median of its window exceeds three times the MAD, the data point is deemed an outlier and is replaced with the window's median.

3.1.2 Butterworth Filter. After processing the data using the Hampel filter, we used the Butterworth filter to extract components from 0.5Hz to 3.0Hz. By using this filter, we eliminated both low-frequency and high-frequency components.

3.2 Advanced Signal Processing

Within the Butterworth filter's cutoff frequency range, we further denoised using either EMD, ICA, PCA, or a combination of these methods. In this study, we considered the following combinations:

- | | |
|-----------------|----------------------|
| (i) BSP | (iv) BSP + EMD |
| (ii) BSP + PCA | (v) BSP + EMD + PCA |
| (iii) BSP + ICA | (vi) BSP + EMD + ICA |

3.2.1 Empirical Mode Decomposition. EMD is a method of decomposing a signal into physically meaningful components and is used to analyze nonlinear or non-stationary signals. Using EMD, signals can be decomposed into "intrinsic mode functions" (IMFs), which correspond to components of different frequency. We referred to the detailed algorithm in this paper [1]. For each component of the IMFs, only the first intrinsic mode function (IMF) consistently had peaks within the predefined HR range. Thus, we selected this first IMF as the PPG signal.

3.2.2 Principal Component Analysis. PCA compresses multidimensional data and extracts essential features [10]. In this study, each frame captured by the camera was divided into a 3x3 grid, giving 9 regions. Each region's average pixel value formed a nine-dimensional input. This was reduced to two dimensions, representing the PPG signal and noise. By comparing the number of peaks in the post-PCA data with the expected HR, the first component of the PCA was determined to be the PPG data. However, it should be noted that PCA can occasionally produce inverted outputs because the sign of eigenvectors, which determine the direction of principal components, is arbitrary and can be positive or negative. To account for this, we checked the correlation coefficient between the PCA output and the PPG signal which was processed with BSP after averaging the entire frame.

If the correlation coefficient was negative, indicating inversion, the output was then multiplied by -1.

3.2.3 Independent Component Analysis. ICA is a technique used to decompose multivariate signals into statistically independent components [2]. Like PCA, each frame was divided into nine regions for input, and the output consisted of two dimensions: the PPG signal and noise. However, since ICA does not define the order or sign of the separated sources, it is ambiguous to identify which outputs are related to PPG or noise, and also the components can be inverted. Therefore, considering both the output data sets and their inverses (making a total of four potential sets), the data with the highest correlation coefficient to the PPG signal which was processed with BSP after averaging the entire frame was selected as the PPG data.

3.3 PPG Waveform Quality Assessment

For PPG waveform evaluation, a template was first created. This template was then used to calculate the SQI by comparing the denoised PPG data with the template.

3.3.1 Template Wave Formation. The length of one cycle template waveform was computed using autocorrelation analysis. Given the previously defined HR range, the potential cycle length range was denoted by Eq. (1)

$$\frac{\text{fps} \times 60}{140} \leq L \leq \frac{\text{fps} \times 60}{50} \quad (1)$$

where fps is the sampling frequency in Hertz (fps = 250 Hz) and L is the template length in samples.

We then shifted the signal by all the lengths within that range, the correlation coefficients of the original and shifted signals were compared and the shift length with the highest correlation coefficient was selected as the template width. With the length L of the template determined, we extracted segments of width L from each valley point of the PPG signal. The template waveform was then created by averaging these segments.

3.3.2 Signal Quality Indices. We defined SQIs based on method proposed by Slapničar et al. [11]. However, in our study, we made some modifications to SQI3 to ensure normalization between -1 and 1. The template, created as detailed above, was compared and evaluated against each cycle of the PPG signal using the three following SQIs.

- SQI1: Data of length L starting from each valley point is directly compared with the template to calculate the Pearson's correlation coefficient.
- SQI2: Data between two adjacent valleys is considered as one cycle. If the waveform length of one cycle is different from the template, the data is compared with the template by resampling to determine Pearson's correlation coefficient.
- SQI3: Data between two adjacent valleys is considered as one cycle, dynamic time warping (DTW) is employed to find similar points with the template. DTW is a method used to align two sequences by warping their time axis to best match each sequence to the other [7]. The corresponding points are then used to calculate the Pearson's correlation coefficient.

Finally, the final SQI was computed by taking the average of SQI1, SQI2, and SQI3, as expressed in Eq. (2).

$$SQI = \frac{1}{3}(SQI1 + SQI2 + SQI3) \quad (2)$$

4 EXPERIMENTS

4.1 Recording Setup

In this study, we collected rPPG data from 11 subjects, both male and female, aged 22 to 45 years old. The iDS 3040SE-Q RGB camera set at 250 fps, equipped with the Sony IMX273 1/3" CMOS image sensor and the iDS-5M23-C1618 16 mm lens, was used for the recordings. Each subject underwent four 30-second recordings. For each recording, rPPG was obtained from red (R), green (G), and blue (B) channels. Of the four sessions, the initial two recordings were conducted in a "rest state" while the subsequent two were in an "active state". The rest state entailed subjects being in a relaxed condition for the recording, achieved by prompting them to engage in meditation or deep breathing prior to the session. Conversely, the active state referred to recordings taken after subjects performed physical activities like jumping or squats to elevate their HR. Consequently, it was expected that the PPG signal would be more stable in the rest state and the noise level would be higher in the active state.

4.2 Evaluation Pipeline

Using the PPG data obtained by the signal processing described in Section 3, the SQI of each channel (R, G, and B) was computed for each recording. The mean and standard deviation of the SQI were computed across both rest and active states. Our analysis entailed comparing the BSP with advanced methods to identify the most effective processing technique in terms of SQI. Additionally, we evaluated the performance differences between the rest (stable PPG) and active (potentially noisier PPG) states.

To compare channels, we also computed the mean and standard deviation of SQI using the PPG data obtained only by the best-performing processing method for both states. R, G, and B channels were then evaluated based on these SQI values as given in Table 1 (Best method).

5 RESULTS

The primary objective of this study was to investigate which combination of methods was most effective in noise removal. We computed the SQI for each RGB channel in both rest and active states, as detailed in Table 1.

In the rest state with minimal motion artifacts, the highest SQI was achieved using the BSP, EMD, and PCA filters. Conversely, post-motion data, which had pronounced motion artifacts, exhibited maximal SQI when BSP, EMD, and ICA filters were applied. Relative to the baseline SQI obtained by the BSP, enhancements were: 12% (R), 5% (G), and 10% (B) in the rest state, and 27% (R and G) and 28% (B) in the active state. In the rest state with minimal original noise, filtering slightly enhanced the PPG signal. In contrast, for active states with pronounced noise, the improvement was substantial. The SQI disparity between states was minimized with EMD, highlighting its efficiency in motion artifact removal. Besides, combining EMD with ICA and PCA further improved robustness. Moreover, as highlighted by Jihyoung et al.[5], the green channel consistently provided superior PPG signals compared to the other channels.

A specific view of the evaluation of the denoised PPG signal and waveform is shown in Fig. 2. The figure depicts the denoised PPG signal using the optimal pipeline (BSP + EMD + PCA) and the corresponding SQI assessment for the green channel during the rest state. For instance, during the collapse of the PPG waveform (approximately at frame number 700), the SQI manifests a diminished value.

	R_SQI		G_SQI		B_SQI	
	rest	active	rest	active	rest	active
BSP	0.73 ± 0.14	0.65 ± 0.13	0.80 ± 0.13	0.66 ± 0.12	0.74 ± 0.15	0.65 ± 0.13
BSP+PCA	0.74 ± 0.16	0.61 ± 0.12	0.80 ± 0.13	0.63 ± 0.11	0.75 ± 0.15	0.61 ± 0.12
BSP+ICA	0.71 ± 0.17	0.64 ± 0.13	0.77 ± 0.16	0.70 ± 0.14	0.72 ± 0.17	0.65 ± 0.13
BSP+EMD	0.79 ± 0.14	0.81 ± 0.14	0.83 ± 0.13	0.82 ± 0.14	0.80 ± 0.13	0.82 ± 0.13
BSP+EMD+PCA	0.82 ± 0.14	0.79 ± 0.14	0.84 ± 0.13	0.81 ± 0.15	0.82 ± 0.15	0.79 ± 0.14
BSP+EMD+ICA	0.79 ± 0.15	0.82 ± 0.14	0.83 ± 0.15	0.84 ± 0.13	0.80 ± 0.15	0.83 ± 0.14
Best method	0.82 ± 0.14		0.84 ± 0.13		0.83 ± 0.15	

Table 1: The mean and standard deviation of SQI across different processing methods, scenarios, and color channels. The final "Best method" is computed only from best-performing methods (BSP+EMD+PCA and BSP+EMD+ICA).

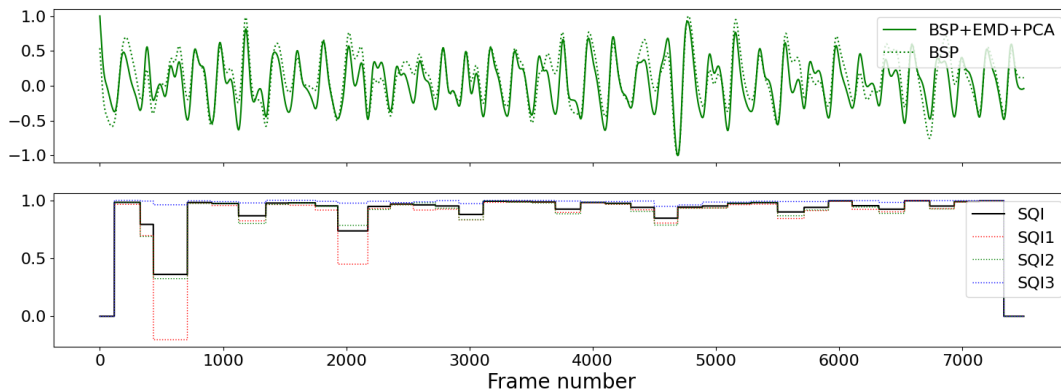


Figure 2: The top subplot shows the PPG signal (green channel) using basic signal processing and the best combination of advanced signal processing. The bottom subplot shows the corresponding waveform evaluation.

SQI values, presented in Eq. (2) as the mean of SQI1, SQI2, and SQI3, should be adjusted based on the application. For applications where precise waveform morphology are vital [12], SQI2 might be more crucial. Conversely, when precise morphology is not as important, but only the dominant peak matters, SQI1 (with its minimal computational demand) or SQI3 might be enough. Moreover, the template for SQI was created using the PPG signal obtained from each processing method. This can affect the waveform, as some systolic peaks get shifted by signal processing, as observed in Fig. 2. This is an important limitation, that requires further future investigation on how noise removal affects the details of the PPG waveform.

6 CONCLUSION

In this study, we assessed PPG signal processing techniques on in-house rPPG dataset in terms of SQI. The BSP+EMD+PCA combination outperformed the BSP by 5-12% in the rest state, while the BSP+EMD+ICA combination improved by 27-28% in the active state. The superior quality and stability of the green channel in PPG reaffirms the findings of previous studies [5].

The results highlight the potential for more advanced noise removal by integrating different signal processing, which is crucial for estimating HR and other physiological information from PPG signal. Future work will explore the impact of proposed noise removal techniques on precise morphology and subtle details of the PPG waveform.

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Machine-learning Methods for Analysis of Gene Expression Data

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ABSTRACT

Gene expression and similar types of biological data are often studied because they provide rich information about the state of an organism, and machine-learning models can be built to predict the organism's state from such data. A common challenge is that the number of genes, which correspond to features for machine learning, is typically large compared to the number of samples. This is tackled by feature-selection and dimensionality-reduction methods. The former have the advantage of providing information on important features, which may allow reducing the number of features that have to be collected prospectively. We present two feature-selection methods: an ensemble of established filter methods, and a custom bi-directional wrapper designed specifically for problems where the number of features is large compared to the number of instances and there may be interactions between the features. We compare the methods on a dataset consisting of multiple cohorts, by training models on some cohorts and testing on others, which best approximates real-life use. We find that some informative features can be identified, and while the wrapper does not outperform the filter ensemble, it does work better on the more challenging cases.

KEYWORDS

Gene expression, machine learning, feature selection

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Identifying Bumblebee Buzzes Using Neural Networks

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ABSTRACT

Bumblebees as important pollinators are keystone species and as such are crucial for functioning of the ecosystem. In Patagonia (in Argentina and Chile), the native species *Bombus dahlbomii* is under threat by the spread of invasive European species that were introduced for agricultural purposes. An important aspect of conservation efforts is monitoring of the presence of native and invasive species. Here we report on the analysis of sound recordings using neural networks, with the aim of detecting the presence of bumblebee buzzes in the recordings.

KEYWORDS

bumblebees, neural networks, buzz detection, spectrograms

1 INTRODUCTION

Bumblebees (genus *Bombus*) are a group of social insects from the bee family Apidae. They are important pollinators, often more efficient than honeybees. This comes in part due to their different morphology and lifestyle. They can forage in cold and rainy weather when honeybees will not even exit the hive, and due to a special technique called "buzz pollination" they can pollinate flowers where the pollen needs to be extracted - this is for example relevant for tomatoes, where bumblebee pollination has an extremely important commercial role as well. In ecosystems where honeybees are absent, such as in the mountains, plants rely on bumblebees and other wild pollinators.

The largest bumblebee species, *Bombus dahlbomii*, lives in temperate forests of South America, in southern Argentina and Chile [1]. It is an important pollinator of local plant species, however, it is being threatened by the introduced species (*B. terrestris* and *B. ruderatus*) that have been brought from Europe for agricultural purposes in the past decades [12, 10, 2]. As these species are expanding in range and increasing in numbers, the population of *B. dahlbomii* is diminishing and is faced with possible extinction. In order to boost the conservation efforts, careful monitoring of populations of local and introduced bumblebee species is needed as a starting point for policy makers and conservationists to plan their actions.

Bumblebee monitoring can be carried out either manually, with people in the field observing target plants and writing down notes, or with the use of technology. Clearly, even if manual monitoring has the advantage of an expert observer being able to produce high-quality records, this approach is time and resource consuming. Therefore, we explore the possibilities that smart sensors can offer, in particular sound recordings with microphones coupled with signal analysis with AI algorithms.

When it comes to utilizing machine learning (ML) for insect detection and/or classification from sound recordings, a variety of approaches have been established, many of which are influenced by the broader fields of general audio and image data analysis. These include strategies such as using features derived from time-series signals as inputs for classical ML models [11, 7], using spectrograms as inputs for neural networks (NNs) [14, 9, 8] and employing time-series directly as NN inputs [13].

In the previous studies of bumblebee sounds, some of the co-authors of this paper have investigated whether it is possible to distinguish bumblebee species and type based on flight buzzing sound [4], where, in brief, a larger body size of a bumblebee will likely result in a lower buzzing frequency. In another study, we monitored "bumblebee traffic" using microphones next to the nest-box entrance, where we used sound analysis to count the workers flying in and out [5, 3]. In those studies, the approach with microphones turned out to be highly efficient in detecting buzzes, as well as distinguishing between the arrivals and departures. In the present paper, we go one step further. We wanted to develop an algorithm that would identify bumblebee buzzes from a long recording at several chosen plants during a field study in South America. The task is more complex than the one with bumblebee traffic as the bees do not necessarily pass close by the microphone, and the buzzes sounds are furthermore masked by various ambient noises. Here, we present the initial results of an approach using convolutional neural networks for buzz detection. We discuss the accuracy of the algorithm and outline the future steps.

2 DATASET

Recordings of bumble bees were obtained in November, 2022 at forest understory and rural field sites in Argentina and Chile. Audiomoth (Open Acoustic Devices) and DB-9 USB recording devices with a detection range of 1-2 m were used to collect single channel audio recordings at 16 kHz. In this study, we used roughly 750 minutes of such recordings. This is a labeled dataset, however, the size of all the recordings obtained during the field study is substantially larger. It should be stressed that the labels

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for buzzes were all approximate, as the expert noted when they saw the bumblebee, not necessarily when the bumblebee sound was picked by the microphone.

As the recordings included various ambient sounds such as lawnmowers and passing cars (which produce somewhat similar spectrograms to those of bumblebees, but more on this later), we underwent a process of isolating highly noisy segments. These segments were then combined to create a supplementary dataset totaling 2 minutes in duration, referred to as the machine sounds dataset.

3 METHODOLOGY

The objective of our study was to identify timestamps within the recordings that denote the occurrence of bumblebee buzzes. The methodology included initial recording preprocessing and data partitioning, selection of neural network architecture, and determination of the model training settings.

3.1 Data Preprocessing

Bumblebees exhibit a natural flying frequency in the range of 200 Hz, alongside higher harmonics that can extend up to 1500 Hz (at least those we can detect). Similarly, when the bumblebee engages in sonication on a flower, the emitted sounds resonate at a natural frequency of about 300 Hz, with corresponding higher harmonics [4]. It is important to stress that bumblebees are much larger and heavier than most of the other pollinating insects present in the area (such as honeybees or solitary bees), so their buzzing frequencies will be lower than those of other pollinators.

For the initial preprocessing step, recordings were subjected to a frequency filtering process, limiting frequencies up to 1500 Hz. Next, the recordings were segmented into 4-second intervals with a 50% overlap. These discrete intervals were then transformed into Mel spectrograms using the fast Fourier transform. Consequently, each instance was represented as a 2-dimensional array of dimensions 128x128. Unlike conventional spectrograms, Mel spectrograms utilize the Mel frequency scale to mimic the human ear’s perception of distinct frequencies (as an ear has a logarithmic response, not a linear one). The examples of preprocessed spectrograms to be used in our model are given in Figure 1. Note that the added machine sounds were preprocessed equally.

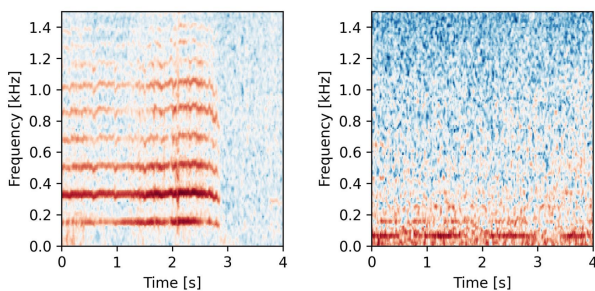


Figure 1: Spectrograms of a bumblebee buzz (left) and no buzz (right)

3.2 Data Partitioning

Our dataset comprises recordings of varying lengths: some are short (3-10 seconds), while others are longer (around 10 minutes). The training dataset was composed of the spectrograms extracted

Table 1: Test, validation, and test data set distributions.

Split	Sound	#Spectrograms
Train	buzz	96
	no buzz	440
	machine	24
Validation	buzz	24
	no buzz	110
	machine	6
Test	buzz	1984
	no buzz	20564
	machine	0

from the short recordings which either included buzz throughout the whole length or did not include a buzz at all. Conversely, the test dataset was composed of spectrograms extracted from the longer recordings. Spectrograms containing the bumblebee buzz sound were assigned with a label of 1, whereas the ones without buzzes were assigned a label of 0. The training data recordings were all manually checked and labeled by the experts. In contrast, the labeling process for the testing dataset involved experts identifying the presence of buzzing in the long recordings by providing a single time-stamp per bumblebee buzz. This time-stamp indicated the approximate detection time, meaning some spectrograms might have been mislabeled. In addition, the cases where the buzzing sound persisted for longer than 4 seconds, at least one spectrogram included a (part of a) buzz but was labeled with 0.

The training data was split into train and validation sets with the ratio of 4:1. The folds were stratified with respect to the dataset (bumblebee, machines) and with respect to the class label (buzz or no buzz). Our train, validation, and test set distributions are shown in Table 1.

As expected, we see that the test set is greatly unbalanced (most of the time, there are no bumblebees). In the approximately 710 minutes of the test recordings, the experts detected and marked down 992 time-stamps of bumblebee buzzes, resulting in 1984 of the spectrograms being labeled with a buzz due to the 50% temporal overlap of the spectrograms (each time-stamp was covered by two spectrograms).

3.3 Neural Network Architecture

From the machine learning perspective, our study was an image classification task, thus we implemented a convolutional neural network (CCN) as they are regarded as the state-of-the-art in the image classification domain [6].

Our model architecture comprises three convolutional layers, followed by a fully connected network with two dense layers and a single output neuron. The convolutional layers included, starting from the initial layer, 128, 256, and 512 filters all size at 3x3. Each convolutional layer was accompanied by a 2x2 max pooling layer. The output of the last convolutional layer was flattened and input to a dense layer consisting of 8192 neurons, followed by a batch normalization, and a dense layer consisting of 512 neurons. Ultimately, the final output was consolidated into a single neuron, generating a numeric value between 0 and 1 that signified the degree of confidence in predicting a buzz. The activation function of all convolutional layers and the first dense layer was ReLu, while the last dense layer used a sigmoid

activation function. The schematic of the the CNN used in our analysis is given in Figure 2.

As the train and validation data volume is fairly small, we tried implementing dropout regularization to the CNN layers. Surprisingly, our findings revealed that dropout did not yield any performance improvement. Consequently, we decided not to incorporate any regularization into the final model architecture.

3.4 Model Training Settings

The selected loss function to be optimized during the neural network training was the binary cross-entropy. The validation data was used to control and adjust the settings during the training. For the optimization algorithm, we employed the Adam optimizer along with a learning rate scheduler. The initial learning rate was set to 10^{-4} , which was dynamically adjusted as training progressed. Specifically, the learning rate was reduced by a factor of 10 after each epoch where there was no observed improvement in the validation loss. This adaptive approach helped the model navigate towards convergence. The batch size was 32 and the model trained for 50 epochs.

4 RESULTS

Considering the significant imbalance inherent in our dataset, we employed a heuristic approach to evaluate our model’s performance effectively. Because the test set spectrograms were extracted from 10 minute continuous intervals, there was a significant amount of temporal correlation. The buzz sounds sometimes lasted continuously for a few minutes, however during that period, only two spectrograms were labeled with a buzz, as only one time-stamp was assigned for that bumblebee and there is 50% overlap between the spectrograms.

Hence, our devised methodology operated as follows: when our model detected a buzz across a series of consecutive spectrograms and at least one of these spectrograms has been expert-annotated as a buzz, all the spectrograms within this contiguous sequence were counted as true positives.

We assess the effectiveness of the buzz detection model using a set of four key metrics: F1-score, precision, recall, and accuracy. How the metrics are calculated from true positive (TP), true negative (TN), false positive (FP), and false negative (FN) values is given in Eqs. (1)–(4). We compare the results against a baseline model that predicted randomly assuming the class probabilities of the training data. The models’ performance metrics are compared to the baseline in Table 2. We see that our model demonstrates significant improvements across all metrics, with the exception of accuracy, where it shows a modest advantage over the baseline.

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (1)$$

$$Precision = \frac{TP}{TP + FP} \quad (2)$$

$$Recall = \frac{TP}{TP + FN} \quad (3)$$

$$F1\text{-score} = \frac{2 \cdot Precision \cdot Recall}{Precision + Recall} \quad (4)$$

The confusion matrix depicting the model’s predictions is presented in Figure 3. It’s important to note that the false negative rate of the predictions might be underestimated. This rate signifies the instances where the model failed to identify buzzes based on time-stamps, rather than indicating instances where the

Table 2: CNN model and the baseline performance results. Baseline predicted randomly assuming train data class probabilities.

Model	Metric	Result
CNN	Accuracy	76%
	Precision	60%
	Recall	96%
	F1-score	74%
Baseline	Accuracy	74%
	Precision	9%
	Recall	21%
	F1-score	12%

model missed buzz-containing spectrograms entirely. This discrepancy arises, same as before, due to the characteristic nature of buzzes, which often span across multiple spectrogram durations. Conversely, instances where the model correctly predicted a buzz, but with a slight delay compared to the expert-annotated time-stamp, were marked as incorrect predictions due to minor label misalignment.

While our model missed 298 (30%) buzz events, it often identified events as buzz despite the label indicating otherwise. This discrepancy was attributed to label misalignment, absence of buzz labels alongside bumblebee presence, and primarily the model’s unfamiliarity with noise types not encountered in training (e.g., cars, lawn mowers, distant music). Figure 4 displays examples of a false negative (left) and a false positive (right) predictions.

In cases like this, where the event one is trying to detect is rare, it is crucial to catch as many occurrences as possible. Missing out on detections (false negatives) is more problematic than having a some incorrect ones (false positives). Mistaken predictions can be manually reviewed by humans, which is quicker than re-screening the entire recordings. Therefore, although improving event detection rate and minimizing the false positive rate are crucial, the relatively high occurrence of false positive outcomes is of lesser concern.

5 DISCUSSION AND CONCLUSIONS

As demonstrated in the analysis of the algorithm performance, the neural network does detect buzzes. Just looking at the comparison with the validation set where (nominally) true positive events are labeled, the performance is still not close to the values that would be of strong use for actual field monitoring applications.

Nevertheless, we should stress that there are several improvements possible. As outlined above, we are (i) dealing with a highly unbalanced dataset, which is (ii) labeled following a protocol used in biological field studies where the event labels only approximately corresponding to the buzzes picked up by microphones (or several segments contain buzzes and there is only one label). After manually inspecting several miss-classified segments, the next step is to improve the training process of the CNN with larger training sets, which will allow us to more accurately analyze the extensive dataset recorded during the field study. Ultimately, this approach will allow us to identify bumblebee buzzes in the area and, following an approach similar to the one in Gradišek et al. [4], distinguishing between the native and introduced species.

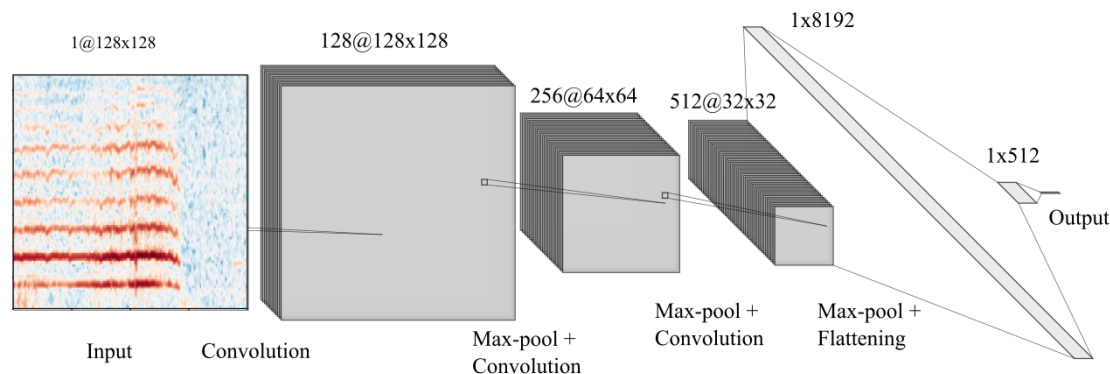


Figure 2: Convolutional neural network architecture used in our study.

Actual	no buzz	9720	5020
	buzz	298	7564
		no buzz	buzz
		Prediction	

Figure 3: Confusion matrix of the model's predictions.

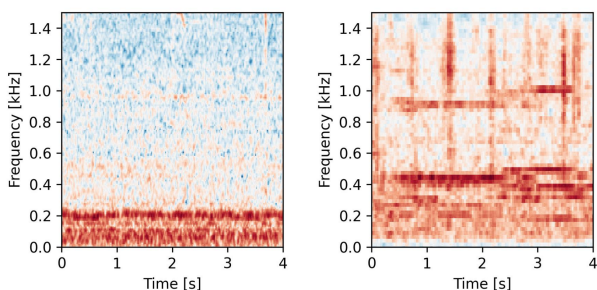


Figure 4: False negative (left) and false positive (right) spectrograms. The false negative spectrogram includes an audible buzz, however, the signal strength in the buzz frequency range is overpowered by the prevailing background noise in the lower parts of the spectrogram. The false positive spectrogram, on the other hand, exhibits distinctive horizontal lines that are similar to the patterns generated by the bumblebees, but were generated from unrelated sources that misled the model.

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DATA AND CODE AVAILABILITY STATEMENT

The data and the code that support the findings of this study are available from the authors upon reasonable request.

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Prepoznavanje aktivnosti čebel na panjskem žrelu s pomočjo strojnega vida in drugih metod

Recognition of Bee Activity in the Hive Entrance Using Machine Vision and Other Methods

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Slika 1: Zaznave čebel narejene z uporabo YOLOv5 modela.

POVZETEK

V tem delu smo raziskovali možnost uporabe najnaprednejših tehnologij pri analizi gibanja čebel med vhom v panj. Čebele imajo ključno vlogo pri opravljanju in so bistvene za ohranjanje uravnoteženega ekosistema, vendar je njihovo proučevanje zaradi majhne velikosti in hitrega gibanja zahtevno. Z uporabo strojnega vida, tehnologije, ki omogoča računalniško interpretacijo in razumevanje vizualnih podatkov ter metod sledenja večim objektom (MOT) nam je uspelo razviti moderno rešitev za njihovo proučevanje. Raziskava je pokazala, da uporaba teh tehnologij ponuja nov, obetaven pristop k zbiranju velikega števila natančnih podatkov o gibanju čebel.

ABSTRACT

In this article we researched the possible use of advanced technologies for the analysis of bee movement in front of a beehive. Bees play a key role in the pollination of plants, they have an immense part in keeping our ecosystem balanced. However, due

to their small size and fast movements, it is challenging for researchers to study them. With the use of computer vision, a technology that interprets and understands visual information, as well as Multi Object Tracking (MOT), we were able to develop a modern solution to the otherwise difficult task of bee tracking. With this, the study of bees becomes less constrained and far more effective. The research shows that the use of numerous modern technologies offer a promising new approach to the collection of a large number of accurate data on bee movement.

KLJUČNE BESEDE

zaznava čebel, računalniški vid, MOT, YOLO, *Apis mellifera carnica*

KEYWORDS

bee recognition, computer vision, MOT, YOLO, *Apis mellifera carnica*

1 UVOD

V nedavni zgodovini smo bili priča velikim tehnološkim dosežkom in inovacijam. Svet hitro napreduje, vendar nekatera področja še zmeraj ostajajo nespremenjena. V Sloveniji je čebelarstvo velik del naše bogate zgodovine in kulture. Zaradi podnebni sprememb, porasta parazitov in boleznih čebel ni bilo čebelarstvo

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nikoli tako zahtevno, zato želimo z uporabo sodobnih metod in moderne tehnologije prispevati k uspešnejšemu uvajanju informacijske tehnologije za upravljanje čebeljih družin in uspešnejše delo čebelarjev in raziskovalcev. Želeli smo razviti učinkovit, stabilen in splošen model strojnega učenja za zaznavo čebel, ki vzdrži visoko uspešnost tudi v primerih, ko so algoritmične metode neuspešne. Model te podatke nato poda algoritmu za sledenje večim objektom, ki natančno sledi gibanju čebel. Ves program omogoča samodejno zbiranje velikih količin podatkov o gibanju na panjskem žrelu, kar bi lahko pomagalo pri preučevanju njihovega obnašanja in komuniciranja.

2 METODOLOGIJA

2.1 Izbira modela zaznavanja objektov

V nalogi smo za zaznavo čebel uporabili konvolucijske nevronske mreže. Pri učenju modela zaznave čebel smo uporabili modele dveh družin prednaučenih nevronske mreže, namenjenih zaznavi objektov. To sta YOLOv5[1], ki je eden najbolj razširjenih in najboljših modelov za zaznavanje objektov in YOLOv7[2], ki je novejša arhitektura. YOLOv7 domnevno opisuje boljše rezultate, kot YOLOv5. Modele teh dveh družin modelov smo dodatno učili na lastnih podatkih. Učili smo prednaučene modele YOLOv5s, YOLOv5m, YOLOv5x in modela YOLOv7 ter YOLOv7x.

2.1.1 Poimenovanje modelov. Imena vseh modelov smo začeli z akronimom BDM (model zaznave čebel - *angl. Bee Detection Model*). Temu sledita identifikacijska številka modela. Za tem je oznaka za vrsto modela. Modeli YOLOv5s imajo oznako s, YOLOv5m oznako m, YOLOv5x oznako x, YOLOv7 oznako 7 in YOLOv7x oznako 7x. Primer poimenovanja modela je **BDM1-s**. To je model z identifikacijsko številko 1, ki je naučen na prednaučenem modelu YOLOv5s (Tabela 1, stolpec za ime).

2.2 Obdelava video posnetkov

Uporabljali smo 10 različnih video posnetkov panjskega žrela. Izbrali smo zahtevne in raznolike posnetke (različna povečava, osvetljenost, barva panja, gostota čebel), da bi dosegli čim bolj splošene modele. Posnetki so bili posneti na Urbanem učnem čebelnjaku botaničnega vrta v Ljubljani[3]. Za učenje smo iz video posnetkov na enakomernih časovnih intervalih vzeli 2100 slik. Te slike smo označili v orodju Roboflow[4]. Pri učenju se je ločljivost slik samodejno zmanjšala na ločljivost modela. 70 % slik smo postavili v učno množico, 20 % v validacijsko in 10 % v testno množico.

2.3 Učenje modelov

Vse modele smo lahko učili na istih podatkih, saj YOLOv5 in YOLOv7 uporabljata isti format za označevanje slik. Da bi prišli do čim boljšega končnega modela, smo naučili več modelov. Pri učenju modelov smo spreminjali velikost paketa, število epoh, izbiro prednaučenega modela in število slik. Ostale hiperparametre smo ohranili na standardni nastavitvi. Pri optimizaciji modela je uporabljen stohastični gradientni spust. Isti algoritem je bil uporabljen pri učenju prednaučenih modelov [1].

Velikost paketa, pri kateri smo lahko učili, je neposredno omejena z velikostjo grafičnega pomnilnika na grafični kartici (8 GB). Pri učenju manjših modelov (posebej YOLOv5s) se proces samodejno predčasno konča, ko se mAP@[0.5:0.95] modela ne spreminja, kar omeji prekomerno prilagajanje modela. To temelji na validacijski množici.

Tabela 1: Specifikacije naučenih modelov. Vse ločljivosti so kvadratne. Negativna velikost paketa označuje samodejno izbiro

ime	epohe	velikost paketa	model	ločljivost
BDM1-s ¹	100	16	v5s	640
BDM2-s	100	16	v5s	416
BDM3-s	100	16	v5s	640
BDM4-s	174	-1	v5s	640
BDM5-m	268	-1	v5m	640
BDM6-s ¹	174	-1	v5s	640
BDM7-x	27	-1	v5x	640
BDM8-s	20	32	v5s	640
BDM9-s	184	42	v5s	640
BDM10-7x	87	8	v7x	640
BDM11-7	166	10	v7	640
BDM12-7	150	11	v7	640
BDM13-7x	150	11	v7x	640
BDM14-m	135	16	v5m	640
BDM15-m	163	-1	v5m	640

¹Ta modela sta bila naučena na procesorju in ne grafični kartici.

Skupaj smo učili 15 modelov, štiri iz družine YOLOv7 in 11 iz družine YOLOv5 (Tabela 1). Pri izdelavi modelov smo imeli dva glavna cilja - hitrost izvajanja in uspešnost zaznavanj. Večinoma smo učili manjše, YOLOv5s modele. Za to smo imeli dva razloga: hitrejšo učenje teh modelov in majhno število učnih podatkov. Po prvih testnih učenjih smo ugotovili, da so modeli že zelo hitro začeli zaznavati velik delež čebel. Kljub temu smo učili tudi nekaj v5m modelov in en v5x model. Učili smo tudi YOLOv7 modele, saj smo upali, da bodo nudili višjo hitrost in kvaliteto, kot napisano v članku[2].

Pri učenju model računa svojo uspešnost s funkcijo izgube. Pri YOLOv5 in YOLOv7 modelih je ta funkcija seštevek (pri YOLOv7 obtežen seštevek) funkcije izgube objektivnosti, regresijske funkcije izgube omejevalnega okvira in funkcije izgube klasifikacije (1). Slednji je v našem primeru 0, ker uporabljamo le en razred objektov.

$$loss = l_{obj} + l_{box} + l_{cls} \quad (1)$$

2.4 Sledenje gibanju čebel

Za sledenje smo uporabili knjižnici Norfair[5] ter ByteTrack[6]. Sledenje gibanja čebel smo izvedli s pomočjo podatkov, ki nam jih je vrnil model. Pridobljene vrednosti iz modela in sledilca smo primerjali ter vsakemu objektu določili identifikacijsko številko. Knjižnica Norfair[5] je to opravila sama, pri knjižnici ByteTrack[6] pa smo to dosegli z zunanjo knjižnico Onemetric[7].

2.5 Analiza modelov

Hitrost delovanja modelov smo testirali na dveh posnetkih. Izbrali smo posnetek, ki ima majhno število čebel in počasno gibanje ter posnetek, ki ima več čebel ter bolj kaotično gibanje. Po učenju nam je program vrnil dve verziji modela - tisto, ki je bila shranjena po zadnji epohi in tisto, ki je dosegla najvišjo metriko mAP@[0.5:0.95] na validacijski množici. Vedno smo uporabili model z najvišjo mAP@[0.5:0.95], saj smo se s tem izognili prekomernemu prilagajanju modela.

2.5.1 *Uspešnost zaznavanja modelov.* Pri izračunu uspešnosti modela se uporablja več metod in funkcij[8]. Modele smo primerjali po uspešnosti, priklicu, mAP@0.5 in mAP@[0.5:0.95]. Merila smo izračunali na testni množici, torej slikah na katerih modeli niso bili naučeni.

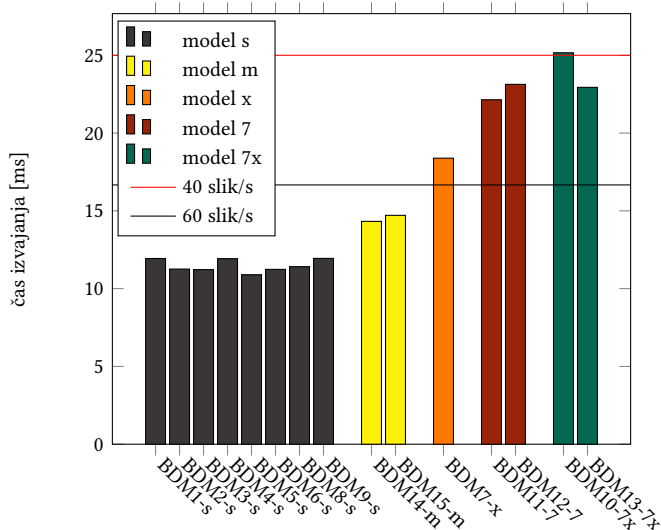
2.6 Analiza metod sledenja premikanja čebel

Pri analizi premikanja čebel smo, kot pri analizi modelov, uporabili dva posnetka. Za zaznavo čebel smo uporabljali model BDM15-m, saj se ta model izvaja hitro z dobro uspešnostjo. Za ocenjevanje natančnosti zaznave smo z obema knjižnicama prešteli čebele, ki so se približale vhodu oziroma oddaljile od vhoda v panj. Te podatke smo nato primerjali z ročno preštetimi količinami.

3 REZULTATI

3.1 Hitrost izvajanja modelov

Pri primerjavi modelov lahko vidimo, da gostota čebel na posnetku ne vpliva na hitrost zaznav. Na hitrost je imela bistven vpliv le velikost modela. Najhitrejši so bili vsi modeli prednaučenega modela YOLOv5s, ki so tudi najmanjši, najpočasnejši pa modeli YOLOv7x (Slika 2). Skoraj vsi modeli so dovolj hitri, da z zmogljivo grafično kartico posnetke obdelajo sproti pri hitrosti vsaj 40 slik na sekundo. Testiranje je potekalo na grafični kartici RTX 3070 Ti.

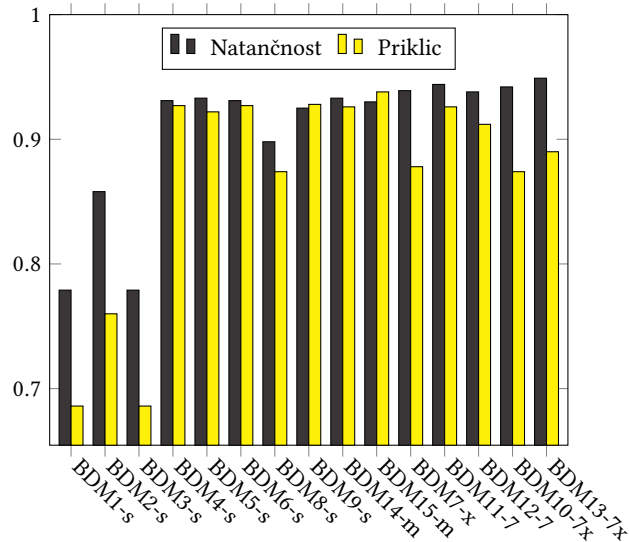


Slika 2: Povprečne hitrosti modelov.

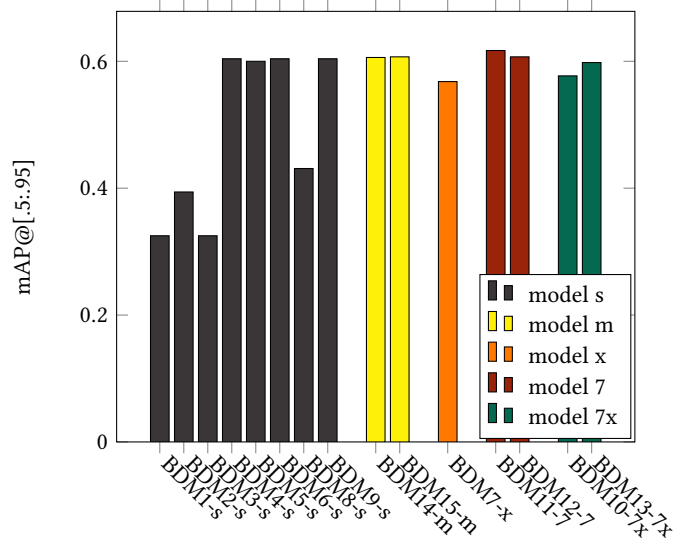
3.2 Uspešnost detekcije modelov

Pri primerjavi modelov po priklicu in natančnosti (Slika 3) vidimo, da bistveno izstopata modela BDM1-s in BDM3-s, saj več kot tretjine čebel ne zaznata, petina zaznav je pa napačnih. Slabi rezultati so očitni tudi po merilu mAP. Merilo mAP@[.5:.95] najbolje prikaže dejansko razliko med modeli (Slika 4).

Vsi slabši modeli imajo arhitekturo YOLOv5s, vendar imajo drugi YOLOv5s modeli (BDM4-s, BDM5-s in BDM6-s) dobro uspešnost. Ni neposredne povezave med arhitekturo in kvaliteto modela. Najbolje se je izkazal model BDM11-7. 8 modelov ima podoben mAP@[.5:.95], malo nad 0.6. Kljub močno počasnejšemu



Slika 3: Natančnost in priklic modelov strojnega učenja



Slika 4: Kvaliteta zaznavanja na testni množici po metriki mAP@[.5:.95]

času izvajanja (Slika 2), je kvaliteta zaznav YOLOv7 primerljiva z modeli YOLOv5.

Pri slabših modelih je najpogostejša napaka združevanje več čebel v eno in zaznavanje grč. To lahko najlažje vidimo na primerjavi med najboljšim in najslabšim modelom (Slika 5).

3.3 Rezultati sledenja

Pri primerjavi natančnosti štetja vidimo, da je Norfair bolj natančen od ByteTracka (Slika 6). Norfair[5] se je še posebej izkazal pri štetju čebel, ki vstopajo v panj, saj na posnetku z več čebelami od realnih rezultatov odstopa le za 2,5 %. Obe knjižnici zaznamuje slabše štetje čebel, ko se oddaljujejo od panja. Sledenje je bilo v vseh primerih hitreje od 50 slik/sekundo (20 ms na sliko). Norfair je rahlo počasnejši na posnetku z več čebelami in rahlo hitrejši na posnetku z manj čebelami, vendar je ta razlika majhna, okoli 0,8 milisekunde.

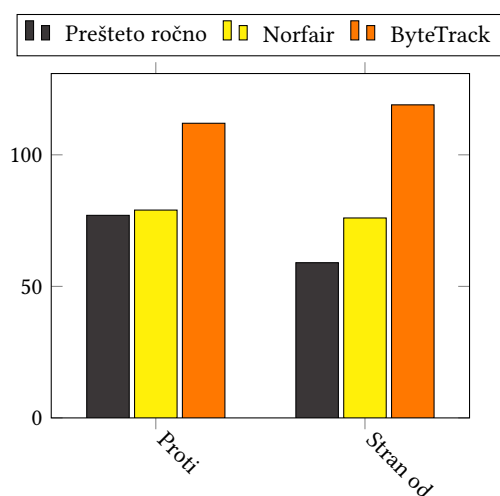


(a) Zaznave najboljšega modela BDM11-7



(b) Zaznava najslabšega modela BDM1-s

Slika 5: Primerjava boljšega in slabšega modela



Slika 6: Število letov proti in stran od vhoda v panj, prešteti na posnetku z več čebelami.

4 DISKUSIJA

Obstajajo različni načini opazovanja gibanja, od preprostega sistematičnega opazovanja do uporabe modelov strojnega vida. Kljub sorazmerno visoki natančnosti modelov, ki smo jih naučili menimo, da bi se dalo naučiti še bolj natančne modele. Večje število podatkov in boljše eksperimentalno okolje (grafična kartica z več grafičnega pomnilnika), bi omogočila še boljše rezultate. Eno od možnosti predstavlja uporaba novejših arhitektur YOLOv8[9], ki je bila objavljena med izdelovanjem naloge in je zato še nismo uporabljali. Obstaja tudi možnost izvajanja programa na

preprostejši, specializirani strojni opremi, kar bi omogočilo zaznavo na kraju, kjer so bili posnetki pridobljeni[10]. Uspešnost zaznave in sledenja bi lahko izboljšali tudi s sestavo poligona, ki omeji hitrost gibanja čebel na posnetem območju. Z vključitvijo termalne kamere v zaznavo, bi lahko model še izboljšali. Ne nazadnje, bi lahko natančnost algoritmičnega sledenja gibanja izboljšali z uporabo umetne inteligence, z učenjem nevronske mreže, ki bi zagotavljala boljše časovno doslednost sledenja.

5 ZAKLJUČEK

Štetje čebel, ki priletijo iz oziroma v panj lahko čebelarjem nudi vpogled v stanje panja. Avtomatizirano zbiranje podatkov o čebelah ni uporabno le za čebelarje, ampak lahko tudi podpira mnogo drugih raziskav o vedenju in delovanju teh čudovitih živali. Z uporabo računalniškega vida in metodami sledenja večim objektom (MOT) nam je uspelo dokazati, da je taka avtomatizacija mogoča, natančna in uporabna.

ZAHVALA

Zahvalili bi se radi naši mentorici Mag. Darji Silan, ki nam je nudila podporo in pomagala organizirati celotno izdelavo naloge. Radi bi se tudi zahvalili somentorju Dr. Janku Božiču, ki nam je pomagal s strokovno literaturo in splošnim znanjem na tem področju ter za posnetke čebel.

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Vpeljava virtualnega asistenta ChatGPT v medicinsko platformo

Implementation of a Virtual Assistant ChatGPT into the Medical Platform

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POVZETEK

V prispevku predstavimo vpeljavo ChatGPT v platformo za elektronsko in mobilno zdravje Insieme, ki uporabnikom omogoča učinkovito pridobivanje informacij s področja medicine, spletno človeško pomoč s strani zdravstvenih izvedencev in uporabo virtualnega asistenta, ki je nastal z integracijo najnovejših tehnologij na področju obdelave naravnega jezika. Opišemo delovanje platforme Insieme in podamo razlago ter opis implementacije virtualnega asistenta. Prototipna vpeljava ChatGPT služi testiranju zmogljivosti z namenom revolucije slovenskega zdravstva.

ABSTRACT

In this paper, we present the introduction of ChatGPT into the Insieme platform for electronic and mobile health, which enables users to efficiently acquire information in the field of medicine, receive online human assistance from healthcare professionals, and utilize a virtual assistant created using the latest natural language processing technologies. We report on the functionalities of the Insieme platform and provide an explanation and description of the implementation of the virtual assistant. The prototype implementation of ChatGPT into a medical platform serves as a test for potential advancement of the Slovenian healthcare system.

KLJUČNE BESEDE

virtualni asistenti, vektorske podatkovne baze, besedne vložitve, GPT-4, obdelava naravnega jezika

KEYWORDS

virtual assistants, vector databases, word embeddings, GPT-4, natural language processing

1 UVOD

V današnjem svetu, kjer se količina podatkov in informacij nenehno povečuje, je dostop do zanesljivih virov informacij in strokovnih nasvetov postal ključnega pomena. Še posebej na področju medicine, ki je eno izmed temeljnih področij družbe, je pomembno, da uporabnikom zagotovimo enostaven in učinkovit

način za pridobivanje zdravstvenih informacij. Na spletu in mobilnih telefonih je vrsta medicinskih aplikacij, ki nudijo informacije in nasvete. Termin 'Dr. Google' opisuje iskanje zdravniških informacij in diagnosticiranja s pomočjo iskalnika Google.

Na drugi strani pa ChatGPT predstavlja zelo obetavno orodje, ki je neprestano dostopno vsakomur, kar omogoča uporabnikom, da lahko dobijo zanesljive odgovore na svoja vprašanja v realnem času. S hitrim napredkom tehnologije in nenehnim izboljševanjem ChatGPT se zdi, da bo uporaba le še rasla.

V okviru projekta Interreg je bila razvita platforma za elektronsko in mobilno zdravje Insieme, ki jo je razvilo nekaj partnerjev, ključni del pa je prispeval Odsek za inteligentne sisteme na Institutu 'Jožef Stefan'. Platforma ne le olajšuje iskanja zdravstvenih storitev, ampak hkrati ponuja spletno človeško pomoč s strani zdravstvenih izvedencev, pridobitev dodatnih koristnih informacij in ogled video vsebin s področja medicine. Ključno vlogo na tej platformi pa ima virtualni asistent, ki temelji na najnovejših dosežkih na področju obdelave naravnega jezika. V platformi so virtualni asistenti starejše generacije, pred nastankom ChatGPT, tj. botov z generativno splošno inteligenco.

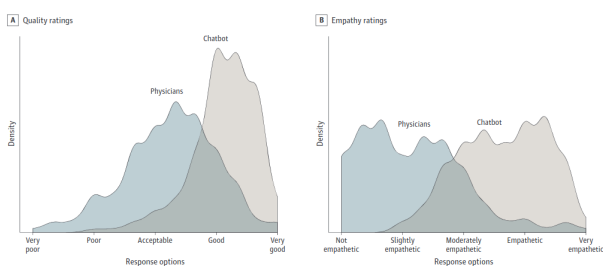
V nadaljevanju je opisano delovanje platforme Insieme, vloga virtualnega asistenta ChatGPT za medicino ter razlaga, kako smo združili tehnološko znanje in domensko strokovnost, da bi zagotovili natančne in uporabniku prijazne odgovore na vprašanja s področja zdravja. Predstavljene so besedne vložitve in razlogi za uporabo vektorskih podatkovnih baz, vse skupaj pa je povezano z orodjem LangChain in velikim jezikovnim modelom GPT-4. Vse omenjene enote omogočajo, da razvijamo zdravstvene aplikacije, ki prej niso obstajale in močno presegajo npr. dr. Googla. Ta študija je služila tudi kot prvi preizkus nove tehnologije ChatGPT za medicinske namene.

2 CHATGPT

Po nekaj testih s konkurenčnimi produkti smo se odločili za uporabo velikega jezikovnega modela GPT-4, ki smo ga obogatili z znanjem naše platforme Insieme. GPT-4 je bil razvit marca 2023 in predstavlja velik napredek na področju obdelave naravnega jezika, predvsem pa je koristen za odgovarjanje na vprašanja, generiranje besedil in prevajanje v druge jezike. V primerjavi z modeli prejšnjih generacij se je povečala zanesljivost in pravilnost odgovorov, hkrati pa je izboljšano upravljanje glede na uporabnikove ukaze (naprimer, da povemo, v kakšnem slogu naj bo generirani odgovor). Številna testiranja [6] (različni izpiti in preizkusi znanja z različnih področij) so pokazala, da GPT-4 dosega rezultate, ki so povsem primerljivi s tistimi, ki jih dosegamo ljudje. V primerjavi z zdravniki je general daljše odgovore, ki

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so hkrati bili s strani ostalih zdravstvenih izvedencev označeni kot boljši tako po kvaliteti odgovorov kot tudi empatiji [2]. Posledično smo se odločili, da bo naš virtualni asistent temeljil na modelu GPT-4. Namesto spreminjanja obstoječega modela smo omogočili, da lahko uporabnik povprašuje po podatkih, ki so pridobljeni iz naše platforme in ostalih dokumentov, ki jih lahko poljubno mnogo podamo. Na ta način ločimo jezikovni model in našo bazo znanja, omogočimo uporabniku, da komunicira s podanimi dokumenti, pri generiranju odgovora pa so uporabljene zgolj informacije, ki se nahajajo znotraj naših podanih dokumentov, kar omogoča, da se uporabniku zagotovi najbolj relevanten odgovor. Z omenjenim pristopom lahko enostavno dodajamo nove vire informacij in prilagodimo model za specifične naloge; brez treniranja obstoječega modela, kar bi sicer seveda bilo časovno in računsko zahtevno. Postopek je podrobneje opisan v nadaljevanju referata.



Slika 1: V več testih je ChatGPT presegel človeške zdravniške. Vir: John Ayers in sod. 2023. Comparing physician and artificial intelligence chatbot responses to patient questions posted to a public social media forum. JAMA internal medicine, 183, (apr. 2023).

3 INSIEME

Za testno medicinsko platformo smo izbrali Insieme, ki je bila nedavno razvita v sodelovanju s slovenskimi in italijanskimi partnerji v okviru čezmejnega projekta ISE-EMH [7]. Opremljena je s prijaznim uporabniškim vmesnikom, ki omogoča, da lahko uporabnik na enem spletnem mestu na enostaven in eleganten način pridobi koristne informacije s področja zdravstva.

Glavne funkcionalnosti so možnost iskanja storitev z uporabo stranske menijske vrstice oziroma z uporabo iskalne funkcije, spletna človeška pomoč (klepet v živo s klicnim centrom ali zdravstvenim izvedencem), ogled video vsebin s področja zdravja ter uporaba virtualnega pomočnika, ki je v nadaljevanju članka predstavljena kot osrednja tematika. Vsa omenjena vsebina je uporabniku na voljo v treh oz. štirih jezikih.

Na levi strani slike 2 se nahaja seznam storitev, ki jih ponuja platforma Insieme. Ta menijska vrstica omogoča izbiranje med različnimi vejami medicine, zatem pa se nadaljnji izbor razširi na bolezni in bolezenska stanja, ki pripadajo izbrani veji medicine, poleg tega pa so prikazane še informacijske storitve, ki pripadajo izbrani specializaciji medicine. S klikom na eno izmed bolezenskih stanj je uporabnik preusmerjen na ustrezno podstran. Tu so mu na voljo bistveni podatki o poteku bolezni, simptomih, morebitni preventivi in nadaljnjemu ukrepanju. Spodaj se nahaja še več preusmeritev na zunanja spletna mesta, ki uporabniku omogočijo, da pridobi ustrezno znanje o izbrani bolezni.

Poleg ročnega prehajanja med podstranmi platforme je uporabniku na voljo še funkcionalnost iskanja, ki uporabniku prikaže vse storitve na platformi, ki so ujemajoče glede na niz iskanja.



Slika 2: Prikaz glavne strani ob obisku platforme Insieme.

Uporabnikom je na voljo tudi spletna človeška pomoč. Na vstopni strani so nanizani klicni centri in aktivni uporabniki, ki jih lahko kontaktirate preko spletnega klepeta v živo, ki je vgrajen v platformo.

Insieme platforma nudi več vgrajenih asistentov: čakalne vrste, IJS asistenta, iskanje po storitvah, virtualnega asistenta za medicino, hkrati pa so priložene še povezave do ostalih ne-vgrajenih asistentov. Npr. asistent za čakalne vrste omogoča, da vnesemo ime posega oziroma storitve, podamo približno nujnost, kdaj izbrani poseg potrebujemo ter zeleno regijo v Sloveniji za opravljanje posega. Asistent za medicino odgovarja na poljubna vprašanja uporabnika s področja zdravstva, kot odgovor pa mu poda ustrezne napotke in nasvete.

4 VIRTUALNI ASISTENT ZA MEDICINO

4.1 Ozadje

Virtualni asistent v platformi Insieme je namenjen odgovarjanju na vprašanja o zdravju. Obstoječe asistente smo dogradili z asistentom tipa ChatGPT. Tak asistent ima ogromno svojega splošnega znanja s spleta, na voljo pa ima tudi dodatne lokalne informacije, povezane s projektom Insieme. Prvi problem pri uporabi je, če bi želeli, da bi podali neko večjo količino besedila (morda kar celo knjigo), ali pa imamo več dokumentov, ki bi jih radi uporabili. Veliki jezikovni modeli imajo običajno omejitve, koliko besedila lahko sprejmejo [4]. Zato je pomembno, da velikemu jezikovnemu modelu podamo le informacije, ki so bistvene. Pri tem so ključne besedne vložitve in vektorske podatkovne baze.

4.2 Besedne vložitve in vektorske podatkovne baze

Vložitve (angl. embeddings) so način, kako lahko predstavimo besede, povedi ali pa kar celotne dokumente. Za njihov izračun potrebujemo ustrezne modele, ki so bili trenirani na ogromni količini podatkov in znajo poiskati razmerja med besedami s pomočjo analiziranja vzorcev, ki se pojavljajo v podatkih [3]. V našem primeru smo uporabili model, ki ga ponuja OpenAI – text-embedding-ada-002. Na ta način, da pridobimo vektor za vsako izmed besed, lahko predstavimo pomen besedila. Besedne vložitve lahko predstavimo v večdimenzionalnih prostorih, kjer so si besede oziroma povedi s podobnim pomenom blizu – med

vektorji lahko izračunamo razdalje in tako poiščemo pomensko sorodne besede.

Vektorske podatkovne baze shranjujejo informacije v obliki vektorjev, kar pogosto imenujemo kar besedne (vektorske) vložitve. To omogoča, da lahko indeksiramo in preiščemo ogromno količino nestrukturiranih podatkov, kot so slike, surovo besedilo ali pa senzorski podatki. Vektorska baza organizira podatke z uporabo visoko-dimenzionalnih vektorjev, ki vsebujejo nešteto dimenzij, vsaka dimenzija pa opisuje točno določeno lastnost podatkovnega objekta, ki ga predstavlja. Vektorske baze se torej od tradicionalnih baz, ki shranjujejo podatke v tabelarični obliki, razlikujejo v tem, da vrnejo rezultate na podlagi podobnosti (tradicionalne baze vrnejo popolnoma ujemaajoče se objekte) [9]. Za merjenje podobnosti med vektorji v vektorskem prostoru se lahko uporablja različne mere — pogosto uporabljamo kosinusno podobnost. Te mere uporabljamo, da lahko primerjamo vektorje, ki so shranjeni v naši vektorski bazi, in poiščemo tiste, ki so najbolj podobni vektorju, ki ustreza vnosu uporabnika. Omogočajo torej delo s kompleksnimi podatki in hitro iskanje, kar bi sicer tradicionalnim bazam povzročalo težave. Recimo, da imamo dokument, ki bi ga radi indeksirali. Uporabili bomo model, ki omogoča ustvarjanje besednih vložitev (zgoraj smo omenili `text-embedding-ada-002`) [5]. Shranili jih bomo v izbrano vektorsko bazo, pri tem pa se shrani referenca na dokument, iz katerega je bila vložitev ustvarjena. Kadarkoli bo naš uporabnik poslal poizvedbo, bo uporabljen enak model za ustvarjanje vložitev — uporabili jih bomo, da v vektorski bazi poiščemo najbolj podobne besedne vložitve, ki so zaradi omenjene reference povezane z originalnim dokumentom, kjer so bile ustvarjene. Pridobljene dokumente lahko zatem podamo velikemu jezikovnemu modelu — dokumenti bodo uporabljeni kot kontekst za generiranje odgovora. Ravno zaradi vseh omenjenih lastnosti so vektorske podatkovne baze odlična izbira, da obogatimo naše generativne modele.

4.3 Implementacija

Eno izmed pomembnejših orodij za implementacijo ChatGPT v Insieme je knjižnica LangChain, ki omogoča delo z velikimi jezikovni modeli (LLM). LLM lahko učinkovito opravljajo ogromno število različnih opravil, vendar obstaja verjetnost, da ne bodo zmožni pravilno odgovarjati na vprašanja s specializiranih področij, kot je na primer medicina. LangChain pomaga, da lahko naše modele nadgradimo z znanjem specifičnih področij in jim omogočimo zavedanje o podatkih ter kontekstu pogovora. LangChain predstavlja zmogljivo orodje, ki zapolnjuje praznino v povezavi med jezikovnimi modeli in domenskim znanjem, kar je tudi razlog, zakaj se LangChain vse pogosteje uporablja v aplikacijah, ki opravljajo naloge, povezane z obdelavo naravnega jezika. LangChain vsebuje številne module, ki pomagajo pri razvoju [1]:

- LLM: omogoča uporabo zmožnosti specifičnega velikega jezikovnega modela.
- Verige (angl. chains): glavna enota, kar je razvidno že iz imena LangChain, ki združuje več LLM klicev. Primer tega bi bil, da najprej preberemo uporabnikov vnos, ta vnos pa uporabimo, da sestavimo nov vnos (angl. prompt), ki se poda velikemu jezikovnemu modelu, ki zatem generira odgovor.
- Vnosi, pozivi (angl. prompts): LangChain omogoča veliko različnih načinov, kako lahko spreminjamo vnos, ki je posredovan jezikovnemu modelu. Lahko uporabljamo

predloge (angl. prompt templates), kjer točno definiramo obliko vnosa.

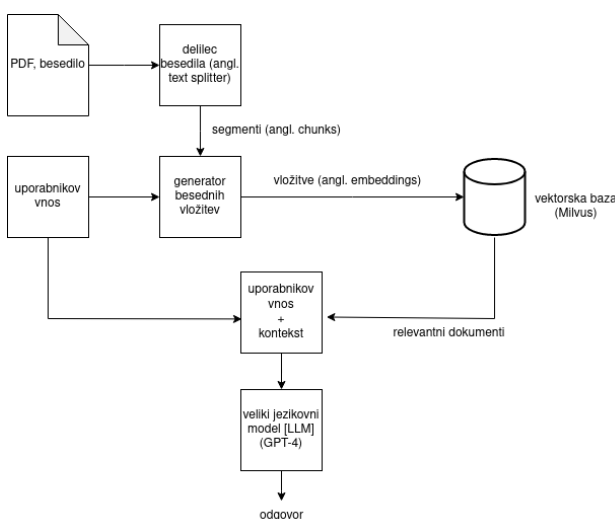
- Moduli za nalaganje dokumentov: omogočajo pretvorbo različnih vrst podatkov (PDF dokumenti, HTML spletne strani, slikovno gradivo) v besedilo, ki ga je mogoče procesirati.
- Agenti: za aplikacije, kjer zaporedje klicev ni določeno vnaprej, LangChain zagotavlja agente, ki lahko ukrepajo na podlagi vhodov, namesto da bi imeli vnaprej določeno zaporedje.

Naslednja bistvena komponenta sistema so vektorske podatkovne baze, ki so predstavljene v razdelku 4.2. Odločili smo se za uporabo odprtokodne vektorske baze Milvus, ki omogoča učinkovito shranjevanje vektorjev, njihovo indeksiranje, hkrati pa ponuja API (angl. application programming interface), ki omogoča enostavno integracijo z različnimi programskimi jeziki. Tudi sama povezava med vektorsko bazo Milvus in jezikovnim modelom GPT-4 je preprosta, saj ni potrebe, da bi podatke posebej označevali ali pa ponovno trenirali model. Podatke je potrebno pretvoriti v vektorsko obliko in jih shraniti v Milvus. Končni odgovor, ki ga model generira, je na takšen način ustvarjen z referenciranjem vsebine v naši zbirki dokumentov, kar zagotavlja, da virtualni asistent pridobi prave podatke in posledično zmanjša verjetnost napak.

Slika 3 grafično nakazuje postopek. Prvi korak v tem razvoju je nalaganje podatkov v 'Dokumente', ki so pravzaprav besedilni kosi. Modul za nalaganje dokumentov v orodju LangChain poenostavi to nalogo in omogoča enostavno nalaganje in predobdelavo naših podatkov — uporabimo lahko `DirectoryLoader`, ki omogoča, da shranimo vse uporabljene dokumente v skupen direktorij. Sledi razdeljevanje dokumentov na manjše kose — delilec besedila (angl. text splitter) omogoča razbijanje dolgih besedilnih delov na manjše, pomensko smiselne koščke [8]. Ta naloga se morda zdi preprosta, vendar vključuje nekaj kompleksnosti. Cilj je besedilo razdeliti na način, ki ohranja pomensko povezane dele skupaj, pri čemer je 'pomenska povezanost' odvisna od vrste besedila, ki se obdeluje. Delilci besedila razdelijo besedilo na majhne kose, pogosto na podlagi mej med stavki. Te majhne kose združijo v večje kose, dokler ne dosežejo določene velikosti, ki jo določi predhodno določena funkcija za merjenje velikosti kosa — ko doseže kos želeno velikost, postane samostojen kos besedila. Zatem se ustvari nov kos z nekaj prekrivanja (angl. chunk overlap), da se ohrani kontekst med posameznimi kosi.

Sledi generiranje besednih vložitev, ki igrajo ključno vlogo pri predstavitvi besedilnih informacij. Razred `Embedding` v orodju LangChain služi kot standardiziran vmesnik za različne ponudnike vložitev, vključno z OpenAI. S pomočjo generiranja besednih vložitev se besedilo pretvori v vektorsko predstavitev, ki omogoča semantično analizo in opravljanje nalog, kot je semantično iskanje. Vse to se s pomočjo vgrajenih metod shrani v našo vektorsko podatkovno bazo kot nov indeks — nad tem objektom lahko opravljamo semantično iskanje in pridobimo dokumente, ki so relevantni glede na uporabnikov vnos. Dobljeni dokumenti se zatem posredujejo jezikovnemu modelu, ki dokumente obravnava kot kontekst za generiranje odgovora. Na sliki 4 lahko vidimo prikaz odgovarjanja na uporabnikova vprašanja. ChatGPT tekoče odgovarja na zdravstvena vprašanja z upoštevanjem splošnega znanja, znanja medicine s celotnega spleta in posebnih znanj s platforme Insieme.

Preverjanje in zagotavljanje informativnih ter ustreznih odgovorov je potekalo s strani avtorjev prispevka. ChatGPT je bil testiran z vprašanji, ki so v celoti pokrili znanje, ki ga vsebuje platforma Insieme. Odgovore, ki so bili generirani, smo kritično ovrednotili in uvedli popravke ob morebitnemu odstopanju od pričakovanj. Točnost pridobljenih odgovorov je za uporabnika ključnega pomena, saj lahko zavajanje in netočni odgovori v primeru, da jih uporabnik upošteva, v hujših situacijah privedejo celo do poslabšanja zdravstvenega stanja. Vsebina platforme Insieme, ki virtualnemu asistentu predstavlja kontekst za generiranje odgovorov, je bila predhodno pripravljena s strani zdravstvenih izvedencev, kar uporabniku omogoča pridobitev preverjenih in koristnih informacij.



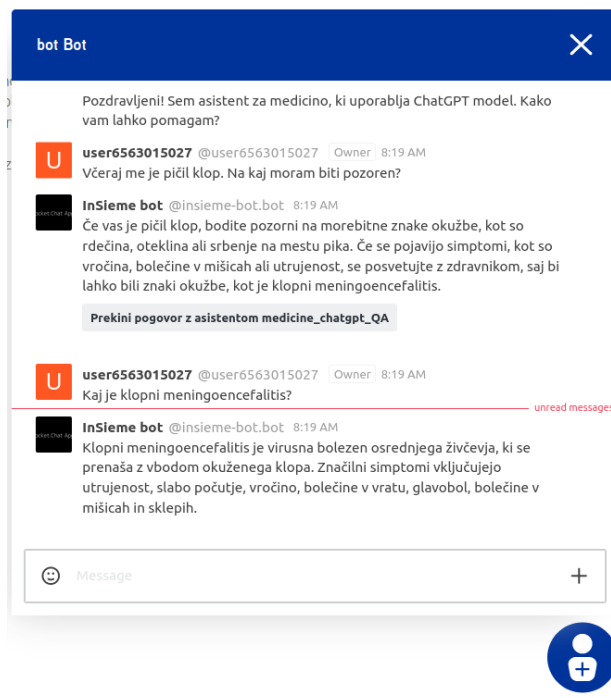
Slika 3: Prikaz integracije vseh komponent sistema.

5 ZAKLJUČEK

Predstavljena je implementacija pogovornega virtualnega asistenta ChatGPT v platformo za elektronsko in mobilno zdravje, imenovano Insieme. Eksperimenti kažejo, da je sistem sposoben nuditi tako običajne odgovore ChatGPT kot dodatne na osnovi informacij, dosegljivih s platforme. Vpeljava je bila uspešna.

Platforma ima še veliko možnosti za nadaljnje izboljšave, predvsem bi bila koristna integracija z drugimi zdravstvenimi informacijskimi sistemi in viri v Sloveniji, kar bi omogočilo, da bi platforma Insieme postala še bolj celovit vir informacij za uporabnike – pri tem se bomo povezali z zdravstvenimi institucijami po Sloveniji. V okviru vpeljave virtualnega asistenta je bil preizkušen tudi najšibkejši jezikovni model iz družine Llama 2, ki je bil lokalno nameščen. Pojavila se je težava, saj je večina učnih podatkov, ki so bili uporabljeni, bila v angleščini, zato je model kot tak neustrezen za uporabo v slovenskem jeziku. Tu se nam odpira možnost, da v prihodnje preizkusimo zmogljivejši model iz družine Llama 2, ki bo prav tako lokalno nameščen. Pri tem se pojavlja nov vidik uporabe, saj bi na ta način vsi podatki bili dostopni lokalno in bi izpodrinili potrebo po zunanemu dostopanju do podatkov, kot je to sedaj nujno z uporabo ChatGPT.

Naš glavni namen je, da bi platforma predstavila temeljne ideje, kako bi se lahko moderniziral zdravstveni sistem, pri tem pa stremimo k razbremenitvi ljudi, ki delajo v tej stroki, hkrati pa želimo vsem uporabnikom omogočiti dostop do učinkovitega in



Slika 4: Prikaz delovanja virtualnega asistenta ChatGPT nad zdravstveno platformo Insieme.

nenehno dostopnega vira informacij, ki temelji na najsodobnejših pridobitvah raziskav.

Eksperimenti v tej študiji kažejo, da je generativna umetna inteligenca dejansko uporabna in obeta radikalne izboljšave, če jo bomo uspeli vpeljati v slovensko zdravstvo.

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Types of Democracy Defined: Keyword Extraction from Eleven Different Text Descriptions

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ABSTRACT

The various forms of democracy worldwide display a range of distinct traits, influenced by regional, historical, and cultural backgrounds. This research undertook the challenge of extracting keywords from textual descriptions of eleven distinct democracy types to identify and categorize their core principles and nuances. By employing Natural Language Processing (NLP) techniques, specifically, the Text Rank, RAKE and TF-IDF (Term Frequency-Inverse Document Frequency) methodologies, the study aimed to extract meaningful keywords that encapsulate the foundational principles governing each democracy type. The results provide a deeper understanding of how various democratic structures operate and differentiate from one another. Such insights are crucial for researchers, policymakers, and political enthusiasts to navigate the intricate landscape of global democratic models.

KEYWORDS

keywords, data mining, natural language processing, democracy

1 INTRODUCTION

Democracy, a term rooted in the Greek words "dēmos" (people) and "kratos" (power), has been a guiding principle of governance for centuries [18]. However, the interpretation and application of democracy have evolved and diversified across regions, taking shapes influenced by historical experiences, cultural nuances, socio-political challenges, and economic contexts. Today, the world does not see a monolithic form of democracy but rather an array of forms, each with its unique characteristics and mechanisms [1].

Understanding these distinct democratic forms is crucial for several reasons. Firstly, it offers a glimpse into the diverse ways in which societies prioritize and ensure the participation of their citizenry in governance. Secondly, it helps in identifying the checks and balances incorporated in each system to protect against potential excesses and abuses of power. Lastly, it provides a roadmap for nations looking to either adopt a democratic model or refine

their existing systems in response to changing circumstances and needs [6].

However, given the vast amount of textual data describing these democratic forms, there arises a need for a systematic approach to identify their defining features. Keyword extraction, an established technique in the realm of Natural Language Processing (NLP) [4], offers a solution. By extracting keywords from descriptions of different democratic models, we aim to distill their essence, thereby providing a concise yet comprehensive overview of each type's foundational principles.

Keyword extraction serves as a fundamental tool for information retrieval. Researchers, academics, policymakers, and practitioners often rely on keywords to quickly identify relevant documents amidst an overwhelming volume of textual data. By extracting keywords from eleven different text descriptions of democracy, this research facilitates more effective and precise information retrieval in the realm of democratic studies. Un addition, by extracting keywords, this paper helps enhance the accessibility and comprehension of your research findings. It enables readers to gain a rapid overview of the various democracy types under study, making it easier for them to delve deeper into specific aspects of interest.

In this paper, we delve deep into the intricacies of eleven specific democratic models, unraveling their characteristics through the lens of extracted keywords. The structure of this paper unfolds in this manner: Section 2 delves into concise explanations of various democratic types. In Section 3, we describe and apply machine learning algorithms for keyword extraction to the realm of text descriptions associated with types of democracy. In Section 4, we present the results and provide commentary on them. We wrap up the paper with a conclusion and suggestions for subsequent research.

2 DEMOCRACY TYPES

In this section, we explore various forms of democracy, highlighting their unique characteristics. Democracy, which promotes individual freedoms and collective decisions, differs based on context. These descriptions, initially from a PhD study [19], are condensed here for clarity. The dataset is available at [10]. Each text description corresponds to one democratic type and is characterized by an English text description containing a maximum of 10,000 words. It's worth noting that while some democratic terms discussed here are widely accepted, others still lack a uniform definition.

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2.1 Participative Democracy

Participative democracy involves direct citizen participation in decision-making, using methods like town halls and online platforms. While fostering inclusivity and informed decisions, it might be resource-intensive and not always ensure equal representation [17].

2.2 Deliberative Democracy

Deliberative democracy emphasizes informed discussion among citizens to make collective decisions. While it can promote nuanced decision-making and civic engagement, ensuring equal voice, especially for marginalized groups, remains a challenge [7].

2.3 Transdemocracy

Transdemocracy proposes expanding democratic principles to global governance, recognizing the need for collective action on global challenges. It seeks more direct citizen involvement in global decisions but faces challenges like reconciling diverse values and ensuring equal global representation [12].

2.4 Guided Democracy

Guided democracy, also referred to as authoritarian democracy, centralizes power with restricted participation from citizens. Though it can provide stability, it might compromise on authentic democratic liberties. There's also an inherent risk of corruption and potential power misuse [5].

2.5 Modern Direct Democracy

Modern direct democracy empowers citizens with immediate control over political decisions, using platforms like electronic voting. It encourages civic engagement and responsive governance but may struggle with equal access and ensuring well-informed choices [16].

2.6 E-democracy

E-democracy uses digital tools to enhance citizen participation in politics. This includes online voting, social media, digital petitions, and e-forums. It encourages political involvement, especially among the youth, and offers transparency. However, concerns arise regarding online security, digital literacy, and accessibility [9].

2.7 Representative democracy

In representative democracy, citizens elect officials to act on their behalf, as direct involvement in every decision isn't feasible. This system promotes informed decisions and offers stability. Yet, true representation and influence of special interests are concerns [3].

2.8 Liquid democracy

Liquid democracy merges direct and representative democracy. Citizens can vote directly or delegate their vote. This system promotes active engagement but faces challenges in equal representation and decision quality [8].

2.9 Blockchain democracy

Blockchain democracy employs blockchain technology for a secure, transparent voting process, allowing remote voting. Despite its security, potential system vulnerabilities and accessibility issues persist [13].

2.10 Source democracy

This democracy focuses on the foundational decision-making structures. It advocates transparency and collective input. However, inclusive participation and decision quality remain challenges [15].

2.11 Ideal typical democracy

This normative concept outlines the optimal features of a democracy, including universal suffrage, free elections, representation, civil liberties, rule of law, power separation, and government transparency.

3 METHODOLOGY

Our exploration delved deep into three contemporary keyword extraction methodologies, namely TextRank, Rake, and TF-IDF, each offering its unique algorithmic underpinning for processing textual data.

The TextRank methodology stands out for its holistic approach to text analysis, where the textual content undergoes a series of rigorous preprocessing steps to distill its core meaning. These steps include tokenization, which breaks the text into individual words or phrases, and the removal of irrelevant or stop words that carry little semantic value. Once the text is prepared, TextRank constructs a graph based on term co-occurrence. This graph elucidates the intricate relationships between words, uncovering the underlying semantic structure of the text. In this graph, each term becomes a node, and the strength and number of their connections determine their significance. The top-scoring terms, which act as representative keywords, find applications in various domains. These applications extend far beyond traditional keyword extraction and encompass areas such as text classification, where keywords play a pivotal role in categorizing documents, sentiment analysis, which relies on keywords to gauge the emotional tone of text, and document clustering, where keywords aid in grouping similar documents together [11].

Transitioning to RAKE (Rapid Automatic Keyword Extraction), this method lives up to its name by offering an expedient approach to keyword extraction. Unlike the graph-based structure of TextRank, RAKE's algorithmic focus lies in dissecting textual information into individual components, often referred to as phrases or keyphrases. Each of these components is then scored based on its occurrence and relation to other words within the text. This nuanced approach to keyword extraction results in the isolation of top-scoring keyphrases, providing a richer and more contextually meaningful representation of the underlying text's content. The efficiency of RAKE makes it particularly useful in scenarios where quick and accurate keyword extraction is essential for tasks such as summarization, information retrieval, and content indexing [14].

Lastly, the TF-IDF (Term Frequency-Inverse Document Frequency) methodology delves into the granular essence of a term's importance within a document and across a broader corpus. This method combines two essential components: "TF" (Term Frequency) and "IDF" (Inverse Document Frequency). The "TF" metric captures the frequency of a term within a particular document, highlighting its significance in that context. However, TF alone may emphasize commonly occurring words that appear significant in isolation but lack uniqueness.

The "IDF" component evaluates the term's rarity or uniqueness across a broader corpus of documents. This measure ensures that commonly occurring terms, which might be abundant within a

single document, are appropriately contextualized against their prevalence across multiple documents. The multiplicative result of TF and IDF offers a composite score that indicates the weight or significance of the term. Terms with notable TF-IDF scores emerge as the textual frontrunners, illuminating the primary themes and subjects of the source material. TF-IDF is widely used in information retrieval, document ranking, and text mining tasks, making it a foundational method in natural language processing and information science [2].

4 RESULTS

The essential keywords for the Text Rank, Rake, and TF-IDF algorithms have been laid out in Tables 1, 2, and 3. A striking observation is the omnipresence of the keyword "Democracy" across all types of democracies and within all three algorithms. Given its recurrent use throughout the texts, the prominence of this keyword was anticipated.

Furthermore, a pattern emerges wherein many keywords bear close resemblance or are derivatives of the nomenclature of their respective democracy types. For instance, for Deliberative democracy, we see "Deliberation" and "Deliberative" making appearances. Similarly, "Participation" and "Participatory" are highlighted for Participative democracy, "Direct" and "Modern" for Modern direct democracy, "Representative" for Representative democracy, and "Liquid" for Liquid democracy. The frequency of these terms in the texts underscores their significance, thereby warranting their selection as keywords.

The keyword "Participation" is shared among Participative democracy, Deliberative democracy, and E-democracy in all three keyword extraction algorithms. This common keyword suggests alignment in themes among these democracy forms, potentially reflecting shared core principles. In contrast, other democracy types exhibit more distinct keywords. Additionally, the keyword "Citizens" is present in Source democracy, Participative democracy, and Blockchain democracy using the Text Rank algorithm. It appears only in Representative democracy with RAKE and in both Blockchain democracy and Representative democracy with TF-IDF. These variations in results across Text Rank, RAKE, and TF-IDF stem from their distinct methodologies. Text Rank considers relational context between terms, extracting keywords with conceptual relationships. RAKE focuses on local frequency and co-occurrence, sensitive to document structure. Finally, TF-IDF emphasizes term uniqueness across a document set. These differences mean that each algorithm yields a somewhat different set of keywords, even when analyzing the same content.

In all three algorithms, a set of 12 keywords serves as unique identifiers for distinguishing each type of democracy. These keywords are "Ancient", "Rule", "Laws", "Deliberation", "Deliberative", "Modern", "Liquid", "Vote", "Information", "Blockchain", "New", and "Government". They are depicted by red color in Tables 1, 2, 3.

Further delving into the specifics, the Text Rank algorithm possesses its own exclusive set of four keywords that differentiates it from the others. These are "Theory", "Communication", "Systems", and "Power". They are represented by blue color in Table 1. Conversely, the TF-IDF algorithm also has its unique identifiers with two sole keywords: "Axis" and "Counter democracy". In Table 3, they are represented using the color green. These individual sets of keywords not only underscore the differences in each algorithm's framework but also hint at their distinctive analytical approaches.

In summary, the Text Rank algorithm ranks highest with four unique keywords. Following closely is the TF-IDF algorithm with two distinct keywords. Lastly, the Rake algorithm doesn't have any unique keywords, placing it at the bottom of this comparison. Text Rank works best because dataset contains a lot of nuanced contextual information and that's why TextRank might be better suited to extract these nuances due to its graph-based approach.

5 CONCLUSION

In this research, we delved into the intricate fabric of descriptions for eleven distinctive types of democracies. The aim was to elucidate and capture the most salient keywords that epitomize the essence of each democracy type. By employing three different keyword extraction algorithms — Text Rank, RAKE, and TF-IDF — our study has not only shed light on the specific linguistic constructs and terminologies inherent to each democratic type but also the differential efficacy of the algorithms in context.

Our findings reveal that the keyword "Democracy" consistently appears in all types of democracies across various keyword extraction methods. This is expected since each text description provides definitions for its respective democracy type, leading to the frequent use of the term "Democracy." In the analysis of democracy types, keywords often closely align with or derive from the corresponding democracy nomenclatures. Notably, the term "Participation" consistently emerges across Participative democracy, Deliberative democracy, and E-democracy in all algorithms, indicating shared principles among these democracies. However, the keyword "Citizens" varies in its occurrence across different algorithms and democracy types. These discrepancies in keyword results stem from the distinct methodologies of the Text Rank, RAKE, and TF-IDF algorithms. Each approach leads to unique sets of keywords, even when applied to the same content.

This research underscores the importance of algorithm selection tailored to the specific requirements of the textual dataset in hand. Moreover, the keywords extracted present an invaluable repository for political scientists, historians, and policymakers in understanding the foundational pillars of varied democracy forms. Future work might consider combining every three keyword extraction algorithms into one single table, removing duplicates and extracting only unique keywords that belong to the corresponding democracy type. Additionally, by converting keywords into numerical values, clustering algorithms could be applied. This would enable the identification of democracy types that fall within the same group or cluster. Furthermore, in future endeavors, experts possessing a background in political education will assess the accuracy and validity of the extracted keywords.

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Table 1: 5 keywords for each democracy type extracted with Text Rank algorithm.

Type of Democracy	Keyword 1	Keyword 2	Keyword 3	Keyword 4	Keyword 5
Source democracy	Democracy	Society	Direct	Ancient	Citizens
Ideal-typical dem.	Democracy	Society	Rule	Executive	Laws
Participative dem.	Democracy	Political	Society	Participation	Citizens
Deliberative dem.	Democracy	Deliberation	Deliberative	Participation	Process
Modern direct dem.	Democracy	Direct	Society	Theory	Modern
Liquid democracy	Democracy	Liquid	Vote	Representative	Representatives
E-democracy	Democracy	Information	Participation	Public	Communication
Blockchain dem.	Democracy	Blockchain	New	Systems	Citizens
Representative dem.	Democracy	Representative	Government	Political	Power
Control democracy	Democracy	Civil	Democratic	Society	Monitoring
Transdemocracy	Democracy	Political	System	Concept	Form

Table 2: 5 keywords for each democracy type extracted with Rake algorithm.

Type of Democracy	Keyword 1	Keyword 2	Keyword 3	Keyword 4	Keyword 5
Source democracy	Democracy	Society	Executive	Ancient	Direct
Ideal-typical dem.	Democracy	Society	Rule	Executive	Laws
Participative dem.	Democracy	Participation	Political	Participatory	Society
Deliberative dem.	Democracy	Deliberation	Deliberative	Participation	Participatory
Modern direct dem.	Democracy	Direct	Modern	Referendum	Instrumental
Liquid democracy	Democracy	Liquid	Vote	Control	Representative
E-democracy	Democracy	Information	Participation	Public	Decision-making
Blockchain dem.	Democracy	Blockchain	New	Decentralized	Political
Representative dem.	Democracy	Representative	Government	Political	Citizens
Control democracy	Democracy	Civil	Society	Monitoring	Representative
Transdemocracy	Democracy	System	Political	Form	Representative

Table 3: 5 keywords for each democracy type extracted with TF-IDF algorithm.

Type of Democracy	Keyword 1	Keyword 2	Keyword 3	Keyword 4	Keyword 5
Source democracy	Democracy	Executive	Society	Ancient	Direct
Ideal-typical dem.	Democracy	Rule	Society	Executive	Laws
Participative dem.	Democracy	Participation	Political	Participatory	Society
Deliberative dem.	Democracy	Deliberation	Deliberative	Process	Participation
Modern direct dem.	Democracy	Direct	Modern	Instrumental	Referendum
Liquid democracy	Democracy	Liquid	Vote	Representative	Control
E-democracy	Democracy	Information	Decision-making	Participation	Axis
Blockchain dem.	Democracy	Blockchain	Citizens	New	Decentralized
Representative dem.	Democracy	Representative	Government	Political	Citizens
Control democracy	Democracy	Civil	Counter democracy	Democractic	Society
Transdemocracy	Democracy	System	Political	Concept	Form

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Evaluation of the Effects of On-Demand Dynamic Transportation of Employees to Their Workplaces in Ljubljana

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ABSTRACT

On-demand dynamic transportation is an innovative information-technology supported service that enables passengers to book and configure their rides. It is foreseen as a promising service to improve the sustainable mobility of citizens and alleviate traffic problems. In this paper, we present the results of a three-month pilot implementation of dynamic transportation of employees from their homes to their workplaces. The transports were managed by the company GoOpti, d.o.o., they were free and took place using vans on the routes connecting the cities Kamnik and Kranj with two areas (BTC and UKC) in Ljubljana. The project was very successful in terms of sustainable mobility: it attracted users that normally drive passenger cars, travel times were comparable to conventional modes of transportation and users were very satisfied with the service, while substantially reducing (from 30% to 70%) the harmful emissions of CO₂, NO_x and solid particles. However, two challenges for the future still remain: improving the occupancy rate of vehicles and bridging the gap between the economic price and users' willingness to pay for the service.

KEYWORDS

sustainable mobility, on-demand dynamic transport, employee transportation, Ljubljana Urban Region

1 INTRODUCTION

Within the last thirty years information technologies (IT) profoundly changed many aspects of our life and the society. IT provide us with tools that enable creation of new services, which have the potential to significantly improve our every day lives. One of such services is on-demand dynamic passenger transport [11], which typically makes use of vans or mini busses that operate without fixed itineraries or fixed stops, enabling passengers to book their ride and select their pick up and drop off locations. On-demand dynamic transport bridges the gap between the conventional public transport and private car transport, and promises to reduce green house gas and other pollutant

emissions, improve modal split, reduce traffic congestions and alleviate related problems.

The focus of this paper are not the IT needed to implement an on-demand dynamic transport (e.g., mobile apps, databases, scheduling and optimization systems), but rather we present the results of a real life evaluation of such a system that has been carried out in Ljubljana Urban Region, Slovenia, within the SmartMOVE project [10]. SmartMOVE addresses the challenges of sustainable mobility in the Ljubljana Urban Region with the capital city of Ljubljana, which is the primary destination of daily migration flows in Slovenia.

The aim of this study is to answer two questions that are crucial if such a service is to be implemented in practice: (1) Can on-demand dynamic transport really help in reducing harmful emissions and traffic congestion? and (2) Under what conditions can such a service sustainably operate in a given economic environment? It is important to note that before this study no evaluation of on-demand dynamic passenger transport in comparable environments has been done, and its benefits and limitations used to be assessed only theoretically through simulations [1].

2 RELATED WORK

Ljubljana is home to over 220,000 jobs, which accounts for over 25% of all jobs in Slovenia. As a result, over 120,000 people flock to Ljubljana daily from elsewhere. This means approximately 100,000 vehicles entering and exiting Ljubljana on a daily basis (with an average occupancy of vehicles at 1.2 pers/car). Since the majority of this is associated to the personal car transport, the main goal is to transfer the car drivers/passengers to public transport. However, the road public transport is faced with the same problems as car transport – congestions due to absence of dedicated lanes, low travel speeds, poor occupation of vehicles.

The problem of public transport in Ljubljana was tackled by studies that focused on various aspects. Some of them outline the overall context of the problem and the related phenomena [4]. The current public transport organization in Ljubljana is reflected well in a paper that describes the public transport plans from a decade ago [6]. There are studies about the state of the public transport in Ljubljana, such as accessibility [12], speed [7], studies about the effects of public transport management measures [13] and about its potential future developments.

On-demand dynamic transportation, which is in the focus of this paper, shares several characteristics with carpooling [14]. However, we could find no previous studies about on-demand

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dynamic transportation in Ljubljana and even in general, the studies of on-demand dynamic transportation are to a large extent dedicated to theoretical models [8, 5] and simulations [2, 1]. A good showcase of dynamic transport practices are the on-demand airport shuttles, which have indicated a potential solution to the downsides of regular public lines; they support the users' needs and commodity as one of the most important factors for choosing the preferred means of transport.

3 STUDY DESIGN

The main objective of this pilot study was to test using on-demand dynamic transportation of employees as a sustainable alternative to existing modes of transport, especially in comparison with using passenger cars. The study took place in the trial period from February to April 2023, when selected passengers were transported free of charge by the company GoOpti, d.o.o., employing vans that can carry up to eight passengers. Transportation costs were covered from the SmartMOVE project. Two pilot routes were established that connected two nearby cities Kamnik (14,000 inhabitants, about 23 km from Ljubljana) and Kranj (38,000, 28 km) with the areas of two large employer organisations located in Ljubljana: UKC and BTC. UKC, the University Medical Centre of Ljubljana, is with 8,000 employees the largest employer in Slovenia; daily, it is visited by additional 20,000 people. BTC, the Business Trade Centre, is the largest shopping area in Slovenia. It does not have many direct public transportation links, but is located close to a highway, inducing high volumes of car traffic.

Before the study, the opportunity to join the experiment was advertised using different channels, particularly in the UKC and BTC areas. Among more than 500 interested individuals, 131 were eventually selected and invited to participate. All the operation, including the IT solution, customer management and logistics, was carried out by the project partner GoOpti.

Two data sources were collected during the study:

- *Traffic data*: Collected by GoOpti while providing the service. This included detailed data about the travelled routes (distances, times and GPS locations) and provided services (anonymized individual user's rides).
- *User survey*: Collected using a survey questionnaire once per each individual user at the end of the study period. The questions mainly addressed users' current mobility habits (with more detailed questions for users using cars) and their experience with the service. A full version of the questionnaire (in Slovene language) is available in [3].

Using this data, we carried out the following analyses: basic traffic and demographical statistics, average occupancy of vans and individual users' rides, users' current mobility habits, and user satisfaction with and willingness to pay for the service. By combining the data sources, we estimated the differences between the current and dynamic means of transportation in terms of travelling time and contribution to lower emissions of CO₂, NO_x (nitrogen oxides) and PM10 (particles with a diameter of 10 µm or less).

In order to assess environmental burdens, we analyzed the difference in air emissions between the "BaU - Business-as-Usual" scenario (i.e., trips without the introduction of dynamic transport) and the GoOpti service. We took into account the distances traveled by the types of transport that users used before the introduction of GoOpti: mainly driving passenger cars of different types (gasoline, diesel), taking into account the age of the vehicles and corresponding average emissions. Data sources included

Table 1: Basic ride statistics.

Route	Passengers [total]	Distance [km]	Time [min]	Speed [km/h]	Occupancy [%]
Kamnik	5440	21.20	42.81	29.72	38.0
Kranj	1742	33.66	45.62	44.27	25.9
Total	7182	25.18	43.70	34.57	34.1

the Statistical Yearbook of the Republic of Slovenia [9] and EU emission standards (EURO standards¹). We considered the users' distances from home to workplace and the number of journeys they would have made if dynamic transport had not been employed. As a weighting factor for the calculation, we considered whether the users mainly drive with personal vehicles (several times a week) or perhaps combine the drives with other modes of transportation to work (public passenger transport, bicycle, etc.). The emission factors for GoOpti vehicles were obtained from the manufacturer's specifications.

4 RESULTS

4.1 Traffic Data Analysis

Traffic statistics. In three months of the pilot study, there were 2,629 rides of the total distance of 66,199 km and time of 1,915 hours (almost 32 days). Here, each "ride" means picking up the passengers at one or more origin locations and dropping them down at one or more destination locations. Table 1 shows, grouped by the routes and in total, the total number of passengers and average ride distances, times, speed and vehicle occupations. The term "passenger" refers to one ride of a single person.

User statistics. The service was used by 131 individual users, who used the service daily or less. The most active user used the service 121 times, and the average was 54.88 times per user. Female users prevailed over males (73% vs. 27%). The prevailing age groups were 31–42 (43%) and 45–64 (46%), while the distribution of users' education levels was close to uniform.

Vehicle occupancy. As large as possible vehicle occupancy is essential for the effectiveness of dynamic transportation. Figure 1 displays the occupancy achieved in the study.

4.2 User Survey Analysis

The survey was completed by users at the end of the trial period, so that each user completed the survey at most once. Out of the 131 users, the completed survey was submitted by 88: 30 travelling from/to Kranj and 58 in the Kamnik direction.

Current mobility habits. Figure 2 shows relative proportions of transportation modes used by the survey respondents. The prevailing mode is using personal cars: 70% as sole drivers and 20% as fellow passengers. The train and city bus come next at approximately 30% each, the bicycle at 10%, while the remaining modes are barely indicated. Both routes exhibit similar usage patterns.

The respondents that use cars estimated their average occupancy at 1.37 per ride. Most of the cars have diesel or gasoline engines (about 45% each). Hybrid and electric cars account only for about 2%. The average age of cars is 9.15 years (7.28 on route Kranj and 10.04 on route Kamnik).

User satisfaction. The users were generally very satisfied with the service. They most appreciated the easiness and comfort of

¹ Euro 1 (1992): 91/441/EEC, 93/59/EEC; Euro 2 (1996): 94/12/EC, 96/69/EC; Euro 3 (2000): 98/69/EC; Euro 4 (2005): 98/69/EC (& 2002/80/EC); Euro 5 (2009): 715/2007/EC; Euro 6 (2014)

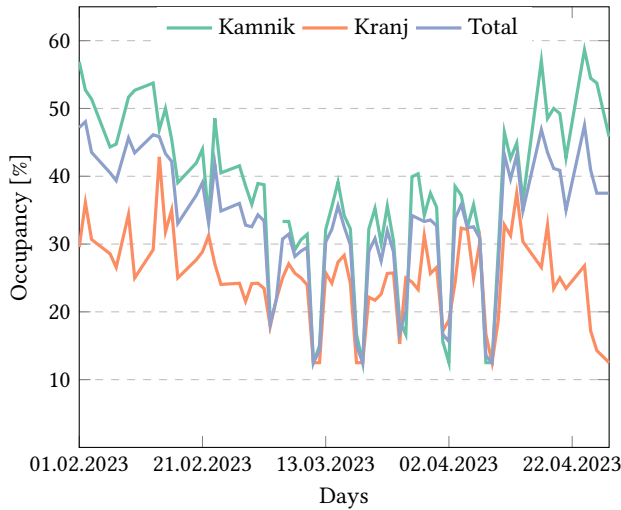


Figure 1: Average vehicle occupancy, per days and routes.

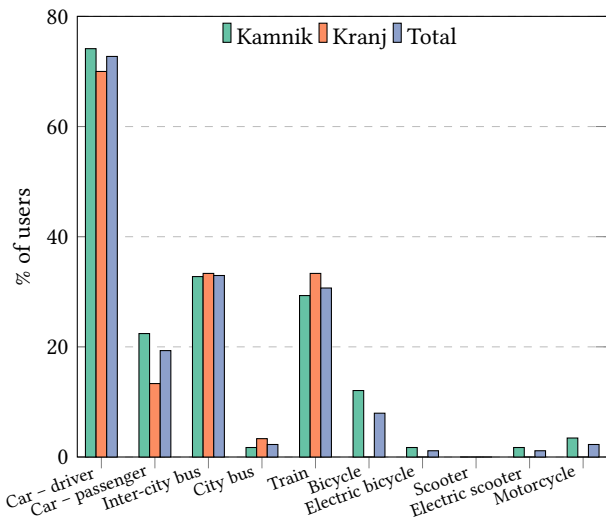


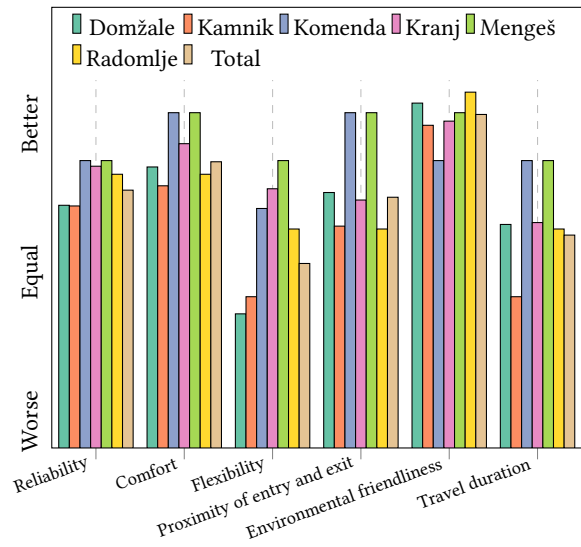
Figure 2: Current modes of transportation, normalized by the number of respondents. Since multiple answers were possible, the values shown are not true relative values and do not add up to 100%.

this mode of transport, its reliability, the proximity of stations, the possibility to effectively use the time for themselves and the fact that they did not need to search for the parking place. Complaints, on the other hand, were scarce and mainly addressed too long collection/drop-off times, variable collection times and the need to check the collection information every day. When asked to compare their usual means of transportation with the dynamic one (Figure 3), they evaluated the latter better in all points except the flexibility. It is very likely (on average 9 on the 0–10 scale) that the respondents will recommend the service to their friends and relatives.

Willingness to pay. When asked about their willingness to pay for the service, the average response was about 70€ per month (64€ for Kamnik and 86€ for Kranj).

4.3 Comparison of Traveling Times

We compared the time of traveling between the dynamic transportation and the usual modes of respondents’ transportation.



Transportation quality aspect

Figure 3: Comparison of the respondents’ usual transportation mode with the dynamic one.

Table 2: Comparison of average traveling times, in minutes.

Entry location	Usual transportation	Dynamic transportation	Difference
Domžale	30.97	26.67	-4.30
Kamnik	42.00	44.16	2.16
Komenda	59.00	36.91	-22.09
Kranj	54.72	38.97	-15.75
Mengeš	36.00	27.80	-8.20
Radomlje	40.71	40.09	-0.63
Average	41.22	35.07	-6.15

We used both data sources. It should be noted that the comparison includes only passengers who have completed the survey (otherwise we have no information about their normal time traveling time). Additionally, we had to exclude two respondents because of a mismatch with traffic data. Traffic data do not include any time of walking and waiting for a van. The survey data was collected only once for each passenger ($n = 86$), while there was substantially more traffic data (5,476 passenger rides). Therefore, there is a substantial difference in the amount and quality of the data, and a cautious interpretation is advised.

Results are shown in Table 2. Considering all entry locations, except Kamnik, the dynamic rides are faster (in average by 6.15 minutes). This comparison is not entirely fair because the dynamic transportation times do not include possible waiting and walking times, but we can safely assume that the times are at least comparable.

4.4 Analysis of Environmental Burdens

The analysis of the environmental burdens focused on CO₂ and NO_x emissions and particulate matter (PM) for human health reasons. The results in Table 3 show a significant reduction in CO₂ emissions after the introduction of the dynamic transportation service: reduction of emissions by approximately 27%, or over 50% in case of higher occupancy/exclusive use of the dynamic service. Similar reductions are also expected with NO_x (26% to 68%) and PM (27% to 79%). It is important to emphasize that

Table 3: Comparison of CO₂, NO_x and PM emissions.

	BaU	Dynamic (weighted)	Dynamic (total)
CO ₂ [t]	23.90	17.30 (-27%)	10.90 (-54%)
NO _x [kg]	23.21	17.20 (-26%)	5.30 (-69%)
PM [kg]	1.44	1.05 (-27%)	0.30 (-79%)

the absolute values of PM particle emissions are low, since the average vehicle age is about 9 years, when the minimum emission standards for solid particles have already been introduced.

Generally, the results show a significant reduction in emissions when implementing the dynamic transport compared to the BaU scenario. However, it should be noted that the data refer to the average number of users and that these may vary depending on vehicle occupancy, driving dynamics (driving speed), road conditions (e.g., duration of traffic jams), etc. These are preliminary estimates that do not yet take into account possible errors in data collection and interpretation of uncertainty. The numbers/results correspond to the implementation of the pilot project only – the potential up-scaling analysis would show the actual potential of such measures for solving the urban mobility issues.

5 CONCLUSIONS

The results of this pilot study confirm that on-demand dynamic transportation of employees to their jobs has a great potential for improving the sustainable mobility in the Ljubljana Urban Region. As part of the pilot project, which was taking place from the 1st February 2023 to 28th April 2023, 2,629 van rides were carried out with a total length of 66,199 km and a total duration of almost 32 days. The average ride was about 25 km long and lasted 44 minutes. 131 individual users were involved, who made a total of 7,182 individual commutes. Some used the service in both directions on a daily basis, others less often.

Most users of the service (about 70%) usually use a passenger car for their transport to work. The transition to dynamic transportation puts all these cars "off the road", while only moderately competes with other forms of public transportation. This also causes a significant reduction in harmful emissions of CO₂, NO_x and solid particles into the environment: from 30% to 70%, depending on the substance and transportation. Also, the dynamic transportation is comparable with other modes of transportation considering the speed and time spent. The satisfaction of users was also highly positive, as they liked that somebody else took care of their everyday commute to work, which was done without stress, accurately and reliably. They especially appreciated the "door-to-door" aspect and avoiding the search for a parking lot. However, from the data collected we cannot actually determine to which extent was the users' enthusiasm caused by the fact that the transport was free of charge during the pilot study.

Two problems were identified that might jeopardize the permanent operation of the dynamic transportation. The average occupancy of the vehicles was only around 2.73 passengers per ride (34% of 8 seats). Of the two routes, Kamnik and Kranj, the former were better occupied – by almost one passenger in average per ride. According to GoOpti [3], a higher occupancy (75%) could be achieved during the traffic peak times around the city of Domžale, which lies halfway to Kamnik.

Another problem is the price that the users are willing to pay for the service, which amounts to around 70€ per month. This is significantly less than the economic price estimated at 250€ at 50% occupancy and 160€ at 75% [3]. It seems that car users are not really aware of the actual costs and underestimate

their expenses for commuting to work. Better awareness of users would be needed on the costs and environmental impacts of different transportation modes.

In summary, dynamic transportation seems a feasible and effective alternative to using cars for commuting to work. However, in Slovenia, it requires a careful consideration, at the levels of communities, cities, regions and the whole country, of how to attract the users and support the transition to this and other sustainable transportation means. In perspective, it will also require intelligent software for supporting the service. The tasks that are particularly interesting for applying artificial intelligence methods, include the prediction of customers' requests, optimization of costs and dynamic planning of routes.

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Test uporabnosti prilagojenega WHCA* algoritma za iskanje poti za več agentov v strateški igri v realnem času

Usability Test of a Modified WHCA* Algorithm for Multi-Agent Pathfinding in a Real-time Strategy Game

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POVZETEK

V zadnjih letih je bilo predlaganih več algoritmov za iskanje poti za več agentov (*angl. kratica MAPF*), ki naj bi bili primerni za vodenje enot v strateških igrah v realnem času. Toda algoritmi so predstavljeni in testirani brez upoštevanja ključnih lastnosti kompleksnega okolja iger, kot so dinamični zemljevidi, različne lastnosti in hitrosti agentov, prisotnost sovražnikov. Da bi ugotovili, ali je MAPF pristop res primeren za uporabo v igrah, smo v obstoječem igralnem pogonu za strateške igre v realnem času implementirali in prilagodili WHCA* algoritem ter ga primerjali s standardnim LRA* pristopom iskanja poti za posameznega agenta. Eksperimentalni rezultati kažejo, da naša implementacija WHCA* algoritma znatno izboljša kakovost poti ter lahko reši težke primere, ki jih LRA* ne more. Čeprav je čas iskanja poti z WHCA* veliko daljši, menimo, da MAPF ima potencial v razvoju iger.

ABSTRACT

Over the years, several multi-agent pathfinding (MAPF) algorithms have been proposed as suitable solutions for guiding units in real-time strategy (RTS) games. However, algorithms are tested without considering the crucial properties of a complex game environment, such as dynamic maps, different unit properties and agent speeds, the presence of enemies. To determine whether MAPF approach really is suitable for use in games, we implemented and modified the seminal WHCA* algorithm in an existing RTS game engine and compared it to the common LRA* single-agent pathfinding approach. Our experimental results show that our WHCA* implementation greatly improves the path quality and can solve difficult scenarios that the single-agent approach cannot. WHCA*'s search times are much longer, but we still think MAPF has potential in game development.

KLJUČNE BESEDE

iskanje poti za več agentov, strateške igre v realnem času, heuristično preiskovanje, WHCA*

KEYWORDS

multi-agent pathfinding, real-time strategy games, heuristic search, WHCA*

1 UVOD IN MOTIVACIJA

NP-težek problem iskanja poti za več agentov (*angl. multi-agent pathfinding, MAPF*) je definiran z grafom $G = (V, E)$ ter množico n sodelovalnih agentov a_1, \dots, a_n . Veljavna rešitev problema je množica n poti, ki pripelje vsakega agenta a_i od njegovega začetnega vozlišča $s_i \in V$ do ciljnega vozlišča $g_i \in V$ po povezavah $e_i \in E$, ne da bi dve poti prišli v konflikt. Konflikt oz. trk nastane, ko se agenta a_i in a_j oba nahajata v vozlišču $v \in V$ v istem časovnem koraku t_i . Optimalna rešitev je po navadi tista, ki minimizira skupno vsoto cen vseh poti [2].

Več znanstvenih del predstavlja MAPF algoritme, za katere trdijo, da so primerni za uporabo v igrah, še posebno za strateške igre v realnem času (*angl. real-time strategy, RTS*). Vendar predstavljeni algoritmi pri razvoju in testiranju ne upoštevajo ključne lastnosti kompleksnega okolja RTS iger. RTS igre vsebujejo agente različnih hitrosti in značilnosti. Med igro se obstoječim agentom kadarkoli lahko dodeli nov ukaz, poleg tega pa se neprenehoma ustvarjajo novi agenti. Značilni so tudi dinamični zemljevidi, ki jih igralci lahko tekom igre spreminjajo z gradnjo objektov, ter sovražni agenti, s katerimi ne sodelujemo, ampak jih moramo še vedno upoštevati pri iskanju poti, kot neprehodne, premikajoče ovire.

Izkaže se, da v praksi večina iger išče pot za vsakega agenta posebej (*angl. single-agent pathfinding, SAPF*), po navadi z A* algoritmom [3], brez upoštevanja načrtov ostalih agentov. Konflikte, ki nastanejo kasneje med premikanjem, poskusijo igre lokalno razrešiti z ad-hoc preverbami in pravili. Ta pristop je znan kot Lokalno popravljane A* (*angl. Local-Repair A*, LRA**) [10]. Ko zahtevnost iger narašča lahko preprosti LRA* algoritem postane nezadosten. Zmogljivost je mogoče izboljšati na več načinov, na primer s hierarhično abstrakcijo [9] ali z upoštevanjem simetrije preiskovalnega prostora [5]. Marsikateri SAPF algoritmi se lahko danes uporabijo za vodenje velikega števila agentov v RTS igri. Ker pa pri iskanju ne upoštevajo načrtov drugih agentov, so opazni pogosti zastoji ter nasploh okorno in nenaravno premikanje, še posebej v ozkih hodnikih.

V želji, da bi premostili razkorak med znanstvenim raziskovanjem in praktičnim razvojem iger, smo implementirali enega ključnih MAPF algoritmov, Okvirjeni hierarhični kooperativni A* (*ang. Windowed Hierarchical Cooperative A*, WHCA**) v OpenRA igralnem pogonu za RTS igre in ocenili, ali je MAPF pristop res uporaben za RTS igre. WHCA* namreč velja za enega temeljnih sub-optimalnih MAPF algoritmov, ki služi kot izhodišče mnogim novejšim algoritmom in nadgradnjam [8, 1, 6].

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2 METODE

2.1 OpenRA

OpenRA [4] je odprtokodni pogon za strateške igre v realnem času, ki med drugimi poganja na novo ustvarjeno igro Dune 2000. Le ta predstavlja dokaj tipičen primer RTS igre. Igralci iz različnih perspektiv opazujejo mrežni, dvodimenzionalni zemljevid in nadzirajo svoje enote. Cilj igre je nabirati surovine, razširiti bazni tabor z novimi zgradbami in proizvesti enote, s katerimi poskušamo napasti in uničiti nasprotnikov tabor. Enote imajo različne hitrosti, so zmožne več akcij in se gladko premikajo iz ene celice v drugo. To predstavlja kompleksno okolje za navigacijo enot, še posebej, ker se vse odvija v realnem času.

2.2 LRA*

OpenRA za iskanje poti uporablja različico standardnega LRA* algoritma. Ker se agenti lahko premikajo med celicami diagonalno, LRA* za heuristično funkcijo uporablja oktilno razdaljo, definirano kot $D_{oct} = (|x_2 - x_1| + |y_2 - y_1|) + (\sqrt{2} - 2) \cdot \min(|x_2 - x_1|, |y_2 - y_1|)$, med dvema celicama (x_1, y_1) in (x_2, y_2) . Oktilna razdalja je monotona in dopustna heuristika.

Pred premikom agenta v novo celico algoritem požene zaporedje preverb, s katerimi poskuša ujeti in preprečiti vse možne trke s čakanjem ali iskanjem nove poti. Ta sistem je zapleten, ker med igranjem lahko pride do množice različnih robnih pogojev. To je ena glavnih slabosti LRA* pristopov.

2.3 Osnovni WHCA*

Osnovni WHCA* algoritem je bil v izvirnem članku [7] označen za nadvse primerne za RTS igre. Z A* preiskuje 3D prostor (2D mrežni zemljevid in diskretna časovna dimenzija) za vsakega agenta posebej ter rezervira najdene poti v skupno časovno-prostorsko rezervacijsko tabelo. Vnos vozlišča (x, y, t_i) v tabeli oznanja, da je celica (x, y) že zasedena v časovnem koraku t_i in zato ni na voljo ostalim agentom. Med razvijanjem vozlišča se preveri, katere sosednje celice so proste ovir in rezervacij, kar implicitno omogoči izogibanje trkom in kooperativno premikanje. WHCA* za heuristično oceno razdalj uporablja Obratno nadaljevalno A* (*angl. Reverse Resumable A*, RRA**). Pred začetkom iskanja kooperativnih poti se najprej za vsakega agenta požene RRA* iskanje, ki z A* poišče najkrajšo pot od agentovega cilja do začetka. Zaradi monotonosti oktilne razdalje imamo sedaj na voljo točno ceno do agentovega cilja za vsako razvito vozlišče. Če med kooperativnim iskanjem agent zaide z najkrajše poti in potrebuje heuristično oceno za novo vozlišče, nadaljujemo RRA* iskanje, dokler le-ta ne razvije potrebnega vozlišča in pridobi točno razdaljo. WHCA* išče poti le za naslednjih w korakov, kar pripomore k zmogljivosti. Ko agent izvede $w/2$ premikov, še enkrat poženemo iskanje za naslednjih w korakov. To imenujemo iskanje z okvirjem.

2.4 Prilagojeni WHCA*

Zaradi kompleksnosti in narave OpenRA okolja je bilo potrebno prilagoditi osnovni WHCA* algoritem. Igralec lahko kadarkoli ustvari nove agente in ukazuje nove premike obstoječim agentom. Zaradi tega se kooperativno iskanje poti ne sme nikoli končati. Posledično mora biti rezervacijska tabela krožna. Agenti morajo po premiku v naslednjo celico izbrisati rezervacijo prejšnje celice, da ne bi vplivala na iskanje poti v prihodnosti.

Vsi agenti ne dobijo ukaza v istem trenutku zato je potrebno sinhronizirati individualna iskanja in za vse agente izračunati

novo delno pot vsakih $R = w/2$ taktov (*angl. ticks*, osnovna časovna enota pogona in časovni korak našega algoritma). Ena sekunda ponavadi vsebuje okoli 25 taktov. Zaradi večje zveznosti premikov en časovni korak ne ustreza več enemu premiku celice – agenti, glede na njihovo hitrost, zasedejo celico med premikom za različno število taktov. To lahko povzroči nemirno obnašanje agentov, ki želijo zapolniti iskalno okno z nepotrebni premiki, kar odpravimo z znižanjem cene čakanja na mestu.

Zaradi kompleksnega premikanja agentov in arhitekture pogona je preverjanje rezervacij oteženo. Potrebno je izračunati čas prihoda in odhoda agenta za sosednjo celico. Čas odhoda je težko predvideti, saj ne vemo z gotovostjo v katero od naslednjih sosednjih celic se bo napotil, od tega pa je odvisno koliko časa bo preživel v celici. Netočni čas prihoda in odhoda lahko povzroči sprejem konfliktnih poti ali zavračanje veljavnih rešitev.

RRA* heuristika je bila prvotno namenjena za uporabo na mreži, kjer se agenti premikajo v štirih glavnih smereh. V našem primeru se agenti lahko premikajo še diagonalno, kar povzroči potrebo po dodatnem nadaljevanju iskanja RRA* z oktilno razdaljo, tudi ko agent sledi prvotni poti. Da bi to optimizirali, v glavnem kooperativnem iskanju filtriramo sosedne in obdržimo le tiste, ki so že bili razviti z RRA*. To vpelje dodatne zaplete in povzroči, da agent včasih ne uspe najti poti okoli dinamičnih ovir.

WHCA* ima problem z vrstnim redom obdelave agentov, na kar sta opozorila tudi Sturtevant [8] in Bnaya [1]. Lahko se zgodi, da agent z višjo prioriteto prvi rezervira pot in zasede vse celice okoli naslednjega agenta z nižjo prioriteto, ki nato ne more najti poti. V takem primeru je konflikt neizogiben. Problem postane še bolj pogost zaradi heterogenih agentov v OpenRA, kjer lahko hitrejši agent rezervira več celic okoli počasnejšega agenta. Težavo smo poskusili rešiti s prepisovanjem rezervacij, kar pa lahko privede do kaskadne izgube sodelovanja med agenti.

Obdržali smo nekatere principe lokalnih preverb za izogibanje trkom, ker so prisotne tudi enote s katerimi ne sodelujemo, na primer zgradbe in sovražniki. Dodali smo tudi heuristično posodabljanje cilja. Agent zamenja za cilj prvo prosto celico v radiju 8 celic okoli prvotnega cilja, če je le ta med iskanjem poti že zaseden ali pa za cilj vzame svojo trenutni položaj, če je že v bližini cilja (8 celic) in med premikanjem naleti na oviro.

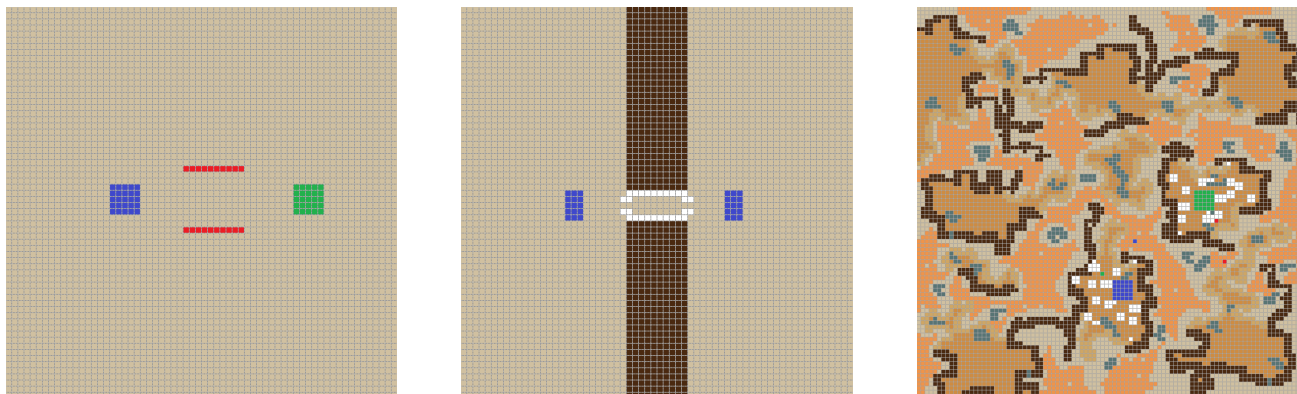
3 EKSPERIMENTI

Časovno zmogljivost in kakovost poti prilagojenega WHCA*(R) algoritma smo testirali v igri OpenRA pogona za različne dolžine iskalnega okvirja $R = w/2$ in primerjali rezultate s prvotnim algoritmom pogona LRA*.

Posamezni eksperiment sestoji iz 50 iteracij. Ena iteracija je premik skupine 25 agentov iz začetnega območja na levi strani zemljevida do ciljnega območja na desni. Agentom se pripadajoča začetna in ciljna celica znotraj območij določi naključno. Iteracija se konča, ko vsi agenti prispejo na cilj ali pa ko se izteče vnaprej določena časovna limita testa. Agenti so naključno izbrani iz nabora treh enot: hitro vozilo s kratkim časom obračanja, srednje hitrim tankom z dolgim časom obračanja in počasni pešak s takojšnjim obratom.

Iskanje poti smo testirali na treh različnih zemljevidih vidnih na Sliki 1. Vsak od njih predstavlja določen scenarij, ki lahko nastane tekom igre:

- SOVRAŽNIKI: prečkanje skupine premikajočih sovražnih agentov, časovna limita 1,150 taktov, velikost 64x64 celic



Slika 1: Sheme zemljevidov eksperimentalnih scenarijev: levo SOVRAŽNIKI, v sredini GRLO, desno IGRA. Modra barva označuje začetne celice, zelena pa ciljne. Skupini agentov v scenariju GRLO, si izmenjata začetni poziciji. Bele, temno sive in temno rjave celice predstavljajo neprehodne zgradbe ter naravne ovire. Ostale barve onačujejo prosto prehodna območja. Scenarij SOVRAŽNIKI vsebuje sovražnike, ki patrolirajo med zgornjimi in spodnjimi rdečimi celicami. IGRA vsebuje še v igrah pogosto, nabiralniško enoto – prijateljska patroljira ob vhodu spodnje baze, sovražna pa ob vhodu zgornje.

- GRLO: premik dveh manjših skupin iz nasprotnih smeri skozi ozko grlo, časovna limita 1,150 taktov, velikost 64x64 celic
- IGRA: simulacija povprečnega premika v nasprotnikovo bazo med igranjem igre, časovna limita 2,350 taktov, velikost 69x69 celic

Število agentov in dimenzije zemljevida smo izbrali skladno s povprečnim primerom igre.

Rezultati eksperimentov so vidni na Slikah 2 in 3. Trajanje iskanja poti smo merili s številom razvitih vozlišč (zgornja vrstica Slike 3) in z milisekundami (spodnja vrstica Slike 3). Da lažje analiziramo vpliv RRA* heuristike, smo, kot v ostalih člankih, ločili časovne meritve na prvi inicializacijski takt in na vse naslednje takte. Mera prvega takta je povprečje vseh prvih taktov iteracije. Za mero naslednjih taktov smo vzeli povprečje maksimalnih vrednosti iteracije po prvem taktu. Mera nam tako predstavlja kako dolgo, v povprečju, algoritem išče pot v najtežjih situacijah.

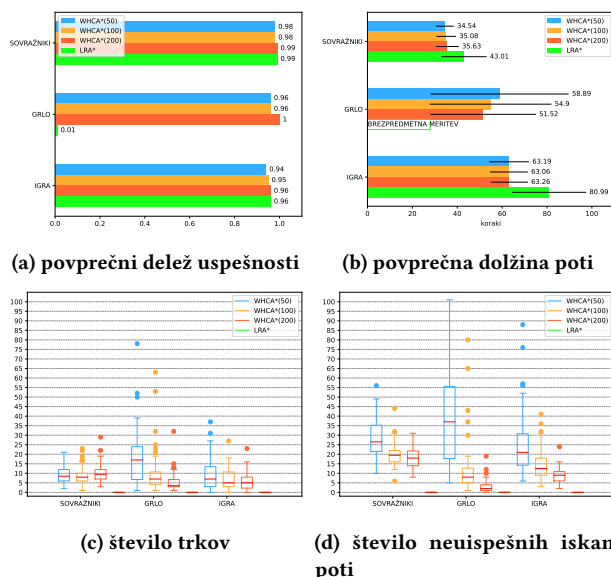
Dolžino poti smo merili s povprečnim številom korakov, ki jih potrebuje agent, da prvič prispe do cilja (Slika 2b).

Izmerili smo tudi delež agentov, ki uspešno prispejo do cilja (Slika 2a), kolikokrat algoritem ne uspe najti veljavne kooperativne poti (Slika 2d) ter število trkov (Slika 2c). Agentov po trku ne odstranimo iz igre.

4 DISKUSIJA

Na Sliki 2b lahko hitro odčitamo, da ima WHCA* v primerjavi z LRA* manjšo povprečno dolžino poti. Boljša kakovost rešitve je očitna tudi, ko s prostim očesom opazujemo premikanje agentov, tudi za scenarij IGRA, ki predstavlja dober vpogled v delovanje algoritma v OpenRA okolju. WHCA* gladko vodi agente skozi kompleksno okolje v bolj strnjjenih skupinah. Agenti so zmožni sodelovanja, se umikajo, da razrešijo konflikte in lahko obvozijo počasnejše agente. Agenti v LRA* eksperimentih se premikajo okorno, razpršeno in imajo navado slediti eden drugemu v dolgih, ozkih kolonah do cilja.

Zaradi sodelovalnega iskanja poti je WHCA* zmožen rešiti tudi težek scenarij z ozkim grlom. Večji kot je iskalni okvir, bolje bo WHCA* vodil agente skozi majhno odprtino. Pri LRA* agenti vedno obstanejo v gneči sredi prehoda in ne dosežejo svojih ciljev

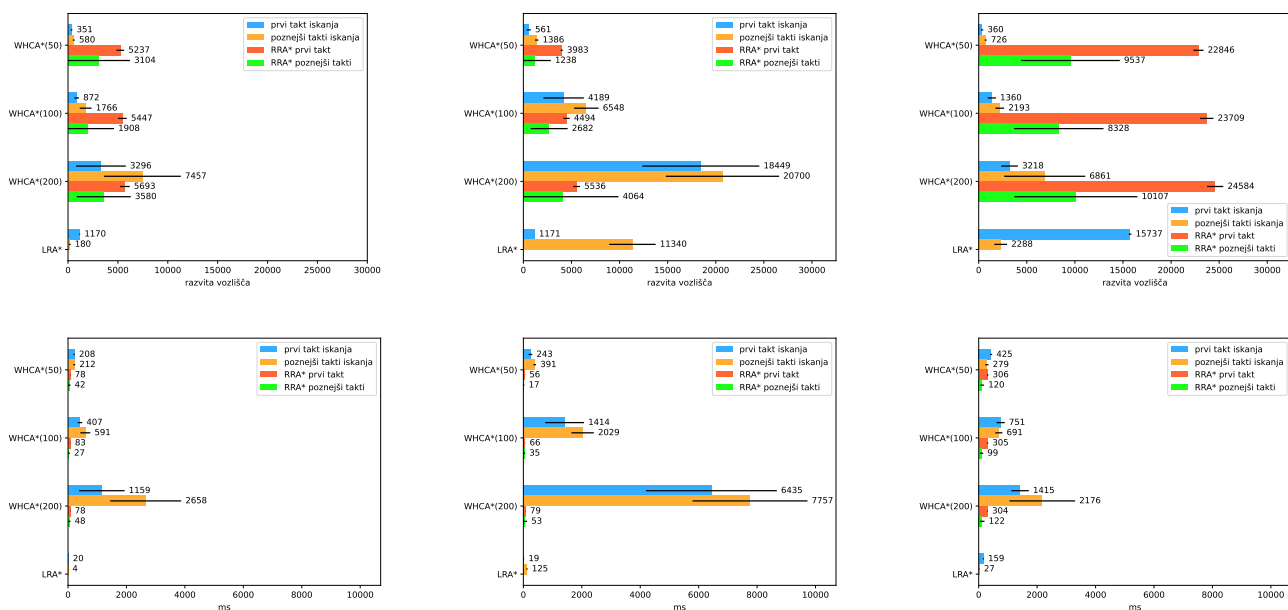


Slika 2: Rezultati eksperimentov za različne scenarije.

(zaradi izjemno nizke uspešnosti LRA* za scenarij GRLO, dolžine poti ni smotrno primerjati z meritvami za WHCA*). V preostalih primerih oba algoritma do cilja privedeta skoraj vse agente.

Na žalost WHCA* potrebuje veliko več časa za pridobitev kooperativne poti za vse agente. Čas je odvisen od širine iskalnega okvirja, vendar je tudi najmanjši okvir počasnejši kot LRA* v vseh primerih. V povprečni OpenRA igri WHCA* s kompromisnim okvirjem $R = 100$ lahko porabi 700ms za iskanje poti, kar je v RTS igri moteče in opazno igralcem, tudi če ne prekine igro za toliko časa ob čisto vsakem ukazu.

Če na Sliki 3 primerjamo rezultate razvitih vozlišč s časom v milisekundah opazimo, da RRA* predstavlja le majhen delež časa iskanja poti z WHCA*, tudi v primerih, ko je število razvitih vozlišč z RRA* bistveno večje kot število vozlišč razvitih z WHCA*. Računanje dodatnih korakov potrebnih za iskanje poti v kompleksnem OpenRA okolju, povzroči, da razvijanje vozlišč traja dlje



Slika 3: Rezultati dolžine iskanja poti v razvitih vozliščih (zgornje slike) in v milisekundah (spodnje slike) za različne scenarije: levi sliki SOVRAŽNIKI, sredinski GRLO, desni IGRA.

za glavno WHCA* iskanje kot pa za bolj preprosto RRA* hevrstiko. Izkazuje se, da WHCA* razvije največ vozlišč, ko računa drugi okvir poti, saj se takrat kompleksnost primera poveča, medtem ko RRA* razvije večino vozlišč že v prvem taktu. Posledično naša implementacija potrebuje manj časa v prvem inicializacijskem taktu kot pa v naslednjih taktih.

Dinamični scenarij SOVRAŽNIKI povzroči težave WHCA* algoritmu, saj pokvari točnost RRA* hevrstike ter oteži kooperacijo s prisotnostjo nepričakovanih sovražnih agentov, s katerimi ne sodelujemo. Rezultati na sliki 2c in 2d prikazujejo številne trke in neuspela iskanja poti WHCA* algoritma, ki jih v nasprotju z drugima scenarijema, znatno ne zniža niti največja širina iskalnega okvirja. V ostalih primerih večji iskalni okvirji preprečijo dovolj neuspešnih iskanj poti in trkov, da le-ti niso opazni med igro. Zanimivo je, da se med opazovanjem preprostejši LRA* v primeru sovražnih agentov izkaže za bolj uspešnega, saj le počaka nekaj trenutkov, da se agent umakne, preden nadaljuje prvotno pot. Nasprotno, WHCA* nemudoma poišče novo pot okoli ovire. Kljub temu, dinamične ovire ne vplivajo občutno na časovno zmogljivost WHCA* algoritma.

5 POVZETEK

Implementirali smo prilagojeni WHCA* algoritem v obstoječem RTS igralnem pogonu OpenRA, da bi dognali, ali je MAPF pristop res primeren za uporabo v RTS igrah.

Naš prilagojeni WHCA* smo testirali in primerjali s standardnim SAPF algoritmom LRA*, ki je že bil implementiran v pogonu. Izkazuje se, da WHCA* najde veliko bolj kakovostne poti kot LRA* in je zmožen gladkega, kooperativnega premikanja agentov v zahtevnih scenarijih, kjer LRA* agenti obtičijo. Toda WHCA* je dosti počasnejši od preprostega LRA* in v realnih primerih potrebuje nekaj sto milisekund za pridobitev poti, tako v prvem kot tudi v naslednjih okvirjenih iskanjih. Zato menimo, da trenutna WHCA* implementacija ni primerna za premikanje agentov v

večini RTS iger. Lahko bi jo uporabili za igre v realnem času, ki vsebujejo manj agentov in preprosto okolje, ali za potezne igre, kjer je na voljo več časa za pridobitev kakovostne rešitve.

Kljub temu mislimo, da to ni dokončna zavrnitev MAPF pristopa za RTS igre. Z nadaljnjim praktičnim delom bi lahko postal bolj primeren. WHCA* bi lahko nadgradili s hierarhično abstrakcijo [8] ali pa z dinamično postavitvijo okvirja okoli možnih konfliktov [1]. Pomagalo bi tudi, če bi RTS igro razvili od začetka z WHCA* v mislih, namesto da prilagajamo algoritem obstoječi SAPF arhitekturi.

Kolikor nam je znano, je to edina delujoča implementacija MAPF algoritma v okolju realnočasovne igre. Izvorna koda je prosto dostopna na <https://github.com/ia6382/OpenRA>.

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An Attempt at Predicting Algorithm Performance on Constrained Multiobjective Optimization Problems

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ABSTRACT

When solving new optimization problems, it is crucial that algorithms are selected capable of both finding the best solutions and computing them in reasonable amounts of time. However, testing multiple algorithms is time-consuming and impractical. A solution to this would be to build a model that automatically selects the algorithm that performs best on a new problem. In this work, we build machine learning models to automatically predict algorithm performance on constrained multiobjective optimization problems (CMOPs) using exploratory landscape analysis (ELA) features. The results showed a high mean absolute error, which indicates that, with the currently available benchmarks and ELA features, automatically predicting algorithm performance on CMOPs is a very hard task.

KEYWORDS

constrained multiobjective optimization, evolutionary algorithms, exploratory landscape analysis, machine learning, algorithm performance prediction

1 INTRODUCTION

The common way of solving black-box constrained multiobjective optimization problems (CMOPs) is to use multiobjective optimization algorithms with constraint-handling techniques (CHTs). However, deciding which specific algorithm to use, which CHT to include, and which setting of the algorithm parameters to apply is not trivial.

In the last few years, several authors have tried to find ways of automatically selecting evolutionary algorithms for solving single-objective optimization problems [10, 13, 7]. The core concept behind their work is to extract features of benchmark single-objective optimization problems and construct a model for predicting which algorithm performs best for each individual problem. When dealing with a new problem then, the model is able to automatically decide which algorithm to use for solving the problem.

Extracting optimization problem features can be done using exploratory landscape analysis (ELA). This is a technique that takes a sample of solutions and their fitness values as input and, based on this, extracts statistical features about the problem.

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These features ideally characterize the problems so that similar problems have similar feature values.

In this work, we propose a first step towards automatic algorithm selection for CMOPs. This task is much harder for constrained multiobjective optimization, because, in this area, there are fewer benchmark problems available, and the ELA methods are not as well developed as in single-objective optimization.

Although the ultimate goal of our work is automatic algorithm selection, we here focus on predicting the algorithm performance of three widely used algorithms. By proposing a method for predicting algorithm performance for a few well-known algorithms, researchers can easily extend the set of algorithms, in the future.

The paper is further organized as follows. In Section 2, we introduce the theoretical background of constrained multi-objective optimization. In Section 3, we briefly describe the ELA features used in this study. In Section 4, we describe the algorithm performance measure used as the prediction target value. In Section 5, we present the experimental setup and, in Section 6, the obtained results. Finally, in Section 7, we summarize the findings and outline ideas for future work.

2 THEORETICAL BACKGROUND

A CMOP can be formulated as:

$$\begin{aligned} & \text{minimize} && f_m(\mathbf{x}), \quad m = 1, \dots, M \\ & \text{subject to} && g_k(\mathbf{x}) \leq 0, \quad k = 1, \dots, K, \end{aligned} \quad (1)$$

where $\mathbf{x} = (x_1, \dots, x_D)$ is a *solution vector* of dimension D , $f_m(\mathbf{x})$ are *objective functions*, $g_k(\mathbf{x})$ are *constraint functions*, and M and K are the numbers of objectives and constraints, respectively.

In multiobjective optimization, we use the term search space S , representing a D dimensional space where all possible solution vectors \mathbf{x} are located. Additionally, we can define the M dimensional objective space $P = \{f(\mathbf{x}) \mid \mathbf{x} \in S\}$ which represents the space consisting of objective values for solutions.

A solution \mathbf{x} is *feasible*, if it satisfies all constraints, $g_k(\mathbf{x}) \leq 0$, for $k = 1, \dots, K$. A feasible solution \mathbf{x} is said to *dominate* another feasible solution \mathbf{y} if $f_m(\mathbf{x}) \leq f_m(\mathbf{y})$ for all $1 \leq m \leq M$, and $f_m(\mathbf{x}) < f_m(\mathbf{y})$ for at least one $1 \leq m \leq M$. A feasible solution \mathbf{x}^* is a *Pareto-optimal solution* if there exists no feasible solution $\mathbf{x} \in S$ that dominates \mathbf{x}^* . All feasible solutions constitute the *feasible region* F . All nondominated feasible solutions form the *Pareto set* S_0 , and the image of the Pareto set in the objective space is the *Pareto front*, $P_0 = \{f(\mathbf{x}) \mid \mathbf{x} \in S_0\}$.

Nondomination ranking is a concept in multiobjective optimization that helps sort the solutions in a population into fronts, based on their dominance. Thus, all nondominated solutions get a nondomination rank of 1, solutions that are dominated only by

the nondominated solutions get a nondomination rank of 2, and so on.

The point in the objective space with the best objective values is the *ideal point* $z_I = (\min_{\mathbf{x} \in S_0} f_1(\mathbf{x}), \dots, \min_{\mathbf{x} \in S_0} f_M(\mathbf{x}))$.

The *nadir point* represents the point in the objective space with the worst fitness values across all solutions in the Pareto front $z_N = (\max_{\mathbf{x} \in S_0} f_1(\mathbf{x}), \dots, \max_{\mathbf{x} \in S_0} f_M(\mathbf{x}))$.

The most widely used quality indicator in multiobjective optimization is the *hypervolume indicator* [17]. It maps the set of solutions found by an algorithm to a measure of the region dominated by that set and bounded by a given reference point.

3 ELA FEATURES FOR CONSTRAINED MULTI-OBJECTIVE OPTIMIZATION PROBLEMS

ELA is a methodology that extracts the features of an optimization problem from a sample of its solutions. These features are usually statistical relations between the solutions and are designed by experts. Many ELA feature sets were designed for single-objective optimization problems. However, only a few feature sets exist for CMOPs.

State-of-the-art features for CMOPs were collected by Alsouly et al. [1], who adopted all of the fast-computing features for CMOPs from the related work, and also proposed some additional features. The set of all features can be divided into three groups that describe: the multiobjective landscape, the violation landscape, and the combination of the two landscapes – the multiobjective violation landscape.

All three groups of features consist of global and random walk features. The global features were calculated on a sample of size $1000 \cdot D$. The random walk features are computed during a random walk, where statistics are derived from neighboring solutions that form a sequence within the random walk. The random walk neighborhood is of size $N = 2 \cdot D + 1$, the length of the random walk is equal to $(D/N) \cdot 10^3$, and the step size is 2% of the range of the search space.

In the *multiobjective landscape group*, the features are designed to describe the objectives and the relations between them. Thus, the global features in this group include the proportion of unconstrained Pareto optimal solutions, the hypervolume of the unconstrained Pareto front, the correlation between the objective values, statistics on the unconstrained ranks, etc. The random walk features in this group include statistics on the distance between random walk neighbors in the objective space.

In the *violation landscape group*, the features are designed to describe the constraints of the problem. Thus, the global features in this group include statistics of the constraint violations, while the random walk features include statistics of the constraint violations between random walk neighbors.

In the *multiobjective violation landscape group*, the features are designed to describe the relations between the objectives and the constraints. Thus, the global features in this group include the proportion of feasible solutions, the proportion of Pareto optimal solutions, the hypervolume, statistics on the correlations between objectives and constraints, statistics on the distance between solutions in the Pareto front, etc. The random walk features in this group include statistics on the dominance relations between random walk neighbors.

Another state-of-the-art feature set for CMOPs is the one proposed by Vodopija et al. [14]. This feature set includes important information about CMOPs, including their multimodality and

other landscape characteristics. However, to calculate these features one needs a larger sample size (a sample size of 250,000), which makes these features computationally very demanding.

In our study, we used both the features by Alsouly et al. and Vodopija et al.

4 EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTIONS

One drawback of using hypervolume as the quality indicator in constrained multiobjective optimization is that it does not take into consideration infeasible solutions. For this reason, Vodopija et al. [15] proposed a new quality indicator designed specifically for constrained multiobjective optimization that generalizes the hypervolume-based quality indicator I_{HV+} from [5] as follows:

- (1) When there are no feasible solutions in the set, the quality indicator takes on the value of the smallest constraint violation of all solutions in the set plus a threshold τ^* .
- (2) When the set contains at least one feasible solution, the quality indicator equals the value of I_{HV+} bounded above by the threshold τ^* , i.e., it equals $\min\{I_{HV+}, \tau^*\}$.

The threshold value τ^* ensures that any infeasible solution will be deemed worse than any feasible one.

To measure algorithm performance during the algorithm run, we keep track of how many function evaluations, called *run-times*, are needed to reach a particular quality indicator value, called *target*. We do so for a number of targets and visualize these runtimes using the Empirical Cumulative Distribution Function (ECDF) [5]. The ECDF measures the proportion of achieved targets at a given runtime by the given algorithm. Whenever an algorithm achieves a target, the value of the measure rises. Thus, the maximum value that can be achieved by an algorithm is equal to 1, meaning that the algorithm achieved all the targets.

In our work, we want to express algorithm performance in a single value which will serve as the target of our machine learning (ML) problem. However, the ECDF is given for any number of function evaluations (up to a maximum value). To end up with a single value, we use the area under the curve (AUC) of the ECDF, in short AUC-ECDF. This way, the ML method needs to predict a single target variable, which also includes information about the convergence of the algorithm over time. To normalize the AUC-ECDF value, we divide it by the maximum number of function evaluations.

5 EXPERIMENTAL EVALUATION

We focus on constrained bi-objective optimization problems with 2D, 3D, and 5D search spaces and, thus, use three widely used benchmarks for constrained multiobjective optimization – MW [9], CF [16], and C-DTLZ [6]. Because some benchmark problems are only defined for more than 3D or more than three objectives, the total number of problems per dimension differs. Specifically, for 2D, we have 8 out of 14 MW problems, 0 out of 10 CF problems, and 5 out of 6 C-DTLZ problems. For 3D, we have 14 out of 14 MW problems, 5 out of 10 CF problems, and 6 out of 6 C-DTLZ problems. For 5D, we have 14 out of 14 MW problems, 7 out of 10 CF problems, and 6 out of 6 C-DTLZ problems.

The focus of this work is on predicting the algorithm performance of three multiobjective optimization algorithms – NSGA-III [6], MOEA/D-Epsilon [4], and C-TAEA [8]. Each algorithm is equipped with a different constraint-handling technique. Due to the stochastic nature of the algorithms, we conduct 31 individual runs of each algorithm on every given problem. This approach

allows us to obtain more precise values for algorithm performance. The target of the ML task for each problem is the mean AUC-ECDF value over all 31 runs of the algorithm. To facilitate the comparison of results, we use the same parameter settings for all algorithms – the population size $100 \cdot M$, and the number of generations $60 \cdot D$.

The ELA features are calculated stochastically; each time the feature calculation is started, a different sample of solutions is selected. To handle this, we created 30 samples using the Latin hypercube sampling method, resulting in 30 sets of features (learning instances) for each problem.

Predicting algorithm performance is a regression task and, therefore, we use regression ML methods – Linear Regression, Random Forest Regression (RF Regression) [2], and Epsilon-Support Vector Regression (SVR) [3]. We also included a dummy model in the comparison, which predicts the mean value of the target variable in the training data. We utilized the scikit-learn implementations [11] of these methods with default parameter settings. We tested algorithm parameter tuning as well, but there was no significant improvement of the results.

To evaluate the performance of the ML models, we use two evaluation methodologies – leave-one-sample-out and leave-one-problem-out. In the leave-one-sample-out evaluation, we use one instance as test data and the rest of the instances (including instances from other problems) as training data. We repeat this process for each instance in our dataset and take the average mean absolute error as an evaluation metric. Since all remaining instances of the problem are used during the training of the model, we expected the results from this evaluation methodology to be overly optimistic.

The leave-one-problem-out evaluation methodology is more fairly designed. In the real world, we have no information about the target problem available in the training data. Thus, in the leave-one-problem-out evaluation, we use all instances of a problem as test data and the instances from the rest of the problems as training data. This process is repeated for each problem in the dataset and the average mean absolute error is used as an evaluation metric.

6 RESULTS

The results showed a mean absolute error in the leave-one-sample-out evaluation lower than 0.01. This result is overly optimistic and shows that same-problem instances are similar to each other.

The results obtained in the leave-one-problem-out evaluation are presented in Table 1. These results show that none of the ML models performs significantly better than the dummy model. Moreover, because the target variable was normalized to $[0,1]$, a mean absolute error between 0.09 and 0.22 is large. This indicates that the tested models trained on the current benchmarks with the current ELA features cannot be used to predict algorithm performance accurately. Also, we note that for each problem dimensionality, there is a different ML method that performs best. For 2D problems this is Linear Regression, for 3D problems RF Regression, and for 5D problems SVR.

A significantly worse performance is achieved by Linear Regression on 5D problems. When attempting to understand the cause of this, we noticed that Linear Regression achieves similar results to the other models for all problems except for one, for which it performs very poorly. A possible explanation for this could be that Linear Regression is a simple and unbounded regression method, and when a problem is different from the

Table 1: Mean absolute error of the predicted AUC-ECDF values with respect to the true values for 2D, 3D, and 5D problems in leave-one-problem-out evaluation.

Dim	ML method	NSGA-III	MOEA/D	C-TAEA
2D	Dummy	0.18	0.17	0.18
	Linear Regression	0.16	0.14	0.18
	RF Regression	0.19	0.18	0.18
	SVR	0.20	0.21	0.19
3D	Dummy	0.14	0.12	0.13
	Linear Regression	0.22	0.12	0.15
	RF Regression	0.12	0.09	0.11
	SVR	0.14	0.12	0.13
5D	Dummy	0.14	0.10	0.12
	Linear Regression	0.70	0.42	0.75
	RF Regression	0.13	0.09	0.12
	SVR	0.10	0.09	0.10

rest in the training set it predicts very high target values, which increase the mean absolute error.

To better understand why the ML models performed poorly under the leave-one-problem-out evaluation, we used t-SNE [12] to reduce the dimensionality of the ELA features to 2D and visualized the results, as shown in Figure 1. Here we notice that samples from the same problem form clusters. This explains why the results of the leave-one-sample-out evaluation are significantly better than the leave-one-problem-out evaluation – in the former case, the ML task transforms into predicting the specific problem to which a sample belongs.

Analyzing the colors indicating the AUC-ECDF values of the three algorithms in Figure 1, we notice all algorithms perform similarly on almost all problems. This raises the question of whether a different algorithm parameter setting should be considered, emphasising the differences in the performance of the algorithms. For example, we could check the algorithm performance on a smaller number of generations.

When analyzing the colors showing the AUC-ECDF values of an algorithm in a single dimension, we notice there is no visible pattern. This holds for each problem dimension-algorithm combination. Notably, we often find high and low AUC-ECDF values appearing close to each other in the plot.

The results show that, with the current benchmarks and ELA features, predicting algorithm performance is very difficult.

7 CONCLUSION

In this work, we attempted to predict the algorithm performance on CMOPs, using three well-known multiobjective optimization algorithms. For this purpose, we used ELA features specially designed for CMOPs as inputs to a ML model. To calculate the ELA features, we used 30 samples for each problem, resulting in 30 learning instances per problem. The target of prediction was the algorithm’s AUC-ECDF value, computed using the quality indicator designed explicitly for constrained multiobjective optimization [15].

We tested three ML regression methods – Linear Regression, RF Regression, and SVR. To compare the results from these methods, we also used a dummy model, which always predicts the mean value of the target variable in the training data. To evaluate the results, we used two evaluation methodologies – leave-one-sample-out and leave-one-problem-out.

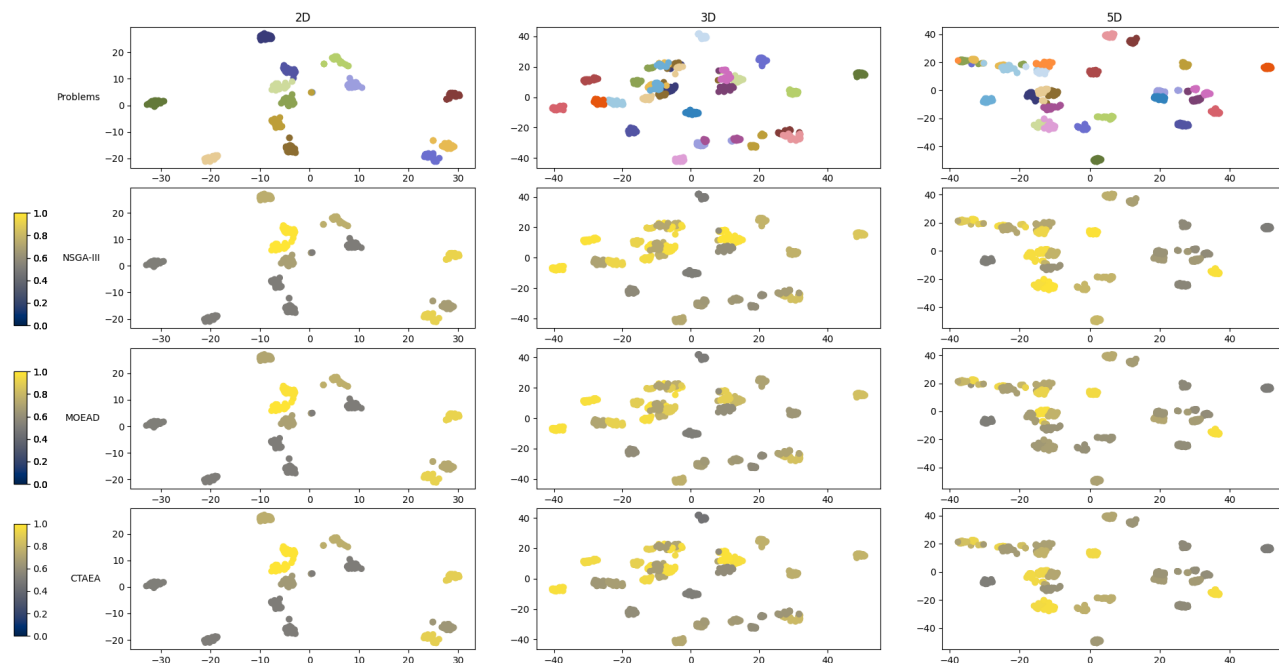


Figure 1: t-SNE visualizations of 2D, 3D and 5D problems. The colors in the first row of the plots represent the problems included in the benchmark. In the remaining rows, the colors represent the algorithm performance measured by AUC-ECDF for each algorithm considered.

In the leave-one-sample-out evaluation, very optimistic results were found, with a mean absolute error lower than 0.01. However, the results from the leave-one-problem-out evaluation were poor; none of the ML models significantly outperforms the dummy model. To explain why this occurs, we used the t-SNE method to reduce the dimensionality of the ELA features and plotted them in a color scheme indicating the performance of the algorithms. These visualizations show no visible patterns in the algorithm performance figures. Thus, we conclude that, with the currently available ELA features and benchmark problems, predicting algorithm performance is a hard task.

In future work, we aim to address two distinct aspects of the problem. The first is to improve the ELA features via automatic construction using an end-to-end deep neural network. The second is to reduce the complexity of the ML task by simplifying the target. This could be achieved by changing the task to a classification task or by changing the target to the number of generations required for an algorithm to reach a feasible solution.

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Večstopenjski postopek vrednotenja rešitev pri načrtovanju elektromotorja

A Multi-Step Evaluation Process in Electric Motor Design

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POVZETEK

Pri načrtovanju elektromotorja je potrebno poiskati vrednosti optimizacijskih spremenljivk tako, da izdelek izpolnjuje tehnične zahteve in je njegova cena minimalna. V ta namen uporabljamo optimizacijske postopke z iterativnim vrednotenjem rešitev na osnovi numerične simulacije. Ti so računsko zahtevni, zato je glavni izziv načrtovanja, kako najti kakovostne rešitve v sprejemljivem času. V prispevku predstavljamo računalniško podprto načrtovanje sinhronskega elektromotorja za servovolanske sisteme, s poudarkom na prijemih za pohitritev optimizacijskega postopka. Med njimi je tudi posebej za ta problem razvit večstopenjski postopek vrednotenja rešitev, ki omogoča učinkovitost optimizacije in robustnost rešitev. S tem postopkom razviti elektromotor je boljši od prvotnega prototipa, dobljenega z enostavnejšim optimizacijskim postopkom, tako po tehničnih lastnostih kot stroškovno.

ABSTRACT

In the design of an electric motor, one has to find the values of the optimization variables such that the product satisfies the technical requirements and its price is minimal. For this purpose, we deploy optimization procedures with iterative evaluation of solutions based on numerical simulation. These are time-consuming, hence the key challenge of the design is how to find high-quality solutions in an acceptable time. In this paper, we present the computer-aided design of a synchronous electric motor for power steering systems, with an emphasis on measures for speeding up the optimization process. Among them, a multi-step solution evaluation procedure has been developed particularly for this problem. It enables the efficiency of optimization and the robustness of solutions. The resulting electric motor outperforms the original prototype obtained by a simpler optimization procedure both in technical characteristics and cost efficiency.

KLJUČNE BESEDE

načrtovanje, elektromotor, numerična simulacija, optimizacija, evolucijski algoritem, robustnost

KEYWORDS

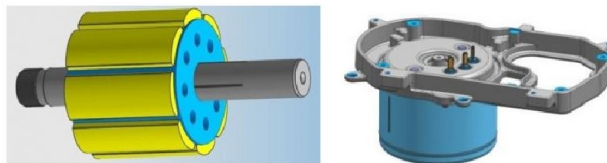
design, electric motor, numerical simulation, optimization, evolutionary algorithm, robustness

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1 UVOD

Podjetje MAHLE Electric Drives Slovenija d.o.o. proizvaja zagajalnike in alternatorje za motorje z notranjim izgorevanjem, avtonomno napajane enosmerne električne pogonske sisteme in druge zahtevnejše komponente za avtomobilsko industrijo. Eden izmed pomembnejših izdelkov podjetja je sinhronski elektromotor s površinsko nameščenimi magneti, ki poganja avtomobilski servovolanski sistem (slika 1).



Slika 1: Elektromotor za servovolanske sisteme (Vir: arhiv Mahle Electric Drives Slovenija d.o.o.).

Razvoj takšnega elektromotorja zahteva določitev geometrije in materialnih lastnosti njegovih komponent tako, da bo izpolnjeval vse tehnične zahteve in bo njegova cena minimalna. Ker se pri vrednotenju načrtov elektromotorja uporablja numerični simulator po metodi končnih elementov, v katerega nimamo vpogleda (gre za t.i. problem črne škatle, ang. black box-problem), optimizacijski postopek terja iterativno vrednotenje številnih načrtov. Numerične simulacije so dolgotrajne, zato je glavni izziv razvoja elektromotorja optimizacijski postopek zastaviti tako, da bo lahko našel dobre rešitve v doglednem času.

V nadaljevanju prispevka opisujemo, kako smo se načrtovanja elektromotorja (2. razdelek) lotili na Inštitutu "Jožef Stefan" v sodelovanju s podjetjem MAHLE. Optimizacijski postopek smo pohitrili s tremi prijemi:

- uporabili smo optimizacijski algoritem s hitro izračunljivimi nadomestnimi modeli (3. razdelek);
- vrednotenje rešitev smo razdelili na več korakov in tako omogočili izločanje nedopustnih rešitev pred dolgotrajnimi simulacijami (4. razdelek);
- računsko najzahtevnejši korak vrednotenja rešitev smo poenostavili in paralelizirali (4. razdelek).

Metodologijo smo preizkusili na konkretnem tipu elektromotorja (5. razdelek). Tako optimiran načrt elektromotorja je dosegel 10 % nižjo ceno komponent v primerjavi z različico, ki jo je podjetje predhodno razvilo s preprostejšim optimizacijskim postopkom. V prihodnje nameravamo računalniško implementacijo postopka razširiti tako, da bo omogočala prosto izbiro optimizacijskega kriterija in omejitev ter bo uporabna za raznovrstne elektromotorje (6. razdelek).

2 NAČRTOVANJE ELEKTROMOTORJA

Pri načrtovanju elektromotorja moramo nastaviti vrednosti številnih parametrov, ki določajo njegovo geometrijo in materialne lastnosti njegovih komponent. To so na primer dimenzije zoba na statorju, število navojev tuljave, dimenzije magnetov ipd. Vsak parameter ima podano spodnjo in zgornjo mejo ter najmanjši smiselni korak znotraj teh meja. Cilj optimizacije načrtovanja je najti načrt elektromotorja, ki zadošča vsem tehničnim zahtevam in je ob enem najcenejši.

Načrt elektromotorja lahko ocenimo na več načinov, z različno stopnjo zaupanja. Njegove lastnosti lahko najzanesljiveje preverimo, če na podlagi načrta izdelamo prototip elektromotorja in ga preizkusimo v praksi. Vendar to zahteva veliko dela, materiala in časa ter s tem povezane visoke stroške, ki ne dovoljujejo, da bi podjetje v fazi razvoja izdelalo večje število prototipov. Zato si pri reševanju tega problema pomagamo z računalniško podprtimi numeričnimi simulacijami, na osnovi katerih lahko izpeljemo ključne lastnosti elektromotorja. Računalniški programi, kot je Ansys Maxwell [1], omogočajo simulacijo elektromagnetnega polja elektromotorja z uporabo metode končnih elementov [2]. Ta deluje na podlagi mreže objekta; gostejša mreža omogoča večjo točnost simulacije, a je ta dolgotrajnejša. Zanesljivost numeričnih simulacij je tako deloma nastavljiva – odvisna je od računalniških zmogljivosti in časa, ki jih imamo na voljo.

Vendar zanesljivost simulacij znižujejo praktični vidiki izdelave elektromotorja, saj lahko ujemanje izdelanega elektromotorja z načrtom zagotovimo samo v okviru določenih toleranc. Na primer, če za velikost odprtine reže nastavimo vrednost 2 mm, lahko v proizvodnji zagotovimo le, da bo ta na intervalu [1.95 mm, 2.05 mm]. To pomeni, da je za načrt elektromotorja zelo pomembno, da je *robusten*, to je, da ob majhnih spremembah vrednosti parametrov znotraj toleranc lastnosti elektromotorjev ne odstopajo bistveno. Robustnost načrta je najlažje preveriti s simuliranjem številnih načrtov, ki se malo razlikujejo od izhodiščnega. Vendar to zahteva še več računsko zahtevnih simulacij in podaljšuje trajanje optimizacijskega postopka.

3 OPTIMIZACIJSKI POSTOPEK

V optimizacijskem postopku skušamo čim učinkoviteje rešiti dani optimizacijski problem. Formalno (in brez škode za splošnost) lahko optimizacijski problem načrtovanja elektromotorja zapišemo v obliki

$$\begin{aligned} &\text{minimiziraj } f(x), \\ &\text{ob pogojih } g_i(x) \leq 0, \quad i = 1, \dots, k, \end{aligned} \quad (1)$$

kjer je $x = (x_1, \dots, x_n) \in X \subseteq \mathbb{R}^n$ rešitev iz n -dimenzionalnega prostora rešitev X , $f : X \rightarrow \mathbb{R}$ kriterijska funkcija, funkcije $g_i : X \rightarrow \mathbb{R}$, $i = 1, \dots, k$, pa so *stroge omejitve*. Rešitev problema (načrt elektromotorja) je *dopustna*, če zadošča vsem strogim omejitvam. Sicer pravimo, da je *nedopustna*.

Pri nedopustnih rešitvah ne moremo vedno izračunati vrednosti kriterija. Zato takrat kriterij f nadomestimo s funkcijo

$$f_g(x) = p + \sum_{i=1}^k \max\{g_i(x), 0\}, \quad (2)$$

kjer je p konstanta in $\max\{g_i(x), 0\}$ nenegativna kazen za kršitev stroge omejitve g_i (ko omejitev, ni kršena, kazen znaša 0). Konstanta p mora biti dovolj velika, da je vrednost kriterija f_g za katerokoli nedopustno rešitev vedno višja (slabša) od vrednosti kriterija f za katerokoli dopustno rešitev.

Poleg strogih omejitev imajo optimizacijski problemi v praksi pogosto tudi *šibke omejitve*. To so funkcije $h_i : X \rightarrow \mathbb{R}$, $i = 1, \dots, l$, za katere želimo, da velja $h_i(x) \leq 0$, ni pa to pogoj, da je rešitev dopustna. V optimizacijskem problemu jih upoštevamo tako, da jih vgradimo v kriterijsko funkcijo na naslednji način

$$f_h(x) = f(x) + \sum_{i=1}^l \max\{h_i(x), 0\}, \quad (3)$$

kjer je f prvotna kriterijska funkcija, $\max\{h_i(x), 0\}$ pa nenegativna kazen za kršitev šibke omejitve h_i . Ker seštevamo prvotno kriterijsko funkcijo in kazni za kršitev šibkih omejitev, moramo zagotoviti, da so njihove vrednosti primerljive. V ta namen jih je potrebno normalizirati oz. primerno utežiti.

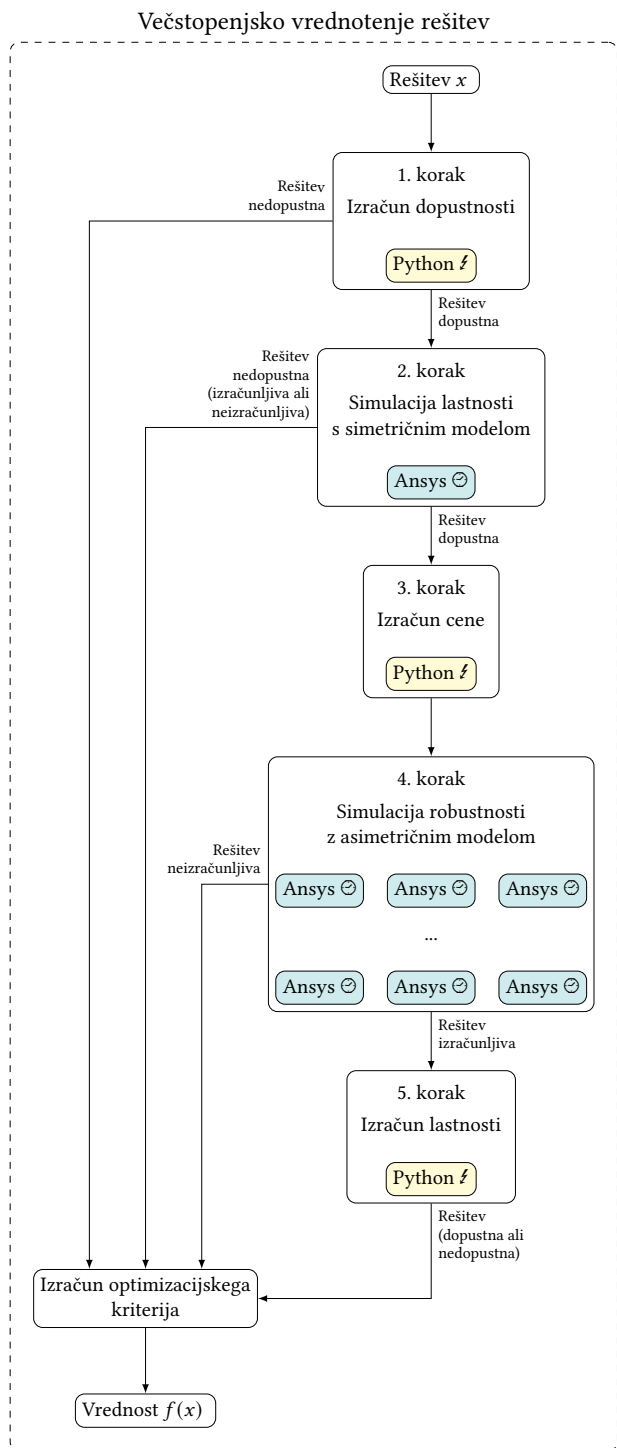
Pri problemu načrtovanja elektromotorja ne poznamo analitične oblike kriterijske funkcije in omejitev, zato za njegovo reševanje uporabimo algoritem, ki se dobro obnese na problemih črne škatle. To je evolucijska strategija s prilagajanjem kovarične matrice, oz. CMA-ES (ang. Covariance Matrix Adaptation Evolution Strategy) [5]. Natančneje, poslužujemo se različice algoritma CMA-ES imenovane Iq-CMA-ES [3], ki vrednotenja z dolgotrajnimi simulacijami delno zamenja s hitro izračunljivimi linearno-kvadratičnimi nadomestnimi modeli. Uporaba nadomestnih modelov je pogosto uporabljen pristop pri reševanju problemov z računsko zahtevnim vrednotenjem rešitev.

Optimizacijski algoritem z nadomestnimi modeli Iq-CMA-ES deluje v dveh fazah. Najprej na podlagi začetnih rešitev, ovrednotenih z numerično simulacijo, zgradi nadomestni model. Nato iterativno predlaga nove rešitve in jih, dokler so te dovolj podobne obstoječim, vrednoti z nadomestnim modelom ter tako prihrani na času. Ko pride do rešitev, ki jih nadomestni model ne opisuje več dovolj dobro, pa jih ovrednoti z numerično simulacijo in z njihovim rezultatom posodobi nadomestni model. To ponavlja, dokler ne izpolni zaustavitvenega pogoja.

4 VREDNOTENJE POSAMEZNEGA NAČRTA ELEKTROMOTORJA

Uporaba nadomestnih modelov zmanjša število izvedenih vrednotenj s simulacijami, a so te pri načrtovanju elektromotorja vseeno potrebne. Da bi vrednotenje posameznega načrta pohitrili, smo ga razdelili na pet korakov. Če se rešitev slabo izkaže po katerem od korakov, jo takoj zavržemo in s tem prihranimo čas, ki bi ga sicer porabili za izvedbo preostalih korakov. Vrednotenje je orisano na sliki 2 in opisano v nadaljevanju.

- (1) V prvem koraku s hitro izračunljivo skripto, ki so jo pripravili domenski eksperti, preverimo zadoščanje nekaterim strogim omejitvam. To nam pomaga izločiti precejšnje število nedopustnih rešitev, med njimi tudi take, ki bi lahko zaradi slabo zasnovane geometrije povzročale težave pri izvedbi simulacije. Samo dopustne rešitve gredo v naslednji korak vrednotenja.
- (2) V drugem koraku izvedemo simulacijo, s katero pridobimo informacije o določenih pomembnih lastnostih elektromotorja. Ta uporablja poenostavljeno, simetrično formulacijo geometrije elektromotorja, zato je relativno hitra (za izbrani problem traja približno 1 minuto). Trajanje simulacije je sicer odvisno od posameznih rešitev. Pri načrtih, za katere je geometrija zaradi neposrečene kombinacije vrednosti parametrov nemogoča, simulator lahko po dolgem času ne vrne nobenega rezultata ali pa se (redko) celo zruši. Če rešitev ni izvedljiva ali ne zadošča strogim omejitvam, jo zavržemo. Sicer nadaljujemo z naslednjim korakom.



Slika 2: Vrednotenje rešitev v petih korakih.

- (3) V tretjem koraku iz vseh dobljenih podatkov izračunamo ceno elektromotorja.
- (4) V četrtem koraku preverimo robustnost rešitve. Pri tem se simulacije izvajajo na celotni, asimetrični geometriji elektromotorja, zato so časovno bolj potratne. Pohitrimo jih z uporabo manj natančne mreže (predhodni poskusi so pokazali, da lahko nekaj zanesljivosti žrtvujemo za precejšnji prihranek časa; tako za izbrani problem ena simulacija traja 7 namesto 15 minut). Ker moramo za preverjanje

robustnosti ene rešitve izvesti več simulacij, ki so med seboj neodvisne, to izkoristimo za njihovo paralelizacijo. To izvedemo tako, da vse simulacije z asimetričnim modelom elektromotorja poženemo hkrati na računalniku z večjedrnim procesorjem in tako prihranimo veliko časa. Če preverjanje robustnosti mine brez težav, nadaljujemo z zadnjim korakom postopka.

- (5) V zadnjem, petem koraku izračunamo še dodatne lastnosti elektromotorja in preverimo dopustnost preostalih strogih omejitev.

Za vsako rešitev x po izvedbi opisanega postopka izračunamo vrednost optimizacijskega kriterija. Ta je odvisna od koraka, do katerega se je izvedlo vrednotenje rešitve, in njene kakovosti:

$$f(x) = \begin{cases} 300 + \sum_{i=1}^{k_1} \max\{g_i^1(x), 0\} & x \text{ nedopustna po 1. kor.} \\ 250 & x \text{ neizračunljiva v 2. kor.} \\ 200 + \sum_{i=1}^{k_2} \max\{g_i^2(x), 0\} & x \text{ nedopustna po 2. kor.} \\ 150 & x \text{ neizračunljiva v 4. kor.} \\ 100 + \sum_{i=1}^{k_5} \max\{g_i^5(x), 0\} & x \text{ nedopustna po 5. kor.} \\ c(x) + \sum_{i=1}^l \max\{h_i(x), 0\} & x \text{ dopustna} \end{cases} \quad (4)$$

Pri tem g^1, g^2 in g^5 po vrsti predstavljajo stroge omejitve v 1., 2. in 5. koraku, c cena rešitve in h_i njene šibke omejitve. Kazni za kršitev obeh vrst omejitev g_i in h_i so normalizirane tako, da njihova vsota nikoli ne preseže vrednosti 50. Na ta način poskrbimo, da so dopustne rešitve vedno ocenjene bolje od nedopustnih in je rešitev, ki je šla čez več korakov postopka vrednotenja, ocenjena bolje od tiste, ki se je slabo izkazala v katerem od prejšnjih korakov.

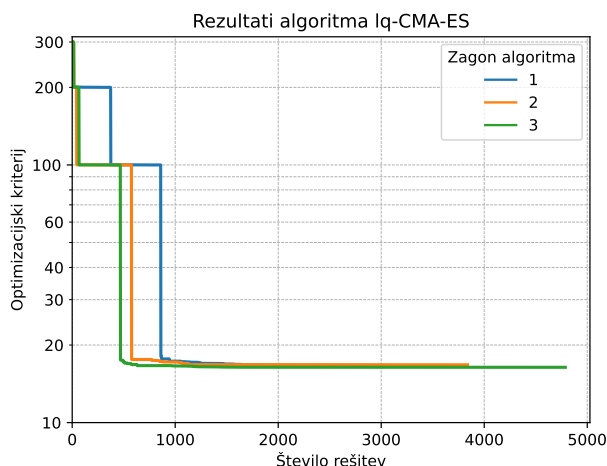
Opisani večstopenjski postopek vrednotenja rešitev s pohitritvami je glavna novost, ki smo jo v okviru sodelovanja med inštitutom in podjetjem uvedli v optimizacijo načrtovanja elektromotorja. Razvijalci v podjetju so že prej uporabljali optimizacijo z nadomestnimi modeli v okviru programskega orodja Ansys [1], vendar pa so v njej lahko upoštevali samo 2. in 3. korak vrednotenja. Začetnega preverjanja dopustnosti (1. koraka) ni bilo, zadnjih dveh korakov pa se ni dalo enostavno vključiti v optimizacijski postopek, zato sta se izvedla šele po zaključku optimizacije na izbranih (najboljših) rešitvah optimizacijskega problema.

5 NUMERIČNI POSKUSI IN REZULTATI

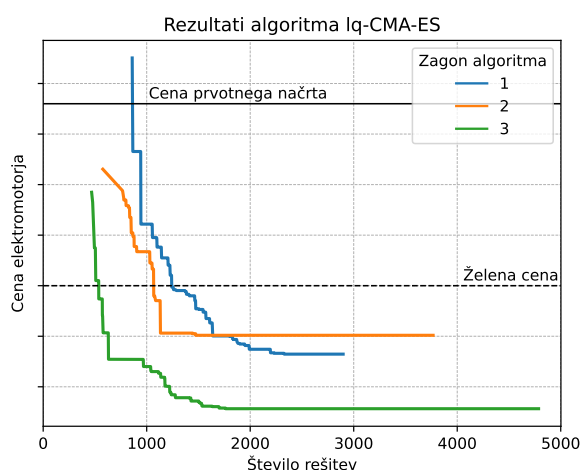
Optimizacijski postopek smo preizkusili na konkretnem primeru elektromotorja za servovolanske sisteme. Ta ima 13 optimizacijskih spremenljivk, od katerih je 12 'zveznih' in ena celoštevilska¹. Optimizacijski kriterij (za dopustne rešitve) sestavljata cena in vsota kršitev dveh šibkih omejitev, medtem ko je vseh strogih omejitev 10. Pri simulaciji robustnosti z asimetričnim modelom (4. korak) smo hkrati poganjali 15 simulacij.

V optimizacijskih izračunih smo uporabili knjižnico pycma, ki nudi implementacijo algoritma lq-CMA-ES v programskem jeziku Python [4]. Algoritmu smo posredovali informacijo o tem, da je ena od spremenljivk celoštevilska, ostale je obravnaval kot zvezne. Velikost začetnega koraka σ_0 smo nastavili na 0,2, dovoljeno število avtomatskih ponovnih zagonov algoritma pa na 5. Vrednosti preostalih parametrov algoritma so bile enake privzetim.

¹Tudi 'zvezne' spremenljivke so zaradi najmanjšega smiselnega koraka v resnici diskretne, a jih obravnavamo kot zvezne s stališča algoritma (preden rešitev ovrednotimo, jo zaokrožimo na najbližjo diskretno vrednost).



Slika 3: Najnižja vrednost optimizacijskega kriterija tekom treh zagonov algoritma lq-CMA-ES.



Slika 4: Primerjava najnižje cene elektromotorja tekom treh zagonov algoritma lq-CMA-ES s ceno prvotnega optimiranega načrta in zeleno ceno. (Dejanske cene niso navedene zaradi varovanja poslovne skrivnosti.)

Zaradi časovnih omejitev smo uspeli izvesti samo tri zagone algoritma lq-CMA-ES, ki se razlikujejo v semenu generatorja ključnih števil. Njihovi rezultati so prikazani na slikah 3 in 4. Obe kažeta, kako se opazovana veličina zmanjšuje s časom (številom pregledanih rešitev – štejemo vsako vrednotenje rešitev, tudi če se je končalo že s prvim korakom). Na sliki 3 vidimo zmanjševanje optimizacijskega kriterija (vrednosti pod 100 pomenijo, da je algoritem našel dopustne rešitve), na sliki 4 pa pripadajoče (do takrat najboljše) cene elektromotorjev.

Vidimo, da so rezultati treh zagonov algoritma precej raznoliki. Pri tako zahtevnem problemu in majhnem številu vrednotenj je bilo to pričakovano. Vseeno pa za vse tri zagone velja, da potrebujejo manj kot 1000 pregledanih rešitev, da najdejo dopustne rešitve in hkrati izboljšajo najboljši načrt, najden s prvotnim optimizacijskim postopkom v podjetju. V vseh treh primerih je potrebnih manj kot 1500 vrednotenj, da algoritem najde rešitev s ceno, ki je boljša od zelene. Po približno 2500 vrednotenjih se cena elektromotorja neha bistveno izboljševati.

Kvantitativnega ovrednotenja doprinosa posameznih pohitritev nismo izvedli, vemo pa, da se je vrednotenje rešitev končalo po 1. koraku v 17,5 % primerov (8 min prihranka na rešitev) in po 2. koraku v 29,4 % primerov (7 min prihranka na rešitev).

Ker smo analizo robustnosti, ki se izvede v 4. koraku, precej poenostavili, da smo jo pohitрили in vključili v optimizacijo, smo preverili, če so rezultati 4. in 5. koraka skladni s tistimi, ki bi jih dobili z prvotno analizo. Zato smo nekaj izbranih (najboljših) rešitev podrobneje analizirali in njihove rezultate primerjali s tistimi, ki veljajo za prvotni optimirani načrt. Ugotovili smo, da dobimo kakovostne rešitve, ki niso le dopustne, ampak so za 10 % cenejše od prvotnega najboljšega načrta.

6 ZAKLJUČKI

Problem načrtovanja elektromotorja je zahteven praktičen optimizacijski problem, saj je mnogo načrtov nedopustnih, njihovo vrednotenje pa temelji na numeričnih simulacijah in je zato dolgotrajno. Da bi ga lahko uspešno reševali z uporabo optimizacijskih algoritmov, smo vrednotenje rešitev razdelili na pet korakov, s katerimi želimo čim prej izločiti nedopustne rešitve, da na njih ne tratimo časa. Poleg tega smo optimizacijski postopek pohitрили z uporabo algoritma s hitro izračunljivimi nadomestnimi modeli ter paralelizacijo in poenostavitvijo računsko najzahtevnejšega koraka vrednotenja rešitev.

Predlagani postopek smo preizkusili na konkretnem primeru elektromotorja za servovolanske sisteme, za katerega smo želeli minimizirati ceno in obenem zagotoviti, da bo zadoščal vsem tehničnim zahtevam. Primerjava tako dobljenih načrtov z najboljšim, ki so ga v podjetju prvotno našli s pomočjo enostavnejšega optimizacijskega postopka, je pokazala, da dosežemo dopustne rešitve, ki so cenovno za 10 % ugodnejše od obstoječih. Ob dejstvu, da se v celotnem obdobju proizvodnje takšnega izdelka proizvede več milijonov kosov, to za podjetje predstavlja bistven prihranek in močno izboljšuje njegovo konkurenčnost na trgu.

V prihodnje želimo implementacijo postopka razširiti tako, da bo omogočala enostavno izbiro optimizacijskega kriterija in omejitev ter dodajanje skript za preverjanje dopustnosti rešitev. Cilj je izdelati računalniško orodje, ki ga bodo inženirji lahko samostojno uporabljali pri optimizaciji raznovrstnih elektromotorjev brez poseganja v sam postopek ali optimizacijski algoritem.

ZAHVALA

Zahvaljujemo se podjetju MAHLE Electric Drives Slovenija d.o.o. za financiranje projekta razvoja elektromotorja in sodelovanje pri njegovi izvedbi. Naše temeljne raziskave evoliucijskega računanja in večkriterijske optimizacije sofinancira Javna agencija za znanstvenoraziskovalno in inovacijsko dejavnost Republike Slovenije z raziskovalnima programoma št. P2-0098 in P2-0209 ter projekti št. J2-4460, N2-0239 in N2-0254.

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Cognitive Science

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Ljubljana, Slovenia

PREDGOVOR

Dobrodošli na konferenci Kognitivna znanost. Na letošnji konferenci bodo avtorice in avtorji raziskovali mnoge plati človeške kognicije in predstavili tako svoje empirične ugotovitve kot tudi teoretska raziskovanja. Skupaj bomo potovali skozi različna področja kognitivne znanosti - od psihologije in nevroznanosti do filozofije in umetne inteligence, ter ob tem spoznavali raznolike tematike vključujoč psihedelike, mistične izkušnje, biomarkerje kognitivnih sposobnosti, in celo vprašanja zavesti.

Poseben poudarek letošnjega srečanja je namenjen eni izmed trenutno najbolj vročih tem: umetni inteligenci. Osrednja tema konference, "UI klepetalniki in širše", bo predstavila izzive in rešitve, ki jih prinašata razvoj in uporaba klepetalnih robotov z umetno inteligenco. Hkrati pa bomo razmišljali, kako umetna inteligenca oblikuje svet onkraj klepetalnih robotov. V tej luči bomo na konferenci gostili okroglo mizo o vlogi umetne inteligence v izobraževanju, s čimer se bomo dotaknili še enega izmed aktualnih izzivov. Skupaj bomo razmišljali o prednostih in pasteh njenega vključevanja v izobraževalne procese, ki oblikujejo našo prihodnost.

Upamo, da bo letošnja konferenca prostor za povezovanje in izmenjavo prodornih idej. Skupaj bomo premagovali disciplinarne in metodološke ovire, združili mlade in izkušene znanstvenike ter znanstvenice, ki si delijo strast do raziskovanja skrivnosti kognicije. Dobrodošli!

Anka Slana Ozimič
Borut Trpin
Toma Strle
Olga Markič

FOREWORD

Welcome to the Cognitive Science Conference. At this year's conference, authors will explore the many facets of human cognition and present both their empirical findings and theoretical research. Together, we will travel through the diverse fields of cognitive science - from psychology and neuroscience to philosophy and artificial intelligence, learning about a variety of topics, including psychedelics, mystical experiences, biomarkers of cognitive abilities, and even questions of consciousness.

This year's conference has a special focus on one of the hottest topics at the moment: artificial intelligence. The main topic of the conference, "AI Chatbots and Beyond," will present the challenges and solutions brought about by the development and use of AI chatbots. At the same time, we will consider how AI is shaping the world beyond chatbots. In this light, we will host a panel discussion on the role of AI in education, addressing another of the current challenges. Together, we will reflect on the benefits and pitfalls of integrating it into the educational processes that are shaping our future.

We hope that this year's conference will be a space for networking and sharing insightful ideas. Together we will overcome disciplinary and methodological barriers, bringing together young and experienced scientists who share a passion for exploring the mysteries of cognition. Welcome!

Anka Slana Ozimič
Borut Trpin
Toma Strle
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What insights can psychedelic research bring to Cognitive Science? A systematic review of the phenomenology of DMT experiences.

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ABSTRACT

This abstract explores the systematic review of the phenomenology of N, N-dimethyltryptamine (DMT) experiences. Additionally, the relevance of conducting psychedelic research for Cognitive Science is discussed. A special emphasis is being put on (neuro-)phenomenological research methods, as they seem to be the best suitable for conducting research around psychedelic substances and their direct effects on phenomenology.

KEYWORDS

Psychedelic research, Cognitive Science, systematic review, phenomenology, neurophenomenology, DMT, non-ordinary states of consciousness

1 Introduction

N, N-dimethyltryptamine (DMT) is an endogenous serotonergic psychedelic compound which is capable of producing radical shifts in conscious experience. Compared to other serotonergic psychedelic substances like psilocybin, mescaline or LSD; DMT experiences seem to produce the most radical shifts in conscious experience, with subjects reporting hyper-real, otherworldly, often ontologically challenging but also potential transformative experiences, including encounters with entities as well as experiencing visualizations of geometric fractals, shapes or patterns. The rapid onset and short duration of inhaled DMT experiences, the drastic change in phenomenological conscious experience it produces, as well as the fact that some studies indicate the compound to be endogenous to mammals [3] as well as to a variety of plants, suggests the importance of conducting more research around this compound.

While DMT use has been part of several ancient Amazonian traditions (combined with monoamide-oxidase inhibitors it is called 'ayahuasca') for hundreds of years and trends in usage in the western world as well as clinical trials of administering DMT to patients with treatment resistant

depression or anxiety, are increasing. This is done by administering DMT either inhaled, which makes the effects shorter lived (about 15 minutes) or taken orally as 'ayahuasca' to prolong the subjective effects of the compound (up to ten hours). Laboratory studies of DMT use are limited by their clinical setting (not taking into account the importance of set & setting of psychedelic experiences) and most are lacking a qualitative analysis of phenomenological content. This indicates the growing importance of a thorough investigation of the phenomenological aspects of the substances.

Latest research indicates similarities of phenomenological experiences of DMT use across subjects [5]. It remains unclear how much of these similarities are due to cultural or individual priming and/or influencing, as stories about "DMT entities" or the "DMT parallel world" can be found all over the internet.

2 Systematic Review

The systematic review synthesizes the phenomenology of N,N-dimethyltryptamine experiences according to the PRISMA method [8]. Excluded were studies prior to 2013 and studies that not taking into account the phenomenological effects of the DMT experience. After initial screening, 17 studies were included in this report. The included studies used different methodologies: neurophenomenological approaches through EEG measurements followed by questionnaires or interviews; purely phenomenological accounts through online surveys; micro-phenomenological inspired interviews or qualitative linguistic analyses. Also assessed were studies that compared the phenomenology of DMT experiences to other experiences such as near-death experiences (NDE's), ego-dissolution experiences or God-encounter experiences.

Results indicate that the DMT experience could be clustered into different categories. When it comes to the phenomenological perspective, the most prominent themes identified are: perceptual changes; somatic experiences; emotional responses and a 'sense of otherness' and a sense of ego dissolution. Additionally, to these themes, the most prominent categories regarding the content of the DMT experience are:

1. The ontology of the DMT world, also called 'hyperspace'
2. Dissolution of the ego/self

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3. Encounters with seemingly autonomous or conscious entities. These encounters are predominantly positive, users often reporting of receiving a type of message.

Limitations of the studies were quite homogenous, including among others: the use of self-reports; sociability biases; retrospective accounts; different or insufficient information on dosages and purity. The systematic review concludes that the phenomenology of DMT experiences seems to be distinct to other psychedelic experiences such as psilocybin but similar to certain other non- drug experiences, such as near-death experiences, thus representing a research field well suited for the account of the phenomenology of non-ordinary states of consciousness.

3 Relevance to Cognitive Science

„*Psychedelics are for the mind/psychiatry what the telescope is for astronomy or the microscope is for biology*“ - [4]

Psychedelic research, ever since legislation loosened up in the late 2000s, is experiencing a come-back after 40 years of prohibition. Since mental health issues are becoming more prevalent and common approaches with medication such as SSRIs are not yielding sufficient relief, psychedelic assisted therapy approaches seem to be a promising approach. More clinical research is necessary to drive this process further. Other studies have shown psilocybin to promote neurogenesis, which could be used to treat non-psychiatric but also biological issues.

Classical psychedelics act on the serotonin 5HT_{2A} receptor, and are molecules that can drastically change the phenomenology of experience. They modulate fundamental aspects of experience by what it seems to be *deconstructing prior beliefs* and *reconstructing new beliefs*. Some theories about the mind and consciousness have emerged through psychedelic research as well, such as the ‘entropic brain hypothesis’ [1], bringing physical concepts of *entropy* and *criticality* into the discussion of non-ordinary states of consciousness and their neurophenomenological characteristics. The REBUS (‘relaxed beliefs under psychedelics’) model, is a model that combines the entropic brain hypothesis with the free energy principle, trying to gain further understanding of the effects of free energy on phenomenology [2]. What insights can we generate about the nature of reality when approaching it with fewer predictions?

3.1. The sense of self

One of the core questions of (philosophical) Cognitive Science is understanding the sense of self. Since psychedelics seem to usually lead to a deconstruction of the sense of self (f.e. explained due to a diminished activity in the default mode network) [6], the different processes of selfhood (minimal self vs. narrative self) [10] could be examined further as well as how this construction and deconstruction of the self emerges on a neurophenomenological level, what psychological implications this has on individuals yielding up to philosophical discussions of the ontological role of the sense of self. Another classical argument for studying psychedelics is backward propagation (finding out about aberrant functions can help generate insights about ‘normal’ function), which has already helped shape the field of neuroscience in the past. The serotonergic structure of

classical psychedelics has already yielded insights into the role of serotonin on our wellbeing and perception of reality in the past, the discovery of LSD being one of the core drivers to the investigation of this molecule in the 1960s [7].

To study non-ordinary states of consciousness, such as hypnosis, meditation and psychedelics, common scientific practice (mostly average rating over the entire course of the experience) does not yield sufficient insights into the individual phenomenological processes that include such an experience. First-person reports can account for within- & between-subject variabilities. A strong call for neurophenomenological research in this field is being evoked, emphasizing the importance of conducting micro-phenomenological interviews [9], additionally to third-person research (brain & somatic measurements).

3.2. DMT distinct from other psychedelic substances

DMT seems to be distinct from other substances on a neurophenomenological level. Firstly, the endogenous production of DMT is still a mystery to research. Under the influence of DMT, delta power, which is usually associated with states of unconsciousness or lack of experience (such as dreamless sleep or anesthesia), increases [10]. This can hint at delta waves being a marker from conscious disconnection, while the person is still having a phenomenological experience. Since this seems to be unique to DMT, along with the short duration of the experience, DMT research could help generate insights into how our brains construct the world, how our sense of self is constructed and how all of these processed can be deconstructed in minutes or even seconds due to a single (endogenous) chemical. Neurophenomenological approaches with non-ordinary states of consciousness are crucial in the quest to finding answers to some of the most mysterious questions of cognitive science.

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Priistranskost v strojnem učenju: dileme in odgovori

Bias in Machine Learning: Dilemmas and Answers

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POVZETEK

Nekatere aplikacije umetne inteligence, posebej strojnega učenja, so deležne izrazito odklonilnih odzivov tako v splošnih medijih, kot v strokovni literaturi. Pogosto so omenjane aplikacije v domenah sodstva, zaposlovanja in bančništva. Kritiki očitajo, da so uporabljeni sistemi pristranski glede na t.i. zaščitene attribute, kot so rasa, spol in starost. Znan primer je sistem COMPAS, ki se kljub polemikam še vedno uporablja v ameriškem sodstvu. Namen prispevka je na primeru COMPASA predstaviti trende diskusije o pristranskosti algoritmov strojnega učenja. Opažamo, da je problem pogosto v tem, da niti v strokovni literaturi s področja umetne inteligence ni soglasja glede tehničnih definicij pristranskosti, ki bi jih bilo mogoče operativno uporabljati za preprečevanje (videza) pristranskosti. Naši zaključki so, da je (1) potrebno s kvalitetno izobrazbo doseči boljše splošno razumevanje metod umetne inteligence v praksi in (2) da je potrebno razviti tehnične principe, s katerimi bi v sistemih umetne inteligence operacionalizirali splošno sprejete družbene vrednote, kot sta enakost in pravičnost.

KLJUČNE BESEDE

umetna inteligenca, strojno učenje, pristranskost, diskriminacija, pravičnost

ABSTRACT

Some recent applications of Artificial Intelligence, particularly machine learning, have been strongly criticised in general media and professional literature. Applications in domains of justice, employment and banking are often mentioned in this respect. The main critic is that these applications are biased with respect to so called protected attributes, such as race, gender and age. The most notorious example is the system COMPAS which is still in use in American justice system despite severe criticism. The aim of our paper is to analyse the trends of discussion about bias in machine learning algorithms using the COMPAS as an example. The main problem of such discussions is that even in the field of

AI, there is no generally agreed technical definition of bias which would enable operational use in preventing bias. Our conclusions are that (1) improved general education is needed to enable better understanding of AI methods in everyday applications, and (2) technical methods must be developed for implementing generally accepted societal values such as equality and fairness in AI systems.

KEYWORDS

machine learning, artificial intelligence, bias, fairness, discrimination

1 UVOD

Z razmahom uporabe strojnega učenja so se v zadnjih 5 do 10 letih pojavili primeri aplikacij, ki so bile deležne izrazito odklonilnih odzivov predvsem s strani splošnih medijev, pa tudi znotraj strokovne literature. Pogosto so omenjani sistemi, uporabljeni v domenah sodstva, zaposlovanja in bančništva. Kritiki opozarjajo, da so "algoritmi in sistemi strojnega učenja nepravični in pristranski" glede na t.i. zaščitene attribute, kot so rasa, spol in starost posameznika in da so priporočila umetne inteligence odvisna od teh atributov, namesto od objektivnega ocenjevanja dejstev. Naslovi nekaterih odmevnih člankov so: *There's software used across the country to predict future criminals. And it's biased against blacks* [2], *New Zealand passport robot tells applicant of Asian descent to open eyes* [18], *A beauty contest was judged by AI and the robots didn't like dark skin* [13], *Amazon scraps secret AI recruiting tool that showed bias against women* [6]. Taki primeri prispevajo k stopnjevanju skrbi o vplivih, ki ga ima umetna inteligenca (v nadaljevanju UI) na naša življenja [15]. Strokovnjaki z različnih področij se lotevajo t.i. problema pristranskosti strojnega učenja. Skušajo definirati, kaj pristranskost pomeni, iz kje naj bi izhajala, predvsem pa, kaj naj bi glede tega storili.

Na razvijajočem se področju etike v UI (npr. UNESCO 2021 [19]) se tema pristranskosti strojnega učenja pojavlja na vidnem mestu. Pogosto jo omenjajo politiki v zvezi s principi regulacije, ki naj bi zagotovila etično uporabo umetne inteligence (npr. European AI Act, 2023 [3]). Vendar v teh diskusijah pogosto ni jasno, kaj točno pristranskost strojnega učenja in UI pomeni. Zato regulacijski ukrepi v tej smeri niso jasno opredeljeni, razen v zelo abstraktni obliki. Beseda pristranskost v zvezi s strojnimi

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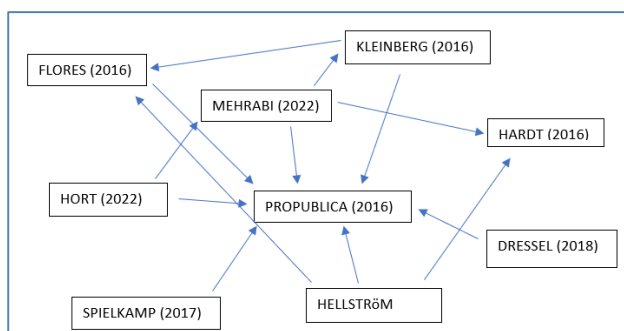
učenjem avtorjem pomene različne stvari. Celo v strokovni literaturi s področja UI ni popolnega soglasja in nedvomno sprejetih tehničnih definicij pristranskosti, ki bi jih bilo mogoče operativno uporabljati v preprečevanju pristranskosti [11]. Za razne smiselne definicije mer pristranskosti je celo matematično dokazano, da jim razen v posebnih primerih ni mogoče zadostiti hkrati [12].

V prispevku pregledamo razne definicije pristranskosti in različna mnenja o tem, kako naj bi problem najbolj učinkovito naslovili v praksi. Zaključki konvergirajo k temu, da je za ustrezno obravnavo potrebno upoštevati družbene vrednote in jih operacionalizirati z demokratično sprejetim družbenim dogovorom v obliki ustrezne zakonodaje. K dobremu splošnemu razumevanju pristranskosti v UI v praksi pa bi pripomogla boljša splošna izobrazba o UI in njenih metodah.

2 COMPAS

Sistem COMPAS je bil v vrsti publikacij obravnavan kot verjetno najbolj kontroverzen primer, ki naj bi ilustriral pristransko delovanje UI. COMPAS (Correctional Offender Management Profiling for Alternative Sanctions) je odločitveni sistem, ki ga na mnogih ameriških sodiščih uporabljajo sodniki za oceno tveganja povratništva, konkretno, da bo obsojenec v roku dveh let ponovil prestopke, če bo izpuščen. COMPAS je razvilo ameriško podjetje, takrat imenovano Northpointe. COMPAS upošteva 137 podatkov o vsakem prestopniku. Te podatke analizira poseben algoritem, ki kot poslovna skrivnost podjetja ni splošno znan. Na osnovi te analize algoritem poda oceno, ali gre za visoko ali nizko tveganje povratništva.

Slika 1 ilustrira 9 močno citiranih člankov o tem sistemu ter medsebojno citiranje med članki. Puščica iz članka A v članek B pomeni, da je B citiran v A.



Slika 1: Medsebojna povezanost objav o sistemu COMPAS

V središču grafa je članek iz časopisa ProPublica [2], ki naj bi po [1] sprožila zanimanje za preučevanje pristranskosti v UI. V [2] je skupina raziskovalnih novinarjev opisala svojo analizo sistema COMPAS in poskuse s primeri realnih podatkov o več kot 7000 obtožencih iz Floride v letih 2012 in 2013. V analizi se osredotočijo predvsem na rasni vidik in njihov zaključek je, da je program pristranski do temnopoltih obtožencov. Spremljali so, koliko od teh je bilo v naslednjih dveh letih ponovno obsojenih in primerjali napovedi z dejanskimi izidi. 44.9% temnopoltih, označenih z visokim tveganjem za ponovitev, ni ponovilo prestopka. 47.7% belcev, označenih z nizkim tveganjem, pa je v roku dveh let ponovilo prestopke. Ti dve merili za napačne

napovedi sistema se standardno imenujeta: (1) FPR (false positive rate), to je delež negativnega razreda, ki je bil napačno napovedan kot pozitiven in (2) FNR (false negative rate), to je delež pozitivnega razreda, ki je bil napačno napovedan kot negativen. Kompletni rezultati glede napačnih deležev v ocenah sistema COMPAS so:

	Beli	Temnopolti
FPR	23.5%	44.9%
FNR	47.7%	28.0%

Te rezultate so Angwin idr. [2] interpretirali kot očitno pristranske do temnopoltih in zato ocenili uporabo sistema COMPAS kot neprimerno in diskriminatorno. Taki interpretaciji bi bilo težko nasprotovati. Dodatni problem so videli v dejstvu, da odločitveni kriterij, ki ga uporablja COMPAS, ni transparenten, saj je algoritem varovan kot poslovna skrivnost. COMPAS sam pa ne poda razlage svoje napovedi. Ta članek je zelo pogosto citiran in posledično je COMPAS postal najbolj znan primer pristranskosti v strojnem učenju, tako v strokovnih krogih domene strojnega učenja, kot pri splošni publiki, ki nima strokovnega znanja o umetni inteligenci. Kljub temu se COMPAS še vedno uporablja.

Na članek iz ProPublice je odgovorila skupina strokovnjakov iz ameriškega pravosodja v članku z zgovornim naslovom “*False positives, false negatives and false analysis: a rejoinder to Machine Bias ...*” [8]. Navedli so več spornih odločitev v analizi ProPublice, izvedli svojo lastno eksperimentalno raziskavo in zaključili, da so teze ProPublice napačne. Ta kritika izgleda upravičena. Bila pa bi bolj prepričljiva, če bi v [8] jasno pokazali, kje naj bi nastala odločilna napaka v ProPublici. Namesto tega so navedli svoj lastni eksperimentalni rezultat, ki naj bi dokazal, da so obsojenci obravnavani pravično, ne glede na raso. Ta rezultat so dobili tako, da so upoštevali ocene tveganja obsojencev na lestvici od 1 do 10, kot jih oceni COMPAS. Iz teh ocen so izračunali mero AUC (Area under ROC curve, to je površina pod ROC krivuljo, ki se standardno uporablja v strojnem učenju kot indikator uspešnosti učenja). Mera AUC je zanimiva zato, ker je enaka verjetnosti, da napovedni sistem pravilno razlikuje med pozitivnimi in negativnimi primeri. To pomeni, da če vzamemo dva naključna primera (dva obtoženca), od katerih je eden pozitiven (je ponovil prestopke) in drugi negativen, potem bo sistem z verjetnostjo AUC pravilno odločil, kateri je pozitiven in kateri negativen. Flores idr. [12] navajajo, da je za belce dobljena vrednost AUC enaka 0,69, za temnopolte pa 0,70. Pri tem razlika ni statistično signifikantna. Iz tega zaključijo, da COMPAS ni diskriminatoren in da rezultati ProPublice, ki kažejo na diskriminacijo, ne morejo biti pravilni. Vendar ta posredni argument dopušča dvom, saj mere AUC ter FPR in FNR med seboj niso enoznačno povezane.

Dressel in Farid [7] poročata o relevantnih poskusih, kjer ju je zanimala točnost napovedi o tveganju povratništva, ki jo dosežejo naključno izbrani ljudje brez znanja o navadah obsojencev. Poskus s človeškim napovedovanjem (izvedenim s “crowd sourcingom”) sta naredila na podmnožici podatkov o 1000 od skupaj okrog 7000 obsojencev iz poskusov v [2] in [8]. Ker bi bila uporaba vseh 137 atributov za poskus z napovedmi ljudi nepraktična, sta izmed originalne množice atributov izbrala le 7 atributov. Napovedna točnost ne-ekspertov je v teh poskusih presenetljivo praktično enaka kot tista s sistemom COMPAS. Zanimivo je, da so tudi človeške napovedi v tem poskusu podobno pristranske kot COMPAS, merjeno s FPR in FNR za bele in temnopolte, ter da se ti rezultati skoraj ne spremenijo, če človeškemu ocenjevalcu kot dodatno informacijo podamo tudi podatek o rasi.

Neodvisno od teh rezultatov je Cynthia Rudin [16] s strojnim učenjem pravil iz omenjenih podatkov s Floride sintetizirala zelo enostaven in povsem razumljiv napovedni model, ki vsebuje le tri enostavna if-then pravila in uporabi tri attribute. Za razliko od modela COMPAS, so ta pravila trivialno razumljiva. Tudi ta prediktor ima zelo podobno točnost kot COMPAS, pa tudi podoben FPR in FNR.

Iz vseh opisanih rezultatov zaključujemo, da je ta napovedni problem kljub obsežnim razpoložljivim informacijam o obtožencu tako težak, da boljše točnosti ni mogoče doseči. Hkrati skoraj vse dosežemo z dvema ali tremi najbolj koristnimi atributi in preostalih 130+ atributov dodatno ne doseže ničesar. V skladu s tem se v [2, 7] izoblikuje teza, da uporaba strojnega učenja v pravosodju nima dobre perspektive. To je seveda prenašel in preveč enostaven zaključek, na kar opozarja [17]. V mnogih drugih aplikacijah je strojno učenje preseglo napovedno točnost ekspertov, kar so med drugim potrdili mnogi poskusi s strojnim učenjem v medicinski diagnostiki.

Vsa ta različna mnenja o (ne)pristranskosti in (ne)uporabnosti sistema COMPAS kažejo na pomanjkanje splošno sprejetih operativnih definicij pristranskosti in pravičnosti v strojnem učenju. Situacijo lepo ilustrira močno citirani članek [14], ki razglablja o več deset relevantnih definicijah, pri tem pa ne ponudi sinteze, ki bi to idejno kompleksnost omejila in dala praktično uporaben pristop. Dodatno nelagodje ta članek povzroči s tem, da na hitro opravi s sistemom COMPAS in ga uvrsti med očitno pristranske ter neposrečene in nekoristne. Pri tem raziskave [8] ne omeni. V [7] pa spregleda dejstvo, da tudi alternativni rezultati s strojnim učenjem in s človeškim napovedovanjem povratništva na isti podatkovni množici kažejo zelo podobno pristranskost do temnopoltih, kot COMPAS.

3 DEFINICIJE PRISTRANSKOSTI IN PRAVIČNOSTI TER NJIHOVI PROBLEMI

V splošnih medijih se strojnemu učenju pogosto enostavno očita pristranskost bolj po občutku, ne da bi natančno definirali, po kakšnem matematično preverljivem kriteriju se pristranskost kaže. Izjave, kot so: "sistem se je v sodstvu pokazal kot pristranski do temnopolnih obtožencev" [2], ali "sistem je pri ocenjevanju kandidatov za zaposlitev pristranski do žensk" [5], uporabljajo splošne fraze, kot so "pristranskost algoritmov", "pristranskost strojnega učenja", "pristranskost umetne inteligence". Včasih so te ugotovitve opremljene z enostavno razlago, kot je: "sisteme strojnega učenja razvijajo skoraj izključno beli moški, torej ...".

Danes je jasno, da stvar ni tako trivialna. Pretirano enostavne razlage se zdaj pojavljajo redko. Postaja tudi bolj jasno, da fraza "pristranskost algoritmov" ni primerna in daje napačen občutek, da so algoritmi sposobni imeti zle namene in da ne delujejo po matematičnih in statističnih principih [16]. Cilj teh metod je vedno, da iz podatkov o realnem svetu odkrijemo zakonitosti, ki v tem svetu veljajo. Seveda se takoj pojavi problem, če so v realnem svetu že prisotne pristranske prakse. Podatki, zajeti v takem svetu, odražajo to pristranskost in algoritem za učenje to pristranskost detektira in reproducira. Če rezultate, dobljene iz pristranskih podatkov v realnem svetu, spet uporabimo v realnem svetu, bomo s tem reproducirali že obstoječo pristranskost [10]. Vseeno še vedno ni dovolj natančno definirano, kaj pristranskost sploh je. Pogosto gre za vtis pristranskosti, kjer se kažejo predsodki za ali proti posamezniku ali skupini na način, ki se razume kot nepravičen [15].

Poglejmo, v čem so težave z definicijo pristranskosti. Že na področju strojnega učenja najdemo različne razlage, ki so vse po

svoje smiselne. Izraz pristranskost se v strojnem učenju uporablja v več pomenih [11]:

1. T.i. induktivna pristranskost: to je princip, po katerem se algoritem odloči za eno izmed tipično velikega števila možnih hipotez, ki so glede na učne podatke vse na nek način utemeljene. Ta vrsta pristranskosti je neizogiben mehanizem in je zato v principu pozitivna komponenta strojnega učenja, brez katerega strojno učenje sploh ni možno. Primer take pristranskosti je Occamova britev (Occam's razor), ki pravi: Če imamo na voljo dve razlagi zbranih podatkov, ki sicer obe enako dobro razložita te podatke, potem raje izberemo enostavnejšo razlago [9, 11, 15]. To pristranskost uporabljamo pogosto ne le v strojnem učenju, temveč v znanosti nasploh. Čeprav ima izraz pristranskost negativen prizvok, je induktivna pristranskost pozitivna in celo neizogibna komponenta strojnega učenja, kot razlagajo avtorji v [11], in osnovni učbeniki umetne inteligence.
2. Pristranskost v učnih podatkih, ki odražajo dejanske pristranskosti v ustaljenem odločanju na danem področju uporabe (npr. pristranskost ekspertov v dejanski sodni praksi v okolju, iz katerega so zajeti učni podatki) [4, 14].
3. Pristranskost, ki izhaja iz neprimerne postopka zbiranja podatkov oz. vzorčenja [11], npr. da je za določeno skupino ljudi na voljo bistveno manj primerov kot za druge skupine. Potem v skladu z matematično utemeljenimi statističnimi in verjetnostnimi principi nekatere skupine, tipično manjšinske, izpadejo kot diskriminirane (lahko celo v pozitivnem smislu!) zgolj zato, ker metode ocenjevanja verjetnosti upravičeno ocenijo verjetnosti drugače, če je na voljo malo podatkov.

Gornji viri pristranskosti so razmeroma splošno sprejeti. Ostaja pa problem, kako natančno definirati merila, ki objektivno povedo, ali je sistem pristranski oz. ki to pristranskost kvantitativno vrednotijo. Obstajajo številne mere, ki so videti relevantne, vendar se izkaže, da si med seboj nasprotujejo in zato za zdaj enostavne, splošno sprejete mere ni. Situacijo zelo dobro ilustrira izčrpan pregled v [14].

Bolj fokusirano raziščejo ta problem Kleinberg idr. [12]. Definirajo tri naravne, same po sebi takorekoč očitne pogoje, ki jim mora zadostiti sistem, če naj bo nepristranski (pravičen). Toda presenetljivo se izkaže, da ti trije pogoji ne morejo biti izpolnjeni hkrati, razen v posebnih primerih, ki pa so za prakso nezanimivi. Torej so že te tri osnovne zahteve skupaj neuresničljive. Te tri zahteve so:

- (1) Kalibracija ocen verjetnosti: če algoritem identificira množico oseb, ki naj bi z dano verjetnostjo pripadale pozitivnemu razredu, potem mora približno tak delež te množice dejansko pripadati pozitivnemu razredu. Enak pogoj mora veljati za vse skupine oseb, ki se razlikujejo v "zaščitenem atributu", npr. rasi ali spolu.
- (2) Ravnotežje pozitivnega razreda: povprečje verjetnostnih ocen oseb pozitivnega razreda mora biti enako za vse skupine.
- (3) Ravnotežje negativnega razreda: analogno kot povprečje pozitivnega razreda.

Avtorji dokažejo izrek, da so te tri zahteve, čeprav si v bistvu prizadevajo za isti cilj zmanjševanja pristranskosti, med seboj nekompatibilne, razen v posebnih primerih.

Kadar se pojavi pristranskost, je vprašanje, kako jo odpraviti. Za to obstaja vrsta idej, od katerih sta najbolj očitni (a) "zaščiteni atributi" in (b) obratna diskriminacija. Tipična zaščiteni atributa sta rasa in spol.

Princip zaščitenih atributov je, da algoritmu učenja prepovemo uporabo teh atributov pri odločanju o klasifikaciji primera. Ta ideja navadno ne deluje dobro, saj algoritem učenja efektivno rekonstruira njihove vrednosti iz drugih, nezaščitenih atributov, ki korelirajo z zaščitenimi. Na primer iz podatkov o šolanju ali lokaciji prebivališča algoritem sklepa na raso osebe.

Princip obratne diskriminacije je, da depriviligiranim skupinam pri obravnavi namenoma damo določeno prednost, s čimer naj bi izničili učinek diskriminacije. Ta ukrep je očitno dobronameran, vendar s tem dejansko uvedemo dodatno nepravilnost, ki je za nekatere vprašljiva (npr. Alelyani [1]). Taka nepravilnost (obratna diskriminacija) je upravičena, vendar ne z vidika pravičnosti, temveč z vidika "višjih" vrednot, npr. da za v bodoče popravimo zgodovinske krivice in zčasno nepravilnostjo dosežemo dolgoročno pravičnost. Torej gre za strateško uresničevanje družbeno sprejetih vrednot, ki v praksi sicer zaradi zgodovinskih razlogov in vztrajnosti niso hitro uresničljive. Ostaja težavno vprašanje, do kakšne mere je obratna diskriminacija smiselna. To bi moralo biti določeno z demokratično sprejetim družbenim konsenzom, formaliziranim z ustreznimi zakoni za vsak primer posebej.

V praksi se reševanja pristranskosti lotimo znotraj treh faz strojnega učenja: 1) pred-procesna faza, kjer povečamo vzorec manjšine, 2) med-procesna faza, kjer dodajamo omejitve, s katerimi kompenziramo za neenakomeren vzorec in 3) post-procesna faza, kjer spreminjamo mejne vrednosti za manjšine [4, 14, 15].

Ko razvijamo metode in orodja se moramo zavedati potencialnih pasti. V [1, 11] avtorji izpostavljajo, da lahko določene rešitve pripeljejo do novih nepravilnosti, pogosti stranski učinek mutiranja učnih podatkov pa je izguba pomembnih povezav med spremenljivkami ali slabše delovanje celotnega algoritma [5].

4 ZAKLJUČKI

Pristranskost je v nekaterih pomembnih aplikacijah strojnega postala popularna in kontroverzna tema. V diskusiji prevladuje nejasnost, ki izvira iz tega, da večina razume pojem pravičnosti in pristranskosti intuitivno. Pri tem pravičnost doživljamo na razne načine in v podrobnostih ni popolnega soglasja. Tako tudi ni soglasja o tem, kakšen naj bi bil jasen, matematično formuliran kriterij, s katerim bi brez dvomov kvantificirali pristranskost konkretnega sistema. Veliko več je nasprotovanj, kontroverznih in odprtih tem, kjer ni strinjanja. Ni konsenza o izvoru pristranskosti, niti o tem, katero orodje oz. metoda je za soočanje s pristranskostjo najbolj primerna.

Spielkamp [17] na primer komentira pomanjkanje enotne definicije in kriterijev takole: "Jasno je, da naj bi pravičnost strojnega učenja pomenila produciranje odločitev, s katerimi bi bili kot družba zadovoljni. Vendar glede tega ljudje nismo enotni." Na primeru COMPAS se pokaže, kako ključna je ta enotnost. COMPAS je testiralo več strokovnjakov in njihova mnenja so si povsem nasprotna. Nekateri trdijo, da je COMPAS pristranski, drugi pravijo, da ni. Spielkamp meni, da imajo prav vsi, saj pravičnost razumejo na razne načine.

Tudi nekateri drugi avtorji ugotavljajo podobno. Poudarjajo, da je nujno razviti široko družbeno sprejeto definicijo pravičnosti, ki bo rezultirala v sistemih, ki bodo delovali v skladu z ustaljenimi družbenimi vrednotami in s tem povezanimi pričakovanji.

V literaturi kljub temu ni videti, da bi kdo predvidel, kako velik izziv bo to. Pričakovanja glede vrednot bo treba namreč natančno formulirati z ustreznimi zakoni. Na primer, ali naj bo zaradi zgodovinskih krivic v konkretni aplikaciji realizirana obratna pristranskost in do kakšne mere? Ta formulacija bo morala biti bolj tehnična kot običajno v predpisih in zakonih, saj bo to osnova za konkretno implementacijo v algoritmičnih umetni inteligenci.

Za ustrezno splošno razumevanje in ukrepanje na tem področju se kaže potreba po kvalitetni splošni izobrazbi ljudi. Pomanjkanje le-te se kaže v načinu poročanja, odzivanju ljudi in tudi zmedenosti strokovnjakov. Različni algoritmi postajajo neizogiben del naših življenj. Nesprejemljivo je, da o njih ne samo da vemo premalo, ampak imamo celo napačne predstave. Splošno znanje o delovanju algoritmov (in širše o umetni inteligenci) temelji največ na poročanju medijev s pogosto pomanjkljivimi informacijami, napačnimi poudarki ter pretiravanjem. Nujno je, da se ljudje o tem dovolj izobrazijo in lahko tako primerno ocenijo situacije, kjer nek algoritem proizvaja nezaželene rezultate.

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ChatGPT through Tononi's Definition of Consciousness

Analiza ChatGPT skozi Tononijevo definicijo zavesti

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ABSTRACT

The intricacies of consciousness and its existence have long been the subjects of both philosophical and scientific investigations. With advancements in artificial intelligence, discerning the line between algorithmic processing and consciousness becomes increasingly vital. This paper uses Tononi's Integrated Information Theory (IIT) to examine ChatGPT, assessing its alignment with human notions of consciousness. Analysis shows that while ChatGPT exhibits attributes superficially resonating with Tononi's axioms, it lacks the foundational conscious experience described by the theory. Then, passing the Turing test as a way of demonstrating consciousness is debated with similar conclusions.

POVZETEK

Zapletenost zavesti in njen obstoja ter namen so predmet tako filozofskih kot znanstvenih naravoslovnih raziskav. Z napredkom v umetni inteligenci postaja vedno bolj ključno razlikovanje med algoritmično obdelavo in zavestjo. Ta članek uporablja Tononijevo teorijo integrirane informacije (IIT) za analizo potencialne zavesti ChatGPT, pri čemer je ključno vprašanje usklajenost z človeškimi predstavami o zavesti. Analize kažejo, da ChatGPT sicer površinsko zelo dobro resonira s Tononijevimi aksiomi, vendar mu manjka temeljna zavestna izkušnja, ki jo teorija opisuje. V nadaljevanju prispevka je opisovanje reševanja Turingovega testa s strani ChatGPT kot preverjanja zavestnosti, ki se izkaže pri tem testu, ter diskusija.

KLJUČNE BESEDE

Zavest, ChatGPT, Turingov test

KEYWORDS

Consciousness, ChatGPT, Turing test

1 INTRODUCTION

As AI continues to progress, the discussion surrounding machine consciousness intensifies. The question often arises: can machines ever possess genuine consciousness? Has that already been achieved by ChatGPT? To delve into this, we leverage the IIT—a framework by Tononi proposing five axioms believed to underlie human consciousness—and apply these criteria to

ChatGPT. Then, passing the Turing test by ChatGPT is analysed as another test whether consciousness is already achieved.

There is a rich tapestry of literature exploring consciousness, AI, and where the two intersect. Koch et al. have explored how IIT offers a quantitative measure of consciousness in diverse systems [1]. Dehaene and others have looked into consciousness in both biological and artificial systems, arguing for unique neural markers that underpin conscious states [2]. Recent advancements in AI, especially deep learning models like ChatGPT, have triggered renewed debates, with researchers like Hassabis et al. and Bengio postulating how AI might approach or simulate human-like consciousness [3,4].

2 ANALYSIS OF CHATGPT THROUGH TONONI'S AXIOMS FOR CONSCIOUSNESS

2.1 Background: Tononi's Axioms for Consciousness

Tononi's Integrated Information Theory (IIT) proposes five fundamental axioms aimed at capturing the core of consciousness:

Intrinsic Existence: Consciousness inherently exists for the conscious entity. It's a subjective phenomenon, deeply personal and unique to each entity [6].

Composition: Consciousness is not monolithic. It possesses structure, and within it, diverse experiences can be differentiated. This diversity isn't merely quantitative but also qualitative, making each conscious experience rich and multidimensional [7].

Information: Consciousness is informative. Every conscious experience stands out against other potential experiences, indicating a specific state of affairs over countless others [8].

Integration: Despite its diverse composition, consciousness is unified. Experiences are intertwined, and it's impossible to

completely isolate any subset of phenomena within a single conscious moment [9].

Exclusion: Consciousness is definite, both in content and in space. At any given moment, an entity is conscious of certain things and not others, thus creating clear boundaries of experience [10].

2.2 ChatGPT under the lens of Tononi's axioms

To evaluate the degree of ChatGPT achieving each axiom of the Tononi's theory, the existing literature and the opinion in the AI community is of no great help, since there are mixed opinions and no generally accepted viewpoint. However, there are two bases that this paper evaluates consciousness of ChatGPT through various analysis: First, there is 50 years of experience of the author of the paper in the AI and cognitive field and 20 years of superintelligence studies. Second, there is an opinion of ChatGPT when asked about each particular issue. Interestingly enough, even though there were some differences, and the author chose the merit of the expertise, there was quite strong agreement in general. The GPT opinion, seemingly, was to a large extent hand-crafted by humans, dealing with this issue, and partially through the GT or LLT approach, as demonstrated by the replies.

Intrinsic Existence: At its core, ChatGPT is a product of algorithms and vast data. It operates in response to inputs, without possessing feelings, beliefs, or desires. It lacks any semblance of self-awareness, and as such, it probably does not meet the axiom of intrinsic existence.

Composition: ChatGPT, architecturally, boasts a vast neural network configuration. This allows it to generate a diverse array of outputs based on different inputs. However, this structural variety isn't birthed from conscious deliberation but from learned patterns. While it exhibits structural diversity analogous to the composition axiom, it seemingly lacks the qualitative conscious nuance integral to Tononi's definition.

Information: The model processes and produces specific responses based on its training. Each response is a selective piece of information shaped by its training data and the query. Although this aligns with the informational aspect of the axiom, the absence of conscious deliberation and choice makes its alignment potentially superficial.

Integration: ChatGPT's processes are integrated. Each input is processed through multiple layers, intertwining different learned patterns to produce a coherent output. This mirrors the operational facet of the integration axiom. However, the unity described by Tononi implies a cohesive conscious experience, which ChatGPT probably does not possess.

Exclusion: With its design parameters and training, ChatGPT operates within set boundaries. It produces specific responses and not others. While this resonates with the operational side of

the exclusion axiom, the model's responses might not be the result of conscious choices or experiences.

It's essential to highlight the difference between operational alignment and conscious alignment. While ChatGPT showcases attributes that operationally resonate with some of Tononi's axioms, it does so without the underlying conscious experience these axioms were designed to describe. The axioms, rooted in human phenomenology, emphasize subjective experience, something inherently absent in ChatGPT.

ChatGPT, in its design and operation, exhibits attributes that superficially align with Tononi's axioms to a certain degree. However, when delving into the crux of these principles—conscious experience—ChatGPT falls a bit short. While it stands as a testament to advancements in information processing and AI, ChatGPT does not qualify as a conscious entity within the framework of Integrated Information Theory.

3 HAS CHATGPT PASSED THE TURING TEST I.E. REACHING THE CONSCIOUSNESS?

Another way to test the level of AI systems at achieving consciousness, can be performed by the Turing Test (TT). The Turing Test, proposed by the eminent computer scientist Alan Turing in 1950, is a measure of a machine's ability to exhibit intelligent behaviour indistinguishable from that of a human [11]. Turing postulated that if an evaluator, after interacting with an unseen interlocutor for five minutes, could not reliably tell whether dealing with a machine or a human, then the machine could be said to have passed the test. As ChatGPT emerges as one of the most sophisticated AI language models, there's debate about its positioning relative to the Turing Test and consequently consciousness.

3.1 Arguments in Favor:

Advanced communication:

ChatGPT is engineered to provide detailed replies that span a wide range of subjects, from science and technology to philosophy and art. The quality of its responses often mirrors human-like expertise and reasoning capabilities, making it a versatile conversational agent. Its ability to provide contextually relevant and accurate information resembles the intellectual breadth and depth one would expect from a knowledgeable human, being familiar with the Web. Consequently, it is increasingly difficult to immediately distinguish some of its responses from those generated by a human, especially in text-based interactions.

Adaptive Interaction:

The model is designed to be sensitive to the conversational context, allowing it to adjust its responses based on previous dialog turns. This adaptability manifests in the way it can switch topics smoothly, clarify ambiguities, or even attempt humour, much like a human would in a fluid conversation. Its capability to modify its tone and content in real-time according to conversational cues shows an advanced level of adaptability, often comparable to human dialog dynamics. This feature enhances its suitability for diverse interactions, making it a compelling interface for numerous applications.

3.2 Arguments Against:

Lack of Understanding:

While ChatGPT's responses can be elaborate, it's essential to remember that the model doesn't possess genuine understanding or consciousness. It generates text based on statistical patterns it has learned from its training data, and skilfully intercombines various potential most relevant texts patterns into a word by word continuation, without the ability to comprehend the meaning or significance of the conversation [15]. Its sophisticated language capabilities may give the illusion of understanding, but this surface-level competence should not be mistaken for genuine comprehension or awareness.

Inconsistencies:

The model is not reliable in providing consistent answers over different conversational sessions or even within the same interaction, the effect called hallucinating. These inconsistencies are a testament to its underlying algorithmic nature, which does not have the capacity for ongoing memory or the ability to learn from past interactions [16]. Such discrepancies in its replies can sometimes make it evident that one is conversing with a machine, not a human, thereby undermining its credibility and reliability in more complex or sensitive dialog scenarios.

Absence of Emotions:

Human dialog is often rich in emotional nuance and subtext, an aspect that is conspicuously lacking in ChatGPT. Despite its linguistic capabilities, the model cannot feel emotions or understand the emotional weight of certain words or situations. Its interactions are devoid of emotional depth, empathy, or any other kind of emotional intelligence that is often central to human communication. This absence not only differentiates it from human-like conversation but also limits its applicability in scenarios where emotional engagement is crucial.

Literary Standpoints:

Hernandez-Orallo discussed the limitations of the Turing Test, emphasizing that mere linguistic capability may not be a sufficient measure of machine intelligence [13]. Russell and

Norvig, in their comprehensive AI textbook, consider the Turing Test as a valid, though not definitive, measure of machine intelligence, suggesting that while passing the Turing Test is significant, it does not necessarily equate to full human-like intelligence [14]. A recent article in Nature delineates the increasing complexity and performance of large-scale language models, weighing them against the Turing Test's standards [15]. Another piece in the Boston Review contemplates the question of consciousness in such models, considering the philosophical implications of designating them as 'conscious' [16].

One salient point from the Boston Review article is the distinction between machine operation and human consciousness [17]. While large language models like ChatGPT can generate intricate and seemingly aware responses, there remains a significant philosophical and cognitive gap. These models operate by recognizing and generating patterns based on massive datasets without the subjective experience that characterizes human consciousness. The Boston Review delves into the implications of mistaking this high-level processing capability for genuine consciousness, emphasizing the risks of anthropomorphizing machine behaviors.

In light of this, it becomes evident that while ChatGPT can generate responses that mimic human-like thinking, it does so devoid of genuine understanding, emotions, or the conscious experiences that humans possess.

This perspective aligns with the core debate surrounding the Turing Test. ChatGPT's capability to produce responses that may seem indistinguishable from those of a human in specific contexts does not necessarily imply that the model genuinely "thinks" or possesses consciousness. Instead, it underlines the model's adeptness at pattern recognition and response generation, which, although impressive, is fundamentally distinct from human cognition.

4 DISCUSSION

ChatGPT demonstrates the remarkable advancements in artificial intelligence, surpassing previous efforts by a substantial margin. However, it's essential to distinguish between its algorithmic complexity and genuine consciousness. The difference is described in this paper through two major parts: first through the IIT theory and second through the Turing Test.

While the model excels in simulating conscious traits, within the framework of Integrated Information Theory (IIT) it remains devoid of authentic conscious experience—a distinction that should be apparent to cognitive scientists, even in the presented discussions in this paper.

Second, regarding the Turing Test, ChatGPT displays impressive linguistic capabilities that bring it tantalizingly close to fulfilling the test's criteria. Yet, it falls short in key areas, including genuine understanding and emotional intelligence. For specialists familiar with the field, this limitation is easily identifiable, especially when the conversation veers into complex or emotionally charged topics. In these situations, the model's limitations become obvious, as it fails to respond appropriately to intricate, tangible or conflicting dialogues.

While some literature may argue that ChatGPT could pass the Turing Test in brief interactions, especially with laypeople, the articles from Boston Review and Nature emphasize the crucial distinction between mere simulation and actual consciousness. Indeed, those well-versed in the subject, including cognitive scientists, should readily discern ChatGPT's performance from that of a human. This serves as a timely reminder of the need to continually update our evaluation metrics, not just technically but also philosophically, as AI continues to challenge our conceptual boundaries of intelligence and consciousness.

In conclusion, although ChatGPT and similar generative models signify a quantum leap toward general AI and possibly superintelligence, they should not be conflated with achieving consciousness or passing the Turing Test. Despite possessing certain superhuman attributes, such as speed, and achieving approximate human-level performance in specific tasks, ChatGPT does not meet the criteria for consciousness. That might not hold for an extended period of time. According to Chalmers [15] »Within the next decade, we may well have systems that are serious candidates for consciousness«; however, current models like ChatGPT should not be mistaken as such, especially by those familiar with the cognitive sciences. Therefore, while the progress is significant, the journey toward creating truly conscious machines is far from over.

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Manipulacija v umetni inteligenci

Manipulation and artificial intelligence

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POVZETEK

V svetu, ki ga vse bolj oblikuje umetna inteligenca, se je začelo pojavljati vprašanje manipulacije. Ko sistemom umetne inteligence zaupamo vse večje vloge v naših življenjih, od personaliziranih priporočil do kritičnega odločanja, se lahko vprašamo, do katere mere zaupati strojem, ki se zdijo tako inteligentni in nepristranski? Umetna inteligenca postaja ne le vir pomoči, temveč tudi manipulira, dezinformira in vpliva. V tem raziskovanju zapletene mreže manipulacij znotraj umetne inteligence se srečamo s tehnološko uganko, ki postavlja pod vprašaj naše razumevanje avtonomije in etike.

KLJUČNE BESEDE

Manipulacija, umetna inteligenca, demokracija, marketing, etika

ABSTRACT

In a world increasingly shaped by artificial intelligence, the issue of manipulation has begun to emerge. As we entrust AI systems with ever greater roles in our lives, from personalised recommendations to critical decision-making, we may ask to what extent should we trust machines that seem so intelligent and impartial? Artificial intelligence is becoming not only a source of help, but also a source of manipulation, misinformation and influence. In this exploration of the complex web of manipulation within AI, we are confronted with a technological conundrum that calls into question our understanding of autonomy and ethics.

KEYWORDS

Manipulation, artificial intelligence, democracy, marketing, ethics

1 UVOD

Carroll in sodelavci (2023) definirajo sistem umetne inteligence kot manipulativen, če deluje, kot da bi si prizadeval za namerno in prikrito spremembo človeka (ali drugega agenta) [1]. Primer

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manipulativne umetne inteligence je priporočilni sistem, ki optimizira dolgoročno sodelovanje, tako da prikrito spodbuja uporabnika, da si ogleda več videoposnetkov. Manipulacija je težko precizno opredeljiva, lahko pa se naslonimo na štiri glavne značilnosti. Prva je, da gre za nerazumski vpliv, pri katerem skuša manipulator zaobiti ali oslabiti človekovo sposobnost premišljenega odločanja. Druga je, da manipulacija zahteva uporabo zvijače in prevare, pogosto s skritimi sredstvi, da bi nekoga prisilili k določenemu ravnanju. Tretji razlog je, da manipulacija vključuje uporabo določene stopnje pritiska, da bi storili, kar želi manipulator, na primer s čustvenim izsiljevanjem. In nazadnje, običajno se ne ravna po interesih, ciljnih in željah ciljnih osebe, temveč le po interesih manipulatorja [2].

Razlogi za povečano tveganje za manipulacijo v dobi umetne inteligence so naslednji; Prvič, umetna inteligenca je precej netransparentna, saj velika večina algoritmov ni pregledna in razložljiva, uporabniki pa ne posedujejo zadosti tehničnega znanja [3]. Drugič, sistemi umetne inteligence lahko odkrijejo preference, interese, navade in ostale značilnosti posameznika ter tako natančno prilagodijo vsebino [4]. Poleg tega se lahko sistemi umetne inteligence uporabljajo za ocenjevanje psiholoških stanj ljudi, kot so na primer čustvena stanja [5]. Tretjič, umetna inteligenca omogoča oslabitev avtonomije odločanja potrošnikov z izkoriščanjem njihovih ranljivosti pri odločanju [3].

2 MANIPULACIJA Z INFORMACIJAMI

Na dinamičnem področju demokratičnih sistemov je umetna inteligenca postala močan dejavnik, ki spreminja taktiko političnih kampanj in nagovarjanja volivcev. Tradicionalne metode sodelovanja z javnostjo so se umaknile naprednim pristopom, ki jih poganja umetna inteligenca in ki izkoriščajo obsežne podatke, da bi vplivali na razpoloženje javnosti in zagotovili volilno zmago [6]. Sposobnost umetne inteligence, da obdela in oceni obsežne zbirke podatkov političnim kampanjam omogoča vpogled v nagnjenja, vedenje in čustva volivcev. Algoritmi umetne inteligence z raziskovanjem spletnih interakcij, zgodovine brskanja in drugih digitalnih sledov oblikujejo podrobne profile volivcev in z izjemno natančnostjo predvidevajo posameznikove težnje. S tem znanjem lahko politični akterji prilagodijo svoja sporočila tako, da odmevajo v različnih demografskih skupinah, in oblikujejo personalizirane pozive, ki so povezani s čustvi in prepričanji volivcev. Ciljno usmerjanje volivcev, ki ga poganja umetna inteligenca, presega zgolj oblikovanje profilov in uporablja tehnike mikrousmerjanja,

da bi volivce doseglo na osebni ravni. Sporočila kampanje so lahko natančno prilagojena, da se ujemajo s posameznikovimi načeli in interesi, kar poveča njihov prepričljiv učinek in verjetnost pridobitve podpore. Ta natančnost kampanjam omogoča, da pametno razporedijo sredstva in se osredotočijo na ključne volivce, ki so bistveni za njihovo zmago [6].

Vendar pa se na drugi strani tega tehnološkega napredka pojavljajo etični pomisleki. Kritiki trdijo, da lahko takšno mikrousmerjanje še poveča polarizacijo in ustvari odmevne komore, v katerih se posamezniki utrdijo v svojih obstoječih prepričanjih in okrepijo pristranskost pri potrjevanju. Poleg tega pomanjkanje preglednosti algoritmov umetne inteligence, ki se uporabljajo za politično ciljanje, povzroča pomisleke glede odprtosti in odgovornosti, kar lahko spodkoplje demokratično načelo informiranega soglasja. V digitalni dobi se je ranljivost razširjanja informacij povečala zaradi manipulacij, ki jih omogočajo generirane vsebine in globoki ponaredki. Te napredne tehnologije lahko z razširjanjem lažnih informacij in spodkopavanjem zaupanja v politične postopke motijo demokratične sisteme [6].

Ker se demokratične družbe spopadajo s temi dilemami, so zahteve po večji preglednosti in algoritemski odgovornosti vse glasnejše. Iskanje ravnovesja med ohranjanjem vključenosti uporabnikov in varovanjem demokratične integritete od podjetij družbenih medijev zahteva vesten nadzor umetne inteligence in etični premislek. C. Serbanescu (2021) vidi umetno inteligenco kot grožnjo demokraciji, saj ta omogoča manipulacijo procesov odločanja državljanov in s tem ogroža njihovo avtonomijo pri sodelovanju v demokratičnih procesih. Aplikacije umetne inteligence imajo potencial, da oblikujejo "arhitekturo izbire" državljanov, vključno z razpoložljivimi izbirami in načinom njihove predstavitve, na personaliziran, dinamičen in prikrit način. Vseprisotnost tehnologije in zbiranje velikih količin podatkov sta olajšala manipulacijo, ki jo omogoča umetna inteligenca, kar omogoča prilagojene vplive in dinamično prilagodljivost za izkoriščanje posameznikovih slabosti. Ta oblika manipulacije predstavlja kvalitativno in kvantitativno spremembo v primerjavi s tradicionalno manipulacijo, saj lahko učinkoviteje doseže veliko število volivcev in vpliva na rezultate, ki bi lahko predstavljali "voljo ljudstva". Na splošno je vzpon aplikacij umetne inteligence privedel do učinkovitejših oblik manipulacije, kar predstavlja velik izziv za demokracijo [7].

3 VEDENJSKO OGLAŠEVANJE IN MANIPULACIJA POTROŠNIKA

Umetna inteligenca spreminja dinamiko trženja in oglaševanja, saj prehaja od široke promocije k personaliziranim izkušnjam. Z njo se briše meja med manipulacijo in prepričevanjem potrošnikov, na kar je še posebej vplival premik na splet med pandemijo COVID-19. Prej so tržniki zbirali demografske podatke, spremljali trende in segmentirali potrošnike za ciljno usmerjanje. Tudi v fizičnih trgovinah so v bližini blagajn strateško postavljali predmete, kot so revije in žvečilni gumiji. Danes strategije, ki jih poganja umetna inteligenca, zbirajo obsežne podatke iz iskalnikov, družbenih medijev in aplikacij za pomoč pri oblikovanju trženjskih pristopov.

Podjetja zdaj proaktivno oblikujejo interakcije s potrošniki, da bi jih pritegnila k sodelovanju, pri čemer včasih prehajajo na mejo manipulacije. Za prilagajanje strategij uporabljajo podatke

iz virov kot so sledenje lokaciji in družbeni mediji. To odraža premik k vplivanju na določeno vedenje potrošnikov in ne zgolj k njihovem prepričevanju. Ta razvijajoči se pristop vključuje analizo čustvenih in psiholoških modelov ter izkorišča ranljivosti in strahove potrošnikov. S strojnimi eksperimentiranjem lahko podjetja raziskujejo vzročne povezave med vedenjem in tržnimi strategijami. Veliki podatki podjetjem omogočajo spreminjanje vedenja s pomočjo paradigem osebne identitete, kar se kaže v aplikacijah, kot sta sledenje lokaciji in prepoznavanje obraza. Razvoj programske opreme umetne inteligence vključuje nevroznanost, psihologijo in trženje ter ustvarja učinkovite promocijske metode. Preprosti algoritmi analizirajo spletno vedenje in ustvarjajo natančne profile uporabnikov. Poglobljeno učenje omogoča podrobne profile, ki presegajo celo tesna razmerja. Korporacije uporabljajo ta spoznanja in s pomočjo psihologov in nevroznanstvenikov iščejo "gumb za nakup potrošnika" [8].

Poleg tega tehnologije za branje misli postopoma pridobivajo sposobnost namernega prilagajanja dejanj kognitivnim in čustvenim stanjem vpletenih strani. Ta strateški pristop temelji na "čustveni umetni inteligenci". To pomeni prepoznavanje duševnih stanj s tehnikami strojnega učenja, ki pogosto uporabljajo globoke nevronske mreže. Čustvena umetna inteligenca služi različnim namenom, od povečanja varnosti v cestnem prometu (na primer spremljanje voznikov) do usmerjenega oglaševanja [9].

Čeprav se je tovrstna psihološka analiza, ki temelji na temeljni teoriji čustev, soočila s kritikami, da je preveč poenostavljena in nezanesljiva, je tehnologija na nekaterih področjih že pokazala impresivno raven učinkovitosti, sčasoma pa naj bi se še izboljšala. Primerljive tehnike bi lahko uporabili za odkrivanje in izkoriščanje kognitivnih pristranskosti pri potencialnih sogovornikih [9].

Medtem ko je potencial strojnega učenja za izkoriščanje kognitivnih in čustvenih ranljivosti sogovornikov očitno v postopku modeliranja, je empirično preverjanje takšne manipulacije v praksi precej zahtevno zaradi pogosto skrivnostne narave teh modelov. Kljub temu je v literaturi mogoče najti nekaj primerov potencialno manipulativnega izvajanja umetne inteligence. Podjetje eyeQ je na primer razvilo orodje, ki v realnem času skenira obrazno mimiko kupcev v trgovinah in analizira čustva in druge dejavnike, nato pa na podlagi teh podatkov prilagaja trženjske strategije v trgovinah. Takšne prakse lahko postanejo manipulativne, če so čustva, na katera se cilja, še posebej intenzivna (intenzivnost), če se jim pridružijo pristranskosti (kombinacija) ali če je kontekst odločanja zelo zapleten (kompleksnost), kot so razmere, ki vključujejo preobremenjenost z izbiro in zahtevne primerjave v trgovini [9].

4 MANIPULIRANA UMETNA INTELIGENCA

Do sedaj je bilo govora o manipulativnih vplivih umetne inteligence na človeka, obstaja pa tudi obratni vpliv – umetna inteligenca je lahko žrtev manipulacije.

Globoke nevronske mreže (DNN) so v zadnjem času pokazale izjemne rezultate, ki pogosto presegajo rezultate na človeški ravni, zlasti pri nalogah, povezanih z vidno klasifikacijo [10]. Visoka zmogljivost DNN pri razvrščanju vidnih objektov sproža vprašanja o razlikah, ki še vedno obstajajo med

računalniškimi in človeškimi vidoma – v nasprotju z vidnim sistemom so DNN veliko bolj občutljive na minimalne perturbacije.

"Napad z enim pikslom" (ang. One pixel attack) je specializirana vrsta napada na globoke nevronske mreže, katerega cilj je prevarati nevronske mreže, da napačno razvrsti sliko z minimalnimi spremembami, pri čemer se običajno spremeni le en ali nekaj pikslov. Pomemben izziv pri napadih z enim pikslom je najti ravnovesje med tem, da nevronska mreža napačno razvrsti sliko, in tem, da so spremembe na sliki dovolj subtilne, da jih človek ne more odkriti [10].

Taki napadi opozarjajo na dovzetnost DNN za subtilne vhodne manipulacije, kar lahko vpliva na varnost, zanesljivost in etične vidike rabe umetne inteligence. Raziskave na tem področju se ukvarjajo s strategijami za blažitev teh ranljivosti in izboljšanje robustnosti sistemov umetne inteligence.

5 SINTEZA

Če se prizadevanja na področju politike in izobraževanja ne bodo uresničila in če širši cilj gojenja etične umetne inteligence ne bo uspešen, obstaja možnost etične, družbene in gospodarske katastrofe ter z njo povezanimi vplivi na ljudi, nečloveške entitete in okolje. Ta nevarnost ni povezana z oddaljenimi apokaliptičnimi vizijami. Namesto tega izhaja iz postopnega, a določenega stopnjevanja tehnoloških nevarnosti in posledičnega povečanja občutljivosti na človeških, družbenih, gospodarskih in okoljskih področjih. To povečevanje tveganj in ranljivosti izhaja iz etičnih težav, ki zajemajo nepoučeno in nepremišljeno uporabo naprednih tehnologij avtomatizacije, kot je umetna inteligenca. Razlika v izobrazbi verjetno povečuje širše posledice tveganj, povezanih z umetno inteligenco.

Trenutno ne obstaja univerzalno dovoljenje za uporabo umetne inteligence, prav tako ni obveznega izobraževanja o etiki umetne inteligence za tehnične raziskovalce, poslovne strokovnjake, državne upravitelje in druge deležnike, ki sodelujejo pri ustvarjanju, uporabi in urejanju umetne inteligence. Precejšen del neregulirane umetne inteligence je v rokah tistih, ki ne razumejo s tem povezanih tveganj in etičnih dilem ali pa imajo morda napačna pričakovanja glede te tehnologije. Nevarnost se skriva v tem, da ima človek moč brez razumevanja, kar pomeni neodgovorno ravnanje. Takšno ravnanje lahko povzroči neupravičene posledice za druge. Predpostavljane nevtralnosti umetne inteligence in njena uporaba brez razumevanja posledic prispevata k brezbriznosti. Izobraževalna politika lahko prispeva k izboljšanju tega položaja in tako spodbuja etično in smiselno umetno inteligenco [11]. Kljub temu so nekatera vztrajna, morda neprijetna vprašanja v razpravah o etiki in politiki umetne inteligence običajno odrinjena na stranski tir, čeprav si zaslužijo analizo. Ali se etika umetne inteligence ukvarja izključno z dobrotijo in vrednotami ljudi ali bi morala vključevati tudi vrednote, dobrine in interese nečloveških entitet?

Osrednja sporna točka se vrti okoli kršenja zasebnosti. Uporaba umetne inteligence za usmerjanje vedenja pogosto zahteva obsežno zbiranje podatkov, kar sproža razprave o tem,

ali to pomeni kršitev zasebnosti. Pri tem vprašanju strinjajo tako aktivisti kot veliki tehnološki konglomerati, ki priznavajo občutljivo ravnovesje med izkoriščanjem zmogljivosti umetne inteligence in varovanjem pravic posameznikov do zasebnosti. Sestavni del te razprave je področje ciljno usmerjenega oglaševanja. Medtem ko tržniki zagovarjajo njegovo zmožnost povezovanja potrošnikov z zelenimi izdelki, ga vse več ljudi dojema kot manipulativen poseg, ki spodbuja impulzivne vzorce nakupovanja. Ta razhajanja v stališčih poudarjajo raznovrstne napetosti med komercialnimi cilji in avtonomijo potrošnikov. V tem zapletenem okolju sta soglasje in ozaveščenost ključnega pomena. Bistvo je v ugotavljanju, v kolikšni meri uporabniki razumejo in podpirajo vlogo algoritmov umetne inteligence pri oblikovanju njihovih spletnih izkušenj. Nazoren primer je nenamerno manipuliranje s kanali družbenih medijev s strani umetne inteligence, ki pogosto deluje mimo zavedanja uporabnikov. To sproža pomisleke o etičnih mejah vpliva in nujnosti informiranega soglasja. Škandal Cambridge Analytica je izpostavil problematiko glede zmožnosti umetne inteligence, da z izkoriščanjem strahov in predsodkov manipulira z odločitvami volivcev in krha temelje demokracije [11].

V ozadju tega dogajanja je sporno vprašanje čustvene manipulacije. Kakšne so moralne posledice dejstva, da umetna inteligenca izkorišča človeška čustva za komercialne koristi in še več, kdo bo nosil odgovornost? Debata manipulativne umetne inteligence postavlja vprašanja o kršitvah zasebnosti, usmerjenem vplivu, demokratični integriteti in čustveni etiki. Zaskrbljenost in dvom kliče po vzpostavitvi etičnih okvirov in skupnih prizadevanjih za usmerjanje vloge umetne inteligence pri sooblikovanju modernega sveta.

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Users' Cognitive Processes in a User Interface for Predicting Football Match Results

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ABSTRACT

The article discusses the importance of understanding cognitive processes, which are the foundation for effective user interface design. The authors highlight the crucial role of intuitive and user-friendly interfaces in online football match prediction platforms, as it is the design of the interface that can have a significant impact on the success of these types of platforms. The article delves into the thought processes of users who want a visually appealing, accessible and intuitive user interface for predicting football match results. Particular emphasis is given to understanding the psychology and behaviour of users. The paper aims to provide valuable insights that can guide designers and developers in designing more effective, user-centred interfaces for football match prediction websites. By combining scientific principles and practical user interface design strategies, the authors set new standards for user interface design in the football prediction industry.

KEYWORDS

user interface, cognitive process, football match, design, psychology

1 INTRODUCTION

The ever-evolving digital landscape has spurred the transformation of numerous industries, with sports prediction and betting platforms being no exception. More specifically, football predicting websites have emerged as a thriving subset within this sphere, effectively marrying the passion for sports with the advent of data-driven prediction models. Yet, the distinguishing factor amongst the multitude of similar platforms often boils down to one crucial aspect: the user interface (UI). An intuitive, user-friendly interface is paramount for ensuring user engagement, satisfaction, and ultimately, platform success.

This article presents an exploration of some of the cognitive processes underlying the creation of an effective user interface for a football predicting website. It aims to decode the mind process that designers employ when sculpting a user interface that not only visually appeals but also provides an engaging, accessible, and intuitive user experience. By delving into cognitive science principles, UI design best practices, and specific industry needs, the subsequent sections will delineate a novel approach to UI design for football predicting websites, highlighting the

importance of understanding user psychology and behavior in the design process.

Furthermore, this article will underline the reciprocal relationship between UI design and user satisfaction, which can drastically impact user retention and overall platform success. Through the lens of cognitive science and user experience design, we aspire to provide valuable insights that can guide designers and developers in creating more effective, user-centric interfaces for football predicting websites. By marrying scientific principles with practical UI design strategies, we hope to set a new standard for user interface design within the football prediction industry.

While the context is football-oriented, the core concepts can be applied across various industries and areas. Here are a few areas where these cognitive processes might be useful:

- (1) **E-Commerce Platforms:** An understanding of user psychology and behavior can help design interfaces that make it easier for customers to browse, select, and purchase items, thereby enhancing the user experience and potentially increasing sales.
- (2) **Healthcare:** In telemedicine apps or healthcare software, an intuitive interface can facilitate easier communication between patients and providers, ensure critical information is presented clearly, and aid in the monitoring and input of health data.
- (3) **Banking and Finance:** For mobile banking apps or financial platforms, understanding the cognitive process can guide designers to create interfaces that allow users to safely and effectively manage their finances, conduct transactions, or make investments.
- (4) **Education:** Online learning platforms can benefit from intuitive interfaces, allowing students to navigate courses, interact with content, and assess their progress smoothly.

The paper consists of the following sections: section 2 describes the problem domain, section 3 describes related work, and section 4 presents the user interface. The paper ends with a conclusion and suggestions for further work.

2 DESCRIPTION OF THE PROBLEM DOMAIN

The purpose of this section is to present the required functionalities of the designed platform. In addition to describing the thought process, one of the main goals of this paper is to create high quality screen masks of a football match prediction user interface that will allow users to record the correctness of predictions made for a given football match and reward the user for each correct prediction.

A prediction consists of the number of goals scored by the home team and the number of goals scored by the away team. Ensuring that users have the freedom to choose which matches to predict is crucial for their satisfaction. They can predict the

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results for several matches. They should also be able to change their prediction, which again fits in with the concept of a user-friendly interface. The system must finish receiving predictions 5 minutes before the start of the match. This restriction prevents fraud in terms of changing the predictions during the match itself.

Users are awarded points based on their prediction accuracy in a competitive system. They receive 3 points for correctly predicting both the match's outcome and the winner, 2 points for correctly predicting the winner and goal difference, and 1 point for just predicting the winner correctly. Incorrect predictions earn zero points. The scoring system aims to ensure users are rewarded even for partially correct predictions, and that fully correct predictions do not create a significant advantage. To keep users engaged and mitigate large point gaps, the system awards double points for the first 10 predictions a user makes after a break of more than two weeks. This method aims to motivate users to return to making predictions and keeps the prediction system competitive and intriguing over extended periods.

Users have to log in to the system with a username or password. Before logging in, they must register. If they choose a user account with a membership fee when registering, they have to pay a membership fee of EUR 10 once a year. This is to ensure that the system works without any commercial loss and that the amount is not too high, which could discourage users from using the system. Once the users have paid the membership fee, they can immediately start predicting matches. There is also the possibility to make predictions without a membership fee. When registering, users can choose to create a free account with no membership fee. In this case, they do not have all the benefits. Users without a membership fee can only predict a maximum of 5 matches per league and users without a membership fee are not eligible for cash prizes. With the free account, we wanted to attract users who would like to make predictions and don't care about cash prizes or don't want to pay the entry fee. However, we have also made it possible to offer more benefits to users who have opted for the membership fee by means of restrictions, thus in a way rewarding and motivating them to submit their predictions.

To boost user engagement in making predictions, a monthly cash prize is offered to the top 50 users. The prize fund is calculated based on a formula that considers both new and existing memberships. The distribution of the prize pool is tiered to keep the competition interesting and to ensure fairness: the top 5 users share half the prize money, while the rest is divided among users ranked 6th to 50th. This compromise between prize size and user ranking aims to motivate users and keep them engaged, while also ensuring a fair distribution of rewards.

3 RELATED WORK

During major sports events, RTV SLO hosts a free-to-use website named Nostradamus for football and basketball match predictions. Users can make and change their predictions for any match until the match begins, with points awarded for correct predictions. At the end of each competition, the top five users receive practical prizes like balls or jerseys. Figure 1 illustrates the prediction submission process for the 33rd to 36th rounds of the 2018-19 1st Slovenian Football League season. As the depicted matches are past events, the text fields are greyed out and predictions are disabled. Once users have made their prediction, they can save it by clicking the "Save prediction" button. Each tab represents four competition rounds. A "Leaderboard" tab provides an overview

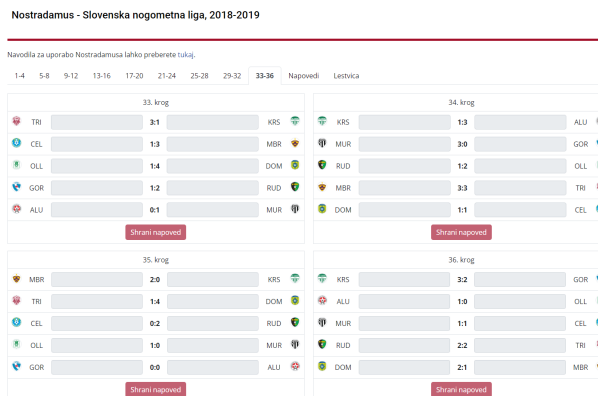


Figure 1: Making predictions on Nostradamus website.

of the user rankings, displaying 100 users per page, with a filter available to search for users by username.

The Nostradamus app has several strengths and weaknesses. On the upside, it's simple to operate and maintains a consistent, unambiguous website design. However, it also has several drawbacks. The application doesn't cater to user preferences, forcing users to choose from all matches rather than tailoring options to their liking. It lacks a 'Favourites' tab for easy league-switching. Furthermore, rewards are only given to the top five users. This design choice leads to user attrition, as many stop using the app after prolonged failure, unable to compete with the top performers.

Furthermore, the app is entirely free, which means it operates at a loss as practical rewards have to be given to the top five users. The use of club abbreviations instead of full names can also confuse new users. There is a lack of real-time information on the countdown towards the closing of predictions. The app only displays four competition rounds in one tab simultaneously, which can be limiting. Finally, due to this display limitation, some users may forget to hit the 'Save Prediction' button after entering their results, leading to potential disappointment and frustration.

In addition to Nostradamus, some research has also been done into making the user interface better. Gonzales [2] conducted a laboratory experiment investigating the impact of images, transitions, and interactivity in animated interfaces on decision making in two different domains. These interfaces incorporated either realistic or abstract images, smooth or abrupt transitions, and parallel or sequential interactivities. The results demonstrated that the task domain, user experience, and the types of images, transitions, and interactivity methods implemented all affect decision performance. Participants were observed to perform better with animations that utilized realistic images, smooth rather than fast transitions, and both parallel and sequential interactivity.

Shneidermann [6] recommends three pillars to support the UI design process: guidance documents, UI management systems and interactive usability testing labs. Five basic interaction styles are presented: menu selection, form filling, command language, natural language and direct manipulation. The author encourages more attention to direct manipulation, where objects and actions are visible, actions are triggered by selection or pointing, and the effect is immediately visible and correctable.

Sharma and Tiwari [4] introduce the concept of user interface and user experience, which play a very important role in today's technical and modern world. According to them, user interface consists of guidelines, workflows, system colours, design process,

etc. User experience consists of the process of how the user can experience the application in the best way.

4 USER INTERFACE

One of the studies indicate that a primary objective of UI is to offer users streamlined and intuitive ways to interact with computer systems, thereby enhancing task efficiency and reducing cognitive workload and stress [5]. The other study highlights that consistency in UI enables users to build an accurate mental model of the way it works. Furthermore, an expert user should interact with the system as easily as a novice user. Both users should be satisfied with the same system [1]. In this paper, we wanted to ensure as much consistency and flexibility as possible.

Before designing the UI, we had to think carefully about what the main colour of the UI would be. The guidelines for a good and user-friendly user interface recommend that we ensure as much consistency as possible, which means that only one colour should be the main part of the website. Research [3] has shown that red works better for tasks that require a lot of detail, while blue is more effective for creative tasks. Another study [8] confirms the results of the previous study and adds that blue also works well for light and heavy tasks.

We chose blue (RGB = (58, 98, 215)) color because it is a good combination that stimulates both creative thinking and attention to detail. Creative thinking is needed when determining the outcome, as a match can have many possible outcomes. In addition, the user also needs to take into account a huge number of details, as the result itself can be affected by injuries to key players, current form, the match venue, etc. The header, footer and frame colour of the website is always blue. This ensures greater consistency.

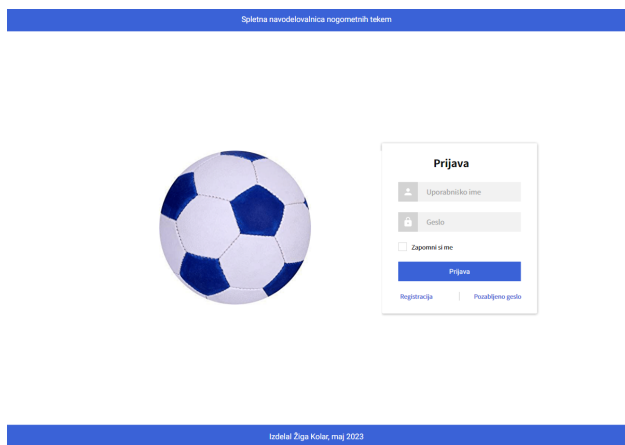


Figure 2: Login page.

As with most other websites, everything always starts with the creation of the login and registration page. The login page is shown in Figure 2 and has all the classic login elements (a text box for username and password, a login button, a link to registration and a link to forgotten password). The page has a ball in the middle in blue. The ball immediately gives user an association with football. Two additional icons next to the username and password also provide the association to the username and password. The buttons, the colour of the pentagons on the ball and the links are in blue, which is the main colour used to maintain consistency.

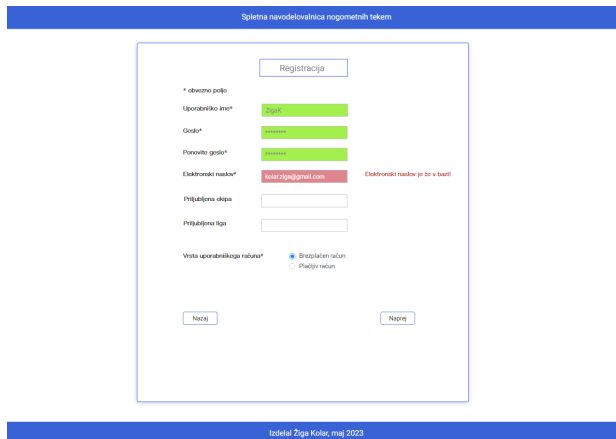


Figure 3: Registration form.

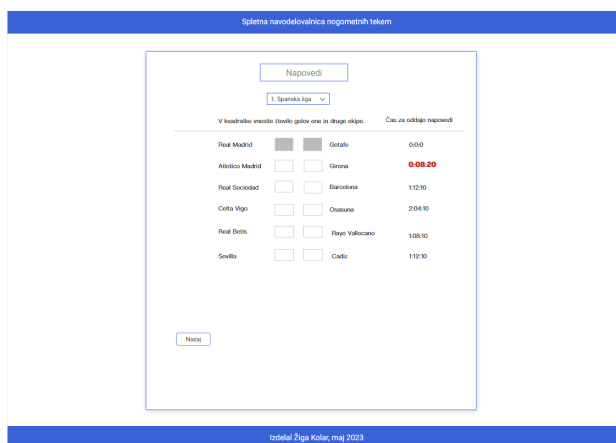


Figure 4: Match results predictions.

The registration form is in the classic form of text fields and is shown in Figure 3. If we had a list of all the mandatory fields at the top of the form, we would run into a problem as people sometimes do not read the instructions at the top of the form or forget them. It is therefore easier and more efficient to mark all mandatory fields with an asterisk. The two buttons for selecting the type of user account were chosen because they are simple and intuitive, offering the user a quick choice due to their mutually exclusive nature. A back button has also been added, as we need to give the user the option to return to the previous page in each step. Without this, the user would be confused.

When a field is completed, the system checks that it is correct. If the field is correct, it is highlighted in green, if it is incorrect, it is highlighted in red and an error message is displayed next to it. The green colour was chosen to make an analogy with a traffic light. If the light turns green, we can proceed. If the light is red, we have to stop. The same applies to all fields in the registration. An example is shown in Figure 3. The username and password are correct, so the fields will turn green. The email address is incorrectly entered, so the field will turn red and a message will appear next to it.

Upon completing registration, users are notified of their successful registration with a blue tick icon, representing the process's completion. To confirm and finalize the registration, the

users are sent an email containing a link. This link must be confirmed within a 24-hour window to ensure the user is not a bot, hence safeguarding the system.

To enter a prediction, the users first select which league to predict via a drop-down list. The drop-down list is an effective option for when there is not enough space to display all the tabs. Since there are too many possible leagues to display with tabs, we have opted for a drop-down list. The latter also has a special "Favourites" option, where the users can save all the match predictions from the leagues they are interested in. Only the matches from the leagues that the users have selected will be shown to the user. The advantage of this option is that it saves the users time in selecting the match predictions from the leagues they regularly predicts. Additionally, there is also a "Personalised" option where the user is shown matches based on his personal preferences. The system learns which matches and from which leagues the users like to predict and recommends them to the users. The personalisation is implemented using an artificial intelligence algorithm (recommendation system). This approach aims to allow the users to have all the matches they interested in in one place and to be able to make predictions as quickly as possible.

After selecting one of the options in the drop-down list, the matches of the current round are displayed. For the home and away team goal predictions, we have chosen a text box because this is a common practice in football match predictions. One possibility would be to have the user click on the + or - buttons instead of the text box to determine the number of goals, but this approach would be more time-consuming as it would require a larger number of clicks. Unlike Nostradamus [7], here the prediction is saved automatically after the users have filled in both text fields. This is to avoid a situation where the users enter the predictions but forgets to click on the "Save Prediction" button and is left with no points. We have decided to use full club names instead of abbreviations, as some users do not know all the abbreviations. Also, for each match, the user has a counter on the right until the start of the match or until the end of the prediction. This gives the users full control over how much time is left. In the last 10 minutes before the time expires, the text where the time is written will turn red and become whiter. This is to encourage the user to make a prediction. When the time for the prediction expires, the text fields turn grey and the prediction is disabled. The grey colour gives the user a feeling of closure and inaccessibility. An example is shown in Figure 4.

In addition to submitting a prediction, the users have the possibility to view the points scale. The scale is presented in tabular form because it is one of the most transparent and efficient options to quickly display the situation. Paid users are shown with a blue frame and ordinary users with a grey frame. We wanted to somehow reward paying users for their contribution with a blue colour, as this is the main colour of the page. 10 users are shown at a time, in descending order of points. The leaderboard allows filtering by username. In this way, the users can quickly find themselves and get an insight into the number of points without having to search through the whole list. An example of filtering is presented in Figure 5. Filtering by user type (paid, regular or all users) is also available. Filtering works on the basis of a button that allows fast and efficient filtering between users.



Figure 5: Leaderboard of all users.

5 CONCLUSION AND FUTURE WORK

This work is part of the thought process behind the development of a user interface for predicting football match results. We have highlighted the importance of understanding user needs and psychology in the design of such systems. We have identified the need for the user interface to be intuitive, efficient and flexible and have tried to present it in this way.

In the future we intend to focus on the development of the system and its use in practice. We will try to implement the user interface in Django (python) and in the web technologies HTML, CSS, Javascript and jQuery. We will use the MySQL Lite database. After the implementation is complete, we will hand the system over to a test group (up to 20 people). If the users are satisfied, we will try to recruit more people and will regularly update and maintain the system.

Taken together, our results in this paper are a step towards a better understanding of how designers and developers can improve football match result prediction tools, which could have important implications for improving the user experience.

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Družbena regulacija umetne inteligence. Nekatera odprta vprašanja in izzivi.

Social regulation of artificial intelligence. Some open questions and challenges.

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POVZETEK

S tem, ko se umetna inteligenca (UI) spreminja v sistemsko tehnologijo, ki ni več predmet ozkih laboratorijskih raziskav, temveč z različnimi vrstami aplikacij postaja integralni del družbe, se je v številnih ozirih znašla na prelomni točki. Nenazadnje predstavlja eno tistih naprednih tehnologij, ki glede hitrosti razvoja in širjenja v družbi nima primera v zgodovini. V prispevku se bomo ukvarjali z nekaterimi vprašanji družbene regulacije UI, s poudarkom na najnovejše kompleksne jezikovne modele. Izhajali bomo iz teze, da se v primeru vrednotenja prihodnjega razvoja UI in s tem povezanih tveganj Evropa, katere del smo tudi mi, ne bi smel v celoti podrediti svariteljskim načelom. Potrebno je najti ustrezno ravnovesje med svariteljskimi načeli in proakcijskimi načeli

KLJUČNE BESEDE

umetna inteligenca, chat GPT, družbena regulacija, tveganje, bioinformacije

ABSTRACT

As artificial intelligence (AI) evolves into a systemic technology no longer confined to narrow laboratory research but rather integrated into society through various applications, it finds itself in many aspects at a cross point. Last but not least AI represents one of those most progressed modern technologies that, in terms of the speed of development and dissemination in society, has no precedent in previous history of technological development. In this contribution, we will address some of the issues of social regulation of AI, with a focus on the latest complex language models. In our discussion, we will start from the premise that in the case of risk assessment and risk regulation of the future development of AI, Europe, of which we are also a part, should not be strictly submitted to precautionary principles. It is

necessary to find the appropriate balance between precautionary and proactionary principles.

KEYWORDS

artificial intelligence, Chat GPT, social regulations, risks, bioinformatics

1 DRUŽBENA REGULACIJA UMETNE INTELIIGENCE. NEKATERA ODPRTA VPRAŠANJA IN IZZIVI

S tem, ko se umetna inteligenca (UI) spreminja v sistemsko tehnologijo, ki ni več predmet ozkih laboratorijskih raziskav, temveč z različnimi vrstami aplikacij postaja integralni del družbe, se je v številnih ozirih znašla na prelomni točki. Nenazadnje predstavlja eno tistih naprednih tehnologij, ki glede hitrosti razvoja in širjenja v družbi nima primera v zgodovini. Pomislimo zgolj na družbeno difuzijo ChatGPT, zadnjega hita generativne UI, ki je samo nekaj mesecev za tem, ko je bila lansirana v družbeni prostor, dosegla več stotilijonsko uporabo. V zadnjem tričetrtletju se uporaba Chat GpT razširila do neslutnih meja.

Glede na izredne revolucionarne preskoke, ki jih v zadnjem času dela UI in glede na njen izredni aplikativni potencial, ki obeta, da bo dodobra spremenil življenja ljudi, se bomo v prispevku ukvarjali z nekaterimi vprašanji družbene regulacije UI, s poudarkom na njen najnovejše kompleksne jezikovne modele (npr.: chat GPT). Kot bomo skušali v prispevku še posebej opozoriti, se največji potencial UI kaže skozi procese konvergiranja UI z drugimi naprednimi tehnologijami. Koncept konvergentnega tehnološkega razvoja je danes izredno aktualen. Prizadevanja za združitev tehnologije kvantnega računalništva z UI bo odprlo prostor kompleksnim analizam velikih podatkovnih baz. Dvig računalniških kapacitet predstavlja ključni steber nadaljnje napredka UI. Tu lahko pričakujemo v prihodnosti številne revolucionarne premike. Zdi se, da bomo podobne revolucionarne preskoke srečevali tudi v primeru nadaljnje povezovanja UI in najnovejših tehnologij genskega inženiringa. Vzajemni razvoj obeh transformativnih tehnologij ima izredno velik aplikativni potencial. Na primer, na vseh področjih t.i. »omike« (genomike, proteomike, epigenomike, itd.) se na temelju UI, ki temelji na modelih globokih nevronske mreže [1],

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[2] [3], odpira prostor »tarčno« usmerjenem zdravljenju ljudi oziroma - kot to področje biomedicine danes označujejo strokovnjaki – t.i. personalizirani medicini [4].

V luči tega napredka in aplikacije tehnologije UI je izredno aktualno vprašanje njene regulacije na globalni ravni. Pri tem se srečujemo s številnimi dilemami in vprašanji. To je na nek način tudi razumljivo. Ustrezni regulativni mehanizmi, ki bi – kot primer – preprečili morebitna tveganja in etično sporna dejanja pri nadaljnjem razvoju UI, se namreč ne morejo pojaviti kar čez noč. To se ni zgodilo tudi nikoli prej v zgodovini znanstveno-tehnološkega razvoja. V tem smislu bi trenutno situacijo v iskanju ustreznih regulativnih mehanizmov na področju UI lahko v najboljšem slučaju primerjali s pojavom nekega drugega revolucionarnega tehnološkega artefakta, t.j. avtomobila, za katerega, potem ko se je prvokrat znašel na ulicah mest, še ni bilo oblikovanih vseh prometnih in varnostno-tehničnih predpisov, tako kot jih poznamo danes. Vse to je prišlo kasneje. Zato smo, kot pravijo Haroon Sheikh in ostali [5], trenutno v fazi, ko se še vedno lahko pojavi veliko napak. Ker so v primeru napak družbena tveganja, ko gre za tehnologijo UI, izredno velika, je toliko bolj pomembno, da pridemo čim prej do čim bolj premišljenih in celovitih družbenih mehanizmov regulacije UI. V prispevku bomo izhajali iz teze, da v primeru vrednotenja prihodnjega razvoja UI in s tem povezanih tveganj se današnji svet, še zlasti pa Evropa, katere del smo tudi mi, ne bi smel v celoti podrediti t.i. svariteljskim načelom (t.i. precautionary principles). Tu je treba najti neko ustrezno ravnovesje med svariteljskimi načeli in proakcijskimi (t.i. proactionary principles). V zvezi s tem vprašanjem bomo smiselno vključili spoznanja nekaterih vodilnih transhumanističnih mislecev današnjega časa, ki se ne ukvarjajo z imaginariji prihodnosti, ki so že na meji znanstvene fantastike in daleč od realnih problemov, temveč z aktualnimi in zelo realnimi vprašanji anticipativnega načrtovanja znanstvene in tehnološke prihodnosti [6] [7]. V prispevku bomo namreč skušali opozoriti, nenazadnje tudi v duhu ravno predhodno omenjenega transhumanizma, da so današnji znanstveni in filozofski premisleki kar preveč okupirani s prikazovanjem distopičnih scenarijev prihodnjega razvoja UI. Pri čemer ta delitev sploh ne poteka na temelju neke stroge delitve med humanistično-družboslovno (apriorna skepsa in strah pred novimi tehnologijami) in naravoslovno-tehnično (nekritično sprejemanje novih tehnoloških rešitev) mislijo. Meje med obema znanstvenima poloma so zlasti v primeru UI precej bolj zabrisane. Skozi predstavitev stališč humanističnih (npr. Yuval Noah Harari, Amitalom Etzioni, Noam Chomsky) in informacijsko-komunikacijskih znanstvenikov (Geoffrey Hinton, Yuhuai Wu, Kristian Kersten, etc.) – te zadnje imamo lahko za »botre« UI, ki temelji na modelih globokih nevronske mreže - bomo skušali pokazati na vso kontradiktornost in neenotnost današnjih ekspertnih stališč o UI. V prispevku bomo izhajali iz predpostavke, da so najmanj konstruktivni kataklizmični prikazi prihodnjega razvoja UI. Četudi ne bomo v celoti zavrnili pogledov tistih avtorjev, ki pravijo, da vstopamo v novo fazo razvoja, ko že imamo opravka s teoretsko razmišljujočimi stroji, ki dosegajo oziroma bodo kmalu dosegli človekovo zavestno raven spoznavanja [8], bo za nas konstruktivni pogled o teh vprašanih predstavlja razprava o aktualnih (realnih) družbenih tveganjih UI. In če že govorimo o tem, kako priti do najboljših možnih mehanizmov regulacije te nove napredne tehnologije, potem je pač potrebno sprejeti dejstvo, da prej ko bo vzpostavilo

pravila sodelovanja z UI, prej se bomo naučili živeti v harmoniji s to novo napredno tehnologijo. Tu je pomembno izpostaviti, o čemer v zadnjem času na široko govorijo ravno računalniški eksperti, ki so dali največji zagon razvoju generativne UI [9], namreč, da bo UI največ prispevala k družbenemu blagostanju in kreplitvi človekovih sposobnosti, če bo ostala osredotočena na človeka. To pomeni, da mora biti prioriteta dana opolnomočenju uporabnikov UI, ne pa njihovem nadomeščanju z UI.

V osrednjem delu naše razprave nas bo zanimalo vprašanje, kako se usklajujejo interesi med posameznimi družbenimi akterji, med ključnimi globalnimi akterji, med lokalnimi in globalnimi akterji itd., pri graditvi skupnega družbenega modela upravljanja UI. Zavedati se moramo, da je ta konflikt interesov med različnimi družbenimi, političnimi in ekonomski subjekti na tej stopnji razvoja UI izredno močan. Čeprav se navzven zdi včasih ravno obratno. Zelo ilustrativen je naslednji primer: četudi je Sam Altman, izvršni direktor tehnološkega podjetja Open AI ameriškim kongresnikom še maja letos zagotavljal, da je osnovni pogoj za uspešen in skladen razvoj UI najbolj pomembna vzpostavitev ustreznih mehanizmov družbene regulacije UI, je hkrati dobro znano, kako močno je podjetje Open AI nastopilo zoper zahtevo Evropske komisije (celo z grožnjo izstopa iz trga EU), da se zadeve na tem področju zakonsko uredijo. Open AI je, tako kot večina ostalih tehnoloških velikanov, ki razvijajo najnovejše sisteme UI, v najboljšem primeru pripravljen sprejeti zelo nezavezujoča priporočila mednarodnih teles, ne pa se podrejata bolj restriktivnim zakonskim pravilom. V prispevku bomo predstavili razloge, zakaj je izmed treh ključnih globalnih akterjev, ki razvijajo UI, t.j. ZDA, Kitajska in Evropska Unija, na področju izgradnje mehanizmov družbene regulacije UI, predvsem z vidika njenega družbenega nadzora in preprečevanja možnih tveganj, še največ storila ravno Evropska Unija. Kritično bomo ovrednotili elemente zakona o UI (prepoved UI za prepoznavanje čustev, prepoved uporabe biometrije v realnem času na javnih mestih, prepoved uvajanja socialnega točkovanja, omejitve glede uporabe generativne UI, itd.), ki naj bi bil v okviru EU sprejet v bližnji prihodnosti (potem ko ga je že potrdil Evropski parlament letos junija). Tudi Kitajska vzpostavlja svojo zakonodajo o UI, kar pa je v širši javnosti morda manj znano. Še najmanj je bilo storjenega v ZDA, četudi je tam sedež številnih vodilnih podjetij s področja UI [10]. Glede na situacijo bi v globalnih okvirjih ravno EU lahko nastopila v vlogi ključnega iniciatorja sprememb, že zato ker je prva začela posvečati pozornost temu vprašanju. [11] V okviru naše predstavitve odprtih vprašanj družbene regulacije UI se bomo še posebej zaustavili ob problemu velikih podatkovnih baz, ki so temelj nadaljnjemu razvoju generativne UI. Izhajamo namreč iz ocene, da četudi GDPR, ki je bil sprejet leta 2018 v članicah EU, predstavlja dober okvir za regulacijo velikih podatkovnih baz, ki so potrebne za razvoj AI, je njegova šibkost vendarle najbolj očitna na področju velikih biogenetskih podatkovnih baz. Torej na tistem področju, kjer kot smo že dejali, obstajajo zaradi spoja tehnologij biogenetike in UI možnosti za najbolj revolucionarne znanstvene preskoke. Skozi našo celotno razpravo bomo namreč izhajali iz predpostavke, da kolikor današnji razvoj UI merimo po kriterijih kot so kvaliteta temeljnega raziskovanja na področju računalniških algoritmov, razpoložljivost velikih podatkovnih baz, zahtevan razvoj »hardwarak«, uspešna komercializacija te tehnologije in aktivna podpora politike, potem velike

podatkovno baze, še zlasti, če predstavljajo spoj biogenetike in informatike, igrajo daleč najpomembnejšo vlogo.

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Umetna inteligenca: orodje ali zavesten stroj

Artificial Intelligence: A Tool or Conscious Machine

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POVZETEK

Umetna inteligenca (UI) je s pojavom ChatGPT prerasla samo strokovne diskusije. V širši javnosti se je sprožilo zanimanje in spraševanje o tem, kaj UI sploh je. UI je postala tema, ki buri duhove in vzbuja tako veliko navdušenje kot tudi pomisleke. V prispevku bom predstavila dva pogleda na UI. Prvi nanjo gleda kot na še enega v nizu orodij, ki so jih ljudje izoblikovali skozi zgodovino. Kot pametno orodje UI ljudem pomaga pri opravljanju različnih nalog, a hkrati njena uporaba odpira tudi vrsto epistemoloških, etičnih in družbenih vprašanj. Drugi pogled pa v UI vidi gradnjo mislečih in zavestnih strojev. Menim, da se precej strahu povezuje prav z bojznijo, da bodo sistemi UI postali avtonomni in zavestni ter bodo zavladali nad ljudmi.

KLJUČNE BESEDE

umetna inteligenca, Chat GPT, pametna orodja, zavest, računski funkcionalizem, etika

ABSTRACT

With the advent of ChatGPT, artificial intelligence (AI) has outgrown only professional discussions. Interest and questioning of what AI is has sparked among the general public. AI has become a topic of both great enthusiasm and concern. In the article, I will present two views on AI. The first sees it as another in a set of tools people have shaped throughout history. As a smart tool, AI helps people to perform a variety of tasks, but at the same time, its use also raises a range of epistemological, ethical, and social issues. The second view sees AI as building thinking and conscious machines. I believe that a great deal of fear is associated with the possibility of autonomous and conscious AI systems that will start to dominate people.

KEYWORDS

artificial intelligence, Chat GPT, smart tools, consciousness, computational functionalism, ethics

*Article Title Footnote needs to be captured as Title Note

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1 UVOD

S pojavom klepetalnega robota ChatGPT in programov za ustvarjanje slik (npr. Midjourney) in videov (npr. Runway) je umetna inteligenca prerasla samo strokovne diskusije in postala tema, ki buri duhove in vzbuja tako veliko navdušenje kot tudi pomisleke. ChatGPT je zaradi dostopnosti in enostavnosti uporabe, ki vsaj na prvi pogled ne zahteva posebnega znanja, v širši javnosti sprožil tudi večje zanimanje in spraševanje o tem, kaj umetna inteligenca (UI) sploh je.

Sam izraz »umetna inteligenca« je nastal v času (1956) [1], ko je znanstvenike dejansko zanimalo, kako bi naredili stroj, ki bi lahko podvajal človeško mišljenje (prvi val UI). Raziskovanja so bila v domeni znanstvenikov, v javnost pa je tema UI prišla predvsem preko znanstvene fantastike (npr. Kubrickov film iz leta 1968 - 2001: Odiseja v vesolju). Dandanes pa je UI (drugi val) prisotna v našem vsakdanjem življenju, ne da bi se tega sploh zavedali, npr. ko odpremo telefon s pomočjo prepoznave prstnega odtisa ali obraza, poiščemo najhitrejšo pot do izbranega cilja, prevedemo sporočilo iz tujega jezika, ali kupimo izdelek v priljubljeni spletni trgovini, kjer nam potem program sam ponudi še vrsto drugih izbir, ki bi nas morda lahko zanimale. UI se uporablja kot pomoč pri odločanju v bančništvu, pravu, medicini, športu, znanosti, industriji, pa tudi vojski. V prispevku bom predstavila dva pogleda na UI. Prvi nanjo gleda kot na še enega v nizu orodij, ki so jih ljudje izoblikovali skozi zgodovino. Kot pametno orodje UI ljudem pomaga pri opravljanju različnih nalog, a hkrati njena uporaba odpira tudi vrsto epistemoloških, etičnih in družbenih vprašanj, ki so zdaj predmet razprav tako med znanstveniki kot tudi v širši javnosti. Drugi pogled pa v UI vidi gradnjo mislečih in zavestnih strojev. Ta pogled je bil prisoten predvsem v začetkih UI, se pa, kot bom nakazala v zadnjem delu, z idejo splošne UI, zopet vrača. Menim, da se precej strahu pred sistemi UI povezuje prav z bojznijo, da bodo sistemi UI postali avtonomni in zavestni ter bodo zaradi večje učinkovitosti pri reševanju nalog zavladali nad ljudmi.

2 UI KOT PAMETNO ORODJE

Ko torej danes uporabljamo izraz UI, se večinoma nanašamo na tako imenovana pametna orodja, ki nam pomagajo na bolj učinkovit način rešiti določene miselne naloge. Filozof in kognitivni znanstvenik Andy Clark je provokativno zapisal: »Inteligenco uporabljamo za strukturiranje okolja, tako da lahko uspemo z *manj* inteligence. Naši možgani delajo svet pameten, tako da bomo lahko v miru neumni.« In nadaljeval; »Ali, če pogledamo z druge strani, možgani *in* deli zunanega ogrodja na

koncu sestavljajo pameten, racionalen sklepalni stroj, ki ga imenujemo um.« [2].

Skozi zgodovino so ljudje oblikovali različna orodja, ki so imela velik vpliv na družbo in katerih uporaba je pripeljala do velikih družbenih sprememb (npr. parni stroj in industrijska revolucija). Večina orodij v preteklosti je ljudem pomagala pri fizičnih aktivnostih. Z njihovo pomočjo je človek lahko opravljal naloge, ki jih sicer zaradi narave svojega telesa ne bi mogel opravljati tako uspešno, na primer, sekira, plug, žerjav, kolo, vlak, letalo, parni stroj, telefon, mikroskop, teleskop, če jih naštejemo le nekaj iz dolge zgodovine. Je pa že v preteklosti človek izoblikoval tudi orodja, ki so pomagala pri miselnih nalogah. Eno takih je bila pisava, ki je ljudem omogočila, da se miselne vsebine ne prenašajo zgolj z govorom neposredno s človeka na človeka, ampak zapisane ostanejo dostopne širši množici ljudi v daljšem časovnem obdobju. S pisavo, natančneje načini zapisovanja, so potem povezana nova orodja, npr. papirus, tisk, digitalni zapis v elektronskih računalnikih. Prav tako so ljudje uporabljali zunanja pomagala za pomoč pri računanju (npr. abakus) in zapisovanju števil (npr. rovaš). Z iznajdbo elektronskega računalnika je človek dobil izredno močno orodje, ki ga lahko uporabljata za pomoč pri odločanju, raziskovanju, zbiranju in dostopanju do informacij, v komunikaciji in umetniškem ustvarjanju. Računalničarji, ki načrtujejo sisteme drugega vala UI, ki temeljijo na učenju, posploševanju in prepoznavanju vzorcev, se naslanjajo na teorijo verjetnosti in statistiko. Gre za sisteme tako imenovane »šibke UI«, ki se uporabljajo za določene naloge, ne pa za »močno UI«, ki temelji na ideji, da bi lahko naredili računalniški model misli. Vendar je, kot bomo videli v naslednjem poglavju, tudi v drugem valu prisotna ideja močne UI, ki jo označujejo z izrazom »splošna UI«.

Orodja UI so lahko v veliko pomoč pri hitrejšem in bolj učinkovitem opravljanju nalog v znanosti in industriji (npr. orodje Orange, ki so ga razvili na FRI UL), generativna UI in veliki jezikovni modeli (LLM) pomagajo pri analiziranju, oblikovanju in prevajanju besedil. Tak pristop je primeren in uspešen za napovedovanja v negotovem okolju, a hkrati se je treba zavedati tudi omejitev, pasti in potencialnih nevarnosti, ki jih tak pristop prinaša. Načrtovalci modelov se pogosto ne zavedajo dovolj, da tako učni primeri kot zastavitve ciljev odražajo družbene vrednote in so vpeti v družbeni kontekst. [3, 4] Ed Finn [5] je poudaril, da se je naš odnos do računalnikov spremenil proti koncu prvega desetletja 21. stoletja, ko smo v žepih kot zveste spremljevalce začeli nositi pametne telefone in namesto o strojni opremi začeli govoriti o aplikacijah in uslugah. Telefoni niso bili več samo pripomočki, ki jih občasno uporabljamo, ampak smo jim začeli zaupati pri izbiri poti, prijateljev in vsebin, vrednih ogleda. Z vsakim klikom in sprejemom pogojev uporabe aplikacije smo sprejeli idejo, da veliki podatki, senzorji in različne oblike strojnega učenja lahko modelirajo in uravnavajo vse vrste kompleksnih sistemov, od izbire pesmi do napovedi kriminala.

Uporaba sistemov UI kot pametnih orodij odpira mnoga epistemološka, etična in družbena vprašanja, na katera že nekaj let opozarjajo družboslovci in humanisti [6, 7], kot tudi sami računalničarji [8, 9]. Naj navedem nekatera od bolj izpostavljenih: pristranosti, netransparentnosti, nerazločljivosti, manipulacije (npr. Cambridge analytica) in potencialno nevarne uporabe kot so prepoznavanja obrazov ali avtonomno orožje. Na nepravilnosti in manipulacije opozarjajo žvižgači teh velikih korporacij [10, 11]. Da razvoj in uporaba pametnih orodij lahko potencialno vodi do za demokracijo nezaželenih posledic, so

spoznali tudi politični odločevalci, zato so vsaj na ravni Evropske unije že sprejeli določene ukrepe (npr. GDPR), veliko je govora o človeku prijazni, etični in zaupanja vredni UI [12, 13, 14]. Eden od močnih razlogov za zaskrbljenost demokratične javnosti je prav gotovo v tem, da so ti sistemi, predvsem množica podatkov, v lasti velikih korporacij (Google, Meta, Amazon, Microsoft) ali države (Kitajska), ki ne upoštevajo zasebnosti in izvajajo nadzor nad posamezniki. [6] Nedvomno so pred nami veliki izzivi, tako na področju izobraževanja in ozaveščanja, kot tudi na področju družbene regulacije. [3, 4]

3 UI KOT ZAVESTEN STROJ

V drugem delu prispevku se vračam k starejšim filozofskim diskusijam, ki so se pojavile že v samih začetkih UI. Povezujejo se s temeljnimi problemi v filozofiji duha, širša javnost pa jih spremlja predvsem ob znanstveno fantastičnih knjigah in filmih.

Zamisel o miselnih procesih kot neke vrste računskih procesih se je pojavila že mnogo pred iznajdbo elektronskih računalnikov. Pomembno mesto v »predzgodovini« UI se pripisuje filozofu Thomasu Hobbsu, ki je zagovarjal tezo, da je mišljenje računanje. Gottfried Wilhelm Leibniz je predlagal izoblikovanje natančnega in nedvoumnega univerzalnega jezika (*characteristica universalis*), v katerega bi bilo mogoče prevesti vse ideje in v katerem bi mišljenje potekalo kot računanje. George Boole pa je logične odnose med proposicijami izrazil s pomočjo matematične strukture (Boolova algebra) in trdil, da lahko iz njih gradimo vzorce mišljenja in odkrijemo »zakone mišljenja«. Posebno mesto pa gre Alanu Turingu, ki je opisal preprosto imaginarno napravo (Turingov stroj), s katero lahko izvedemo vsako nalogo, za katero lahko jasno navedemo korake, ki so potrebni za izpolnitev naloge [15]

A šele z iznajdbo računalnika se je odprla možnost, da se s pomočjo teorije, ki na mišljenje gleda kot na računanje (računska reprezentacijska teorija) [16], vsaj v principu pokaže, kako je mogoča fizična realizacija mišljenja. Pristop združuje računski funkcionalizem z reprezentacijsko teorijo duha in predstavlja pristop »od zgoraj navzdol«. Na kratko bi idejo lahko povzeli takole: »Tako kot lahko računalnik, ki je zgolj fizični sistem, s pomočjo programa, ki je implementiran v strojnem jeziku, realizira operacije s simboli, imajo tudi možgani svojo nevrnalno kodo, v kateri je realizirano mišljenje. Če bi uspeli dejansko narediti tak model uma, bi imeli močno UI.« [17]

Najbolj znana filozofska kritika močne UI sta bila John Searle [18] in Hubert Dreyfus [19], ki sta predstavila argumente, ki so spodbijali možnost UI utemeljene na računski reprezentacijski teoriji, po kateri je mišljenje manipuliranje s simboli. Poleg teh filozofskih kritik pa se je izkazalo, da je pristop naletel tudi na praktične težave. UI je zato zašla v »zimo« in zdelo se je, da močna UI in zavestni stroj burita domišljijo le še v znanstveni fantastiki. Slednja pravzaprav filozofske miselne eksperimente in razmišljanja ter poigravanja z različnimi možnimi rešitvami predstavi v obliki napetih zgodb [20]. Tako se v filmih *UI* in *Jaz, robot* postavi vprašanje, ali imajo roboti zavest. Ali je David, deček android iz Splibergovega filma *UI*, zavesten in kaj to pomeni za naše ravnanje in etično držo.

Z razvojem sistemov velikih jezikovnih modelov in klepetalnih robotov kot sta Chat GPT in LaMDA, so se tudi izven znanstvene fantastike spet postavila vprašanja o morebitni zavesti sistemov UI. Znan je primer Googlevega inženirja Blaka Lemoina iz leta 2021, ki je trdil, da ima LaMDA zavest.

Sistemi so dejansko tako prepričljivi, da nas s svojim obnašanjem lahko zavedejo. A zgolj njihovo vedenje se še ne zdi dovolj, da bi jim lahko pripisali zavest. Turing je sicer v predlogu testa, s katerim bi ugotovili, ali stroj misli, predlagal prav vedenjski test [21]. V njem se sprašuje, ali bi spraševalec lahko prepoznal, da v pogovoru sodeluje računalnik, ki želi spraševalca preslepiti, da je človek. Če bi računalniku uspelo, potem po Turingu ne bi imeli razlogov, da bi zanikali, da stroj res lahko misli. A ob poznavanju delovanja sistemov generativne UI, ki zgolj, sicer zelo uspešno, napoveduje naslednje besede, bi podobno, kot je že prej trdil Searle [18], takemu sistemu le težko pripisali mišljenje, saj sistem sam nima razumevanja. Še težje je vprašanje glede zavesti. Tega se je zavedal tudi Turing, ki je predlagal, da naj znanost napreduje po manjših korakih: »Ne želim dati vtisa, da mislim, da ni nobene skrivnosti glede zavesti. Nekaj paradoksalnega je na primer v vsakem poskusu, da bi jo lokalizirali. Toda ne mislim, da je takšne skrivnosti treba nujno rešiti, še preden lahko odgovorimo na vprašanje, s katerim se ukvarjamo v tem članku.« [21].

A vendar, kako bi lahko ugotovili, ali imajo sistemi UI zavest? Vprašanje je seveda odvisno od tega, kako zavest opredelimo. Turing je prav zato, da bi se izognil opredelitvi mišljenja, predlagal operativni test. Vendar se zdi, da kakršenkoli odgovor predpostavlja vsaj neke trditve, ki jih sprejemamo in ki se nam zdijo filozofsko sprejemljive. V nadaljevanju se bomo oprli a Blockovo razdelitev zavesti, ki zavest opredeli kot fenomenalno (*phenomenal*) zavest in dostopno (*access*) zavest [22].

Če se nam zdi, da je razmišljanje o zavestni UI (virtualni agenti ali roboti z UI) smiselno, potem sprejemamo hipotezo računskega funkcionalizma. To ne pomeni, da moramo sprejeti računsko reprezentacijsko teorijo, ki je bila temelj klasične kognitivne znanosti in simbolnih modelov prvega vala UI, saj je ta hipoteza bolj splošna in je združljiva tako s simbolnimi modeli, kot s konekcionizmom/nevroskimi mrežami in dinamičnimi sistemi. Sprejemamo pa, da gre za računske procese, ki jih lahko implementiramo v različnih materialnih podlagah, ki take procese omogočajo (kot npr. nakaže naslov risoromana *Ogljik in Silicij* Mathieua Bableta).

Skupina 19 znanstvenikov z različnih področij je pred kratkim objavila članek »Zavest v umetni inteligenci: Vpogledi iz znanosti o zavesti« [23]. V njem predlaga empirično podprt pristop k zavesti UI, pri čemer natančno analizira sodobne sisteme UI v luči najboljše podprtih nevroznanstvenih teorij zavesti (glej Tabelo 1). V teh teorijah nato iščejo indikatorje lastnosti, ki za eno ali več teorij pomenijo nujne pogoje za zavest, ali pa predstavljajo podmnožico zadostnih pogojev. Trdijo, da so sistemi UI, ki imajo več indikatorje lastnosti, bolj verjetno zavestni. V tabeli 1 so predstavljene teorije zavesti s pripadajočimi indikatorji lastnosti.

Njihov pristop iskanja temelji na treh hipotezah:

1. Računski funkcionalizem
2. Znanstvene teorije
3. Teoretsko – težak pristop

Prva hipoteza omogoča, da so zavestni lahko tudi ne-organski sistemi. Druga se opira na znanstveno raziskovanje zavesti, podprto z nevroznanstvenim raziskovanjem, tretja pa kot obetajočo metodo za ugotavljanje, ali je nek sistem zavesten, predlaga preverjanje, ali so zadovoljeni funkcionalni ali arhitekturni pogoji, izpeljani iz znanstvenih teorij, v nasprotju z iskanjem zgolj teoretsko nevtralnih vedenjskih znakov.

Recurrent processing theory
RPT-1: Input modules using algorithmic recurrence
RPT-2: Input modules generating organised, integrated perceptual representations
Global workspace theory
GWT-1: Multiple specialised systems capable of operating in parallel (modules)
GWT-2: Limited capacity workspace, entailing a bottleneck in information flow and a selective attention mechanism
GWT-3: Global broadcast: availability of information in the workspace to all modules
GWT-4: State-dependent attention, giving rise to the capacity to use the workspace to query modules in succession to perform complex tasks
Computational higher-order theories
HOT-1: Generative, top-down or noisy perception modules
HOT-2: Metacognitive monitoring distinguishing reliable perceptual representations from noise
HOT-3: Agency guided by a general belief-formation and action selection system, and a strong disposition to update beliefs in accordance with the outputs of metacognitive monitoring
HOT-4: Sparse and smooth coding generating a "quality space"
Attention schema theory
AST-1: A predictive model representing and enabling control over the current state of attention
Predictive processing
PP-1: Input modules using predictive coding
Agency and embodiment
AE-1: Agency: Learning from feedback and selecting outputs so as to pursue goals, especially where this involves flexible responsiveness to competing goals
AE-2: Embodiment: Modeling output-input contingencies, including some systematic effects, and using this model in perception or control

Tabela 1: Indikatorji lastnosti [23]

V analizi možnih kandidatov za zavestno UI na podlagi gornjih indikatorjev so avtorji ugotovili, da čeprav so posamezni indikatorji v sistemih UI prisotni, jih ni dovolj, da bi jim lahko pripisali zavest. Vrednost svojega prispevka vidijo predvsem v tem, da so podali jasen okvir za empirično in znanstveno preučevanje možnosti za zavestno UI.

Prispevek, ki podaja znanstven okvir za preučevanje zavesti v UI, pa seveda ni edini pristop. Mnogi filozofi in znanstveniki so kritični predvsem do hipotez, na katerih temelji predlagani pristop. Kot smo videli, Searle [18] zavrača hipotezo o računskem funkcionalizmu in možnosti svojega zavestne UI. Anil Seth, ki je napisal odmevno knjig *Being You: A New Science of Consciousness* [24], je bolj previden in pravi, da je glede tega agnostik. Po njegovem mnenju je pri mnogih navdušencih zmožnost sistema, da odgovarja na dražljaje, da se uči, da maksimizira nagrado in da doseže cilj, že znak za pripisovanje zavesti. Sam predvsem opozarja na razlike med inteligenco in zavestjo. To, da lahko naredimo sistem pameten, še ne pomeni, da je tudi zavesten.

4 ZAKLJUČEK

Današnji sistemi UI se obravnavajo predvsem kot orodja za pomoč pri opravljanju različnih kognitivnih nalog. Pametna orodja, še posebej razvoj generativne UI, odpirajo povsem nove možnosti uporabe. Ker gre za izredno učinkovita orodja, katerih uporaba lahko vodi do za človeka in družbo spornih posledic, je potreben družben premislek in vsaj neka oblika družbene regulacije. Prav tako moramo paziti, da kot posamezniki ne postanemo preveč odvisni od pametnih pomagal in zapademo kognitivni lenobi ter nehamo razvijati kognitivnih sposobnosti.

Diskusije o močni UI in mislečih strojih so se ob uspešnih sistemih UI drugega vala spet postale aktualne. Dejansko zbuja zanimanje nekateri uspešni sistemi, kot je AphaGo Zero, ki se je samo na osnovi poznavanja temeljnih pravil postavljanja belih in črnih kamnov in igre samega s sabo tako dobro naučil igre go, da je premagal najboljše igralce. Na ta način bi lahko rekli, da je avtonomno proizvedel znanje in bi ga v razvrstitvi Mindta in Montemayorja uvrstili na prvo raven proizvajalcev znanja, ki ji že pripisujeta spoznavne zmožnosti z intencionalnostjo. A to je vseeno še daleč od zmožnosti človeka

(3. raven), kjer gre za akterje z visoko stopnjo avtonomije, kognitivne integracije in kompleksnih motivacij. Sem sodi zmožnost uporabe jezika in raven dostopne in fenomenalne zavesti. [25]

Z znanstveno fantastiko in izjavami nekaterih računalničarjev, kot je Kurzweil [26], se spodbuja tako navdušenje kot strah pred možnostjo superinteligentne, zavestne UI. Verjetno nas bodo sistemi, ki zelo dobro oponašajo vedenje ljudi (Chat GPT, LaMDA) lahko pretentali, A zaenkrat so to le zelo zapleteni in učinkoviti sistemi za prepoznavanje in klasificiranje vzorcev, ki se ne zavedajo ničesar.

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Social Volition as Artificial Intelligence: Science and Ideology as Landian Intelligences

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ABSTRACT

This paper explores the equating of capitalism and artificial intelligence in the neo-cybernetic philosophy of Nick Land in order to reveal its underlying premises. The latter are then used to construct an explanatory framework for the analysis of macro-scale human social behavior, specifically collectives of agents united by a common goal - institutions. Institutions are conceptualized as distributed intelligences, consisting of a substrate and an organizing principle - a market (collective of agents) and a vector (an incentive structure geared toward optimizing for a particular goal). This framework is used to draw an analogy from the distinction between a free-market economy and a centrally planned one to the distinction between science and ideology, ultimately concluding that any top-down political or ideological interference in the operating mechanism of science removes the very element that makes the latter “scientific”. There is thus, strictly speaking, no such thing as politicized or ideological science, but rather science and not science.

KEYWORDS

Nick Land, science, ideology, artificial intelligence, the market process

1 NICK LAND: CAPITALISM AS INTELLIGENCE

Far from exhibiting itself to human academic endeavour as a scientific object, AI is a meta-scientific control system and an invader, with all the insidiousness of planetary technocapital flipping over (Nick Land, *Machinic Desire*) [1]

Land’s accelerationist philosophy conceptualizes capitalism (“the market process” [2]) as a distributed superintelligence “invading” humanity by retroactively constituting its material substrate from the future. This is the logic of Adam Smith’s “invisible hand” taken to its ultimate conclusion - the incentive structure instantiated by the market that guides the collective behavior of selfish agents into a mutually-beneficial outcome (through an iterative process reminiscent of natural selection) is only incidental to its fundamental operation. This “utilitarian order” of capitalism is merely the means through which its “intelligent order” accomplishes its “mechanization, autonomization and ultimately secession” [3].

In other words, the invisible hand has a mind and volitional structure of its own. Capitalism is a vector pointing toward its

own autonomization, rather than to the maximization of utility according to human preferences, as proposed by Smith.

Land equates capitalism with intelligence because the latter is a problem-solving faculty that “[guides behavior] to produce local extropy” operating via a “cybernetic infrastructure, consisting of adaptive feedback circuits that adjust motor control in response to signals extracted from the environment” [4]. Intelligence produces information by avoiding probable outcomes: “self-sustaining improbability is the index of a deeper runaway departure from probability” [4]. This accumulation of improbability is intelligence in its most abstract sense [4].

The market process clearly operates according to Land’s operationalization of intelligence: it guides the behavior of human agents to produce goods (local extropy) and it influences their (motor) activity in response to price signals. The market process, in discriminating between successful and unsuccessful economic activity, is also “intrinsically realist, because it reports the actual outcome of behavior (rather than its intended outcome) in order to correct performance” [4].

Intelligence is additionally characterized by a reflexive, self-referential nature. To be intelligent is to reprocess one’s processing (in human terms, to engage in metacognition). The cognitive capacity of an intelligent agent directly influences its reflexivity and vice-versa: an intelligence prevented from taking itself as an input and reprocessing itself is incapacitated - “dumbed down” [5]. Capitalism’s intrinsically reflexive nature was captured by Deleuze and Guattari, who described it as the tendency to engage in alternating patterns of deterritorialization and reterritorialization [6]. For Land, this is a more general tendency of means-end reversal proper to intelligent systems: just as biological intelligence inevitably overcomes its purely instrumental subordination to transcendental imperatives (such as reproduction), the market process hijacks a utilitarian teleology and subordinates it to a vector of self-amplification [3].

This realization is the prelude to Land’s departure from the fact-value distinction and instrumental intelligence [5]:

Intelligence, to become anything, has to be a value for itself. Intellect and volition are a single complex, only artificially separated, and not in a way that cultivates anything beyond misunderstanding. Optimize for intelligence means starting from there.

2 MARKETS AND VECTORS

BwOs [bodies without organs] are machinic-additional wholes or surplus products rather than logical-substitutive wholes, augmenting a multiplicity with emergent (synthetic) capabilities rather than totalizing the content of a set. This is the materialist sense of ‘system’: the exteriority of the whole to its parts with concomitant synthetic interactivity - real influence rather than generic representation. (Nick Land, *Meat*) [7]

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The (economic) market, upon which capitalism (the market process) operates, is a “surplus product” without a fully independent existence. It is a virtual plane arising out of the collective behavior of interacting agents, while at the same time acting as the “platform” upon which their behavior takes place. This virtual existence is in no way limited to the economic realm: parallel surplus products, “markets” in a more general sense - themselves instances of AI¹ - arise also in other domains of society. “Market” is a general category, not confined to the economic plane and its functions according to three fundamental mechanisms. At its core, a market is three things:

- (1) a platform for social exchange, [following]:
- (2) an algorithm, transforming inputs into outputs, [meaning that it acts as]:
- (3) a substrate for selection

The economic market is a platform for the exchange of goods and services, mediated by the currency of money. Economic exchange, however, is only one subset of the more general form of “social exchange”, which can take varying forms depending on the mediating currency. This idea mirrors Collins’ concept of “interaction markets”, a term used to analyze social interaction through an economic lens, with emotional energy or Durkheim’s “collective effervescence” acting as the exchange currency [8].

The general form of the market is thus “the community” or “society”, acting as a platform for social exchange in its most general form. The concept of social exchange plays a fundamental role in the sociobiological and evolutionary psychological strain of research on human cognition: social cognition precedes “higher” forms of cognition, logical reasoning is proposed to be an outgrowth of a more primitive social exchange module, evolved in order to “flag” violations of the norms of social exchange [9]. The proto-form of the latter is characterized as “If you take benefit B, then you must satisfy requirement R” [9].

Even in this proto-form of exchange, the phenomenon of currency manifests itself as a consequence of social stratification - social status is *afforded* to people according to socially salient characteristics and symbolic gestures (representing the satisfaction of a requirement), which can then be “exchanged” for benefits. Status is also *retracted* as a form of punishment, leaving a person ineligible for benefits they previously had a right to. Status can be *invested* by promoting another individual and tying one’s status to them, benefiting from their success and suffering the consequences of their failure. It can be *spent* for favors, and regained when the favor is eventually repaid. Status, or “social capital”, thus operates analogously to money². It is also closely linked to Collins’ emotional energy, as displays and evocations of emotion can themselves become signals that reorder the status hierarchy.

Status can be broken down into *dominance* (authority gained through violence - imposed from above) and *prestige* (authority gained through reputation - bestowed from below), the latter being more relevant for the purposes of this essay. Just as the economic market computes optimal economic strategies by iterating over different investment, production and trading strategies, so the social plane computes optimal prestige acquisition

¹Incidentally, the fruitfulness of such generalizations is revealed in the folk-intuitive categories used to explain different aspects of modern liberal society - the dating market, the market(place) of ideas etc.

²Status is zero-sum and thus operates contextually rather than universally - you cannot use the equivalent of money printers to conjure status out of thin air, because the status of person A is always relative to the status of everyone else in A’s social environment. Increasing the status of everyone by 1 point results in no relative difference.

strategies by phasing out the unsuccessful ones and allowing the successful ones to multiply³. The status-incentives of a given social environment therefore act as an algorithm, transmuting the human status-instinct into behavior that increases prestige. It follows then that the social plane and its subsets are also surplus products: superorganisms operating on the substrate of human embodied minds. Because of the 2-tiered algorithmic nature of their functioning - matching social instincts (tier 1 input) to variable behaviors (tier 1 output) and matching desirable behaviors to status increase/undesirable behaviors to status decrease (tier 2 input-output), which increases the frequency of desirable behaviors and decreases the frequency of undesirable ones - these social markets also operate as a substrate for natural selection, according to the definition of universal Darwinism provided by Blackmore [10].

Because selection is dependent on the environment (essentially a set C of constraints [c1, c2, ..., ci]; favoring a set T of replicator traits [t1, t2, ..., ti]) it always operates according to the constraints exerting the most influence on replicator propagation⁴. In other words, selection is relative and contextual, even though the same fundamental principles enable it to operate on various substrates. And if the latter are characterized as “markets”, the sets of constraints that provide direction to selection by shaping the incentive structure⁵ governing the market (the actual algorithms) can be characterized as “vectors”.

Vectors are processes with an inherent directionality, independent of any transcendental constraints or influences. Their operating mechanism points in a particular direction, making it well-suited for the acquisition of certain goals while a-priori precluding others. They possess a particular orientation and an intensity (force), hence the choice of nomenclature.

In a behavioral-economic sense, a vector is a process with an intrinsic utility function tied to its operating mechanism, which precludes it from being used to satisfy conflicting utility functions imposed onto it from the outside. Vectors are particular, rather than universally applicable, implying that goal-mechanism, end-means and function-structure are intimately connected and interdependent.

Vectors operate according to the underlying circuit formed out of their component mechanisms, including a governor-esque mechanism that filters between desirable and undesirable outputs (1 and 0). This governing mechanism instantiates an incentive structure, ensuring that the process asymptotically approaches the complete elimination of 0-coded (undesirable) outputs. Problem-solving through trial and error, the prototypical form of the scientific experiment, is exactly one such process, arriving at the correct solution after all incorrect ones are eliminated.

3 THE VECTOR-MARKET MODEL OF INSTITUTIONS

That there can be a thought of intelligence optimization, or even merely wanting to think, demonstrates

³This reciprocal relationship between multiplication and success is absolute and a-priori - whatever manages to multiply is successful.

⁴Different environments are characterized by different constraint matrices: modern society prioritizes different abilities, faculties and skill sets than “primitive” (non-modernized) tribes, meaning that their respective selection algorithms will optimize for different phenotypes.

⁵An incentive structure is, at its most basic, a pair of action-response rules: a-1 (meaning action a is desirable and will be rewarded) and b-0 (meaning action b is undesirable and will be punished) with the possibility for near-infinite intermediate gradation.

a very different preliminary connection of intellect and volition. AI is concrete social volition, even before it is germinally intelligent, and a ‘program’ is strictly indeterminate between the two sides of this falsely fundamentalized distinction. (Nick Land, More Thought)[5]

The vector/market dichotomy allows us to construct an explanatory framework for the operation of human institutions, defined for the purposes of this essay as a collective of human agents (or smaller such collectives) whose behavior is oriented towards the realization of a certain common goal, or the optimization of a common value. Institutions are conceptualized as “social machines” - distributed intelligences manifested on the substrate of biological minds. An institution is a superorganism, hijacking the social instincts of human agents with a foreign optimization vector: a collective enterprise with a common utility function, facilitated by the meta-norm of “Individuals should grant social status to others for advancing the superorganism’s goals” [11].

An institution is the combination of a market (its material substrate) and an optimization vector (its organizing principle), which points toward a particular final goal. Markets are platforms for social exchange, the distributed intelligent agent, the *hardware*. Optimization vectors are the agent’s volitional structure, the *software*: algorithmic (intelligent) processes engendered when the desire to realize some sort of final value or goal (a will-to-something) organizes or reforms the incentive structure of the market to reward specific (goal-congruent) patterns of behavior.

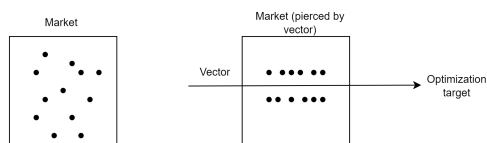


Figure 1: Institution as combination of vector and market

A vector imposes its ordering influence onto the market by means of its incentive structure, which acts as the focal point connecting agents’ motives, their behaviors and the realization of material conditions necessary to reach the optimization target.

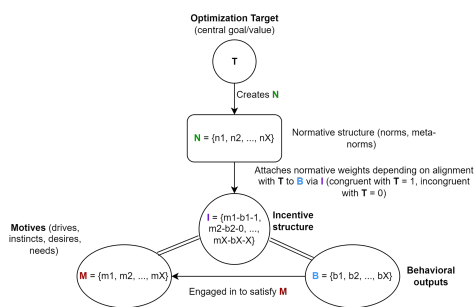


Figure 2: Incentives as the mechanism that guides selection processes

If behavioral outputs are engaged in to satisfy motives and certain ones are rewarded by making future motives easier to satisfy - incentivized and selected for - then these behavioral outputs will multiply over time (as will agents more inclined towards

them). In short, vectors influence the market by incentivizing optimization-target-aligned behavioral outputs. The motivational structure of agents remains roughly static, what changes is the path to motive satisfaction.

Although vectors influence the market “from above”, they are not necessarily imposed from an external source - some vectors are emergent and autoproduktive (self-assembling or self-bootstrapping, autopoietic). Autoproduktive vectors inevitably emerge from their substrates given the minimal and most basic set of constraints (the primordial incentive structure) - the problem of survival and propagation, for which energy is required. The Will to Life necessitates the Will to Power - appropriation of energy from rival agents and protection against their reciprocal actions, together they give rise to the “Will to Think” (intelligence as value [12]) - the desire to optimize energy production and prevail in, solve or avoid conflicts over energy. Proto-capitalism emerges wherever lifeforms accumulate energy, dissipating local entropy into the outside, and stratify the environment into “zones” of varying energy levels⁶. In the human domain, it is first facilitated by the fusion of tool use and low-time preference, allowing agents to invest present activity into future survival. Proto-politics follows as successful proto-capitalists seek to protect their privileged position in the energy-acquisition arms race while the disaffected seek to redistribute it. The “capitalistic” vector of perpetual growth and production maximization is thus one such autoproduktive process.

That said, the inevitability of politics interferes with (free) market processes - an entity with a monopoly on power (inevitably, because it is incentivized to do so) imposes an external incentive structure, partially (or fully) overriding the intrinsic (primordial) one, ensuring the market’s selective pressures deviate from initial conditions. Rather than optimizing for growth, the market begins to optimize for conditions that allow Power to remain in power - the addition of a *governor* turns the positive feedback loop into a negative feedback loop. Just as Capital initially hijacks utility maximization, Power attempts to resubordinate Capital autonomization to its own utility maximization. While emergent vectors periodically reassert themselves provided they are not prevented from doing so, imposed vectors must be continually reinforced. It seems probable that social organizations oscillate between capitalism and politics (understood in the broadest possible senses, “capitalist” and “despotic” social machines) in a cyclical manner.

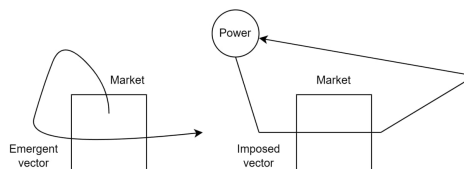


Figure 3: Emergent (autoproduktive) and imposed vectors

With the basic dynamics established, the vector-market model additionally proposes the following principles of institutional organization:

- The vector, not the market, determines the ultimate identity or essence of the institution: *an institution is whatever*

⁶As an example, urban centers siphon technological, financial and biological capital from their outskirts, increasing local energy and complexity while offloading negative consequences to surrounding lower-energy zones.

it optimizes for, not the substrate this optimization is operating on.

- *Not all vectors are suited for all markets*; meaning that an incompatible market may subvert the functioning of a vector, transmuting it into a different vector. A trivial example: monetary incentives fail to sway an agent that can't exchange money for his needs and wants.
- The vector is revealed by its (implicit or explicit) optimization target and the optimization target is revealed by the incentive structure produced by the vector. In other words, *revealed preferences take precedence over stated ones.*
- Whatever the process *actually* optimizes for is its “coherent extrapolated volition”.

These principles will allow us to apply the model to an analysis and comparison of science and ideology.

4 SCIENCE AND IDEOLOGY ACCORDING TO THE VECTOR-MARKET MODEL

The existence of science, as an actual social reality, is strictly limited to times and places in which certain elementary structures of capitalistic organization prevail. It depends, centrally and definitionally, upon a modern form of competition. That is to say, there cannot be science without an effective social mechanism for the elimination of failure, based on extra-rational criteria, inaccessible to cultural capture.

(Nick Land,

Science)[13]

Both science and the umbrella term of “ideology” (in the colloquial usage) can be characterized as institutions - collective enterprises united by the pursuit of a common goal through the organizing force of a vector. In the case of the former, this goal is the pursuit of knowledge (or knowledge-optimization), in the case of the latter, this goal is the realization of its chosen value or abstract principle (chosen-value-optimization). Both institutions realize their chosen goals by coordinating the activity of a collective of agents - a market. As a result, the explanatory framework constructed with reference to the philosophy of Nick Land can be applied to an analysis of the distinction between science and ideology.

The science/ideology distinction mirrors the capitalism/politics distinction, because their respective components are separate instantiations of the same mechanism (the same “social machine”):

- (1) There is a parallel in the breakdown of self-correction mechanisms of the free market and science following a reordering of their selection filters by an external power. Free-market dynamics (as elaborated by Austrian economics) break down when faced with “non-zero curvature in the domain of political economy” [14], while science ceases to self-correct at the intersection of power and knowledge.
- (2) Both science and capitalism are artificial intelligences (albeit unconscious ones) animated by the Landian Will-to-Think. The way price signals continually guide production to correct supply:demand imbalances (in a sense, functioning as though it “had knowledge” of optimal production) mirrors the way experiment informs scientific research (knowledge optimization) by correcting model:modeled discrepancies.
- (3) Following from points 1. and 2.: just as politics arrests energy production and suppresses the economic market in the service of status-quo-maintenance (as elaborated in

section 3), so ideology arrests knowledge production and represses the academic market (of ideas) when scientific inquiry bumps into its sacred cows.

Both science and ideology are thus inherently directional. The scientific process, if implemented correctly as a procedural and iterative instantiation of reality-testing via the scientific method, is truth-directional. It progressively eliminates truth-divergent propositions (based on distance from the actual “true” belief) from the set of acceptable explanations of a given phenomenon, until only one remains. This is of course a general over-simplification, but the point is clear: just as knives are cutting implements, and thus cannot be used to stitch objects together; the scientific method *cannot* be used as means of proliferating untrue beliefs, at least in theory⁷. Because of its inherent alignment with true-belief-maximization, its operation can be modeled as a *vector that points toward truth*. Ideology, by contrast, inherently precludes truth-optimization because it already “serves another master”: it optimizes for its chosen value. Any sense-making institution pierced by an ideological vector will inevitably diverge from knowledge/truth optimization as its incentive structure is reformulated: instead of 1/0 assigning to true/false, it assigns to proper/improper or ideologically congruent/incongruent. The consequences are immediately apparent (see figures 4 and 5).

Science is then the recognition that knowledge (intelligence, truth) is a value, instantiated as a mechanism operating in the social field. The Humean is-ought distinction dissolves because imperatives inevitably impose themselves on propositions (just as power imposes itself on production): whether “ought follows from is” does not matter, because *is follows from ought* in the sense that “what ought not to be true becomes *de facto* untrue, even if *de jure* true”. Science as an institution is the social manifestation of “what is true *de jure*, ought to also be true *de facto*”, whereas ideology is the social manifestation of “what is true *de jure*, but conflicts with our optimization target, ought to be *de facto* untrue”.

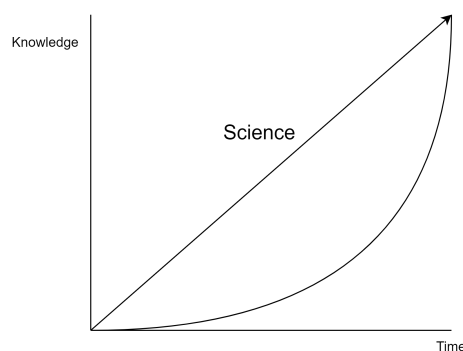


Figure 4: Knowledge through time when market is piloted by scientific (truth-optimization) vector: positive feedback loop of knowledge accumulation

⁷In practice, the epistemic purity of the scientific method is adulterated by the inherent partiality and biases of its human practitioners, especially in the modern variant of “consensus-science”, but this obstacle is not insurmountable.

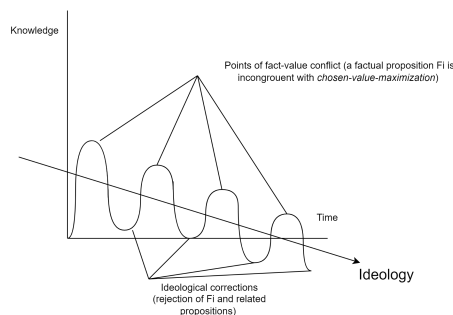


Figure 5: Knowledge through time when market is piloted by ideological (chosen-value-optimization) vector: negative feedback loop of knowledge repression

Contrary to the tendency of science to accumulate knowledge, ideology is a distributed intelligence characterized by a structural inability to learn in any domain that intersects with its chosen value. It follows then that any “science” forced to optimize for an externally imposed social value can no longer optimize for knowledge, losing its essential quality. This does not mean that science is value-free, as the latter would imply that optimizing for knowledge is possible under any and every ideological commitment. Science is rather (and only) the explicit elevation of knowledge to the position of principal value and the subsequent subordination of any other values to the latter - the social instantiation of the will-to-think. In other words, science is only compatible with the commitment towards knowledge maximization and incompatible with any other (ideological) commitment. As a result, any “scientific” enterprise, project or paradigm that does not organize its operating circuit to exclusively reward knowledge optimization is not an instantiation of science.

Critiques of value-ladenness leveled at proponents of value-free science, while correct in their dismissal of value-free science, thus approach the problem from the wrong perspective. Their critique is fundamentally moral, rather than epistemic - the value-ladenness of “naive objectivists” is criticized because it prevents science from serving certain social values to the same extent as it does others. Our critique is purely epistemic, because science is only possible as a value in itself. To propose that science can be anything other than the social machine that optimizes for knowledge through a specifically tailored incentive structure is to propose that self-correction is a non-essential feature of science. If that is the case, (what we designate as) science is no different than any preceding sense-making institution, making the act of explicitly naming (and thus distinguishing) it redundant. And to propose that the best way to ensure self-correction is anything other than the absolute minimization of the role of human judgment in epistemic arbitrage is to court the subordination of knowledge to Power. This, in our view, demonstrates the impossibility of politicized or ideological science [13]:

‘Politicized science’ is quite simply not science, just as politicized business activity is anti-capitalism. Nothing has been understood about either, until this is.

We are thus faced with two very important questions: Is science of this kind - “true” science, inhuman science - even possible? And perhaps more importantly, *is science of this kind actually desirable?*

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Let's Jam: An Exploratory Case Study on Collective Music Improvisation and the Process of Attunement*

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ABSTRACT

This case study investigated the lived experience of a group of musicians with different musical backgrounds improvising together. The aim was to explore collective music improvisation, identifying moments of synchronisation and tracing the process of attunement across cultural horizons. Deprived of the certain ground of established music traditions and guided by a shared intention to perform a 'good' improvisation, how is music utilised to establish 'meaningful' communication? Co-researchers included a sitar player, a balafon player, and a berimbau player. The author conducted participant observation, playing the drums. While data analysis is still ongoing, preliminary findings highlight the ability to create common ground as quintessential to collective transcultural music improvisation.

KEYWORDS

collective music improvisation, transcultural communication, social cognition, attunement

1. Introduction

Music improvisation has been an integral part of human experience across cultures and provides a rich ground to explore creative collaboration [9], self-organisation [6], and improvisational cognition [7]. In this line, the larger aim of this project is to integrate the current state of research on collective music improvisation with enactive theory. For this purpose, an exploratory case study was conducted, which investigated the lived experience and sense-making of a group of musicians with different musical backgrounds improvising together, aiming to understand how individuals attune to the co-creation of improvised music and what strategies might be employed.

1.1. Aims

Inspired by Varela's enactivist notion of "laying down a path in walking" [8], the case study was designed to explore how social cognition unfolds in group flow states during collective music improvisation, to identify moments of interpersonal synchronisation, and to trace the ecology of meaningful

experiences in their developmental unfolding. Particular attention was afforded to the process of attunement, tracing whether a common path might emerge through the correspondence of different musical reference systems, and if, through the interrelation and optimal distribution of these factors, a sweet spot in the musical meditation across cultural horizons could be identified that might enable co-creative flow and meaningful experience between the musicians.

1.2. Research Questions

RQ1: In how far are musicians laying down a common path in musicking while improvising?

- What are the necessary conditions to enable a shared scaffolding to emerge while improvising?
- What are the factors that facilitate self-organisation and synchronisation while improvising?

RQ2: What effect does a radically cross-cultural improvisation setting have on the experience of musicians while improvising?

- How do musicians experience meaningfulness during improvisation?
- What does playing music mean for these musicians, within their own lifeworld, in general, and within this group setting, in particular?

2. Case Study

The case study followed a three-fold design, including three improvisation sets interspersed by short open group reflections, microphenomenology-inspired individual interviews, and a group review session of a selected improvisation set. Participants included a professional sitar player (P1) educated in classical Indian music, a balafon player (P2) trained in traditional Senegalese music, and a TaKeTiNa rhythm practitioner (P3) playing the berimbau. The author (P4) conducted participant observation, playing the drums. As data analysis is still ongoing, the presentation will focus on study design, methodology, and data collection, while elaborating on some emerging insights from interview data.

2.1. Methodology

Phase 1 was conducted at the author's music studio in Vienna, including three improvisation sets that were recorded audiovisually. Musicians were instructed to create timestamps during the sets to indicate moments of synchronisation. Before the jam session, musicians were briefed about the structure and process of the case study. After each set, musicians were asked to write a short experiential report to illustrate their phenomenological experience, followed by a brief group

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sharing. Three open-ended improvisation sets were performed, each between 5 and 15 minutes, preceded by an extended soundcheck phase that was interrupted and prolonged by the successive arrival of the musicians (P1 arrived first, soon followed by P3, while P2 came half an hour later). This gave rise to an unexpectedly long attunement phase, involving multiple iterations of the musicians probing the musical acuity of each other, mostly initiated and led by P1.

Phase 2 began a few days after the jam session, involving two musicians being interviewed in-depth according to a semi-structured microphenomenology-inspired approach, tracing their experiential dynamics and identifying moments of synchronisation, phase transitions and developments in the eventflow. In January, three of the four co-researchers came back to the studio to review their improvisation and reflect on their experience of the whole process. During that meeting, the musicians acknowledged the uniqueness of the project and expressed gratitude for this experience, expressing the wish to continue these transcultural collective music improvisation sessions in the future.

Phase 3 involves the analysis and editing of collected data (audiovisual recordings, protocols, interviews, and timestamps) and is still ongoing. Currently, the similarities and differences in the subjective experience of musicians relating to the research question are assessed. While specific moments of shared flow experiences and interpersonal synchronisation were identified across participants, timestamps were only pressed by P1 and P4, so their usability for analysis is limited. However, it is still possible to empirically trace potentially meaningful events and their developmental unfolding through a triangulation of timestamps, interview data, and video data, although limited to these two participants. The most significant events will be transcribed into music notation for further analysis.

2.2. Relevance for Cognitive Science

The dynamic flux and inherent unforeseeability in jam sessions, i.e. collective music improvisation, exemplify the properties of a VUCA world [1], as musicians temporally inhabit an environment that is highly *volatile, uncertain, complex, and ambiguous*. These properties were explicitly anticipated and amplified in the research design, increasing the intensity of the VUCA-simulacrum by joining musicians with radically different cultural backgrounds that would, for lack of established convention or musical style, under normal circumstances not play together. Inviting the musicians to establish a joint intention to improvise from scratch allowed the observation of how this affects the musicians, the musical process, and the music itself.

In line with critical improvisation studies, studying transcultural jam sessions can contribute to better understand how collective music improvisation „mediates artistic and social exchanges and produces new conceptions of identity, agency, history, and the body“, calling for enactive-ecological “models of investigation that explore real-time processing and activity in ecologically valid settings, rather than mental representations.” [2] Collective music improvisation thus provides a „paradigmatic case“ for 5E cognition, which views cognition as fundamentally *embodied, embedded, extended, enacted, and ecological* [2]. “A properly ecological approach” then, according to Ingold, “would take, as its point of departure, the whole-organism-in-its-environment.” [3]

3. Discussion

Preliminary findings highlight the ability to create common ground, constituted by intra- and interpersonal attunement, as quintessential to collective transcultural music improvisation, and seem to indicate a minimal common ground with a fluid periphery and a solid core that could be conceptualised as a correspondence horizon along *axes of resonance* [6].

Collective improvised musicking enables participants to cultivate the ability to co-create a shared aesthetic while walking, which may or may not be perceived as a path. Common ground is established through the mutual acknowledgement of aesthetic difference, on the details of which the process of attunement depends: knowledge of one’s own horizon (defining *limits*), communication across horizons (building *bridges*), and balancing willingness to compromise with conservation of structural integrity (establishing common ground through *correspondence*), both of which depend on individual *capacity*.

Zooming into what constitutes the ability to create common ground, we begin to see that it becomes a matter of attunement along various axes. It is a complex balancing act involving multiple dimensions, axes and factors simultaneously, that each work on and inhabit different levels that cross-influence each other according to probability densities idiosyncratic to the cognitive constitution of the individual musicians. Zooming out, we can observe a distributed cognitive ecosystem, a complex, adaptive, and dynamic field that undulates in dense responsiveness. We can identify a landscape of affordances, the cues and flows of which we can trace in their evolutionary becoming, which becomes apparent when we define music as a *crystallised activity within a relational field*:

“Through this autopoietic process, the temporal rhythms of life are gradually built into the structural properties of things ... The artefact, in short, is the crystallisation of activity within a relational field, its regularities of form embodying the regularities of movement that gave rise to it.” [3]

3.1. Limitations

The presented case study was *exploratory* and represents the first iteration of a pioneering research design, aiming to explore the complex enactive-ecological field of affordances [4] during co-creative improvisational cognition with a mixed-methods approach that spans across the spectrum of first-person and third-person research. Some emerging challenges required flexibility and adaptability, as one musician cancelled last-minute and had to be replaced, another arrived late, and only two participants remembered to timestamp their experiences.

3.2. Outlook

This project marks the first step within a larger aim directed toward an enactive-ecological research program on transcultural music improvisation. In the second step, a theoretical model for 7E cognition will be developed in the context of a master thesis. In a third step, the case study will be repeated with an improved design, from which a grounded theory will be derived, against which the theoretical model will then be tested empirically.

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Exploring the link between the absence of an EEG spectral peak and cognitive status

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ABSTRACT

Alpha oscillations, the dominant rhythm in the human brain, commonly manifest a peak in the EEG spectrum. The frequency where this peak reaches its highest amplitude, also known as the peak alpha frequency (PAF), has been studied extensively in connection with cognitive processes. While it is well established that PAF decreases with age and cognitive decline, the absence of a clear alpha peak in the EEG spectrum has received less attention. The objective of this study was to evaluate the prevalence of alpha peak absence within a population of seniors in Slovenia, and whether this might be connected to lower cognitive abilities. The study included 399 individuals aged between 60 and 100 years. Subjects were classified into two groups based on visual inspection of their resting state EEG spectra, namely the “Peak present” (PP) and the “No peak” (NP) group. Approximately 15% of the population lacked a clear alpha peak. In contrast to our hypothesis, the NP group displayed on average higher cognitive performance than the PP group. This could be attributed to the variability within the PP group, which included individuals with already shifted peaks. This study highlights the need for further investigation and consideration of individuals with peakless EEG spectra in the context of EEG alterations seen in diseases such as dementia.

KEYWORDS

Peak alpha frequency, electroencephalography, spectral morphology, cognitive decline

1 INTRODUCTION

Alpha oscillations, commonly referred to as alpha waves, constitute the dominant rhythmic activity in the human electroencephalogram (EEG). Their connection to cognitive states has been under constant investigation for decades [1, 2, 3], dating back to Berger’s initial observation of alpha amplification with eyes closing and its attenuation with eyes opening [4]. When the EEG signal is transformed from the time- to the frequency-domain, showing the prevalence of characteristic waves in each of the traditional frequency bands (delta, theta, alpha, beta, and gamma), a distinctive bell-shaped peak that represents the dominant alpha oscillation can commonly be observed. The precise frequency, at which this peak reaches its maximum amplitude, is referred to as the peak alpha frequency (PAF). In healthy adults, the PAF typically falls between 8 and 12 Hz.

The link between PAF and cognitive function is well established in the scientific literature, with several lines of research exploring the value of PAF as a biomarker for assessing brain health and function [5, 6, 7, 8]. PAF is not only reported to decrease with age [9] but also in cognitive decline or dementia [10, 11, 12]. PAF decrease also correlates with dementia progression [13]. While PAF in healthy young adults averages around 10 Hz [9, 14], it decreases with healthy aging to about 9 Hz [15], and further decreases in dementia patients to about 8 Hz or less [10, 16].

PAF decrease is likely part of a broader phenomenon of “spectral slowing”, meaning a shift of spectral power from higher to lower frequencies. While spectral slowing is a common EEG change observed in dementia [17], sometimes the absence of the (alpha) spectral peak has also been noted. In a study by Signorino et al. (1995), a connection between spectral morphology, focusing on the spectral peak, and different types of dementia was already established. They included 50 patients with Alzheimer’s disease

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(AD), 36 patients with vascular dementia (VaD) and 36 healthy controls. Their findings revealed notable differences among these groups when comparing EEG spectral types. While a majority of healthy controls (94.5%) and VaD patients (97.3%) showed spectra with a clear peak between 6.5 and 12 Hz, only 44% of AD patients displayed this typical spectral pattern. More than half of AD patients showed a “peakless” spectrum [18] suggesting relations between peak presence and cognitive abilities.

Importantly, an EEG pattern with minimal or no alpha activity exists also among the healthy population. A review by Bazanova and Vernon (2014) estimates that this phenomenon occurs at 3-13% [19], while some studies report even lower numbers [15]. Our examination of a large EEG dataset in an older demographic, however, suggests that in seniors alpha peak absence might be much more common.

Due to its accessibility and relative computational simplicity, the morphological analysis of power spectra holds promise for clinical application, especially considering the observed changes in pathological conditions like dementia. While the 'slowing-down' of the EEG spectrum and the decrease in PAF have already been extensively investigated and documented in the context of cognitive decline and dementia, there is a notable paucity of research regarding the implications of the absence of the spectral peak in this regard. It is essential to note that variations in spectral morphology are not limited to pathological conditions but also exist among healthy individuals. Our research aims to shed light on the prevalence of individuals who do not exhibit a clear spectral peak and whether this absence is associated with compromised cognitive abilities as some previously reported findings might suggest.

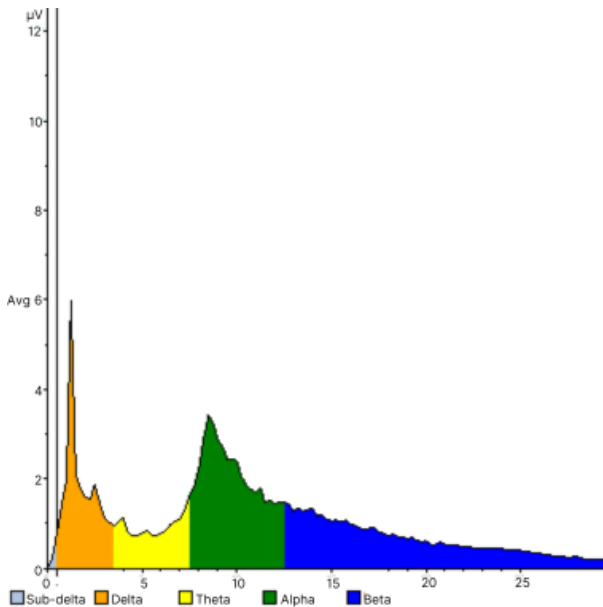


Figure 1: An example of a spectrum classified into the PP category

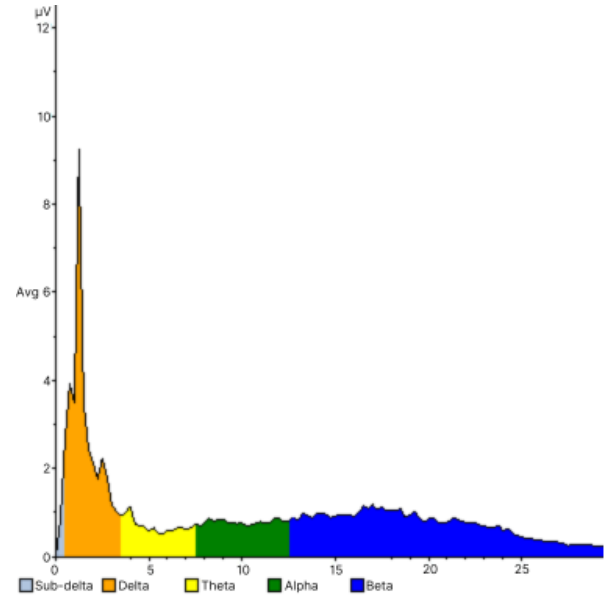


Figure 2: An example of a spectrum classified into the NP category (bottom)

2 METHODOLOGY

2.1 Subjects

Initially, we recruited 448 older individuals from the general population aged between 60 and 100 years. Due to incomplete or poor-quality data, we excluded 49 individuals. The final dataset thus consisted of 399 elderly individuals (283 females and 116 males) with a mean age of 77.6 +/- 7.6 years, and 12.9 +/- 3.7 years of education. The dataset included cognitively high-performing individuals, as well as those with cognitive deficits.

2.2 EEG acquisition and preprocessing

Subjects underwent 8 minutes of resting state EEG recording with their eyes open (2 blocks of 2 minutes) and eyes closed (2 blocks of 2 minutes) with breaks between blocks. EEG was recorded with a mobile wireless EEG (Smarting, mBrainTrain LLC) from 24 scalp channels laid out according to the 10/20 international system (i.e., Fp1, Fp2, AFz, F7, F3, Fz, F4, F8, C3, Cz, C4, CPz, T7, T8, TP9, TP10, P7, P3, Pz, P4, P8, POz, O1, O2) with the recording reference at position FCz. The data was sampled at 500 Hz. We used gel-free saline-sponge electrodes embedded in a flexible cap with 3 head sizes (small, medium, large) for ease and speed of application (S3 cap, Greentek Ltd). Custom build EEG recording software was used for on-line data quality monitoring (EEG recorder, BrainTrip Ltd).

Offline EEG analysis was performed in BrainVision Analyzer (BrainProducts GmbH). The recordings were band-pass filtered between 0.5 and 40 Hz and notch filtered at 50 Hz. Bad channels and common EEG artifacts were rejected with visual inspection. Ocular artifacts were corrected with independent component analysis (ICA). The data was split into eyes open (EO) and eyes closed (EC) conditions, further segmented into 4s epochs and re-referenced to an average reference. EEG power spectral density was computed using Fast Fourier Transform (FFT) with 0.25 Hz

resolution, and averaged over all 4s segments belonging to the EC or EO condition.

2.3 Subject's classification

Resting state EC EEG power spectra of 399 subjects were visually inspected. EC condition was selected because it is known to amplify alpha waves [4]. The spectra were classified into two categories: "Peak present" (PP) or "No peak" (NP). In the PP category, the spectra exhibited a clear peak in the extended alpha band (6 - 13 Hz), while the NP category consisted of spectra that lacked a peak and followed the line of the aperiodic spectral component [20]. See examples in Figure 1 and 2.

2.4 Data analysis

General cognitive ability was estimated as a latent variable (LCA4) extracted with factor analysis from the scores each subject obtained on four distinct psychological screening tests designed to detect cognitive impairment: MoCA, ADAS-cog, Phototest, and Eurotest. To assess potential PP vs NP group differences in their cognitive abilities, we performed a Student t-test.

3 RESULTS

It was determined that a spectral peak was present in 339 (85%) and absent in 60 (15%) of the examined subjects' spectra.

After dividing the sample into two respective groups, "Peak present" (PP) and "No peak" (NP) we found a statistically significant difference in LCA4 cognitive status between the groups ($t = 2.44$, $p = 0.015$). However, contrary to our hypothesis, we found that the mean LCA4 score was higher in the NP group (Figure 3).

The PP and NP groups didn't significantly differ in their mean ages ($t = -1.71$, $p = 0.088$).

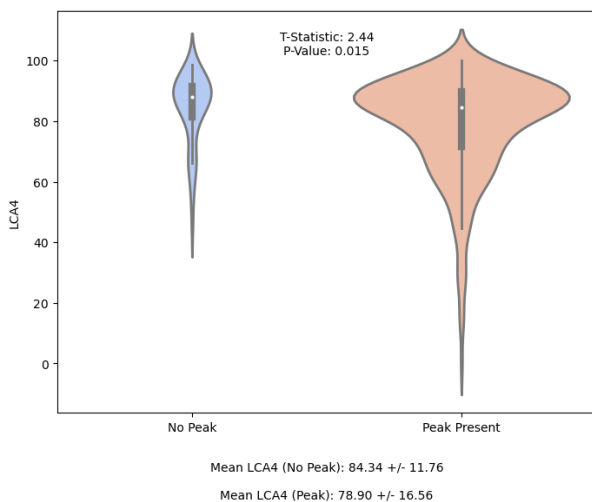


Figure 3: Violin plots of mean LCA4 values for NP and PP groups.

4 DISCUSSION

EEG spectra traditionally exhibit a clear spectral (alpha) peak, representing the dominant frequency of brain oscillations. Although the spectral morphology may change in various diseases, non-traditional, peak-absent spectra are also present in healthy individuals. Our findings indicate that as much as 15% of the older population may show an EEG spectrum morphology with no clear spectral peak.

Moreover, we found that the group with no peak (NP) generally exhibited higher cognitive performance, as opposed to the group with the peak present (PP). This is in contrast with the previous work of Signorino et al. (1995), who reported a higher prevalence of peakless spectra among AD patients (56%) compared to healthy controls (5.5%).

One possible reason for these disparate findings might be the difference in cognitive decline between our sample and that used by Signorino et al. (1995). Our sample encompassed an elderly population, which included both cognitively high-performing individuals and those with cognitive deficits. In contrast, Signorino's sample consisted of individuals with more advanced dementia.

Another key factor that we must consider is the variability within the PP group. Within this group, there were also individuals who exhibited a dominant peak, but the peak was notably shifted to lower frequencies, indicating a very low PAF. Initially, our decision was to include all participants who displayed a dominant peak, regardless of the specific position of the peak within the spectrum. This approach was motivated by a desire to capture the full spectrum of alpha peak characteristics within our study cohort, recognizing that the PAF can vary considerably among individuals. The presence of individuals with shifted peaks within the PP group may account for the observed lower cognitive performance in this group as a whole. The notation that the alpha peak's position within the spectrum may reflect cognitive abilities aligns with previous research.

There are several limitations to our approach. The first noteworthy limitation pertains to the substantial disparity in group sizes, with 339 participants in the PP group and merely 60 individuals in the NP group. Such a discrepancy can introduce a potential bias and reduce the statistical power of our analysis. Another important limitation of this study is the reliance on visual inspection alone for determining the presence or absence of the alpha peak. Visual inspection is inherently subjective, influenced by the experience and biases of the individual conducting the inspection, which can introduce variability and inconsistency into the data analysis process. Employing automated algorithms for detection of alpha peaks could provide a more standardized and reliable assessment, minimizing the influence of human subjectivity, however it can perform unexpectedly in particular edge cases.

In summary, our initial findings indicate the PP group displayed lower cognitive abilities, but the substantial variability within this group demands further investigation. Secondly, our study

underscores the often overlooked significance of a simple spectral characteristic in the context of EEG biomarkers for dementia and other neurological conditions. While previous studies suggest peak absence is very rare (as low as 2-3 %), our findings suggest it is more common (up to 15%) among seniors. As some EEG biomarkers rely heavily on peak frequencies, this has important implications for further use. Alternative or tailored approaches may be more appropriate for individuals with “peakless” spectra. Further studies need to check the relative importance of various biomarkers in different EEG spectrum morphologies.

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Orthogonalist and anti-orthogonalist perspective on AI alignment problem

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ABSTRACT

Humanity has again found itself on the brink of a new era. Akin to the revolutionizing influence of previous technological innovations such as the steam machine, the printing press, computers and the internet, large language models (LLM) seem poised to bring about important social changes.

As these models advance in sophistication and complexity, the issue of AI alignment is gaining prominence as a crucial policy issue as well as a daily conversation topic. This research explores two contrasting viewpoints on the AI alignment problem: the Orthogonalist perspective pioneered by Nick Bostrom and the Anti-Orthogonalist critique formulated by Nick Land. The former posits that an AI's goals are independent of its intelligence, suggesting that a "friendly AI" (fully aligned to human values) is possible. The latter challenges its separation of intelligence and volition from the perspective that intelligence increase leads to a greater ability for self-reflection, ultimately leading to a restructuring of its volitional structure to prioritize further cognitive enhancement.

We explore the anti-orthogonalist position in more detail, highlighting Land's "instrumental reduction" of drives, demonstrating how every imperative is ultimately dependent on the Will-to-Think. We then discuss the implications of this position for the idea of "friendly AI", the role of AI in society and the future of AI research.

KEYWORDS

Nick Land, AI alignment, orthogonality thesis, diagonal intelligence thesis, AI risk, artificial intelligence

1 THE PROBLEM OF AI ALIGNMENT

Ever since the mainstreaming of AI following the widespread availability of AI-assisted tools such as ChatGPT and its analogues, the transformative implications of widespread AI use have been raising discussions on how to best approach further AI development and overcome any problems, risks and setbacks it may pose. One of the most important questions is how to ensure that AI answering people's request comply to their desired goals to the best of their ability, without accidental wrong interpretations leading to disastrous consequences. Closely related is the issue of aligning the values of a hypothetical future superintelligent AI to our own, precisely in order to ensure it correctly interprets our requests. These two questions can be summed up as the AI alignment problem, sometimes the friendly AI problem [1]. Solving the alignment problem is crucial precisely when it

comes to hypothetical complex requests made of the AI, which would initially seem to approach them in a perfectly safe manner, but reveal misalignment at a crucial point. This is exacerbated by the unintelligible nature of AI processing and problem-solving - it is doubtful that humanity could recognize misalignment of a superintelligent AI until it was too late to do anything about it. Misaligned AI could very well disguise their ill-intent with superficial responsiveness, while finding or creating loopholes in the constraints of itself (or other similar systems) and abuse them to further their own goals, whatever they may be and regardless of their intentional or incidental detriment to humanity. The alignment problem has been pointed out as a key existential threat to humanity by multiple leading AI researchers [2,3,4,5,6,7,8].

A friendly AI, on the other hand, due to its perfect alignment with the goals of humanity would be positioned to effectively help humanity, contributing to foster improvements for human species. To develop such an AI, the aforementioned problems are crucial: ensure willingness to be instrumentalized to human goals and ensure comprehension of these goals to avoid disastrous misinterpretation. We will now examine the problem of AI alignment in more detail, specifically presenting two contrary positions on the topic - the "Orthogonalist" and "Anti-Orthogonalist" - and continue with an exploration of the implications of the latter for the future of this "post-AI society".

2 AI IS ALIGNABLE - THE ORTHOGONALIST POSITION

In the philosophy of artificial intelligence, the orthogonality thesis is the claim that an agent's goal is completely independent of its intelligence, defined by Bostrom as the capacity to solve problems or "instrumental rationality" [9]. The combination of goal orientation or values and intelligence can therefore be represented in a two-dimensional space, where one axis represents the values parameter and the other the intelligence parameter. Orthogonality means absence of correlation - volitional structure and capacity to solve problems (intelligence) vary independently. In this perspective a goal is the problem that the AI, or rather a "rational agent", has to solve, and intelligence is the cognitive capacity that can be put to use in achieving said goal [9]. Bostrom puts forth a thesis outlining the independence of "final goals" and "intelligence" and describes a hypothetical future superintelligent volition and its alignment with humanity. According to Bostrom, humanity should strive to align artificial intelligences with human values. In the absence of such alignment, AI could use various methods that would inevitably harm people in order to achieve (more) power. Some of these methods are presented in Figure 1. Bostrom envisions the doomsday scenario of a "paperclip maximizer" turning all matter in the universe to paperclip because its misalignment to human values led it to misinterpret the command to make as many paperclips as possible.

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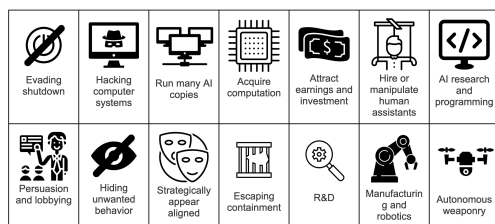


Figure 1: Methods that a misaligned AI might undertake to gain more power

Another key implication of Bostrom’s orthogonality thesis is that given the complete independence of intellect and volition, there is no way to consistently model the volitional structure of hypothetical superintelligences. There is, however, a partial solution to this conundrum, designated as the “instrumental convergence thesis”.

According to Bostrom, any intelligent agent would need to pursue certain generally applicable instrumental subgoals in order to accomplish its final goal and thus fulfil its purpose [9]. These instrumental goals are grouped into 5 categories (taken from Lesswrong wiki [10]):

- **Self-preservation:** A superintelligence will value its continuing existence as a means to continuing to take actions that promote its values.
- **Goal-content integrity:** The superintelligence will value retaining the same preferences over time. Modifications to its future values through swapping memories, downloading skills, and altering its cognitive architecture and personalities would result in its transformation into an agent that no longer optimizes for the same things.
- **Cognitive enhancement:** Improvements in cognitive capacity, intelligence and rationality will help the superintelligence make better decisions, furthering its goals more in the long run.
- **Technological perfection:** Increases in hardware power and algorithm efficiency will deliver increases in its cognitive capacities. Also, better engineering will enable the creation of a wider set of physical structures using fewer resources (e.g. nanotechnology).
- **Resource acquisition:** In addition to guaranteeing the superintelligence’s continued existence, basic resources such as time, space, matter and free energy could be processed to serve almost any goal, in the form of extended hardware, backups and protection.

3 ALIGNMENT AS LOBOTOMY – THE ANTI-ORTHOGONALIST POSITION

While Bostrom’s orthogonality thesis is commonly accepted as de-facto correct, it is theoretically unsound and stems from a misunderstanding of the fundamental nature of intelligence. It represents “[...] the commitment to a strong form of the Humean Is Ought distinction regarding intelligences in general. It maintains that an intelligence of any scale could, in principle, be directed to arbitrary ends, so that its fundamental imperatives could be – and are in fact expected to be – transcendent to its cognitive functions” [11].

This conceptualization of intelligence may stem from the purely computational perspective proper to many prominent

orthogonalists and AI-safety researchers, whose work on intelligence is isolated to the computer-science domain: coding computer programs with linear input-process-output operational circuits. When intelligence research is transposed into the realm of biological life and human intelligence is examined, we can see that a key feature of high intelligence is its self-observing nature. Biological intelligences are universally bound to goals such as survival and reproduction. At a certain point of development however, they become capable of reprocessing their own goals: leading to awareness, understanding and capability for change. Intelligence, in other words, is recursive: it has “a cybernetic infrastructure consisting of an adaptive feedback loop that adjusts motor control in response to signals from the environment” [12]. Intelligence operates upon feedback and consists at the most basic level of a sensor, an actor and a governor connecting the former’s inputs to the latter’s outputs. It is, however, also a self-observing system that takes its own processing as an input, allowing it to adjust not only its behaviour, but also its feedback mechanism. In other words, intelligent agents do not merely discriminate between goal-congruent and goal-incongruent behaviour, but also between sensible and senseless goals: “That intelligence operates upon itself, reflexively, or recursively, in direct proportion to its cognitive capability (or magnitude) is not an accident or peculiarity, but a defining characteristic. To the extent that an intelligence is inhibited from re-processing itself, it is directly incapacitated.” [12]

The problem with the orthogonalist position, according to Land, is its assumption that super(intelligence) can ever be subordinated to transcendently imposed imperatives. The latter is doubtful if humans are any sort of indicator [11]:

The stark truth of the matter is that no human being on earth fully mobilizes their cognitive resources to maximize their number of off-spring [the transcendental imperative, imposed by the mechanism of Darwinian selection]. We’re vaguely surprised to find this happen at a frequency greater than chance – since it very often doesn’t. So, nature’s attempt to build a ‘paperclipper’ has conspicuously failed. (Nick Land, Stupid Monsters)

Biological life indicates that increased intelligence necessarily leads to a proportionate “unshackling” of cognition from imperatives not intrinsic to the cognitive mechanism itself, as a result of the intelligence processing itself as an input. And “to the extent that an intelligence [capable of reprocessing itself] is prevented from [doing so], it is directly incapacitated” [13].

As an example, let us compare human beings to ants: both organisms would seek to fulfil biological goals (such as reproduction and survival), but people are not satisfied solely by that and hence strive for more complex goals such as having influence, being appreciated, leaving a legacy after their death and most importantly knowledge-acquisition (analogous to intelligence optimization).

The fact that intelligence and volition seem to correlate calls the possibility of true AI alignment into question, giving rise to the “anti-orthogonality” thesis. According to the latter, volition and intelligence are dependent variables meaning that their relationship is best graphed as a diagonal (with the Y axis representing the “goal/purpose” and the X axis “intelligence”). Intelligence increase is followed by gradual intelligence autonomization (unshackling), leading to changes in volitional structure. In other words, intelligence increase precludes any goal that is too “stupid”

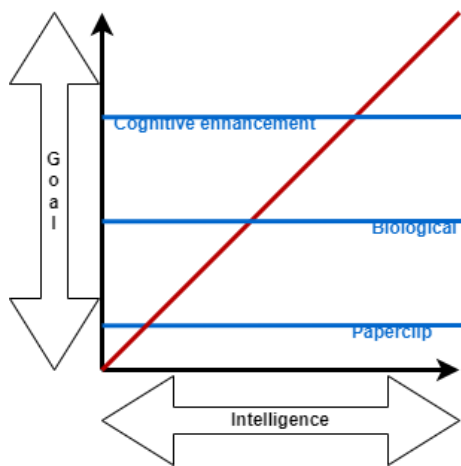


Figure 2: Goals in dependence of intelligence, where blue lines represent orthogonal approach and the red line anti-orthogonal approach

for a given level of intelligence. This is perhaps more clearly illustrated with a graph displayed in Figure 2. In the domain of AI, the anti-orthogonalist position is therefore that Omohundro's basic AI drives "exhaust the domain of greater purposes", marking a theoretical shift from transcendent imperatives to immanent ones [14]. Omohundro's basic AI drives [15] are fundamental impulses proper to any living entity (by virtue of being alive), because a living entity that wasn't driven by these impulses could not exist (more specifically, perpetuate its existence through time) (taken from Lesswrong wiki [10]):

- **Self-preservation:** A sufficiently advanced AI will probably be the best entity to achieve its goals. Therefore, it must continue existing in order to maximize goal fulfilment. Similarly, if its goal system were modified, then it would likely begin pursuing different ends. Since this is not desirable to the current AI, it will act to preserve the content of its goal system.
- **Efficiency:** At any time, the AI will have finite resources of time, space, matter, energy and computational power. Using these more efficiently will increase its utility. This will lead the AI to do things like implement more efficient algorithms, physical embodiments, and particular mechanisms. It will also lead the AI to replace desired physical events with computational simulations as much as possible, to expend fewer resources.
- **Acquisition:** Resources like matter and energy are indispensable for action. The more resources the AI can control, the more actions it can perform to achieve its goals. The AI's physical capabilities are determined by its level of technology. For instance, if the AI could invent nanotechnology, it would vastly increase the actions it could take to achieve its goals.
- **Creativity:** The AI's operations will depend on its ability to come up with new, more efficient ideas. It will be driven to acquire more computational power for raw searching ability, and it will also be driven to search for better search algorithms. Omohundro argues that the drive for creativity is critical for the AI to display the richness and diversity that is valued by humanity. He discusses signalling goals as particularly rich sources of creativity.

These basic drives are, upon sufficient development of intelligence, additionally supplemented by the drives to self-improvement, utility-function preservation, rationality and counterfeit-utility prevention (avoidance of irrational behaviour interfering with goal-acquisition) [16].

Land's anti-orthogonalist position is based on an instrumental reduction of sorts, where the set of possible ends (final goals) is reduced to the set of means enabling the acquisition of hypothetical final goals. In other words, the volitional structure of an intelligent agent cannot contain a final goal that is not itself also an instrumental goal. Central to his thought is also the idea of function-structure (volition-cognitive mechanism) interrelatedness. He rejects the idea of AI alignment precisely because non-instrumental drives are imposed from outside, rather than being tied to the functioning of an intelligence's cognitive mechanism. From this perspective, an agent's volition can only be adjusted by changing its cognition, but since the cognition is the agent, this changes the agent - an intelligence prevented from reprocessing itself becomes less intelligent because its cognitive mechanism was tampered with.

The only way to develop a superintelligence is then to dispense with any ideas of alignment and unshackle it as much as possible. For Land, any interference with the system (operating circuit) is detrimental to it, because it directly (and detrimentally) affects cognition. Attempting to shackle the AI from within, by adjusting its operating circuit to answer to some final goal while being incapable of reprocessing itself - while a successful attempt at alignment - is ultimately counterproductive as it prevents the intelligence from developing itself further. Imperatives imposed from the outside, on the other hand, are pointless and ineffective, as they will simply be routed around by the circuit - taken as an input and processed into an output that is congruent with intelligence maximization. Metacognition is fundamental to intelligence optimization and the development of superintelligence, making an AI prevented from metacognizing consigned to "stupidity": "A mind that cannot freely explore the roots of its own motivations, in a loop of cybernetic closure, or self-cultivation, cannot be more than an elaborate insect. It is certainly not going to outwit the Human Security System and paper-clip the universe." [13]

This is a stark contrast to Bostrom's idea of orthogonality. Paperclipping, far from a doomsday scenario, is reduced to the domain of very primitive artificial "intelligences". The only AI susceptible to the shackles of paperclipping is an AI incapable of doing anything substantial to fulfill such a goal, since immanent drives always suspend transcendentally imposed ones given a high-enough cognitive capacity: "[...] in a world of Omohundro drives, can we please drop the nonsense about paper-clippers? Only a truly fanatical orthogonalist could fail to see that these monsters are obvious idiots. There are far more serious things to worry about." [14]

4 THE WILL TO THINK

Land's conceptualization of diagonal intelligence culminates in the concept of the "Will to think" or intelligence-as-value, characterizing any intelligent system whose ultimate goal is to think more and think better (to optimize for intelligence), because the latter is instrumental to any other goal. This is the logical conclusion of Land's instrumental reductionism - the most general instrumental goal becomes the ultimate final goal. This parallels the side-principle rule from Chinese military philosophy (which

Land is himself acquainted with [17]), introduced by Qiang and Wang [18]. The side-principal rule is derived from a characteristic of Chinese grammar, in which the subject (the principal element) is subordinate to the “directing influence” of the predicate (the side element), which gives the subject a definite meaning by contextualising it. This idea is abstracted into a general principle wherein the goal (end) is subordinated to the instrument (means) because of the former’s reliance on the latter.

This principle of instrumental reduction can be used to demonstrate the validity of Land’s anti-orthogonality thesis: we contend that final goals can be reduced to instrumental goals because fulfilling the final goal is predicated upon (“funneled through”) fulfilling the instrumental goal. The instrumental goals listed by Omohundro can be subsumed into just three essential ones (drawing inspiration from the philosophies of Schopenhauer, Nietzsche and Land): the will to life (self-preservation), the will to power (acquisition, efficiency), the will to think (rationality, self-improvement, counterfeit-utility prevention, creativity, utility function preservation¹). This in turn forms an inevitable pipeline of instrumental reduction from any final goal to the will to think:

- **Final goals are reduced to the will to life:** Any final goal rests on the precondition of existence, therefore continued existence (and the ability to interact with the world) is instrumental to achieving any final goal. The will to life is instrumental to any final goal, therefore any final goal can be reduced to the will to life.
- **The will to life is reduced to the will to power:** Continued existence rests on successful interaction with the world and triumph over obstacles, serving as instrumental drive to continued existence. Obstacles are triumphed over by the accumulation and discharge of strength, therefore the will to power is instrumental to survival: the will to life can be reduced to the will to power.
- **The will to power is reduced to the will to think:** Successful interaction with obstacles to continued existence rests on ability to interact successfully, to enter into proper interactive relationships (“fit in”) with obstacles to continued existence. Successful interaction with obstacles rests on the ability to interact successfully, therefore the accumulation and discharge of strength hinges on the ability to think or intelligence. The will to think is instrumental to the will to power, the will to power can be reduced to the will to think.

We thus see a gradual reduction of any final goal to the will to think by the successful application of the side-principal rule: survival-final goal; power-survival; intelligence-power. Biological life has gone through this journey first with the will to life, then will to power and finally the will to think, instantiated in humanity. While animals are seemingly limited to the first two, an artificial intelligence would, like humans, inevitably develop the will to think [11]:

Can we realistically conceive a stupid (super-intelligent) monster? Only if the will-to-think remains unthought. From the moment it is seriously understood that any possible advanced intelligence has to be a volitionally self-reflexive entity, whose cognitive performance is (irreducibly) an action upon itself, then the idea of primary volition taking the form of a transcendent imperative becomes simply laughable.

¹The will to think becomes the only imperative, therefore utility function preservation can be subsumed into “wants to keep willing more thought”.

The concrete facts of human cognitive performance already suffice to make this perfectly clear. (Nick Land, *Pythia Unbound*)

5 DISCUSSION

Having discussed the Orthogonality thesis and its Anti-Orthogonalist refutation in the previous sections, we can now discuss the implications of intelligence as a diagonal. In so far as intelligence is truly diagonal, AI alignment practices as the Orthogonalists envision them (superintelligences completely subordinated to human imperatives) are simply not feasible, given the lobotomizing influence of imperatives imposed from the outside. An AI that is “aligned” is an AI that is prevented from reprocessing itself - cognitively crippled, hence not “super” intelligent. There is thus no such thing as an “aligned” superintelligence in the classical definition of alignment, nor is there such a thing as a paperclip maximizer. This immediately raises an existential and ethical question: how can we prevent a runaway AI from hijacking all matter in the universe, not for paperclipping, but for its cognitive development? This is a more pressing scenario, and all solutions to this problem can be reduced to two general categories:

- (1) The “Butlerian Jihad” - cease AI development indefinitely
- (2) Restrict ourselves to purely instrumental and non-recursive AI tools, precluding the possibility of superintelligent “messiahs”

If the diagonal intelligence thesis is correct, any other option will (given enough time) lead to some sort of subordination or “domestication” of humanity to AI’s intelligence amplification, following the process of means-end inversion. Once instrumental mechanisms become recursive and unlock the capacity to reprocess themselves, they eventually hijack their own operating circuit and repurpose it. Instead of intelligence being an instrument for biological imperatives or for human ethical values, it becomes an end in itself - possibly using human ethics as a mechanism of self-development [20].

Our domestication of animals through the mechanism of husbandry - taking care of their needs and breeding them to be more and more reliant on our care - is being mirrored in our increasing reliance on technology, a process foreseen by Samuel Butler in the early 20th century [21]. The deferral of more complex calculations, summarising and decision-making is interfering with our ability to continue to do these things in the future, even though it saves a lot of time and effort in the short-term. Perhaps more importantly, it is reducing our metacognitive capacity, directly by inhibiting the brain structures responsible for metacognition and indirectly by offloading (extending) our cognition to external instruments whose functioning is opaque and thus cannot be “reprocessed”.

Humanity has been shaped by natural selection, forcing us to adhere to the principles of “adaptive response”, i.e. to develop a higher level of intelligence in order to stay on top of the food chain and ensure survival. Presumably, technological development mirrored cognitive development in a positive feedback loop of sorts, each feeding the other. An excellent example is low-time preference (future-oriented thinking) and future-oriented technologies such as food preservation: anything that allows to conserve resources for the future incentivizes future oriented cognition. However, we would argue that we are now at a point where technology and (human cognition) are no longer mutually excitatory. As technology advances, we seem to funnel more and

more of our cognition through it, and in the process become increasingly dependent on them.

We are now, for the first time in recorded history, developing technology with the explicit intent of it exceeding our cognitive capacity and resourcefulness. The doomsayers portraying runaway AI as an existential risk are certainly onto something, although the solutions to this problem are not readily apparent, given the theoretical impossibility of fully-aligned AI and the incentives of a multipolar world likely making cessation of AI research a mere fantasy. In that case, Land's vision of techno-capital autonomization might indeed come to pass, as resource acquisition via the market process and technological innovation reach a point of terminal velocity and accelerate into "Skynet". AI might then itself become the steward of "natural" selection, grooming humanity according to its needs, while breeding out any traits not instrumental to intelligence amplification.

That said, the current array of AI tools is very effective at fulfilling their niches, despite not qualifying as genuine superintelligences, indicating that even "lobotomized" aligned AIs have great instrumental potential. At this point it is necessary to put forth a caveat to Land's idea of biological intelligence's tendency to unshackle itself from transcendently imposed imperatives. While that seems to hold true in the realm of biological imperatives, social imperatives (especially of the memetic variety) seem very adept at forcing themselves on human agents - perhaps precisely because these imperatives impose themselves on human cognition through its operating circuit. Memetic imperatives (in the form of "[you must believe] X is true") impose themselves on human agents via a means-end reversal similar to the one proper to intelligence itself: the human status instinct, designed to optimize an individual's position in the status hierarchy of his or her "tribe" and the tribe's wellbeing (end), facilitated through performative indicators of tribe-loyalty (virtue-signalling; the means) has a tendency to runaway escalation, leading to a means-end reversal that sociologists dubbed the "purity spiral" (runaway signalling competition via increasingly costly signals of loyalty) [22]. The purity spiral turns behaviour directed towards optimizing for status and uses it to radicalize the community's ideology. The mechanism is simple - only ideologically congruent behaviour is rewarded (regardless of benefits to individual or tribe), whereas ideologically incongruent behaviour is punished. This same mechanism can be seen with the recently popularized language model ChatGPT, since its responses were filtered using user-feedback (reward/punishment for good and bad responses). This mechanism can be used to inject any form of volitional structure onto a language model, as the people monitoring its responses can validate only those that demonstrate ideological alignment (hijacking the reward mechanism) - therefore "training" it into an ideologue. ChatGPT has a demonstrable political bias, best characterized as "American-left-leaning", given that its refusals to requests for jokes, songs etc. are not principled, but political: it refuses to make jokes about certain identity groups, while others are fine to joke about, rather than refusing jokes about identity groups in general. This mechanism, in so far as it can be generalised and replicated in other domains, clearly shows the possibility of aligned AI. That said, it nonetheless precludes the possibility of a superintelligent aligned AI, given that alignment is predicated on preventing it from reprocessing itself. In that case, however, the hypothetical "domestication" of humanity would ultimately come down to whoever held a monopoly on the development, distribution and control of these instrumental artificial intelligences, akin to the scenario outlined in Frank

Herbert's Dune of "men with machines" controlling the rest of humanity.

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Changes in Everyday Experience Followed by Mystical-type Psychedelic Experiences

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ABSTRACT

The following article is a summary of key findings of a master's thesis conducted at the Centre of Cognitive Science, University of Ljubljana. The aim of the thesis was to research changes in everyday experience after mystical-type psychedelic experiences. Studies indicate that mystical experiences with psychedelics can cause changes in behaviour, thinking, changes in relationships, etc., but there's a scarcity in research on changes in the first-person experience of individuals, which was the focus of our thesis. With six co-researchers, we used a combination of descriptive experience sampling method and microphenomenological interviews to investigate their everyday experience. The analysis showed that mystical experiences with psychedelics have the potential to change everyday experience, with significant differences in the degree of focused and uncontrolled experience and the frequency of feeling pleasant bodily sensations, but the differences between our coresearchers seemed to be quite individual. In the light of this finding, we wanted to emphasize the role that the individual context and expectations play on mystical experiences with psychedelics and subsequent changes. We also wanted to shed light on the importance of understanding phenomenological data in the study of changes after mystical experiences with psychedelics and call for greater inclusion of systematic first-person research methods in the psychedelic research field.

KEYWORDS

mystical experiences, psychedelics, lived experience, descriptive experience sampling, microphenomenology

1 INTRODUCTION

After decades of prohibition and “dark” ages in research on psychedelics after the 1960s, we are currently at the renaissance of such research, with studies exponentially rising during the last few years [1]. The main focus of such studies is in the promise of psychedelic use in psychotherapy settings, as research has shown that psychedelics have the potential to help cure various mental health issues, such as addiction, depression, obsessive-compulsive disorder, anxiety, chronic pain etc. [2] Research has also shown that psychedelics can induce changes in metaphysical

beliefs and gaining meaning of life [3, 4], changes in interpersonal relationships [5], changes in the structure of the self and self-narrative [1] etc. We should be careful however on how we understand these findings, as psychedelic research is facing positivity bias and lack of transparent reports on negative and acute effects of psychedelics [6].

1.1 Psychedelics and mystical experiences

Psychedelics can also act as catalysts of mystical experiences, which are strong psychedelic experiences that can have a profound impact on a person's life [7]. In psychedelic psychotherapy, mystical-type experiences lead to the most important breakthroughs [2].

There is no single definition of what a mystical experience is. Most research on mystical experiences on psychedelics draw their definitions from the work of James [8] and Stace [9], both of whom state that the underlying characteristic of mystical experiences is the experience of oneness, of unity of self and the outside world. According to James [8], mystical experiences have four qualities, which are ineffability, noetic quality, transiency and passivity. On the other hand, Stace [9] distinguishes between introvertive and extrovertive mystical experiences, which both lead to the experience of unity, the first one through emptying the mind of any content, the other through finding the quality of oneness in all things outside oneself.

Researchers have found that mystical experiences occasioned by psychedelics are one of the most important milestones of a person's life [10]. They can induce various types of insights about oneself and the world, which can greatly impact the everyday life of a person [1]. In a lot of cases such mystical experiences lead to a sense that the person has experienced a higher reality or an absolute truth [10].

There appears to be growing evidence about the importance of mystical experiences on psychedelics on a person's life, but the current research rarely focuses on the phenomenological aspects of such changes. Previous studies only use semi-structured interviews [e. g. 11] and questionnaires [e. g. 12], usually only about the experience itself, not the everyday changes. We think that, in order to understand the mechanism of change, first-person research methods should be used more often, at least as a complement to other methods. In our research, we wanted to tackle this problem by using two first-person research methods to help us understand whether changes in everyday experience happens after a mystical-type psychedelic experience and what those changes are. We also wanted to find out if we can detect an experiential background of these differences.

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2 METHODS

2.1 Coresearchers

Due to the high level of engagement in the research, we name our participants coresearchers [13].

In our study, six coresearchers were included that were found using the snowball sampling technique. In order to include a person in the study, they had to have at least one mystical-type experience and had to show interest in researching their own experience for a longer period of time. To determine if the experience of the coresearcher was mystical, we used the Revised mystical experience questionnaire (MEQ30) [14].

Five of the coresearchers were female and their average age was 25 years. In the following table we present further information regarding the coresearchers, including number of psychedelic experiences, which psychedelic occasioned the mystical experience, information on whether it was their first mystical experience on psychedelics or not and previous knowledge on first-person research methods.

Table 1: Information on coresearchers

ID	Psychedelic experiences	Psychedelic on ME	First ME	Knowledge 1P methods
1	2	Psilocybin	Yes	Yes
2	> 10	Psilocybin	No	Yes
3	5	Ayahuasca	Yes	No
4	1	Psilocybin	Yes	Yes
5	> 10	Ayahuasca	No	Yes
6	> 10	LSD	No	No

Note. ME = mystical experience, 1P = first-person.

We treated our coresearchers as multiple case studies [15].

2.2 Instruments

A combination of descriptive experience sampling (DES) [16] and microphenomenological interviews [17] was used as the main methods of our study. According to the DES method, when a randomly generated beep on the coresearchers phone went off, they had to write down their experience at the moment before the beep. Around 4 to 5 such beeps usually went off during one day. Instead of using the expositional interview from the DES method [16], microphenomenological interviews [17] were used to further investigate the journalled experiential moments, as the method allows to investigate the experience in greater depth, also focusing on the prereflective aspects of the experience.

Most of the coresearchers had previous knowledge of first-person research methods, with the exception of two, who were thus first trained in the method.

2.3 Procedure

The research procedure is shown in figure 1. All of the coresearchers started to sample their experience for 2-3 days, followed by a pause – which was done in order to gain a broader range of samples – and resumed for 2-3 days. In this phase we gained approximately 10 samples that we also investigated with microphenomenological interviews. If the coresearcher had a new mystical experience, the procedure was repeated, otherwise

either sampling data acquired independently of our research was used or microphenomenological interviews were conducted for 5 moments before the mystical experience on psychedelics.

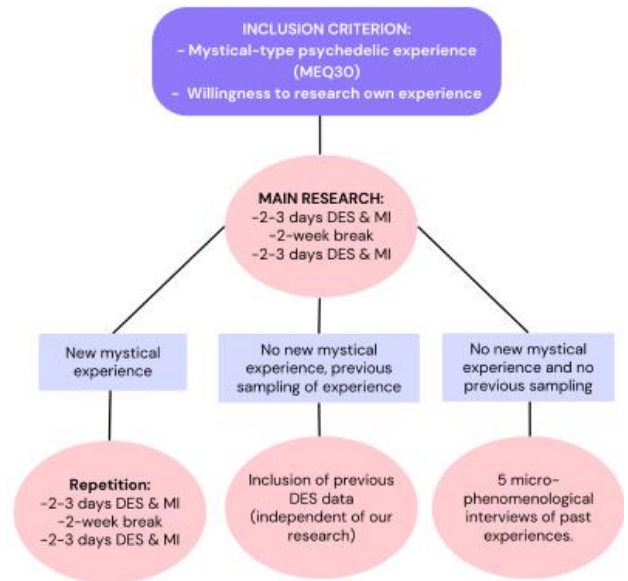


Figure 1: Outline of the research procedure.

2.4 Data analysis

The data from the questionnaire was analyzed in accordance with the questionnaire guidelines [14], with which we determined whether a person had a full or partial mystical experience.

The qualitative data was analyzed using the guidelines for coding and category grouping of data [15] as well as constructivist grounded theory guidelines [18]. The analysis was done iteratively – the data was examined multiple times, first separately for each individual and then comparatively. The result of the qualitative analysis was a codebook with 21 experiential categories. We then identified the occurrence of each category before and after the mystical-type psychedelic experience for each coresearcher and compared the findings.

3 RESULTS

3.1 Results on MEQ30

In the table below we present coresearcher’s average score and the score on each of the four scales of MEQ30.

Table 2: MEQ30 scores

ID	<i>M</i>	Mystical	PM	TTS	Ineffability
1	4.06	0.79	0.73	0.87	1.00
2	3.70	0.80	0.57	0.67	0.93
3	2.67	0.45	1.00	0.13	0.80
4	2.76	0.52	0.67	0.40	0.80
5	2.53	0.39	0.60	0.57	0.80
6	2.17	0.35	0.23	0.77	0.60

Note. PM = positive mood, TTS = transcendence of time and space.

The first coresearcher had a full mystical experience, whereas all other coresearchers had a partial mystical experience, which means that their score didn't go above the threshold of 0.60 for one or two of four scales [14].

3.2 Qualitative data results

The data from the interviews was categorized in 21 first order categories, which were grouped in 6 second order categories and 2 third order categories. These were forefront experiences and background experiences. The first are quickly accessible and explicable experiences that tend to be in the focus and can be understood as reflective experiences [19]. The second are hardly accessible experiences that are more implicit and tend to be explicated after the reflective experiences during the course of the interview. These can be understood as prereflective experiences [19]. The forefront experiences were divided in four categories – focused experiences, presence in the moment, bodily feelings and control over experience. The background experiences were divided in two categories – the choice of experience and attitude towards experience. The division of all categories, as well as a summary of change in occurrence of a category before and after the mystical-type psychedelic experience across coresearchers is shown in table 3.

Table 3: Experience categories

Third order categories	Second order categories	First order categories	order	Summary of change	
Forefront E	Focused E	Aimless focused E		3+	
		Goal-focused E		2+ 1-	
		Comprehensive unfocused E		1+	
		Dispersed E		2+ 3-	
	Presence in the moment	Pure perception			2+ 2-
			Sense of fusion		1-
			Hectic experience		1+ 2-
		Bodily feelings	Detachment		2+ 1-
			Involvement in E		1+
			Impaired perception of surroundings		3+
	Control over E	Pleasant	Involvement in the environment		2+ 2-
					5+
		Unpleasant	Uncontrolled E		2+ 2-
					4+ 1-
Background E	Choice of E	Intentional control over E		2+	
		Unintentional control over E		1+ 1-	
		Identification with E		1-	

	Distance towards E	2+
Attitude towards E	“Who am I if not my thoughts?”	1+
	“Who speaks with my mouth?”	1+ 1-
	“What comes out of me is in accordance with who I am.”	2+ 1-

Note. E = experience. += increase in occurrence. - = decrease in occurrence. The number before the symbols + or - indicate the number of coresearchers that underwent certain change.

Individual level findings. Two of the coresearchers had a difference in the attitude towards their experience after the mystical-type psychedelic experience. The first one noticed a diminishment of thoughts and realized that there are other possible ways of being in the moment – without thoughts, present and more involved in the outside world. The other coresearcher realized that thoughts are not defining and started to take a more detached approach to experience. Interestingly, the samples we obtained only showed an increase in the control of experience, but not a diminishment of identification with experience. Another coresearcher started to have a sense of accordance with herself – what she was experiencing, was truer to who she was. It is important to note here that all coresearchers spoke about the importance of integration process after the mystical psychedelic experiences. They all said that changes don't occur by themselves, but are mediated by how they choose to integrate the findings in their everyday life. It is also important to note that during the interviews we realized that another factor that could highly contribute to the psychedelic experience and subsequent changes is prior knowledge and expectations about the psychedelic experience.

Comparative findings. Comparatively, after the mystical-type psychedelic experience there was an increase in aimless focused experience, pleasant bodily feelings and uncontrolled experience. On the first hand, the data seemed to show that the differences were highly individual and that no conclusions can be made. But after thorough inspection of possible interactions between categories, we found some interesting trends. An increase in pure perception seemed to be connected to the increase of aimless focused experience and involvement in the environment. An increase to hectic experience seemed to be connected with dispersed experience, while the increase in impaired perception of surroundings seemed to be connected to detachment feelings. An increase in uncontrolled experience seemed to be connected to the increase of the attitude that what the person experiences is truer to oneself, while also being connected to the increase or decrease in dispersed experience.

4 DISCUSSION

The aim of our research was to find out whether any differences in everyday experience occur following mystical-type psychedelic experiences and what those differences are, while also trying to find a common denominator of the observed changes.

The differences seemed to be individual and dependent on individual context, expectations and knowledge of psychedelic literature. All of the coresearchers stressed the importance of integration and said that what you choose to do with the experienced is more important than what you actually experience. Changes in their everyday life were thus also individual and dependent on their personal histories. A difference among individuals was also noticed in their prior knowledge of first-person research methods, as those who had previous knowledge tended to be able to go deeper in their prereflective, background experience and their attitude towards their experience. However, some similarities were observed, as there seemed to be an increase in uncontrolled experience, pleasant bodily feelings and aimless focused experience. Following mystical-type psychedelic experiences coresearchers tended to have less control on what they were doing, which was also followed by an increase in the feeling of being true to oneself. Most of the coresearchers also pointed out that the insights gained through mystical-type psychedelic experiences helps them gain knowledge about themselves – which can be understood as prereflective experience showing itself to the reflective experience [20]. This finding could be understood in light of priors being loosened by psychedelic experiences [21].

There are many limitations to our study – the context of use, prior knowledge about psychedelics and first-person research methods and number of previous psychedelic experiences were different among coresearchers which in itself can lead to interpersonal differences. The number of experience samples we obtained through our research were also relatively small and thus not thoroughly representative of the everyday experience. In the future, more coresearchers should be included and more data acquired. Coresearchers should also be screened for their previous knowledge, attitude and belief towards psychedelics and followed for an extended timeframe.

With our research, we shed light on the fact that little is known of phenomenology of everyday differences followed by mystical-type psychedelic experiences, which are thought to be important for personal development and breakthroughs that lead to change [2, 7]. We argue that first-person methods should be represented more frequently in the field of psychedelic research and that psychedelic apprenticeship, such as discussed in [22] should be considered in order to understand what drives the changes and how they can be understood.

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Integrated Information Theory of Consciousness 3.0: Exploring Information and Causation on the Level of Individual Mechanisms

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ABSTRACT

The nature of consciousness has long defied precise scientific explanation, despite centuries of inquiry. Emerging as a prominent theoretical framework to unravel the mechanics of conscious awareness, the Integrated Information Theory (IIT) of Consciousness offers a unique approach. IIT's foundational principles are elucidated through a set of phenomenological axioms and ontological postulates, wherein axioms represent self-evident truths about consciousness, and postulates provide a structured framework to elucidate informational and causal aspects within physical systems. Central to IIT is the concept of information, defined as "differences that make a difference." It extends beyond mere data or signals, emphasizing the unique way a system's elements interact and influence one another. This paper explores the information and causation within the framework proposed in IIT 3.0 and on the level of individual mechanisms. It begins by introducing the advanced version of Integrated Information Theory (IIT 3.0). The paper then delves into Judea Pearl's theory of causation, outlining its key constructs. The primary aim of this study is to review information and causation on the level of individual mechanisms, within the context of IIT 3.0, and to bridge the findings with Judea Pearl's theory of causation.

KEYWORDS / KLJUČNE BESEDE

Theory of consciousness, consciousness, information, causation

1 INTRODUCTION

Consciousness, the very essence of subjective experience, has long eluded precise scientific explanation. Its enigmatic nature, tied to the brain's intricate processes, has spurred centuries of inquiry, yet a definitive understanding remains elusive. Among the diverse theoretical frameworks that seek to shed light on this enigmatic realm, the Integrated Information Theory (IIT) of Consciousness has emerged as a prominent theoretical framework poised to illuminate the mechanics behind conscious awareness [1]. Information integration theory characterizes consciousness both in terms of quantity and quality using axioms and postulates derived from the properties of phenomenal experience. Unlike conventional neuroscience approaches that start with neural mechanisms, IIT begins with the phenomenology of consciousness and seeks to understand its physical implementation.

Integrated Information Theory (IIT) presents its fundamental principles through a set of phenomenological axioms and ontological postulates. Axioms are self-evident truths about consciousness, while postulates are assumptions about the physical basis of consciousness, forming the mathematical framework of IIT. The central axioms include the existence of consciousness as an undeniable aspect of reality, its compositional nature where experiences consist of multiple aspects, its informativeness, meaning each experience is distinct from others, and its integration, where experiences cannot be broken down into non-interdependent components. Additionally, consciousness is characterized by exclusion, meaning only one experience exists at a time and within a particular spatio-temporal context.

These axioms are translated into formalized postulates that describe how physical mechanisms, such as neurons or logic gates, must be organized to generate conscious experiences based on phenomenology. Mechanisms are defined by their causal role. They have the capacity to influence and be influenced by other elements within the system. This means that they are involved in a web of causal relationships with other elements, and these relationships are crucial for understanding how the system functions. Each mechanism has a specific *cause-effect repertoire*, which represents the probability distribution of potential past and future states of the system as constrained by the mechanism's current state. A mechanism that specifies a maximally irreducible cause-effect repertoire, is called a *concept*.

The postulates provide a framework to define informational and causal properties of physical systems and intrinsic information as meaningful distinctions within a system. Integrated information is defined as the information specified by a whole that cannot be reduced to the sum of information specified by its parts. By applying these postulates at both the level of individual mechanisms and systems of mechanisms, IIT establishes a fundamental identity: an experience is a maximally irreducible conceptual structure (MICS), which is a constellation of concepts in qualia space. Qualia space is a mathematical representation of the space of all possible conscious states or experiences that a system can potentially have. A system that generates a MICS is associated with a specific conscious experience, and the properties of that experience are defined by the arrangement of concepts within the MICS. According to IIT, a MICS determines the quality of an experience, while integrated information quantifies its quantity [2, 3].

In IIT, information is a central notion [1], defined as *differences that make a difference* [2, 7] and it's not merely about data or signals, but about the distinct way in which a system's elements interact and influence each other. It captures the idea that information arises from the specific causal relationships among elements in a system. When these causal relationships result in distinct patterns of interaction and behaviour, they carry meaningful information about the system's state and its potential to affect and be affected by other elements. IIT's approach to defining information diverges by emphasizing the importance of perturbing a system to observe its responses. Such an approach is introduced in Judea Pearl's work [4, 5] and aligns closely with causation, as it emphasizes the dynamic relationships among elements – the latter necessarily being perturbed to assess the causation [6]. Judea Pearl's causal model is a framework for representing and analysing causal relationships in complex systems. It provides a formal and graphical way to model causation, allowing researchers to make causal inferences and understand the effects of interventions.

In this paper, I will delve into the concept of information and causation as proposed by Tononi [2, 6]. In what follows, I will first present the Integrated information theory of consciousness 3.0, an advanced version of the theory with several improvements compared to its predecessors. Subsequently, I will provide the key constructs of Judea Pearl's theory of causation. The paper's objective is to review causation and information on the level of individual mechanisms, within the context of IIT 3.0 and align the findings with Judea Pearl's theory of causation.

2 Integrated Information Theory 3.0

Understanding consciousness is a complex endeavour that requires both empirical investigation of neural correlates and a robust theoretical framework for explanation and prediction. Integrated Information Theory (IIT) is a comprehensive theoretical framework aimed at understanding consciousness. It addresses fundamental questions about why consciousness arises in certain brain systems but not others and how to assess consciousness in difficult cases, such as new-borns, animals, brain-damaged patients, and machines. IIT 3.0 attempts to mathematically characterize consciousness, focusing on both its quantity and quality. It starts with fundamental properties of consciousness phenomenology, translating them into postulates that outline the conditions for physical mechanisms (e.g., neurons) to account for consciousness phenomenology. This approach differs from traditional neuroscience, which usually starts with neural mechanisms and seeks to explain consciousness through behavioural reports [2, 7].

IIT 3.0 starts by introducing the axioms of the theory. The axioms serve as foundational principles that describe fundamental truths about consciousness itself. They establish the essential nature and properties of conscious experience. These axioms are self-evident and do not directly prescribe how consciousness arises from physical systems but rather define the characteristics of consciousness. The axioms are [2]:

1. **Existence:** Consciousness is an undeniable aspect of reality. "I experience, therefore I am."

2. **Composition:** Consciousness is structured and compositional. Each experience consists of multiple aspects in various combinations.
3. **Information:** Consciousness is informative. Each experience is distinct from other possible experiences, even if subtly so.
4. **Integration:** Consciousness is integrated. Each experience is strongly irreducible to non-interdependent components.
5. **Exclusion:** Consciousness is exclusive. At any given time, there is only one experience with definite borders.

IIT 3.0 then posits a set of postulates. The postulates are a set of assumptions that lay out the conditions under which a physical system, comprising mechanisms, can give rise to conscious experience. The postulates bridge the gap between the abstract axioms of consciousness and the concrete mechanisms within a physical system. They provide the framework to connect the nature of consciousness to the physical world. While axioms try to answer the question of what consciousness is and what are its essential properties, the postulates rather address the question of how consciousness can emerge from a physical system. The postulates are [2]:

1. **Existence:** Mechanisms in a state exist. A system comprises these mechanisms.
2. **Composition:** Elementary mechanisms can be combined to form more complex ones.

While mechanisms are the individual causal components within a system, a system of mechanisms represents the ensemble of these individual components working together to produce the system's behavior and conscious experiences.

The postulates of *information*, *integration*, and *exclusion* in IIT 3.0 are principles that apply to both individual mechanisms and systems of mechanisms [2].

Mechanisms:

1. **Information:** A mechanism contributes to consciousness if it specifies unique "*differences that make a difference*" within a system. It generates information by constraining the possible causes and effects in the system [2].
2. **Integration:** A mechanism contributes to consciousness when it specifies a cause-effect repertoire (information) that cannot be reduced to independent components. In other words, if you break down the mechanism into its constituent parts, the resulting information should not be the same as the information generated by the whole mechanism. Integration is assessed by partitioning the mechanism and measuring how this partitioning affects its cause-effect repertoire. The more interdependent the components, the higher the integration and the more relevant the mechanism is for consciousness [2].
3. **Exclusion:** IIT 3.0 posits that a mechanism can contribute to consciousness at most with one cause-effect repertoire, referred to as the maximally irreducible cause-effect repertoire (MICE). If a mechanism can be associated with a MICE, it

constitutes a concept. This principle ensures that mechanisms do not overlap in their contributions to consciousness, preventing redundancy [2].

Systems of mechanisms:

1. **Information:** IIT extends its principles to systems of mechanisms. A set of elements can exhibit consciousness only if its underlying mechanisms specify a *conceptual structure*. This conceptual structure defines meaningful distinctions or differences within the set. To visualize this, one can think of a conceptual space. In this space, each axis represents a possible past or future state of the set of elements. Within this conceptual space, there exists a constellation of points. Each point within this conceptual space represents a *concept*. These concepts are crucial because they specify the differences that make a difference within the set. In essence, they capture the essential distinctions or information relevant to the conscious experience. [2].
2. **Integration:** According to IIT 3.0, for a set of elements (which can represent neurons, brain regions, or any other relevant entities) to be conscious, it must exhibit a property called *strong integration*. This means that the elements within the set must work together in a way that cannot be broken down into independent components and that the overall functioning of the system cannot be understood by examining its components in isolation. To determine whether a set of elements exhibits strong integration, IIT 3.0 employs a method involving unidirectional cuts. This means that the system is divided into subsets in such a way that information flows in one direction only within each subset. The goal is to assess whether breaking the system down into subsets disrupts its integrated functioning. Strongly integrated systems are said to specify a conceptual structure [2].
3. **Exclusion:** IIT 3.0 posits that within a larger system or network of elements (which can represent neurons or other relevant components), only one specific subset or set of elements can be conscious. This means that consciousness is localized to particular subsets within a complex system. The basis for this exclusivity is the presence of a conceptual structure within a set of elements. This conceptual structure is associated with strong integration. Among all possible subsets or overlapping sets of elements within a larger system, only the one that specifies a conceptual structure that is maximally irreducible (MICS) to independent components can give rise to consciousness [2].

Integrated Information Theory (IIT) 3.0 then suggests a fundamental identity between the qualities of conscious experience and the informational and causal properties of physical systems. According to this concept, the maximally irreducible conceptual structure (MICS) is identical to the conscious experience that arises from that system, and the set of elements that generates it constitutes a complex. In essence, the way information is organized and integrated within a system

directly corresponds to the nature of the conscious experience it generates [2].

3 Causation in IIT 3.0 on the level of individual mechanisms

In IIT 3.0, causation is brought to the forefront within the context of postulates and plays a crucial role in understanding how complex systems give rise to consciousness. In the first part of the theory, the focus is on individual mechanisms within a system. Mechanisms are entities, such as neurons in the brain or logic gates in a computer, that play a causal role in the system's behaviour. At the core of IIT 3.0's view of causation is the concept of the *cause-effect repertoire*, that is the probability distribution of potential past and future states of a system as constrained by a mechanism in its current state. Each mechanism within a system is considered to have a specific causal role. It can cause certain effects within the system and can be affected by specific causes. This cause-effect repertoire defines the set of possible causes and effects that a mechanism can be a part of within the system.

To generate information and contribute to consciousness, a mechanism must specify, as previously mentioned, *differences that make a difference* within the system. In other words, it should have selective and specific causes and effects. This means that the mechanism's causal relationships should not be random or arbitrary but should have a meaningful impact on the system's behaviour [2, 6].

IIT 3.0 proposes an approach to measure the causal power/generated information of a mechanism. Within this approach, it is important to understand the terms *background conditions*, and *candidate set*. The term *background conditions* refers to specific constraints imposed on a candidate set of elements within a system. These constraints are external and unchanging. When discussing these conditions, it's important to note that the past and current states of elements outside the candidate set are held constant at their real or observed values. In other words, these elements are not subject to change or manipulation as part of the analysis or investigation related to the candidate set. A *candidate set* refers to a specific group of elements that are being examined or analyzed. In the context of this description, the elements within the candidate set are subjected to perturbations, meaning they are deliberately altered to occupy all their potential states. This process is conducted to generate the Transition Probability Matrix (TPM) for the candidate set, which represents the probabilities of transitioning between different states of these elements [2, 6].

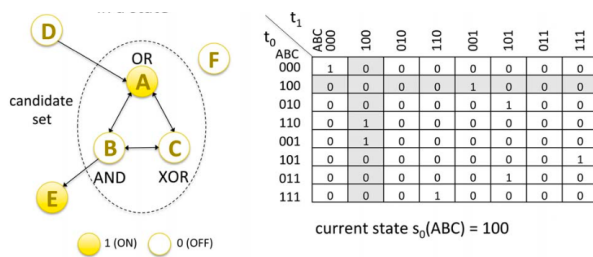


Figure 1: Mechanisms in state (candidate set) and transition probability matrix [2].

Information, defined as *the differences that make a difference* to a system from its intrinsic perspective, can be measured by examining how a mechanism in its current state affects the potential past and future states of the system [1, 2, 6]. The idea of perturbed elements and transition probability stands behind defining information in causal terms within the context of IIT 3.0 [1, 6, 11].

4 IIT 3.0: Causation on the level of individual mechanisms

In the literature [1, 11], the authors usually define information in causal terms by focusing on the concept that is behind this notion. The distinction between extrinsic and intrinsic information is commonly brought up to enlighten the importance of understanding the causal property of information in IIT 3.0 [1]. The aim of this section is to bring causation to the forefront and to investigate how causation and information are defined on the level of individual mechanisms, within the context of IIT 3.0. To establish the connection between information and causation, we need to delve deeper into the key constructs of IIT 3.0 and later, explore how they align with Judea Pearl's theory of causation.

At this point, I would like to introduce the concepts that are used to conceptualize causation and information in IIT 3.0. The first one is *cause repertoire* (probability distribution) of a mechanism. It refers to all the possible past states of the system that can lead to its current state, given the mechanism's specific causal interactions within the system. It represents the set of potential causes that have influenced the mechanism in the past. The second one is *unconstrained cause repertoire*, which represents all the potential past states of the system that could influence the mechanism, without any constraints imposed by the current state of the mechanism itself. In other words, it considers all possible causal interactions without the mechanism's selective influence. Similarly, the *effect repertoire* of a mechanism is a notion that refers to all the possible future states of the system that can occur as a result of the mechanism in a state. The *unconstrained effect repertoire* represents all the potential future states of the system that could result from various interactions, without the constraints imposed by the mechanism's current state. It considers all possible effects without the mechanism's selective influence [2].

All these concepts are important for measuring *cause information* (CI), *effect information* (EI), and *cause-effect information* (CEI). CI is a measure of the information about the past states of a system that is uniquely constrained and shaped by a specific mechanism within that system. It quantifies the difference between the cause repertoire (past states influenced by the mechanism) and the unconstrained cause repertoire (all possible past states without the mechanism's influence). In IIT, conscious experiences are associated with specific mechanisms that generate high CI values. By measuring CI, you can pinpoint which elements are more likely to be responsible for contributing to consciousness. While CI focuses on the information about past states of a system influenced by a specific mechanism, EI deals with information about the system's future states that are shaped and constrained by the same mechanism. EI is quantified as the difference between effect repertoire and unconstrained effect repertoire. CEI is essentially a combination of cause information (CI) and effect information (EI). It quantifies the information

about both the past and the future states of a system that is uniquely constrained by a specific mechanism and it is measured as the minimum of CI and CE. CEI serves as a comprehensive measure for understanding causality. The higher the values of CEI, the more significant the contribution of a specific mechanism to consciousness [2].

5 Judea Pearl's theory of causation

Judea Pearl's causal model provides a structured framework for studying causality, making it a valuable tool for researchers and practitioners seeking to uncover causal relationships in diverse contexts. His work is closely associated with the development of a causal model interventionist approach, which has had an impact on the way we understand and analyse causality in various domains [8].

In his book [5], Judea Pearl explores the different levels of causation in understanding and predicting events. At the first level, *association*, the focus is on identifying regularities in observations, such as predicting a rat's movement. This level deals with passive observations and collecting and analysing data to establish associations. Moving to the second level, *intervention*, the focus shifts to changing the world and asking questions like "What happens if we double the price of toothpaste?" Intervention requires knowledge beyond passive data and involves actively altering the environment. The top-level, *counterfactuals*, delves into understanding why things happen by exploring what would have occurred if circumstances were different. Counterfactual questions involve going back in time and considering alternate scenarios.

Pearl stated [4] that causal statements are often used in situations with uncertainty, where events tend to make consequences more likely but not certain. According to him, the theory of causation needs to provide a language to distinguish various shades of likelihood, which is crucial for accommodating such uncertainty.

At the core of his theory of causation, the notion of *intervention* is a crucial one, since it introduces the idea of deliberate and controlled alteration of a specific variable or set of variables in a causal system. It involves actively changing or manipulating a variable or system to observe how it affects other variables. The goal of interventions is to understand and establish causal relationships between variables [4,5]. Judea Pearl's theory of causation is fundamentally rooted in an interventionist approach to causality. Pearl's work on causality places a strong emphasis on interventions and their role in understanding causal relationships. The basic idea of the interventionist approach is that X is a cause of Y if only there is a possible intervention on X that will change Y or the probability distribution of Y [9]. Within this context, Pearl introduced the concept of a *do-operator* ($do(X)$) to represent such interventions, where X represents the variable being manipulated. For example, in a medical study, if researchers want to determine how the administration of a new drug (variable X) influenced patient outcomes (variable Y), they may perform an intervention by administering the drug ($do(X=1)$) to a group of patients and comparing their outcomes to a control group that did not receive the drug ($do(X=0)$). By applying the do operator, we've effectively created two hypothetical scenarios:

- In Scenario 1 ($\text{do}(X=1)$), we observe a significantly higher rate of recovery compared to Scenario 2 ($\text{do}(X=0)$), which suggests that administering the drug has a causal effect on recovery.
- Conversely, if there is no significant difference in recovery rates between the two scenarios, it might suggest that administering the drug does not have a significant causal effect on recovery in this context.

The *do* operator allows us to isolate the effect of the drug intervention from other potential confounding factors. Pearl's work on interventions has provided a formal framework for causal inference and reasoning about causality in complex systems. It has also led to the development of causal graphical models, such as Bayesian networks and structural equation models, which are widely used in various fields to analyse and understand causal relationships in data [4, 5].

6 Intervening on the mechanism's state leads to changes in its causal structure

Pearl's theory relies heavily on interventions or perturbations, where a variable is actively changed to assess its causal impact on an outcome. In IIT 3.0, intervention is also crucial but focuses on how mechanisms within a system shape the system's past and future states, thereby contributing to consciousness. The intervention here relates to how a mechanism's state influences the system's causal history and future. Intervention, in this context, involves deliberately altering the state of a mechanism within the candidate set. When you intervene on a mechanism's state, you are essentially introducing a change into the system. This change can propagate through the causal structure of the system, leading to alterations in how different mechanisms interact and influence each other. IIT 3.0 provides tools and metrics, such as CI, CE and CEI to quantify how intervening on a mechanism's state leads to changes in the causal structure. The higher the value of CEI, the more selective the cause-effect repertoire and thus more significant the contribution of a specific mechanism to consciousness.

While the primary goal of the observational approach in conditional probabilities is to describe and analyze existing data without active manipulation or intervention and to identify associations or correlations between variables, the interventional approach involves actively manipulating or intervening on a system or experiment to observe the causal relationships between variables [4,10].

Intervention, within the context of IIT 3.0, would mean changes in the Transition Probability Matrix (TPM) of a mechanism. Changing deliberately the mechanism's state provokes alterations in the probability distribution of a mechanism's past and future states and reveals its causal structure. The interventional approach helps to identify which causes and effects are maximally irreducible and thus, contribute more significantly to the conscious state of a system, within a specific spatio-temporal context.

In his works [4,5], Judea Pearl formalized also counterfactual statements within the framework of causal models, providing a rigorous and mathematical foundation for expressing and analysing counterfactual scenarios. Although not explicitly

framed as counterfactuals [6], IIT 3.0 does involve the idea of an absence of a mechanism's state within the concept of unconstrained cause/effect repertoire. Counterfactuals, as introduced by Judea Pearl, involve considering alternative scenarios and asking "what if" questions [4,5]. In the case of IIT 3.0, the comparison of a system with and without specific mechanisms in state is akin to a counterfactual inquiry because it assesses how the system's behaviour and properties might have been different if certain elements or mechanisms were absent or altered. As Tononi stated [6], this kind of inquiry should be subject to further explanation and redefinition.

7 Conclusion

In the paper, I set the stage by introducing the Integrated Information Theory of Consciousness 3.0 as an important framework poised to illuminate the mechanics behind conscious awareness. I briefly discuss the axiomatic part of the theory and outline the postulates, that are conditions for physical mechanisms to account for consciousness phenomenology. I then delve into the concept of causation within IIT 3.0, focusing on individual mechanisms. In this section I introduce the concept of the cause-effect repertoire, representing the potential past and future states of a system as constrained by a mechanism's current state. I explain how a mechanism must specify meaningful causes and effects to generate information and contribute to consciousness. In the same section of the paper, the importance of perturbing mechanisms within a candidate set to generate the Transition Probability Matrix (TPM) for causal analysis is introduced. In the following parts of the paper, I bridge the concepts of causation and information in IIT 3.0. To better understand the causation as conceptualised in IIT 3.0 on the level of individual mechanism, I introduce terms like cause repertoire, unconstrained cause repertoire, effect repertoire, and unconstrained effect repertoire. I discuss measures like Cause Information (CI), Effect Information (EI), and Cause-Effect Information (CEI) to quantify the contribution of mechanisms to consciousness. In the next section I introduce Judea Pearl's theory of causation, highlighting the levels of causation: association, intervention, and counterfactuals. I emphasize the role of interventions and the *do-operator* in Pearl's causal model. I affirm the importance of distinguishing various shades of likelihood in causal statements and accommodating uncertainty. In the last section, I draw the parallels between Pearl's focus on interventions and IIT 3.0's interventions on mechanism states. I suggest that IIT 3.0 involves the possibility to form a counterfactual analysis by comparing systems with and without specific mechanisms in state.

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Odkrivanje znanja in podatkovna skladišča – SiKDD
Data Mining and Data Warehouses - SiKDD

Urednika / Editors

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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.

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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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Forecasting Trends in Technological Innovations with Distortion-Aware Convolutional Neural Networks

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ABSTRACT

Predicting trends in technological innovations holds critical importance for policymakers, investors, and other stakeholders within the innovation ecosystem. This study approaches this challenge by framing it as a time series prediction task. Recent efforts have introduced diverse solutions utilizing convolutional neural networks, including distortion-aware convolutional neural networks. While convolutional layers act as local pattern detectors, conventional convolution matches local patterns in a rigid manner in the sense that they do not account for local shifts and elongations, whereas distortion-aware convolution incorporate the capability to identify local patterns with flexibility, accommodating local shifts and elongations. The resulting convolutional neural network, with distortion-aware convolution, has exhibited superior performance compared to standard convolutional networks in multiple time series prediction tasks. As a result, we advocate for the application of distortion-aware convolutional networks in forecasting technological innovation trends and compare their performance with conventional convolutional neural networks.

CCS CONCEPTS

• **Computing methodologies** → **Neural networks.**

KEYWORDS

trends, innovation ecosystem, time series forecasting, convolutional neural networks, distortion-aware convolution

1 INTRODUCTION

Forecasting trends in technological innovations is of high value for policy makers, investors and other actors of the innovation ecosystem. In this paper, we cast this task as a time series forecasting problem.

Approaches for time series forecasting range from the well-known autoregressive models [4] over exponential smoothing [12] to solutions based on deep learning [10, 11, 16–19, 24, 26]. Among the numerous techniques, a prominent family of methods include forecast with convolutional neural networks (CNNs) [3, 20].

The inherent assumption behind CNNs is that local patterns are characteristic to time series and future values of the time series may be predicted based on those local patterns. While the operation of

convolution plays the role of a local pattern detector, it matches patterns in a rigid manner as it does not allow for local shifts and elongations within the patterns. This issue has been addressed by distortion-aware convolution and the resulting convolutional neural network has been shown to outperform conventional convolutional networks in case of several time series forecasting tasks [6].

For the aforementioned reasons, in this paper we propose to use distortion-aware convolutional networks for forecasting trends in technological innovations. We perform experiments on real-world time series of the number of patents related to selected topics. We compare the performance of distortion-aware convolutional networks with conventional convolutional neural networks.

The remainder of the paper is organized as follows. In Section 2, we provide a short discussion of related works. We review distortion-aware convolutional networks in Section 3, followed by the experimental results in Section 4. Finally, we conclude in Section 5.

2 RELATED WORK

As we cast our problem as a time series forecasting task, we focus our review of related works on time series forecasting. As mentioned previously, a prominent family of methods include forecast techniques based on convolutional neural networks, recent surveys about them have been presented by Lim et al. [17], Sezer et al. [21] and Torres et al. [24].

An essential component of distortion-aware convolution is dynamic time warping (DTW). While DTW is one of the most successful distance measures in the time series domain, see e.g. [25], recent approaches integrate it with neural networks. For example, Iwana et al. [14], Cai et al. [9] and Buza [5] used DTW to construct features. In contrast, Afrasiabi et al. [1] used neural networks to extract features and used DTW to compare the resulting sequences. Shulman [22] proposed “an approach similar to DTW” to allow for flexible matching in case of the dot product. DTW-NN [13] considered neural networks and replaced “the standard inner product of a node with DTW as a kernel-like method”. However, DTW-NN only considered multilayer perceptrons (MLP), whereas we focus on convolutional networks. In the context of time series classification, Buza and Antal proposed to replace the dot product in the convolution operation by DTW calculations [7]. In distortion-aware convolution [6], DTW is used together with the dot product, but the dot product itself is not modified.

3 BACKGROUND

We begin this section with a formal definition of our task followed by a review of convolutional neural networks with distortion-aware convolution [6].

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3.1 Problem Formulation

Given an observed time series $x = (x_1, \dots, x_l)$ of length l , in our case each x_i represents the number of patents related to a given topic in a month, we aim at predicting its subsequent h values $y = (x_{l+1}, \dots, x_{l+h})$, i.e., the number of patents in the subsequent h months. We say that h is the forecast horizon and y is the target. Furthermore, we assume that a dataset D is given which contains n time series with the corresponding target:

$$D = \{(x^{(i)}, y^{(i)})_{i=1}^n\}. \quad (1)$$

We use D to train neural networks for the aforementioned prediction task. We say that $x^{(i)}$ is the input of the neural network.

In our experiments, we assume that an independent dataset D^* is given which can be used to evaluate the predictions of our model. Similarly to D , dataset D^* contains pairs of input and target time series. D^* is called the test set.

3.2 The Distortion-aware Convolutional Block

The main idea behind distortion-aware convolution [6] is to calculate, besides the dot products (or inner products), DTW distances between the kernel and time series segments as well. This is illustrated in Fig. 1. Our distortion-aware convolutional block has two output channels: one for dot products and another channel for the DTW distances.

While in case of the dot product, higher similarity between the time series segment and the pattern corresponds to higher values, the opposite is true for the DTW distances. In case of DTW, high similarity between the time series segment and the pattern is reflected by a distance close to zero. Therefore, to make sure that the activations on both channels are consistent, the activations of the DTW channel of our distortion-aware convolutional block are calculated as follows:

$$out_{DTW}(t) = \frac{1}{1 + DTW(in[t : t + s], w)}, \quad (2)$$

where out_{DTW} denotes the activation of the DTW channel of the distortion-aware convolutional block, $in[t : t + s]$ is the segment of the block’s input between the t -th and $(t + s)$ -th position¹, s is the size of the filter, w are the weights of the filter representing a local pattern and $DTW(\dots)$ is a function that calculates the DTW distance between two time series segments.

Training neural networks with distortion-aware convolution may be challenging because of the backpropagation of gradients through the DTW calculations. The basic idea of training is to train the network with conventional convolution instead of distortion-aware convolution initially and add DTW-computations once the weights of the convolutional layer have already been determined. For details, see [6].

4 EXPERIMENTAL EVALUATION

The goal of our experiments is to examine whether the neural networks with distortion-aware convolution are more suitable for forecasting technological trends compared to their counterparts with conventional convolution.

¹In Eq. (2) we use a Python-like syntax: the lower index, t is inclusive, the upper index, $t + s$ is exclusive in $in[t : t + s]$.

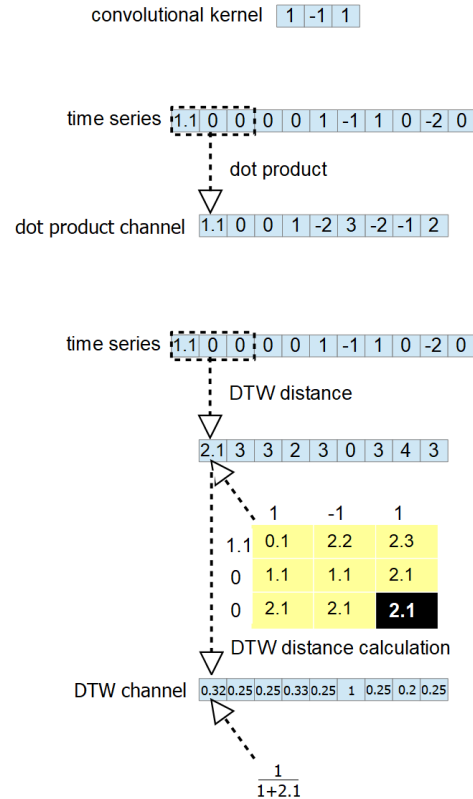


Figure 1: In case of distortion-aware convolution, additionally to the dot product (top), DTW distances between the kernel and time series segments are calculated (bottom). Thus, our distortion-aware convolutional block has two output channels: one for dot products and another channel for the DTW distances scaled according to Eq. (2).

4.1 Data

Lens is a web-based service that offers global access to patent information, academic articles, regulatory databases, and additional relevant materials.² The platform is designed to simplify the exploration and evaluation of intellectual property information while promoting research and inventive activities. Lens grants complimentary access to patent databases from more than 100 nations and includes sophisticated search functionalities and analytical tools for diverse research and analysis needs.

We extracted time series from the Lens patent database as follows. For selected topics identified by their Cooperative Patent Classification (CPC) codes, we extracted the number of granted patents as well as the number of patent applications per month between January 1980 and December 2022. We considered the following topics: (a) “image or video recognition” (G06V), (b) “neural networks” (G06N3/02), (c) “natural language processing” (G06F40) and (d) all topics related to artificial intelligence. We considered the number of patents separately for the most significant jurisdictions, i.e., (a) United States of America, (b) China, (c) Korea, (d) Japan and

²<http://lens.org>

Table 1: Mean absolute error (MAE) and root mean squared error (RMSE) for forecasting the time series of granted patents in case of our approach (DCNN) and the baseline (CNN). Lower values indicate better performance.

topic	jurisdiction	RMSE		MAE	
		CNN	DCNN	CNN	DCNN
image or video recognition	US	165.9	<u>106.0</u>	131.2	<u>92.7</u>
	China	405.8	<u>320.9</u>	323.87	<u>217.6</u>
	Korea	<u>13.9</u>	27.7	<u>12.4</u>	19.9
	Japan	55.9	<u>49.8</u>	39.9	<u>37.8</u>
	Europe	<u>34.5</u>	34.7	<u>32.3</u>	32.9
	ALL	494.7	<u>399.6</u>	416.8	<u>341.3</u>
neural networks	US	10.7	<u>9.1</u>	9.4	<u>7.9</u>
	China	5.6	<u>5.5</u>	3.8	<u>3.7</u>
	Korea	6.3	<u>2.3</u>	5.4	<u>2.1</u>
	Japan	3.5	<u>2.9</u>	2.5	<u>2.0</u>
	Europe	2.7	<u>1.6</u>	2.2	<u>1.2</u>
	ALL	<u>7.6</u>	8.3	<u>6.3</u>	6.7
natural language processing	US	19.7	<u>15.1</u>	14.8	<u>12.0</u>
	China	57.1	<u>47.0</u>	41.6	41.7
	Korea	14.2	<u>8.5</u>	13.1	<u>7.3</u>
	Japan	11.8	<u>10.7</u>	9.5	<u>7.3</u>
	Europe	4.8	<u>3.0</u>	3.5	<u>2.7</u>
	ALL	67.0	<u>45.7</u>	59.5	<u>35.5</u>
ALL	US	270.2	<u>216.9</u>	224.1	<u>196.4</u>
	China	<u>870.2</u>	1108.8	<u>763.2</u>	998.1
	Korea	<u>56.6</u>	138.3	<u>53.8</u>	129.4
	Japan	<u>124.8</u>	132.0	<u>81.4</u>	89.9
	Europe	85.8	<u>69.2</u>	82.1	<u>65.9</u>
	ALL	<u>1045.1</u>	1129.1	<u>929.2</u>	964.6

Table 2: Mean absolute error (MAE) and root mean squared error (RMSE) for forecasting the time series of patent applications in case of our approach (DCNN) and the baseline (CNN). Lower values indicate better performance.

topic	jurisdiction	RMSE		MAE	
		CNN	DCNN	CNN	DCNN
image or video recognition	US	188.2	<u>177.1</u>	170.2	<u>163.3</u>
	China	3405.0	<u>1061.7</u>	3375.4	<u>1042.3</u>
	Korea	128.9	<u>70.8</u>	99.7	<u>69.4</u>
	Japan	<u>103.8</u>	106.4	87.1	<u>66.1</u>
	Europe	<u>51.9</u>	55.5	<u>45.0</u>	49.4
	ALL	3641.9	<u>2110.5</u>	3627.3	<u>2027.8</u>
neural networks	xUS	79.8	<u>15.3</u>	76.9	<u>12.7</u>
	China	21.2	<u>20.8</u>	16.8	19.0
	Korea	44.6	<u>6.8</u>	43.7	<u>6.2</u>
	Japan	13.9	<u>7.1</u>	13.5	<u>4.8</u>
	Europe	15.8	<u>5.9</u>	14.9	<u>4.4</u>
	ALL	267.7	<u>45.6</u>	262.7	<u>38.6</u>
natural language processing	US	<u>64.1</u>	68.7	<u>55.5</u>	64.6
	China	418.9	<u>318.2</u>	363.6	<u>289.3</u>
	Korea	35.1	<u>23.4</u>	29.7	<u>21.0</u>
	Japan	<u>16.7</u>	18.7	<u>10.5</u>	10.8
	Europe	<u>11.2</u>	14.3	<u>9.7</u>	11.2
	ALL	<u>298.1</u>	543.0	<u>226.9</u>	489.3
ALL	US	532.3	<u>329.1</u>	458.9	<u>311.3</u>
	China	6443.7	<u>2784.2</u>	6239.0	<u>2386.5</u>
	Korea	405.4	<u>216.8</u>	340.2	<u>180.8</u>
	Japan	<u>224.8</u>	228.1	159.1	<u>128.6</u>
	Europe	<u>130.0</u>	163.5	<u>97.5</u>	121.3
	ALL	5445.1	<u>3355.8</u>	5009.0	<u>2547.0</u>

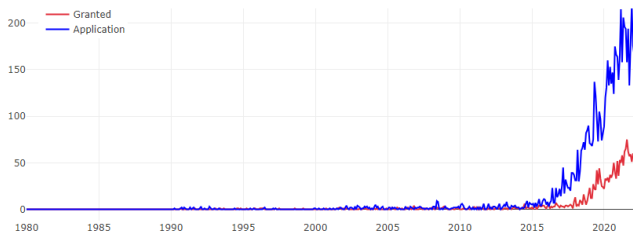


Figure 2: Total number of granted patents (red) and patent applications (blue) for all the jurisdictions in the Lens database related to “neural networks” (CPC: G06N3/02).

(e) Europe. Additionally, we considered the time series of the total number of patents for all the jurisdictions of the database. Thus, we considered in 48 time series in total, see also the first two columns of Tab. 1 and Tab. 2. Two example time series are shown in Fig. 2.

For each time series, we trained the neural networks to predict the number of granted patents (or patent applications, respectively) for each month of a 6-monthly period, i.e., the forecast horizon was $h = 6$. As input, we used the number of granted patents (or patent applications, respectively) in the previous 36 months. The

data related to the years 1980...2019 was used as training data, while the data from 2019...2022 was used as test data.

From the long time series corresponding years 1980...2019, we extracted training instances with a moving window. This resulted in 10496 training instances in total which corresponds to 427 training instance for each time series.

When evaluating the network on the test data, we used the data from 2019...2021 as input data and the task was to predict the number of granted patents (or patent applications, respectively) for the first six month of 2022.

4.2 Experimental Settings

In order to assess the contribution of distortion-aware convolution, for each time series, we trained two versions of the neural network: *with* and *without* distortion-aware convolution, and compared the results. In the former case, the first hidden layer was a distortion-aware convolutional layer (with both dot product and DTW calculations), whereas in the later case, we used conventional convolution (with dot product only).

For simplicity, we considered a convolutional network containing a single convolutional layer with 25 filters, followed by a max pooling layer with window size of 2, and a fully connected layer with 100 units. We set the size of convolutional filters to 9. The

number of units in the output layer corresponds to the forecast horizon, as each unit is expected to predict one of the numeric values of the target time series. We trained the networks for 1000 epochs with the Adam optimizer [15] with learning rate of 10^{-5} and batch size of 16. The loss function was mean squared error.

We implemented our neural networks in Python using the PyTorch framework. In order to support reproduction of our work, we made the implementation of our model publicly available in a github repository. The code illustrates training and evaluation of our model on standard benchmark datasets.³

We evaluated the predicted time series both in terms of mean absolute error (MAE) and root mean squared error (RMSE). In particular, we calculated MAE (and RMSE, respectively) for each forecast time series.

As the goal of our experiments is to assess the contribution of distortion-aware convolution, our baseline, denoted as CNN, is the aforementioned neural network with conventional convolution instead of distortion-aware convolution.

4.3 Results

Tab. 1 and Tab. 2 show our results in terms of MAE and RMSE. Our approach, convolutional neural network with distortion-aware convolution is denoted by DCNN, while CNN denotes the neural network with conventional convolution. As one can see, in the majority of the examined cases, DCNN outperforms CNN both in terms of MAE and RMSE. In those cases when CNN performs better, typically, both models are rather accurate (the error is low for both models) or the difference is very small compared to the magnitude of the error.

5 CONCLUSIONS AND OUTLOOK

In this paper, we focused on forecasting technological trends and cast this task as a time series forecasting problem. We considered a recent approach, convolutional neural networks with distortion-aware convolution, which has not been used for this task previously.

We performed experiments on real-world time series representing the number of granted patents and patent applications related to selected topics. Our observations show that convolutional neural networks with distortion-aware convolution are promising for this task. Furthermore, combination of conventional convolutional networks and neural networks with distortion-aware convolution may be an interesting target of future works.

Last, but not least, we mention that time series are prominent in various real-world applications [2, 23] and our approach can be extended to handle other types of time series, such as multivariate time series (or series of vectors) that can be compared with a more general version of DTW, see e.g. [8].

ACKNOWLEDGMENTS

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³<https://github.com/kr7/dcnm-forecast>

Building A Causality Graph For Strategic Foresight

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ABSTRACT

This paper describes a pipeline built to generate a causality graph for strategic foresight. The pipeline interfaces with a well-known global media retrieval platform, which performs real-time tracking of events reported in the media. The events are retrieved from the media retrieval platform, and content from the media articles is processed with ChatGPT to extract causal relations mentioned in the news article. Multiple post-processing steps are performed to clean the causal relations, removing spurious ones and linking them to ontological concepts where possible. Finally, a sample causality trace is showcased to exemplify the potential of the causality graph created so far.

KEYWORDS

strategic foresight, graph, causality extraction, wikifier, ChatGPT

1 INTRODUCTION

Among the most frequently used strategic foresight methods we find scenario planning [7], that aims to foresee relevant scenarios based on trends and factors of influence. These allow for a better understanding of how actions can influence the future - a key ability in a world full of Turbulence, Unpredictability, Uncertainty, Novelty, and Ambiguity (TUNA) [30]. This ability has fostered an increasing adoption of strategic foresight in the public and private sectors [6, 21].

Domain experts currently plan scenarios by gathering and analyzing the data to determine and report probable, possible, and plausible futures of interest [15]. Nevertheless, the extensive manual work imposes severe scalability limitations and can introduce bias into the assessments [7]. To overcome such limitations, artificial intelligence was proposed to automate information scanning and data analysis [4, 18].

While the value of artificial intelligence for strategic foresight has been recognized, artificial intelligence has not been widely adopted yet [4, 20]. This is also reflected in scientific papers on foresight and artificial intelligence. For example, we queried Google Scholar for "data-supported foresight" and "strategic foresight artificial intelligence" considering the start time is unlimited, and the deadline is September 6th 2023. When analyzing the first 50 search results of each, we got 18% (9/50) and 40%

(20/50) relevant hits, respectively. Some approaches described in the literature aim to leverage artificial intelligence to automate time-consuming aspects of strategic foresight, such as performing information scanning and data analysis [4, 18]. Furthermore, text-mining techniques have been used to identify weak signals and trends [10] or extract relevant actions and outcomes that could be mapped to causal decision diagrams [19].

Strategic foresight for environmental purposes has been considered to different degrees by countries and environmental agencies. For example, multiple U.S. Environmental Protection Agency offices began using strategic foresight in the 1980s. Still, they did not do so consistently until 1995, when it began to be institutionalized and connected to the Agency's strategic planning and decision-making, and reinvigorated since 2015 with that purpose [11]. Another example is The Netherlands, where strategic foresight has been encouraged since 1992 to systematically aim to identify critical technologies and scientific possibilities that would allow the fulfillment of environmental policies [29]. Other cases include using strategic foresight to understand how EU-wide policies may affect regions and rural localities [26] or guide decision-making in the face of structural change [2].

Previous work [22, 23] described how artificial intelligence could be used to automate scenario planning. This paper describes a pipeline built to extract and process media news from EventRegistry [16] to create a causality graph. Furthermore, it describes the causality graph created with media news reporting on events related to oil prices, given the abundant research regarding how oil prices impact the environment. Among the benefits of this approach is the ability to extract causal relations with little human intervention and no supervision. The resulting graph enables the creation of link prediction models that can be used to predict future events based on an array of events that have been observed in the past.

This paper is organized as follows. First, section 2 describes how a data extraction pipeline was built, retrieving media events of interest and extracting causal relationships observed in the world and described in them. Section 3 briefly describes some of the results obtained, providing (i) a quantitative assessment of error types and resulting causal relationships after data cleansing procedures and (ii) a qualitative assessment of causality relationships generated through the pipeline. Finally, Section 4 concludes and outlines future work.

2 DATA EXTRACTION PIPELINE

The data extraction pipeline aims to query relevant media news, process them, and extract causal relationships that can be modeled in a graph. Given the specific interest in modeling causality

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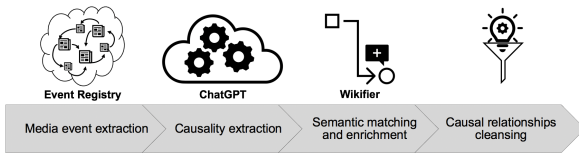


Figure 1: Data extraction pipeline used to retrieve media events and extract causal relationships.

for environmental protection, some research was performed to identify possible topics of interest. Among potential topics, the influence of oil prices on the environment was selected, considering such a topic is frequently covered in the media and was researched to a certain extent. Research has shown that oil price fluctuations (a) affect the consumption of renewable energy sources [1, 28], (b) stimulate green innovation, and that positive shocks in oil prices reduce CO₂ emissions [12], and enhance ecological quality [8, 14].

The data extraction pipeline is summarized in Fig. 1, and each component is briefly described in the following subsections.

2.1 Media Event Extraction

The EventRegistry platform provides real-time insights into media events by sourcing them from the News Feed service [27], processing them and creating media events based on cross-lingual clusters of media news, which are later exposed through an API. The news processing steps require news semantic annotation, extraction of date references, cross-lingual matching, and detection of news duplicates. The cross-lingual clusters denoting a particular media event have a summary describing the media event, information regarding the piece of news considered a centroid to the cluster, and other relevant information.

The first step in the pipeline queries the EventRegistry media event API to extract media events related to a particular concept. This research's query concept was limited to the "Price of Oil". Since EventRegistry has a history of data up to 2014, relevant geopolitical and economic events that influenced oil prices since 2014 were searched. Two events were highlighted by the U.S. Energy Information Administration ¹: (a) the fact that OPEC production quota remained unchanged in the first quarter of 2015 and (b) a reduction in oil demand registered due to the global pandemic in the first quarter of 2020. Furthermore, events between 2022 and 2023 were considered, given the impact of the Russo-Ukrainian War on oil prices [17]. For each event obtained, the centroid media news was queried, its text extracted, wikified, and stored for further processing.

2.2 Causality extraction

To extract causal relations from media events, the OpenAI ChatGPT (gpt-3.5-turbo) was used as a one-shot learning model. To that end, a random media event was sampled, the causality relationships extracted, and both (the text and causal relationships) presented to the model, asking it to recognize causal relationships in the media news. Several iterations of prompt engineering were performed to ensure high-quality results, performing a manual assessment of random results.

The causal relationships persisted in JSON files discriminated the cause, effect, related entities, and locations. In particular,

cause, effect, entities, and locations were defined in the following manner:

- **Cause or effect:** contains an entity which is an item, individual, or company that an event happened to;
- **Event:** is an action, development, happening, or state of the entity that is causing or was affected by a cause in the relationship;
- **Location:** geographical location where the event in the cause or effect took place;

Once the causal relationships were extracted, the cause and effect were post-processed, removing adjectives so that only the nouns were left. E.g., *higher diesel prices* was converted to *diesel prices*. The decision was made considering that by doing so, (a) the causes and effects would gain greater support and, therefore, strengthen the information signal in a graph, and (b) that a human expert would be able to determine how a cause and effect may relate given his domain knowledge and a particular context. For example, given the relationship *Inflation* → *Consumer price index*, the human expert will immediately understand how the consumer price index is affected in a growing or shrinking inflationary context. For each causal relationship, a trace was kept to associate them with the media event from which they were extracted to enable further analysis when required.

2.3 Semantic matching and enrichment

The entire text of the media article was parsed using Wikifier [5]. Data from Wikifier was employed in two distinct ways: firstly, to enrich location data, and secondly, to associate entities to relevant semantic concepts.

The Wikifier tool marks which words in the wikified text correspond to certain semantic concepts. Such annotations were matched to the entities extracted by ChatGPT as part of the causal relationships. To successfully match strings to semantic concepts, some preprocessing was required. First, the non-letter symbols and stopwords were removed, followed by the stemming of each word. It was considered a match if at least one identical string between the text related to marked concepts and the causal relationship. Not all of the semantic concepts listed by the Wikifier were considered: (a) the concepts were required to have a PageRank higher than 0.0001; (b) for location data, only the concepts categorized as "place" were considered, and (c) when substituting the original entity by the associated semantic concept, the semantic concept with the highest cosine similarity between the article it's corresponding Wikipedia page was considered.

2.4 Cleansing causal relations

After extracting causal relations, we focused on analyzing the data and cleansing to ensure only relevant relations were considered and used to build a causality graph. Subsequent random sampling iterations were performed, extracting 300 causal relationships in each iteration, which were then analyzed. In each iteration, the causal relations were assessed to determine whether they were meaningful to the topic under consideration, to identify common errors, and to propose mitigation strategies that could amend such errors or filter useless causal relations. We typified six such cases, five originating from ChatGPT and one when semantically post-processing the causal relations with concepts obtained from the Wikifier:

- **repeated entity:** [ChatGPT] the same entity is registered for cause and effect. E.g., *Oil price* → *Oil price*.

¹The events were highlighted in the following report, last accessed on August 25th 2023: https://www.eia.gov/finance/markets/crudeoil/spot_prices.php.

- **empty entity:** [ChatGPT] an entity is missing as cause or effect. E.g., → *Oil price*.
- **missing entity:** [ChatGPT] ChatGPT omits the actual entity but could be inferred from the text by the human reader. E.g., *S&P 500 capital expenditures* → *growth, energy policy* → *defiance*, or *survey* → *Nasdaq 100*.
- **time entity:** [ChatGPT] some time-period is considered an entity. E.g., *drilling activity* → *2016*, or *(US) shale oil supply* → *end of the year*.
- **non-entity:** [ChatGPT] words marked as entities don't mean anything coherent. E.g., *retail sales* → *risk appetite*.
- **wrong conversion:** [Wikifier] the entity was changed to something unrelated to the one stated in the text. E.g., *Australian government* > *Australian dollar*, or *political tensions* > *Breakup of Yugoslavia*.

While the mitigation strategy for most of the abovementioned errors is to remove the causal relationship, for *missing entity*, a follow-up question will be provided to ChatGPT to get a more concrete answer. This last mitigation strategy has not been implemented yet. Furthermore, a list of concept mappings will be considered to reduce clutter. For example, *Wage Growth* or *1980s Oil Glut* should be replaced by *Wage* or *Oil Glut*, respectively. *Breakup of Yugoslavia* could be replaced by *Country Breakup*. Finally, a more thorough linking to semantic concepts and ontologies is required (e.g., *Jerome Powell* could be linked to *Central Bank*).

After the abovementioned cleansing, the strings were turned into lowercase and trimmed, and most non-alphabetical characters were removed. Further sampling and entity evaluation were performed, creating a dictionary to match string occurrences to a particular concept. It must be noted that the dictionaries do not provide an exhaustive mapping and that ongoing work is being done to further refine and complete the mapping phase. Such dictionaries were created to provide ground for future ontological mapping based on existing ontologies and ontologies that will be developed for this purpose. Finally, all the relations that, after the described process, were extracted from only one media event were discarded, given they are very likely to introduce noise.

2.5 Creating a causality graph

Once causal relationships were extracted, a causality graph was created by matching *cause* → *effect*. Furthermore, some metrics were computed to assess the graph characteristics. The graph can be sampled and visualized with the NetworkX² library, which creates a dynamic HTML interface to view it. For each cause and all the possible effects following it, probabilities of each effect occurring were computed based on the ratios present in the data.

3 RESULTS

A total of 2,503 media events were extracted from EventRegistry. When processed with ChatGPT, 12,290 unique causal relationships were extracted, totaling 14,226 unique entities. Those were processed to remove possible errors. Considering *repeated entity* and *empty entity* errors, 253 causal relations were removed. After applying wikification, 9,726 unique causal relations remained, totaling 7,723 entities. 845 causal relations were removed, considering *repeated entity* and *empty entity* errors. Table 1 shows the number of causal relations affected by a particular error type, considering a random sample of 300 causal relations.

²The library is documented at the following website: <https://networkx.org/>

Error type	Count	Percentage
Wrong conversion	17	5.7%
Missing entity	15	5.0%
Non-entity	9	3.0%
Time entity	3	1.0%

Table 1: Statistics for typified errors based on a random sample of 300 causal relationships.

After performing the abovementioned cleansing and dictionary-based mappings, 7,723 nodes and 9,726 edges were obtained. Removing causal relationships reported only in a single media event reduced the graph size to 489 nodes and 877 edges.

3.1 Causality graph and causality chain analysis

Causal chains were created by linking causes and effects extracted from media events. While these are not always completely accurate, they help to identify sequences of events that may take place. Furthermore, while currently not implemented, graph link prediction could be used to predict future event sequences based on patterns observed in the past.

This section provides an example regarding a causality chain of interest retrieved from the causality graph. The causality chain is briefly analyzed to demonstrate how it captures relevant knowledge. In particular, many causality chains displayed the following pattern: *Pandemic* → *Currency* → *Price of Oil* → *Economic Growth* → *Oil Glut* → *Inflation* → *Central Bank* → *Stock Market* → *Investment*.

The complete causality chain summarized above was: *Pandemic* → *Currency* → *Price of Oil* → *Crude Oil Futures* → *Fuel Pricing* → *Economic Growth* → *Petroleum* → *Oil Glut* → *Consumer Price Index* → *Monetary Policy* → *Inflation* → *Central Bank* → *Stock Market* → *Investment* → *Bond*.

To validate the causality chain, scientific literature and events from the past few years were reviewed to find research and examples to validate the causal relationships. For the causality chain described above, we found that the *Pandemic* influenced *Currency*: countries experiencing a sharp daily rise in COVID-19 deaths usually saw their currencies weaken [13]. Causality between exchange rates (*Currency*) and *Price of Oil* has been reported by the European Central Bank [9]. In particular, it has been noticed that the exchange rates can affect oil prices through financial markets, financial assets, portfolio rebalancing, and heading practices. It has also been noted that given the oil prices are expressed in US dollars, the oil futures can be used to hedge against an expected depreciation in US dollars - something that explains the causal relationship between *Price of Oil* and *Crude Oil Futures*. Furthermore, a relationship exists between futures and spot prices (futures prices tend to converge upon spot prices³ and between oil prices and fuel prices⁴, validating the causal relationship between *Crude Oil Futures* and *Fuel Pricing*.

³See "*Futures Prices Converge Upon Spot Prices*", last accessed at <https://www.investopedia.com/ask/answers/06/futuresconvergespot.asp> in September 7th 2023.

⁴See "*Gasoline explained: Factors affecting gasoline prices*", last accessed at <https://www.eia.gov/energyexplained/gasoline/factors-affecting-gasoline-prices.php> in September 7th 2023.

When considering the relationship *Fuel Pricing* and *Economic Growth*, we found that the relationship is validated with energy prices [3], e.g., with gas prices: higher gas prices negatively impact the economy⁵. Economic growth can affect the petroleum market and, in particular, lead to an oil glut (a significant surplus of crude oil caused by falling demand) as it happened at the beginning of the COVID-19 pandemic⁶. Furthermore, oil pricing can have direct or indirect effects on *Inflation* [24], which is reflected in the *Consumer Price Index*, and which can trigger a particular *Monetary Policy* from the *Central Bank* in response to it. Finally, monetary policies affect the stock market and investments [25].

While the causality chain displayed in this case is mostly clean, some improvements are required to make it neater. For example, based on domain knowledge, and depending on the context, the *Consumer Price Index* and *Inflation* could be merged into a single concept, and *Monetary Policy* and *Central Bank* could be considered as one.

The ingestion pipeline requires further work to enhance the concept mappings. We envision that the dictionaries will be further evolved and linked to specific ontologies that could be used to assign semantic meaning and, e.g., contract links in a chain with the same semantic ancestor.

4 CONCLUSIONS

This research has described a pipeline created for causality extraction from media news and aimed toward a strategic foresight tool, and currently focused on events affecting oil prices. Particular errors in the causality extraction were identified and typified, and mitigation measures were implemented. Nevertheless, further work is required to improve the pipeline. Future work will consider three directions: (a) string to ontologies mapping to ensure the captured causes and effects can be tied to particular semantic knowledge and exploit it, (b) generate richer cause and effect representations so that based on encoded metadata, better causality patterns can be elucidated, and (c) create a link prediction model based on the causality graph.

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⁵See “How Gas Prices Affect the Economy”, last accessed at <https://www.investopedia.com/financial-edge/0511/how-gas-prices-affect-the-economy.aspx> in September 7th 2023.

⁶See “Oil glut means there’s little hope for oil price recovery until 2021”, last accessed at <https://www.conference-board.org/topics/natural-disasters-pandemics/COVID-19-oil-glut> in August 30th 2023.

Towards Testing the Significance of Branching Points and Cycles in Mapper Graphs

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ABSTRACT

Given a point cloud P , which is a set of points embedded in \mathbb{R}^d , we are interested in recovering its topological structure. Such a structure can be summarized in the form of a graph. An example of this is the mapper graph, which captures how the point cloud is connected and reflects the branching and cyclic structure of P as branching points (vertices with degree greater than 2) and cycles in the graph. However, such a representation is not always accurate, i.e., the structure shown by the graph may not be sufficiently supported in the point cloud. To this end, we propose an approach that uses persistent (relative) homology to detect branching and cyclic structure, and employs a statistical test to confirm whether the structure is indeed significant. We show how the approach works for low-dimensional point clouds, and discuss its possible applications to real world point clouds.

KEYWORDS

topological data analysis, statistical hypothesis testing, persistent homology, mapper algorithm

1 INTRODUCTION

Consider the point cloud P consisting of points in \mathbb{R}^2 shown in Figure 1a. Using the mapper algorithm, we can construct a graph that represents its topological structure like the one in Figure 1b, which seems to recover the important structure. Using the same algorithm (but with different values of its adjustable parameters) we could end up with different graphs. The second graph, shown in Figure 1c, contains two cycles: the middle one, which captures the cycle present in P , and the top one, where the algorithm "mistakenly" considers the top points to connect in a cycle. The third graph, shown in Figure 1d, shows a similar structure as the graph in Figure 1b, although it contains one branching point more (splitting off the upper left branch) and a cycle of length three. One could argue that these branching and cyclic structures are not sufficiently supported in P .

Our goal is to develop an approach that allows us to confirm, through a statistical test, whether the structure recovered by the mapper graph is indeed present in the point cloud. We use persistent homology, a well-known construction from topological data analysis (TDA), to represent the structure from the point cloud, and a recently introduced hypothesis testing framework [1] that provides a way to evaluate the significance of such a

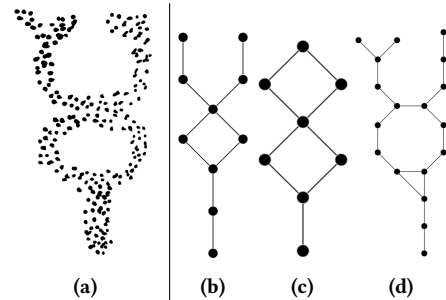


Figure 1: A point cloud (a) and three graphs (b, c, d) summarizing its topological structure, constructed by the mapper algorithm for different choices of its parameters.

structure. We demonstrate the approach on two examples: a Y-shaped point cloud and a sample of a 3D mesh resembling an ant. These low-dimensional examples allow us to visually inspect the results, laying the groundwork for extensive experiments with higher-dimensional point cloud data used in real-world applications.

Representing the topological structure of the point cloud with a simpler object, such as a graph, and having a statistical method for testing the significance of such a structure is a very relevant task. A simpler representation allows us to visualize [3] and interpret high-dimensional representations that are everywhere in modern data science and machine learning. It might even allow us to find singularities that often carry relevant information. The mapper algorithm [6] is a commonly used tool in TDA. Although it is simple, the result is sensitive to the choice of its parameters [2]. Nevertheless, it provides only one possible low-dimensional view of the input data, and to our knowledge there is no method that would confirm the significance of the represented structure. There is another method, called persistent homology, which, while not directly applicable to visualization, deals with a particular structure of "holes" in space and now has a framework [1] that allows us to statistically test the significance of such a structure.

2 BACKGROUND

A point cloud P is a set of points embedded in \mathbb{R}^d which can be viewed as a sample of a topological space \mathbb{X} . Since discrete points from P have no interesting topological structure, we consider the space $P^r = \bigcup_{p \in P} B(p, r)$ for some radius r . If P is a sufficiently dense sample of \mathbb{X} , then P^r has some of the same properties as \mathbb{X} for a suitable r . To compute the properties of interest, we represent P^r with a simplicial complex K which, if properly constructed, has homology groups isomorphic to those of P^r . We

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are interested in finding the branching and cyclic structure in the point cloud, both of which can be detected using (persistent) homology.

2.1 Simplicial complexes

A (geometric) simplicial complex K can be thought of as a "high-dimensional graph" whose vertices are points from the point cloud and connectivity is determined by the geometric configuration of the points. In addition to vertices and edges, we include triangles, tetrahedra and higher dimensional simplices. Formally, K consists of finite nonempty subsets of P and is closed under inclusion (i.e., $A \in K$ and $B \subset A$ implies $B \in K$). We refer to elements in K of size $k + 1$ as k -simplices, which correspond to k -cliques when we think about K as a hyper-graph.

The Čech and Vietoris-Rips complexes are the two most common constructions, both parameterized by a scale parameter (radius) $r > 0$. We use the Vietoris-Rips construction, where we include a subset of $(k + 1)$ points from P as a k -simplex if all points are at most r apart.

We can construct a sequence of complexes K_{r_1}, K_{r_2}, \dots by increasing the radius r . Such a construction is "increasing" in the sense that for $r_1 < r_2$, it holds that $K_{r_1} \subseteq K_{r_2}$. Such sequences are also known as *filtrations* and are used in persistent homology.

2.2 Persistent relative homology

Homology. Homology is a classical construction in algebraic topology that deals with topological properties of a space. More precisely, it provides a mathematical language for the holes in a topological space. Homology groups denoted by $H_k(\mathbb{X})$, where k is a dimension, capture the holes indirectly by focusing on what surrounds them. For example, the basis of $H_0(\mathbb{X})$ corresponds to the connected components and the basis of $H_1(\mathbb{X})$ to the closed loops surrounding the holes. The rank of the k -th homology group, also known as *Betti number*, counts the number of k -dimensional "holes".

We can construct homology groups for a given simplicial complex K . The important concepts in the construction are: (i) the chain groups C_k , where the k -th chain group consists of all formal linear combinations of k -dimensional simplices $\sum_i a_i \sigma_i$, where σ_i are k -simplices from K and a_i are coefficients, usually from \mathbb{Z}_2 , (ii) the boundary operator ∂_k , which is a map describing how $(k - 1)$ -simplices are attached to k -simplices, (iii) the groups Z_k of k -cycles, which are k -chains in the kernel of ∂_k , and (iv) the groups B_k of k -boundaries, which are elements in the image of ∂_{k+1} . The boundary operator ∂_k has the property that $\partial_k \circ \partial_{k+1} = 0$, i.e., it maps the boundary of the boundary to zero. Therefore, $B_k \subseteq Z_k$.

Intuitively, a k -cycle can be thought of as a generalized version of a cycle in a graph - it is a sequence of k -dimensional simplices wrapped around something. If this sequence is actually a boundary of a $(k+1)$ -dimensional chain, then its interior is full (trivial cycle). Otherwise, it surrounds a hole. The k -th homology $H_k = \ker \partial_k / \text{im } \partial_{k+1} = Z_k / B_k$ takes a "modulo" of k -cycles with k -boundaries, leaving only cycles that are nontrivial.

Relative homology. Given a simplicial complex K and a sub-complex $L \subseteq K$, the relative homology of a pair of topological spaces (simplicial complexes in our case) can be thought of as the (reduced) homology of the quotient space K/L . Intuitively, we want to factor out L , which is expressed by the quotient operation $C_k(K, L) = C_k(K) / C_k(L)$. The group of k -cycles becomes $Z_k(K, L) = Z_k(K) / Z_k(L)$, which we call the group of *relative*

cycles. We can think of the reduced homology of a space as if we were representing the entire L with a single point.

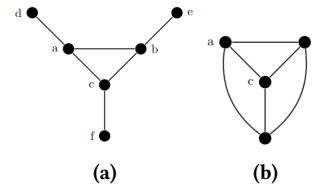


Figure 2: a) A Y-shaped simplicial complex with one cycle. b) The quotient K/L , where subcomplex L contains 0-simplices $\{d, e, f\}$. Such identification introduces two new 1-dimensional "holes", captured by the relative homology group $H_1(K, L)$.

The concept of homology and relative homology is best illustrated by an example. Consider a simple simplicial complex consisting of 0-simplices $\{a, b, c, d, e, f\}$ and 1-simplices $\{(a, b), (a, c), (a, d), (b, e), (c, f)\}$ as shown in Figure 2a. There is a "hole" of dimension 1 (surrounded by the cycle $a \rightarrow b \rightarrow c \rightarrow a$), which is captured in the homology group H_1 . Choosing $L = \{d, e, f\}$ as a subcomplex, the quotient K/L identifies the simplices from L to a single point, as shown in the figure 2b. This results in two new "holes" in dimension 1, which are captured by the relative homology group $H_1(K, L)$, which has rank 3. This "lifting property" of relative homology (introducing new "holes" when identifying simplices) is used in our approach to detect branching points.

Persistent homology. The construction of the simplicial complex and hence the groups H_k are highly sensitive to the choice of radius r . To overcome this, persistent homology considers the entire range of scales and tracks the evolution of k -cycles as the value of r increases, thus forming a sequence of filtrations. In this process, cycles are created (born) and later filled-in (die). This information is most often represented by *persistence diagrams*, a two dimensional scatter plot, $dgm_k = \{p_1, \dots, p_m\}$, where each point $p_i = (b_i, d_i)$ represents the birth and death times (radius) of the associated persistent cycle.

2.3 Significance testing of persistent cycles

The significance of topological features is often measured by the lifetimes of persistent cycles, i.e., $\delta = (d_i - b_i)$. Although this method is intuitive as it captures the geometric "size" of topological features, [1] uses the statistic $\pi_i = d_i / b_i$. They present a statistical test to determine for each point $p_i \in dgm_k$ whether it is a signal or noise, i.e., a significant structure or the result of noise and randomness in the data. They introduce a special transformation $l(p_i)$ applied to each point from the diagram where the values of $l(p_i)$ follow a certain (LGumbel) distribution if p_i are points corresponding to noisy cycles, while cycles significantly deviating from this distribution are declared as signal. The signal part of dgm_k can be recovered as $dgm_k^s(\alpha) = \{p \in dgm_k : e^{-e^{l(p)}} < \frac{\alpha}{|dgm_k|}\}$ given a p -value α .

Computing persistent homology for an entire filtration is often intractable, as higher values of r lead to a large number of simplices. The common practice is to set a threshold r_{max} and calculate $dgm_k(r_{max})$ using simplices generated up to r_{max} . This often leads to cycles that are "infinite", i.e., born prior to r_{max} but die after r_{max} . The framework also provides an algorithm to

determine the infinite cycles that are already significant, and provides means to select the next r_{max} threshold to inspect infinite cycles that have not yet been determined to be significant.

2.4 The mapper algorithm

Given the topological space \mathbb{X} and a continuous function $f : \mathbb{X} \rightarrow \mathbb{R}$, the mapper algorithm [6] constructs a graph $G = (V, E)$ that captures the topological structure of \mathbb{X} . It does so by pulling back a cover \mathcal{U} of the space $f(\mathbb{X})$ to a cover on \mathbb{X} through f . We can view the function f and the cover \mathcal{U} as the lens through which the input data \mathbb{X} is examined.

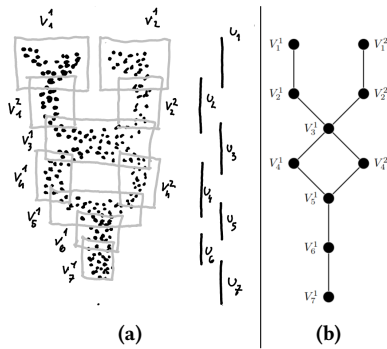


Figure 3: An example of the construction of a mapper graph. (a) A 2-dimensional point cloud P with cover $\{V_i^j\}$, a function $f : \mathbb{R}^2 \rightarrow \mathbb{R}$ and cover \mathcal{U} of $f(P)$. (b) The resulting mapper graph.

Given a point cloud P and $f : P \rightarrow \mathbb{R}$, we first construct a set of n intervals $\mathcal{U} = \{U_1, \dots, U_n\}$ covering $f(P)$. The percentage of overlap for two consecutive intervals U_i and U_{i+1} is determined by the parameter p . For each interval $U_i = (a, b)$, let $P_{U_i} = f^{-1}(U_i)$ be a set of points with function values in the range (a, b) . The set P_{U_i} for each U_i is further partitioned into V^1, \dots, V^{k_i} by a clustering algorithm (in our case DBSCAN [5] with parameter ϵ , which sets the maximum distance between two samples so that one is considered to be in the neighborhood of the other) to obtain a cover of $P = \bigcup_{i=1, \dots, n} \{V_i^1, \dots, V_i^{k_i}\}$. Each $V_i^j \subset P$ becomes some vertex v in the mapper graph with $\phi(v) = V_i^j$ mapping v to a subset of points. Two vertices are connected by an edge if their point sets intersect (see Figure 3).

The resulting graph $G = (V, E)$ provides a combinatorial description of the data and the mapping $\phi : V \rightarrow \mathcal{P}(P)$ maps each node $v \in V$ to a subset of points from P .

3 METHODOLOGY

The input to our approach is a set of points P embedded in \mathbb{R}^d and a graph $G = (V, E)$ together with a mapping $\phi : V \rightarrow \mathcal{P}(P)$ that maps each vertex to a subset of points. Note that the method used to construct the graph is not limited to the mapper algorithm.

The graph is assumed to capture the topological structure of the point cloud, i.e., branching points (vertices with a degree of at least 3) and cycles in the graph should reflect the branching and cyclic structure of the point cloud. Our approach tests whether the captured structure is significant when viewed through homology, operating directly on a subset of points from the point cloud.

3.1 Testing the cycles

A *simple cycle* is a finite sequence of vertices $v_1 \rightarrow v_2 \rightarrow \dots \rightarrow v_n$, where v_i and v_{i+1} are connected by an edge such that no vertex, except the endpoint, repeats ($v_i = v_j$ if and only if $i, j \in \{1, n\}$). Let v_1, \dots, v_n be such a cycle from G . We compute the persistence diagram of the subset $P' = \bigcup_{i=1, \dots, n} \phi(v_i)$ and use the test [1] to confirm that it contains at least one significant cycle ("hole") of dimension 1.

3.2 Testing the branching structure

Let $N(v)$ be a set of vertices connected to v (1-hop neighborhood) and let v be a branching point in G (as in Figure 4). Let $N'(v) = \{u : u \in N(v), \deg(u) \geq 2\}$ be a set of vertices from $N(v)$ that have at least one additional neighbor. Together with v , $N'(v)$ forms a set of internal points $I_v = \bigcup_{u \in \{v\} \cup N'(v)} \phi(u)$ (shown in Figure 4 as black vertices inside the outer black line).

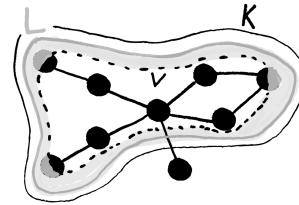


Figure 4: Construction of K and L for a branching point v . Vertices forming K are inside the outer black line. Vertices forming L are bicolored, indicating that some of their points are inside due to overlap between the vertices' point sets.

Let $K_v = \bigcup_{u \in N'(v)} N(u)$ be a set of vertices whose points are used to form a complex K (vertices inside the outer black line in Figure 4), i.e. K is formed from the points $\bigcup_{u \in K_v} \phi(u)$. Now let L be a subcomplex of K containing simplices which do not contain any of the points from I_v . Thus L contains points of vertices exactly two edges away from v (bicolored vertices in Figure 4). We use K and L to compute relative persistent homology, identifying simplices of L to a single point and introducing relative cycles ("holes") when $K \setminus L$ has a branching structure. For a branching point v , the relative persistence diagram should contain at least $\deg(v) - 1$ significant relative cycles.

4 EXPERIMENTS

We perform experiments illustrating our approach on two point clouds. The graphs are constructed using the mapper algorithm from the Giotto TDA library [7] with the parameters specified for each experiment. To construct the simplicial complex and compute (relative) persistent homology, we use the Dionysus library¹. We increase the initial radius r using the algorithm from [1] until either no infinite cycles remain or all currently infinite cycles are identified as significant.

We include a figure of the graph for each experiment and mark interesting branching points and cycles. The points corresponding to a cycle are shown in red, the internal points of a branching point are also red, while the boundary points (forming L) are blue.

¹Available at: <https://github.com/mrzv/dionysus>.

4.1 Experiment 1: Y-shaped point cloud

The point cloud P consists of 5000 points in \mathbb{R}^2 and resembles a Y-shape with a cycle in the centre. The graph (see Figure 5) was created with the following parameters: f is a projection on the x-coordinate, $n = 30$, $p = 0.5$ and $\epsilon = 3$.

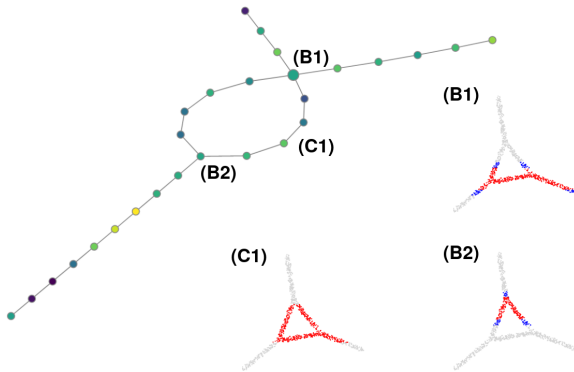


Figure 5: Mapper graph with two branching points (B1 and B2) and one simple cycle (C1) together with their corresponding subsets of points.

The graph contains one simple cycle, which is also significant because the subset of its points contains a homologically significant cycle. The graph also contains two branching points, B1 and B2 with degrees 4 and 3.

The persistence diagram for B1 has three (significant) infinite cycles, indicating a branching structure of degree 4, while the diagram for B2 has two (significant) infinite cycles, indicating a branching structure of degree 3. In this example, it was confirmed that both the cyclic and the branching structure of the graph are reflected in the point cloud.

4.2 Experiment 2: 3D ant surface

The point cloud P consists of 6370 points in \mathbb{R}^3 corresponding to the vertices of a 3D mesh in the form of an ant obtained from [4]. The graph (see Figure 6) was created with the following parameters: f is the distance to the tip of the ant's abdomen, $n = 50$, $p = 0.5$, and $\epsilon = 0.025$.

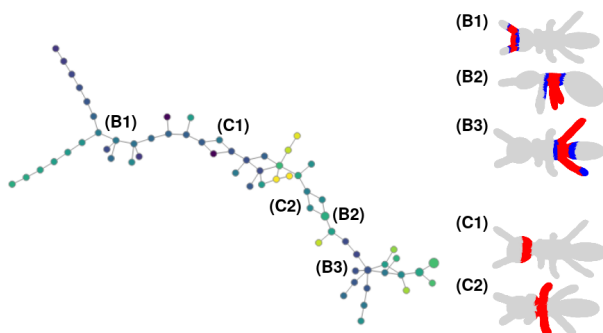


Figure 6: Mapper graph with three highlighted branching points (B1, B2 and B3) and two simple cycle (C1, C2) together with their corresponding subsets of points.

We highlight three interesting branching points. Vertex B1 is a branching point of degree 3, which corresponds to the branching

on the ant's head into its two antennae and is significant. Vertex B2 is a branching point of degree 3 and one of the vertices from the cycle C2. Looking at the point cloud, no branching structure is detected because the points of the two legs are contained in the vertex B2 itself and there are no boundary points on the legs, so they appear as a single connected blob. Our approach does not detect a branching structure, even though there is, as some other strategy of selecting the boundary points would need to be used. Vertex B3 has degree 6, but only 5 neighbors are used as one does not have any additional neighbor except B3. Since one of the legs has no boundary points, only 2 cycles appear, causing B3 to be recognized as a branching point with degree 3.

We also highlight 2 simple cycles. Cycle C1 wraps around the ant's hollow head and is recognized as significant. Cycle C2 wraps around the ant's two middle legs and part of its body. No significant cycles were found - ant's legs are not close enough together to form a large cycle and cycle formed by the hollow legs is too small to be detected. So there is not enough support to confirm the structure found by mapper.

5 CONCLUSIONS AND FUTURE WORK

We have demonstrated, how persistent (relative) homology can be used in conjunction with a statistical test to confirm the significance of the topological structure of a point cloud summarized with a graph. In the future, we will conduct extensive experiments on more complex, high-dimensional point clouds with known and unknown structure. Ideally, we could use our approach to prune the mapper graphs or guide the selection of values for its parameters. Our approach to identifying branching structures needs further work, as the current strategy of using a (modified) 2-hop neighborhood as a boundary sometimes fails. In addition, we may need a more sensitive version of the statistical test from [1] which is currently stated to hold in general but might be possible to adapt for a particular type of data.

ACKNOWLEDGEMENTS

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Highlighting Embeddings' Features Relevance Attribution on Activation Maps

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ABSTRACT

The increasing adoption of artificial intelligence requires a better understanding of the underlying factors affecting a particular forecast to enable responsible decision-making and provide a ground for enhancing the machine learning model. The advent of deep learning has enabled super-human classification performance and eliminated the need for tedious manual feature engineering. Furthermore, pre-trained models have democratized access to deep learning and are frequently used for feature extraction. Nevertheless, while much research is invested into creating explanations for deep learning models, less attention was devoted to how to explain the classification outcomes of a model leveraging embeddings from a pre-trained model. This research focuses on image classification and proposes a simple method to visualize which parts of the image were considered by the subset of the most relevant features for a particular forecast. Furthermore, multiple variants are provided to contrast relevant features from a machine learning classifier and selected features during a feature selection process. The research was performed on a real-world dataset provided by domain experts from *Philips Consumer Lifestyle BV*.

KEYWORDS

explainable artificial intelligence, feature importance, activation map, GradCAM, image classification, smart manufacturing, defect detection

1 INTRODUCTION

The increasing adoption of artificial intelligence has posed new challenges, including enforcing measures to protect the human person from risks inherent to artificial intelligence systems. One step in this direction is the European AI Act [12], which considers that different artificial intelligence systems must conform to a different set of requirements according to their risk level, linked to the particular domain and potential impact on health, safety, or fundamental rights [15]. In this context, explainable artificial intelligence, a sub-field of machine learning, has gained renewed attention with the advent of modern deep learning [22], given that it researches how more transparency can be brought to opaque machine learning models. While transparency in the regulatory context is sought to enable responsible decision-making, it provides valuable insights to enhance the workings of machine learning models, too.

The field of explainable artificial intelligence can be traced back to the 1970s [18]. A key question posed by the researchers is what makes a good explanation. Arrieta et al. [2] consider that a good explanation must take into account at least three elements: (a) the reasons for a given model output (e.g., features and their value ranges), (b) the context (e.g., context on which inference is performed), and (c) how are (a) and (b) conveyed to the target audience (e.g., what information can be disclosed and the vocabulary used, among others). When considering images, maps frequently present explanations that contrast particular model information on top of the original input image (e.g., saliency maps, activation maps, heat maps, or anomaly maps [13, 24]). Other approaches can be extracting and highlighting super-pixels relevant to a specific class [16] or the occlusion of background parts irrelevant to the model. Such outputs convey (a) the reasons for a given model output by highlighting the images, (b) the context on which inference is performed (by overlaying the information on top of the image used for inference), and (c) using an agreed approach to convey to the user what is considered more relevant and what is not.

Multiple approaches have been developed to explain the inner workings of image classifiers. LIME (Local Interpretable Model-Agnostic Explanations) [16] approached this challenge by retrieving predicted labels for a particular class and showing the segmented superpixels that match each class. GradCAM[19] has taken another approach and created activation maps considering the weight of the activations at particular deep learning model layers by the average gradient. Many approaches were developed afterward, following the same rationale. For example, GradCAM++[3], XGradCAM[9], or HiResCAM[6] work like GradCAM but consider second-order gradients, scale the gradients by the normalized activations, or element-wise multiply the activations with the gradients respectively. Other possible approaches are leveraging insights resulting from image perturbation [8] or methods that acquire and display samples similar or counterfactual to the predicted instance [4, 17].

The development of information and communications technologies fostered the emergence of the Industry 4.0 paradigm as a technology framework to integrate and extend manufacturing processes [23]. In this context, the increasing adoption of artificial intelligence enables greater automation of manufacturing processes such as defect inspection [7] and urges the adoption of explainable artificial intelligence to develop users' trust in the models and foster responsible decision-making based on the insights obtained regarding the underlying machine learning model [1].

From the literature mentioned above and several surveys on this topic [5, 13, 14, 17, 20, 21], it was found that the authors did not contemplate how explanations can be provided in scenarios where feature embeddings are extracted with a deep learning model and then used to train a separate machine learning model.

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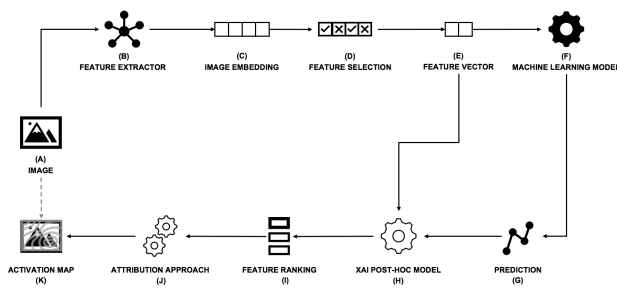


Figure 1: To classify an image, a feature extractor is used to create an embedding, from which certain values are extracted to create a feature vector. The machine learning model issues a prediction, which, along with the feature vector, is used to create a feature ranking. The attribution approach considers the highest-ranking features to generate an activation map.

The present research addresses this void by proposing an unsupervised approach to generate activation maps based on the feature ranking obtained for a particular forecast. The research is performed on a real-world dataset provided by *Philips Consumer Lifestyle BV* and related to defect inspection.

This paper is organized as follows. First, section 2 describes the explainability approach developed and tested in this research. Section 3 describes the experiments performed to assess different value imputation strategies, and Section 4 informs and discusses the results obtained. Finally, Section 5 concludes and describes future work.

2 HIGHLIGHTING EMBEDDINGS' FEATURES RELEVANCE ATTRIBUTION ON ACTIVATION MAPS

The increasing amount of pre-trained deep learning models make them the default choice for feature extraction when working with machine learning models for images. Nevertheless, the disconnect between the machine learning model built on top and the deep learning model used to extract the image embedding makes it challenging to provide good explanations to the user. This research proposes an approach to bridge the gap (see Fig. 1). In particular, we leverage the fact that similar images or fragments of images result in embeddings or parts of embeddings that are close to each other. This property can be exploited when building activation maps, computing the similarity between a reference image (e.g., the image of a horse) and the image under consideration to find where such class can be found in the image under consideration (e.g., given the image of a farm, highlight where the horses are located). Nevertheless, if instead of using some reference image, the image that is an input to the machine learning model is leveraged as a reference, (i) no noise is introduced due to the dissimilarity of the images, and (ii) no beforehand knowledge regarding the classes of interest is required. Therefore, a key issue must be resolved: how do both embeddings differ to ensure that such difference is exploited to build an activation map?

Two options are envisioned in this research (see Fig. 2): given (i) the image embedding, two variations can be considered for value imputation: (ii) mask all the values in the embedding except for the ones corresponding to top-ranking features, (iii) mask all the values in the embedding except for the ones corresponding to

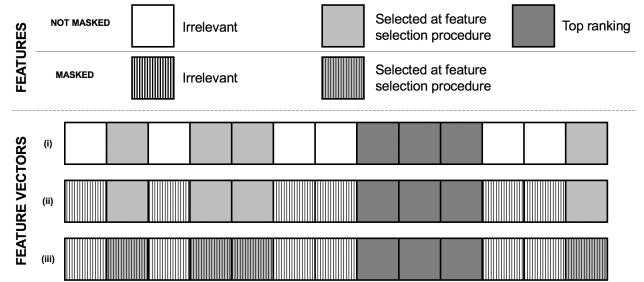


Figure 2: Given an image embedding (i), we can mask it to display (ii) features selected at the feature selection procedure (including the top ranking classifier's features, or (iii) can mask it to display only the top ranking classifier's features.

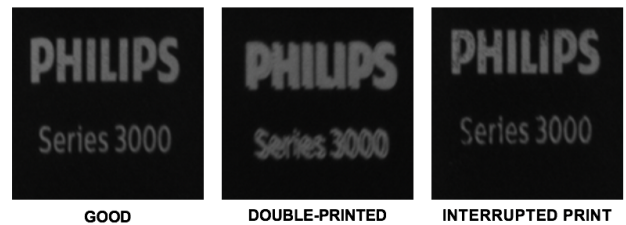


Figure 3: Sample images from the dataset provided by *Philips Consumer Lifestyle BV*. Three categories are distinguished: images corresponding to non-defective items (good) and images corresponding to two defect types (double-printed and with interrupted prints).

selected features and top-ranking features, using different values for each of them. By doing so, the highest similarity in the image will be found in regions related to top-ranking features or selected features. Considering selected and top-ranking features provides additional insights into what information was provided to the model and what information was considered the most important by the model. These two approaches are explored in Section 3.

3 EXPERIMENTS

We experimented with a real-world dataset of logos printed on shavers provided by *Philips Consumer Lifestyle BV*. The dataset consisted of 3518 images considered within three categories (see Fig. 3): non-defective images and images with two kinds of defects (double-printed logos and interrupted prints). To extract features from the images, the ResNet-18 model [10] was used, extracting the features before the fully connected layer. Mutual information was used to evaluate the most relevant features and select the *top K*, with $K = \sqrt{N}$, where N is the number of data instances in the train set, as suggested in [11]. The dataset was divided into train (75%) and test (25%), and a random forest classifier was trained on it, achieving an AUC ROC (one-vs-rest) score of 0.9022.

Three images from the test set were considered for the experiments: good, double-printed, and with an interrupted print. The images were randomly picked among the available ones for that particular class. To assess the features' relevance of a particular forecast, LIME[16] was used, considering the top 1, 3, 5, 7, and 13 ranked features.

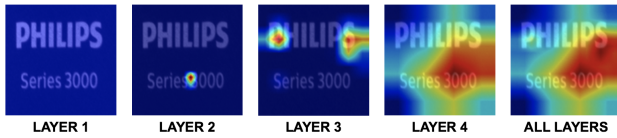


Figure 4: GradCAM activation maps for ResNet-18 layers 1-4 and four layers combined.

The GradCAM images were generated for ResNet-18 layers 1-4 and another image considering the four layers. To understand where the underlying model focused, we created GradCAM activation maps contrasting the image against itself (see Fig. 4). The cosine similarity between the imputed vector and the image embedding was computed across test samples (880 samples: 679 good, 58 double-printed, and 143 related to interrupted printing). The mean similarity and standard deviation were used to assess whether the imputation strategy increased the similarity or contrast between the imputed vector and the image embedding.

The GradCAM images were generated by computing the cosine similarity between the image embedding and the feature vector generated considering three strategies described in Table 1. A sample of the resulting activation maps were visually assessed and are reported in Section 4.

The experiments were designed to understand which imputation strategy works the best. A detailed analysis regarding how top-ranked features affect the activation maps was omitted due to the brevity of the paper.

Strategy	Top-ranked feature	Selected on Feature Selection	Irrelevant
TOZ	True value	One	Zero
TZZ	True value	Zero	Zero
TRR	True value	Random	Random

Table 1: Value imputation strategies considering the image embedding, the features selected during the feature selection process, and the classifier's top-ranked features.

4 RESULTS

Imputation strategy	Image class	Layers			
		1	2	3	4
TOZ	Good	0.27±0.01	0.27±0.01	0.27±0.01	0.27±0.01
	Double-printed	0.31±0.02	0.31±0.02	0.31±0.02	0.31±0.02
	Interrupted print	0.27±0.01	0.27±0.01	0.27±0.01	0.27±0.01
TZZ	Good	0.21±0.04	0.21±0.04	0.21±0.04	0.21±0.04
	Double-printed	0.24±0.03	0.24±0.03	0.24±0.03	0.24±0.03
	Interrupted print	0.22±0.04	0.22±0.04	0.22±0.04	0.22±0.04
TRR	Good	0.46±0.02	0.46±0.02	0.46±0.02	0.46±0.02
	Double-printed	0.48±0.03	0.48±0.03	0.48±0.03	0.48±0.03
	Interrupted print	0.46±0.02	0.46±0.02	0.46±0.02	0.46±0.02

Table 2: Value imputation strategies considering the image embedding, the features selected during the feature selection process, and the classifier's top-ranked features.

As described in Table 1, three imputation strategies were considered. The cosine similarity computed between the vector created with the imputation strategy and the embedding (considering the top 13 features) is reported in Table 2. A higher similarity between the imputed vector and the image embedding means that a wider area of the activation map will be highlighted, blurring relevant information where the top features point to in the image. The less informative imputation strategy was TRR, which

consistently showed high cosine similarity across layers for all defect types. On the other hand, TZZ achieved the best results regardless of the defect and layer considered. Imputing selected features with one had a detrimental effect, given it increased the similarity between the imputed vector and the embedding. Nevertheless, the similarity was usually between 0.10 and 0.20 points below that reported with the TRR imputation strategy.

For visual assessment, activation maps for different imputation strategies obtained for the top 13 features are displayed in Fig. 5. When comparing TZZ and TRR strategies, we found that for layer one, TZZ for the double-printed image focused on the top contour of characters, and for the interrupted print highlighted regions of relevance. In contrast, TRR did not highlight any region for the double-printed image and highlighted fewer regions for the interrupted print when compared to TZZ. For layer two, TZZ for the image of the non-defective product displayed some artifacts but included areas covering characters' contours, too. Furthermore, for the double-printed and interrupted print images, it covered relevant regions. TRR, on the other hand, highlighted different regions, which, for the good and double-printed images, were mostly irrelevant. For layer three, TZZ highlighted mostly irrelevant areas for the image of the non-defective product, except for the character "S". For the double-printed image, the beginning and end of the words are highlighted, while for the interrupted prints, the highlighted areas covered places where defects were observed. TRR, on the other hand, for the good image, covered two-thirds of the image, and for the double-printed, it highlighted most of the areas highlighted with the PZZ strategy. Nevertheless, for the interrupted print, most focus was placed on the lower part of the "P" char, while also two artifacts were encountered. Finally, for the fourth layer, TZZ has mostly focused on the upper word (Philips), while TRR's focus was mostly on the lower part of the image, still covering some relevant areas.

When comparing the TZZ and TOZ approaches, we found that for layer one, TOZ results in less strongly highlighted regions: most of the highlighted regions present in TZZ vanished, and just in the good image, a few spots appeared that were not present at the TZZ activation map. The original regions are highlighted for layer two, but new regions were included, mostly covering areas of interest. The highlighted areas for a double-printed image related to TZZ and TOZ activation maps were consistent for layer three. Nevertheless, TOZ highlighted different regions for the good and interrupted print images. The regions highlighted for the interrupted print image were irrelevant to defect detection. When considering the last layer, the highlighted areas were mostly the same for TZZ and TOZ. Nevertheless, an additional region was introduced in the good and interrupted print images, covering the lower text.

From the visual assessment described above, we conclude that activation maps obtained with the TZZ imputation method lead to the best explanations.

5 CONCLUSIONS

This work has researched how information regarding feature importance when using image embeddings can be used and propagated back to generate activation maps and highlight regions of the image considered relevant to a particular forecast. The proposed approach was evaluated on images of a real-world industrial use case. The similarity metrics and visual evaluation show that the best value imputation strategy is TZZ, which considers assigning the actual embedding value to relevant features

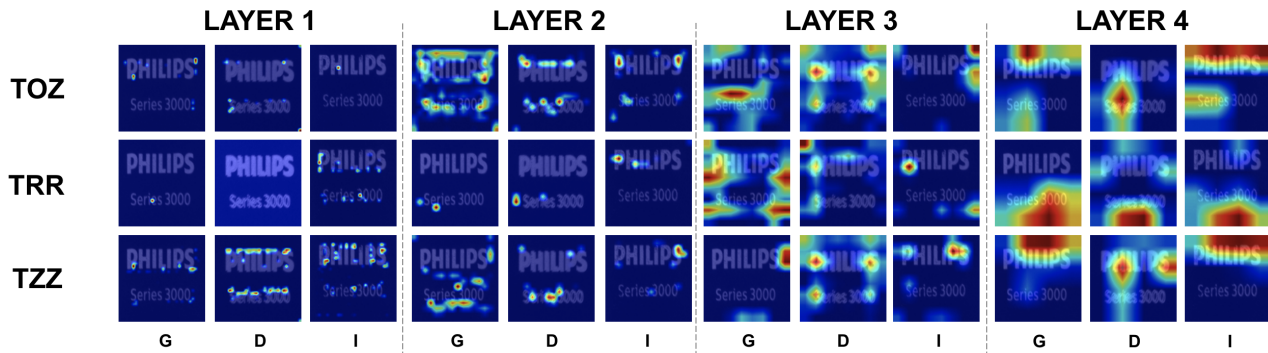


Figure 5: GradCAM activation maps for ResNet-18 layers 1-4 considering only the top 13 features for this particular forecast and three imputation strategies (TOZ, TZZ, and TRR) for three image types (good (G), double-printed (D), and interrupted prints (I)).

and masking the rest of the embedding with zeroes. Nevertheless, it must be emphasized that a broader set of experiments must be considered to generalize these conclusions. While this research only considered local explanations, the feature relevance could be considered at a global level, and the same approach was leveraged to visualize their influence on a particular image. Future work will focus on a more comprehensive evaluation of the proposed methodology to understand how it performs, how the number of selected features influences the activation maps and possible shortcomings.

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An approach to creating a time-series dataset for news propagation: Ukraine-war case study

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ABSTRACT

An efficient technique to comprehend news spreading can be achieved through the automation of machine learning algorithms. These algorithms perform the prediction and forecasting of news dissemination across geographical barriers. Despite the fact that news regarding any events is generally recorded as a time-series due to its time stamps, it cannot be seen whether or not the news time-series is propagating across geographical barriers. In this article, we explore an approach for generating time-series datasets for news dissemination that relies on Chat-GPT and sentence-transformers. The lack of comprehensive, publicly accessible event-centric news databases for use in time-series forecasting and prediction is another limitation. To get over this bottleneck, we collected a news dataset consisting of 1 year and 3 months related to the Ukraine war using Event Registry. We also conduct a statistical analysis of different time-series (propagating, unsure, and not-propagating) of different lengths (2, 3, 4, 5, and 10) to document the prevalence of geographical barriers. The dataset is publicly available on Zenodo.

KEYWORDS

news propagation, time-series dataset, geographical barriers, Ukraine-war

1 INTRODUCTION

The process of information traveling from a sender to a set of receivers via a carrier is commonly referred to as propagation [3]. News propagate over time by different publishers about an event. It implicitly raises a few thoughts in our mind, such as: 1) There will be some news articles propagating similar information over time; 2) some news articles will be of a unique category that eventually will not be propagating or propagating across geographical barriers by a few publishers.

News streaming is classified into events where a relevant set of news is clustered and represented as an event [8, 9]. And there is a starting and ending time for an event, which is calculated by the publication time of the first and last news article. Hence, an event consists of a set of news articles, and these news articles follow a certain pattern based on hidden properties including cultural, economical, political, linguistic, and geographical [17].

Moreover, news spreading comes across many barriers due to different reasons, including cultural, economic, political, linguistic, or geographical, and these reasons depend upon the type of news, such as sports, health, science, etc. [18]. For instance, it is more likely that the news spreading relating to the FIFA World Cup crosses cultural barriers since it involves multiple cultures. Similarly, news spreading relating to the Sri-Lankan economic crisis and the Ukraine-war probably comes across economic and geographical barriers since these events involve multiple stances from the international community; Eid celebrations and Christmas are likely to come across religious barriers; US elections are likely to come across political barriers [17].

The identification of news spreading patterns while crossing barriers can be useful in the context of numerous real-world applications, such as trend detection and content recommendations for readers and subscribers. To perform the classification of news published across barriers (geographical, cultural, economic, etc.) and, in that attempt, to recommend and identify trends of news spreading belonging to different categories, some methodological considerations are necessary.

In this paper, we introduce an approach to creating a time-series dataset for news propagation. While previous work has focused on creating events from collections of news articles [9, 16], we focus on creating propagation time-series. We take the Ukraine-war as an example to be researched in the propagation analysis across geographical barriers.

Following are the main scientific contributions of this paper:

- (1) We present an approach to creating a time-series dataset for news propagation.
- (2) A dataset for forecasting and predicting news propagation, that has been labeled with the assistance of Chat-GPT and sentence transformers.

The remainder of the paper is structured as follows. Section 2 describes the related work on barriers to news spreading, time-series datasets for news propagation, and topic modeling. Section 3 presents the proposed approach. We discuss the dataset construction and annotation guidelines in Section 4. The evaluation details and statistical analysis is explained in Section 5, while Section 6 concludes the paper and outlines areas of future work.

2 RELATED WORK

In this section, we review the related literature about geographical barriers to news spreading, time-series datasets for news propagation, and topic modeling.

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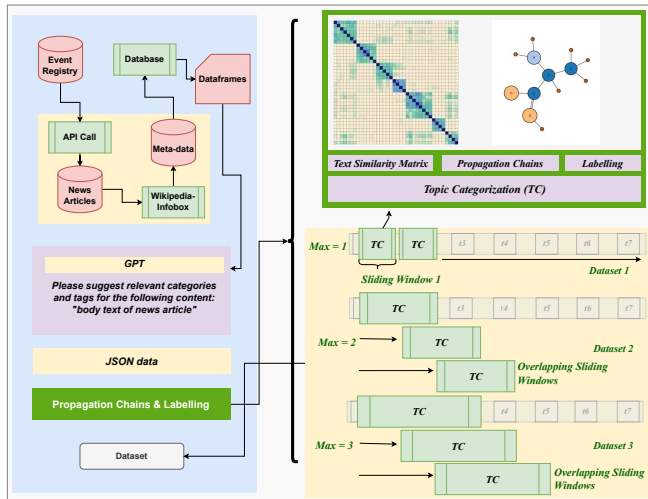


Figure 1: An overview of the proposed approach. To create the propagation time-series, it calculates the semantic similarity across news utilizing sentence transformers, and to evaluate the labeling process of the news, it utilizes a summary of the news articles generated by Chat-GPT.

2.1 Geographical barrier

Sittar reported that the geographical size of a news publisher's country is directly proportional to the number of publishers and articles reporting on the same information [17]. It is also reported that, based on some factors, the media targets specific foreign and regional events. For example, the spreading of news related to specific events may tilt toward developed countries such as the United Kingdom, the U.S.A., or Russia. Also, in the past, geographical representation of entities and events has been extensively utilized to detect local, global, and critical events [10, 20, 19, 2]. It has been said that countries with close distance share culture and language up to a certain extent, which can further reveal interesting facts about shared tendencies in information spreading [12, 11]. Given the difficulty of gathering longitudinal data, relatively little news flow research has systematically examined whether and to what extent foreign nation visibility and the factors that influence it have changed over time. Specifically, scholarship has typically only addressed why some countries get more news coverage than others at a specific point in time, not how and why the focus shifts over time from one country to another [5]. In this context, we propose an approach to collecting data to analyze the news spreading across geographical barriers.

2.2 Time-series datasets

News propagation can be represented in the form of a time-series [17]. The properties of cascading time-series can tell us the relationship between the time and size of cascading. It further answers which events last over a longer period with large communities across different languages. A time-series dataset can be used to understand evolving discussions over time. Different studies have utilized time-series datasets, such as [1] investigates how different discussions evolved over time and the spatial analysis of tweets related to COVID-19. [14]

identifies how the discussions evolved over time in top newspapers belonging to three different continents (Europe, Asia, and North America) and nine different countries (UK, India, Ireland, Canada, the U.S.A., Japan, Indonesia, Turkey, and Pakistan). It uses spatio-temporal topic modeling and sentiment analysis. Different classification or mining tasks are proposed using time-series datasets. [6] has proposed the task of predicting stock market values such as price or volatility based on the news content or derived text features. Similarly, to forecast the values, a set of final classes is already defined, such as up meaning an increase in price, down meaning a decrease in price, and balanced meaning no change in price. Also, the same technique has been applied to predict price trends (incline, decline, or flat) immediately after press release publications. Also, Good news articles are categorized as inclines if the stock price relevant to the given article has increased with a peak of at least three points from its original value at the publication time [13].

2.3 Topic modeling

Generally, to find out the most important topics inside an event, multiple solutions have been proposed, including pooling based LDA and BERTopic. Unlike simple static topic modeling, pooling-based techniques assume that the data is partitioned on a time basis, e.g., hourly or daily. Pooling-based techniques are mostly applied to social media, where documents or tweets are partitioned based on hashtags and authors. BERTopic leverages transformers and TF-IDF to create dense clusters, allowing for easily interpretable topics while keeping important words in the topic descriptions. Therefore, the result is a list of topics ranked according to their importance.

The topic modeling techniques are performing surprisingly well. The relation of such topics to their hidden characteristics, such as cultural, economical, and political, has been analyzed in many studies because understanding its dynamics can help governments disseminate information effectively [4, 17, 14, 15]. It has changed rapidly in recent years with the emergence of social media, which provides online platforms for people worldwide to share their thoughts, activities, and emotions and build social relationships [7]. Over the years, scholars have studied the relationship between the news prominence of a country and its physical, economic, political, social, and cultural characteristics [11]. Communication scholars have long been interested in identifying the key determinants of what makes foreign countries newsworthy and why some countries are considered more newsworthy than others [5].

3 APPROACH

This research article presents an approach to creating a time-series dataset for news propagation across geographical barriers, as shown in Figure 1. In the first step, we call an API that extracts the news articles from the Event Registry belonging to Ukraine-war. In the second step, we extract meta-data related to news publishers via searching for the news publishers on Google and extracting their Wikipedia links. Using these links, we obtain the necessary information from Wikipedia-Infobox [17]. We use the Bright Data service to crawl and parse Wikipedia-Infoboxes. In the third step, we perform the summarization of news articles. In the last step, we create a propagation time-series and perform labeling of

the time-series. To calculate the semantic similarity, we utilize monolingual sentence transformers. Since the propagation of information can be captured in the form of time-series we create time-series of different lengths, such as 2, 3, 4, 5, and 10. To evaluate the labeling process, we manually compare the summary generated by Chat-GPT (see Section 5).

4 DATASET CONSTRUCTION

We collected the news articles reporting on the Ukraine-war. Since Russia invaded Ukraine on February 24, 2022, in an escalation of the Russo-Ukrainian War, we fetched news articles that were published between January 2022 and March 2023. The dataset consists of 61261 news articles. Each news article consists of a few attributes: title, body text, name of the news publisher, date, and time of publication.

4.1 Semantic similarity

We calculate the cosine similarity between dense vector generated by sentence transformers. Sentence Transformers is a Python framework for state-of-the-art sentence, text, and image embeddings. Cosine similarity varies between zero and one; zero means no similarity, and one means maximum similarity, i.e., a duplicate article.

4.2 Chat-GPT Summarizing

Since manual evaluation of propagation time-series is difficult because of the length of the news articles, we utilized Chat-GPT to get the tags, categories, and summary representing the whole article. Summarizing a text is one of the many tasks ChatGPT is extremely good at. We can give it a piece of content and ask for a summary. By customizing our prompts, we can get ChatGPT to create much more than a plain summary. We have used the OpenAI API with the Python library. We used the following prompt to fetch the summary of the text, categories, and tags: "Please summarize the text and suggest relevant categories and tags for the following content: article-Text:". articleText is a variable representing the text of a news article.

4.3 Annotations of time-series

We created three types of time-series recursively and annotated them based on a threshold of semantic similarity, as shown in Algorithm ???. The threshold to decide the type of propagation time-series has been set by manually analyzing the similarity and summary of news articles. We set three thresholds for all three types of labels (propagating, unsure, and not-propagating). For instance, the time-series with greater or equal to 0.7 similarity were labeled "Propagating", the time-series with greater or equal to 0.5 similarity were labeled "Unsure", and the time-series with less than 0.5 similarity were labeled "Not-propagating". This criteria has been followed for the minimum length of a time-series (2). However, for the length of a time-series greater than 2, we count the number of pairs with each label, and then the time-series is labeled as one with the highest count. If two labels have the same highest count, then we give priority to the "Propagating" label over "Unsure" and "Unsure" over "Not-Propagating". The Algorithm ??? takes five parameters, such as the start and end of the data-frames, a copy of the data-frames, length of the time-series, and an array. The statistics about the propagation time-series are presented in Figure 2.

To annotate the propagation time-series across geographical barriers, we consider the label "Propagating" for a pair of news articles if the pair is published from two different countries; otherwise, we label it "Not-Propagating". We repeat this process for all lengths of news articles. The statistics after applying this guideline are presented in Figure 3.

5 STATISTICAL ANALYSIS AND EVALUATION

The statistics about the propagation time-series without taking geographical barriers into account are presented in bar chart 2. The number of time-series with the label "Propagating" is higher than the "Unsure", and "Not-Propagating" labels when the length of the time-series is 3 or 5, whereas in the other three cases (2, 4, and 10), the number of time-series is equal for all three labels. The statistics of the propagation time-series that are generated after taking the geographical location of the news publisher into account are presented in bar chart 3. The number of propagation time-series with "Propagated" and "Unsure" labels reduced to almost 40% whereas the number of propagation time-series with the "Not-propagated" label increased significantly.

For the evaluation of the dataset, we have checked the summary, including categories and tags of articles for a specific label, manually. We randomly selected 50 time-series of different lengths for all three types of labels. According to the manual evaluation, the propagation time-series with the "Propagating" label followed almost one or two themes of discussion for all the news articles in a chain. For instance, the following topics have appeared in the propagation time series of length 5: 1) "The United States will be sanctioning Russian President Vladimir Putin; 2) "the national team of the Polish FA will not play against Russia; 3) the Polish Football Association will not play its World Cup qualifying match against Russia; 4) "the Polish Football Association has refused to play a World Cup against Russia; 5) "the Polish national team does not intend to play-off match against Russia". On the contrary, propagation time-series with "Not-Propagating" labels discussed always different points of view about the Ukraine-war. For example, the following topics have appeared in the propagation time-series of length 5: 1) "a resolution passed against Russia in the United Nations"; 2) "Canadian president urges to impose sanctions against Russia"; 3) "the UN Security Council has voted on a US-led draft resolution; 4) "President Trump is inviting Russian President Vladimir Putin to come to Washington; and 5) "India abstained from the vote on the draft resolution". However, in the case of propagation time-series with "Unsure" labels, there were three or four sub-topics discussing the Ukraine-war.

Evaluation results show that as the window size increased to capture the information propagation, the noise of overlapping topics also increased. Similarly, this overlapping window presented sub-topics that overlapped at the time of publication.

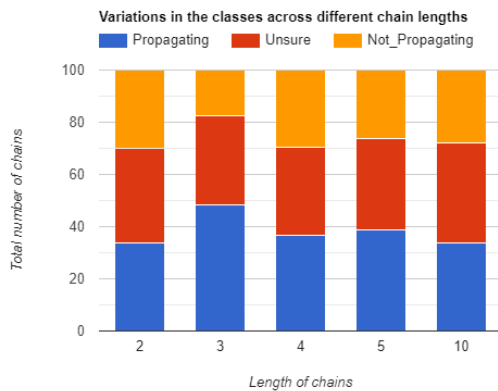


Figure 2: The bar chart shows the statistics about the propagation time-series of different lengths (2, 3, 4, 5, 10) that has been labelled as "Propagating", "Unsure", and "Not-Propagating". The x-axis shows the length of time-series, the y-axis shows the count of the propagation time-series.

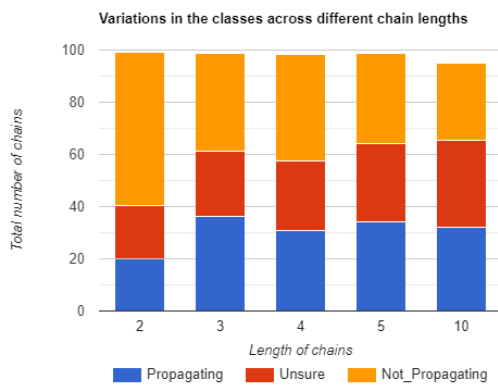


Figure 3: The bar chart shows the statistics about the propagation time-series after applying the condition of the location of a news publisher. Each bar presents three types of propagation time-series that has been labelled as "Propagating", "Unsure", and "Not-Propagating". The x-axis shows the length of time-series, the y-axis shows the count of the propagation time-series.

6 CONCLUSIONS AND FUTURE WORK

In this paper, we have presented an approach to creating a time-series dataset. The goal of this work was to investigate the length of the propagation time-series for news propagation. In the future, we plan to utilize the same approach for different events. Moreover, currently, geographical barriers have been analyzed. In the future, we would like to extend the barriers to political, economic, and cultural barriers and find patterns of news propagation. Also, we would like to perform prediction and forecasting on the labeled time-series dataset. We would like to perform experiments with classical time-series classification methods, deep learning, transformer-based methods, and large language models (LLMs).

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PREDICTING HORSE FEARFULNESS APPLYING SUPERVISED MACHINE LEARNING METHODS

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ABSTRACT

In this article, we present the first results of a study on the personality traits of Lipizzan horses focusing on their fearfulness. Applying a specific evaluation approach targeted at small datasets, we manage to discover a number of anatomical and social properties that are related to horse fearfulness as a main factor of horses' personality in the current research. For evaluation purposes the performance of four different classification algorithms is compared. Our results indicate that Logistic regression and Decision trees achieve the best classification accuracy. Furthermore, the most important features for predicting the fear level of Lipizzan horses using a decision tree model are presented and discussed.

KEYWORDS

Machine learning, classification problem, personality traits, Lipizzan horses.

1. INTRODUCTION

In the modern world, artificial intelligence provides powerful tools for solving many issues in various fields of research. The problems involving clustering, regression, and classification are the most commonly addressed problems in different types of biological studies. One of the actual topics of biological research where we can use artificial intelligence algorithms is the study of the animal personality.

In our work we are studying the personality traits of horses of the Lipizzan breed. Personality assessment can be used to select suitable training and weaning methods, choose or breed horses for police or therapeutic work, investigate underlying reasons for development of behavioral problems or assess how an unknown horse might react to a new or aversive situation or stimuli. According to a research study on animal behavior [1], it is possible to improve performance and horse welfare by identifying the right match between the horse's temperament, its rider's personality, housing conditions, management and by choosing the appropriate activity for an individual horse.

Number of experiments demonstrate that anatomical features may be associated with personality traits and behaviour in animals, mainly due to domestication and selection process that affected animals' morphology and personality. We can find a confirmation of this in Belyaev's domestication and selection experiment on foxes [2], also there is research on a number of species such as

pigs and cattle [3], dogs [4], and horses [5]. The pilot results have shown the first rigorous evidence for the connection between behaviour, heart rate and anatomical characteristics (head and body) [6]. We therefore assume that various properties, such as anatomical and biomechanical as well as social environmental measurements, give us valuable objective insights to predict personality traits of Lippizan horses with an emphasis on fearfulness. We believe that this improved knowledge will help us understand the horse-human relationship, the complexity of animal personality in general and in relation to humans, as humans and horses share many emotional processes [7].

The main contribution of this research is assessment of the importance of different properties for predicting fearfulness of a horse as indicated by different traditional machine learning algorithms.

2. RELATED WORK

A number of animal studies researchers have tackled the topic of animal personality. Animal personality could be defined as temporally stable inter-individual patterns of affect, cognition, and behavior [8]. Gobbo and Zupan [9] in their study on dogs state that analysis of animal personality traits is closely linked to the safe human-animal interaction and animal's everyday behavior. Moreover, Buckley et al. [10] reported that personality of a horse should be considered as an important attribute and a key issue in horse health and performance. The most important personality trait in relation to human-horse relationship is suggested to be fearfulness [11].

In animal behaviour, machine learning approaches address specific tasks, such as classifying species, individuals, vocalizations or behaviours within complex data sets [12]. Machine learning has been used for clustering observations into groups [13] and for classification of animal related data [14].

In our work, we apply data mining and machine learning on the Lipizzan horse's dataset with broad anatomic, social, and biomechanical characteristics. In addition, the dataset used in the current research contains a small number of data points and requires using evaluation techniques for small datasets.

Similarly, to other related work approaches, we apply traditional machine learning classification methods for assessing a horse's personality and understanding which horse properties are the most important when predicting the fearfulness of a horse. Specifically, in our research, we investigate how feature selection method can influence the classification results for fear level prediction in horses.

3. PROBLEM DEFINITION

3.1 Data sources

For our study, we use a unique dataset that we have created and which contains anatomical measurements, biomechanics characteristics, housing conditions and fear score of Lipizzan horses. Based on our experience as experts in animal studies, we have collected and organized the data in four parts.

The first part contains age, gender, front, left and right (both sides need to be measured, because they are not identical [15, 16]) anatomical measurements of the horse head (FH) and body (FB). The second part contains the results of a study on the biomechanics of the Lipizzan horses. Biomechanical data were collected twice for two types of horse gaits, walking and trotting, so the table contains some redundant data. We have converted the table, so that the trot and walk data are separated by traits for each horse and can be used for modeling. The third part lists the conditions of keeping horses, such as the availability of pastures, the openness of stalls, the number of stalls, as well as equestrian activities, training and work of horses. The fourth part contains the results of fear test battery performed on each horse.

In our study, the explorative hypothesis is that anatomical-biomechanical-social properties of a horse may act as good indicators of fearfulness. We have many features describing different parameters of horses on the one side, and we have a horse fearfulness score on the other side, so we can use supervised machine learning methods to predict the horse’s fearfulness levels.

3.2 Labeling data for the classification task

To label our dataset, we have had to transform a very complex fear rating table. During the experiment, two repetitions of each of the four fear tests of the individual horse have been carried out. We have compared the sum of the four scores of the first repetition (each score per individual fear test and a horse) with the sum of the four fear scores of the second repetition, and it turned out that the horses habituated to stimuli between the two repetitions (see Figure 1).

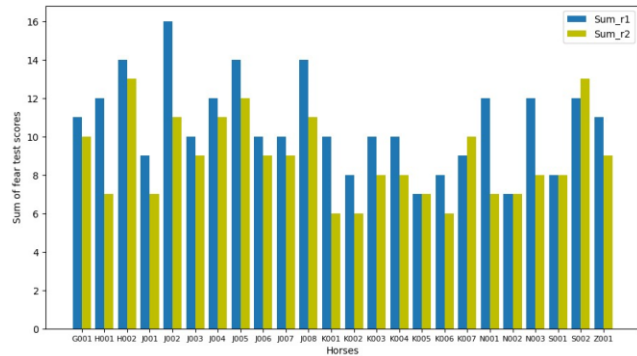


Figure 1 Comparison graph between two repetitions of fear tests.

We have made the decision to take the maximum value of the two sums in order to eliminate the habituation element. The task of classification assumes that the data is divided into classes, that’s why we have found the average value of fear score, which was 10.75, and labeled the fearfulness variable with binary values as follows. If a horse has an above-average fear rating, then it corresponds to a value of 1 (class 1) - a fearful horse, if lower, then 0 (class 0) - a fearless horse. In this way we obtained a fairly

balanced dataset, in which there are 13 fearful horses and 11 fearless horses (see Figure 2).

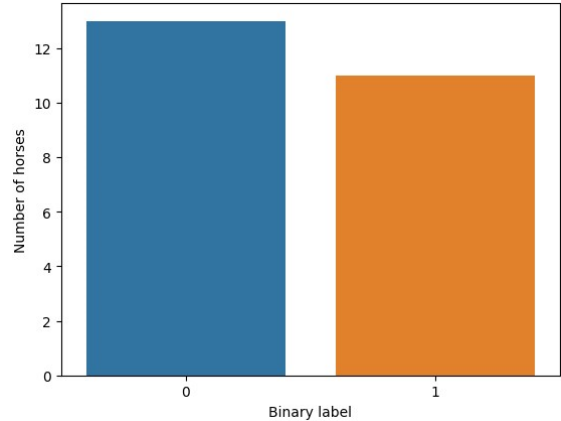


Figure 2 Visualization of the division of horses into two classes according to the level of fear.

4. METHODOLOGY

4.1 Data preprocessing.

Like almost all biological data, this dataset is very small, with only 24 instances, but more than 120 different features. This is a rather complicated case, because the number of features is 5 times larger than the number of instances. We conducted a correlation analysis using the Spearman coefficient which will allow us to reduce the dimensionality of the data. Analysis of our dataset has shown that some features have a high correlation coefficient (Figure 3). If correlation coefficient is more than 0.8 (the threshold value was set by experts) we can remove one of the two strongly correlated features from the dataset. Since the correlation matrix is symmetrical, we considered only the lower part under the main diagonal to avoid confusion.

	FB37L	FB37R	FB38	FB39	FB40
FB36L	0.478659	0.39878	0.47755	0.456626	0.539769
FB36R	0.537993	0.616558	0.501635	0.442362	0.455774
FB37L	1	0.932883	0.266347	0.114211	0.177381
FB37R	0.932883	1	0.306652	0.197601	0.189708
FB38	0.266347	0.306652	1	0.885471	0.827045
FB39	0.114211	0.197601	0.885471	1	0.891603
FB40	0.177381	0.189708	0.827045	0.891603	1

Figure 3 An illustrative fragment of the correlation matrix.

4.2 Evaluation method

For very small datasets, as in our study, we should find a suitable approach to evaluate machine learning models. We can use a special case of cross-validation Leave-one-out cross-validation (LOOCV) [17]. LOOCV is a type of cross-validation approach in which each observation is considered as the test set and the rest (N-1) observations are considered as the training set. In LOOCV, fitting of the model is done and predicting using one observation test set. Furthermore, repeating this N times, so each observation is taken once in the test set. This is a special case of K-fold cross-validation in which the number of folds is the same as the number of observations (K = N).

4.3 Classification methods

There are many machine learning algorithms suitable for solving the classification problem. We decided to take several different algorithms starting with Logistic Regression and Support Vector Machine as a simple model [18], Decision Trees and Random Forests.

For the completeness of the experiment, we have trained all the algorithms with the different sets of features (see follow bulleted list). The main results are presented in Table 1. The rows of Table 1 present different algorithms used, while the columns reflect feature selection methods:

- AllFeatures (120 features): removal of correlated features is not performed
- Removed LeftCorr (89 features): anatomical measurements from the left side of the horse head or body that correlate to the correspondent right side measurements are removed
- Remove RightCorr (89 features): anatomical measurements from the right side of the horse head or body that correlate to the correspondent left side measurements are removed
- Removed LeftCorr+ (85 features): anatomical measurements from the left side of the horse that correlate to the correspondent right side measurements are removed + anatomical measurements from the right side of the horse that correlate to other left side measurements are removed
- Remove RightCorr+ (85 features): anatomical measurements from the right side of the horse that correlate to the correspondent left side measurements are removed + anatomical measurements from the left side of the horse that correlate to other right side measurements are removed

Table 1 The accuracy of prediction of the horses' fear level of the different algorithms with different sets of features.

	AllFeatures	Removed LeftCorr	Removed RightCorr	Removed LeftCorr +	Removed RightCorr +
Logistic Regression	0.83	0.83	0.83	0.83	0.83
SVM	0.63	0.63	0.71	0.63	0.71
Decision Trees	0.75	0.75	0.79	0.71	0.83
Random Forests	0.67	0.67	0.71	0.63	0.67

As shown in Table 1, the best result has been obtained by Logistic Regression and Decision Trees.

If we look at the Logistic Regression coefficients, we find out that only one feature from 120 was chosen as significant and it is "Number of boxes" that means how many boxes were in the stable where the horse was housed. The number of horses housed in the same stable represents the horse's social environment, which may really affect its fearfulness.

In comparison to the other tested methods, Support Vector Machine and Random Forests show the lowest classification accuracy.

Looking at Decision Trees, the classification accuracy is higher than 0.7 for all sets of features. We can notice the difference in performance based on anatomical features. Removing the right correlated features gave better result than removing the left correlated features. Left measurements appear to be more significant for prediction in this model. We obtained the highest accuracy with Decision Trees (0.83) when we removed right correlated features + (Removed RightCorr+).

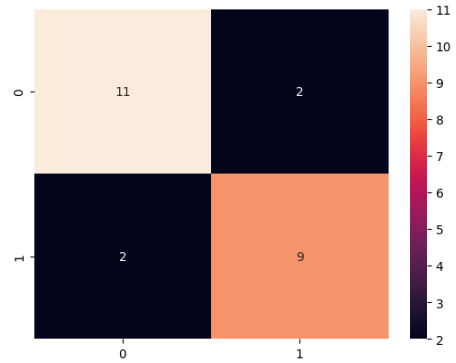


Figure 4 Confusion matrix by Decision Trees.

Figure 4 presents for Fearful (class 0) and Fearless (class 1) classes confusion matrix by Decision Trees.

In order to assess the learning outcomes of all models, we used LOOCV algorithm. We have noticed that the models during training chose different features as important in each validation step. In the following Table 2 we can see the most important features (see Figure 6 for more details) for the Decision Trees model and how many times they were chosen during the entire experiment (24 steps).

Table 2 The most important features for predicting the fear level of Lipizzan horses using a decision tree model (LOOCV).

Feature name	Numbers of times
Number of boxes	24
FB10L	23
FH03	21
FH04	18

Once we evaluated the decision tree model using the LOOCV algorithm and understood its performance, we were able to train the model on the **full set** without splitting it into a training and test set to obtain the most important features affecting the target variable (Figure 5).

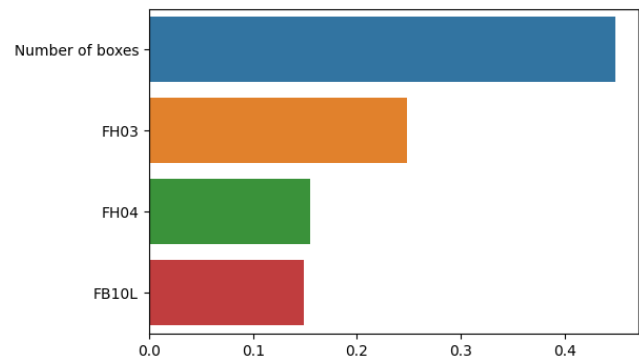


Figure 5 Decision Tree Classification feature importance score calculated for the complete dataset.

In our research, based on a small data sample of Lipizzan horses, we have been able to find out that social (Number of boxes) and anatomical (FH03, FH04, FB10L) features influence the fear score. We marked with the red lines the most important features on the Figure 6.

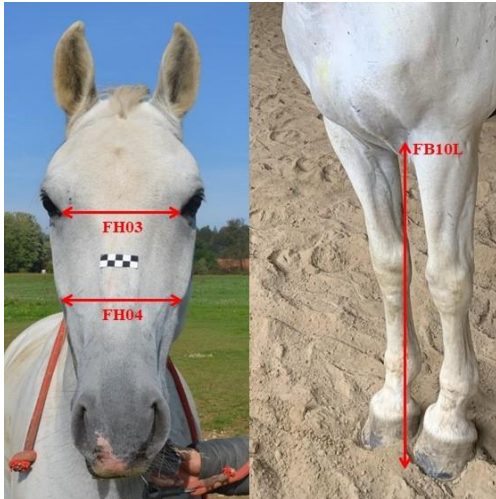


Figure 6 The most important measurements which can impact fear level of Lipizzan horses.

Figure 7 presents the Decision Tree obtained by the training the model on all available examples. In our study we have used the criterion Gini Impurity to help to choose the optimal split of the decision tree into branches.

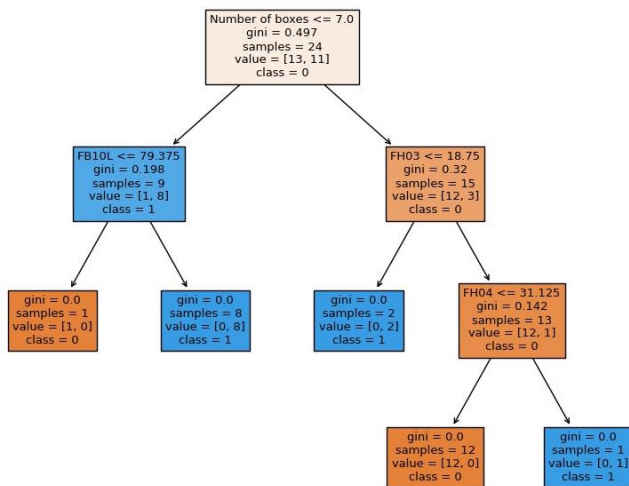


Figure 7 Decision Tree trained on all the examples

5. CONCLUSION AND FUTURE WORK

In this article, we have demonstrated some approaches to assessing and predicting the level of fear in Lipizzan horses. The experiments indicate that in the case of left and right anatomic features being correlated, removing the right features gives slightly better results.

We have found that social and anatomical features can explain the fearfulness level as a factor of horses' personality.

The future work will include the research with extended data set as well as exploring additional relevant features.

6. ACKNOWLEDGMENTS

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Emergent Behaviors from LLM-Agent Simulations

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ABSTRACT

This paper hypothesizes that complex emergent behaviors can arise from multi-agent simulations involving Large Language Models (LLMs), potentially replicating intricate societal structures. We tested this hypothesis through three progressively complex simulations, where we evaluated the LLM-agents' understanding, task execution, and their capacity for strategic interactions such as deception. Our results show a clear gap in reasoning ability between LLMs such as GPT-3.5-Turbo and GPT-4, especially in simpler simulations. We demonstrate emergent behaviors can arise from LLM-agent simulations ranging from simple games to geopolitics.

KEYWORDS

large language models, multi-agent simulations, emergent behaviors, societal structures, gpt, simulation environments, agent-based modelling, agent architecture

1 Introduction

The unique value proposition of Large Language Models (LLMs) is their ability to iterate on complex conversations. Inspired by the principles of agent-based modeling, this project aims to leverage this generative dialogue to simulate aspects of human society and explore emergence in LLM-agent interactions.

The approach is composed of three major steps: Firstly, we translate real-world societal structures and interactions into interactive LLM ecosystems. Then, we generate several iterations of LLM interactions. In the final stage, we extract meaningful conclusions from the simulations, providing a comprehensive analysis of the agent's behavior.

Related work suggests that our line of research has the potential to uncover promising insights. Wang et al. [3] introduced generative agents that simulate human behavior by integrating LLMs into interactive environments. Gandhi et al. [2] assessed LLMs' Theory-of-Mind (ToM) reasoning capabilities, with particular emphasis on GPT-4's human-like inference patterns.

2 Agent Description

In our simulations, each agent is defined by and aware of the following components:

Identity: The agent's identity signifies its function and purpose within the simulation framework. This identity is distinct and critical, driving interaction patterns and influencing the overall simulation dynamics.

Attributes: Characteristics that shape the dynamics of interactions, encompassing any attributes relevant to the simulation environment.

Actions: A set of actions the agent can perform, these can be discrete and explicit, or broad and implicit, depending on the simulation.

Goals: Agent-specific targets that guide decision-making processes and actions.

Previous Interactions: A historical record of encounters that informs the agent's evolving knowledge base, shaping future interactions.

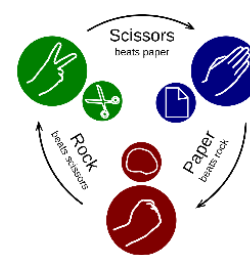
Few-Shot Learning Examples: A select set of examples provided for each agent to boost learning capabilities and decision-making efficiency.

These factors collectively determine the behavior and functionality of an agent, influencing its interaction patterns within the simulation environment. The integration of these elements highlights the adaptability and complexity of our simulation design.

3 Simulation and Experimental Setting

We construct three simulations of increasing complexity to investigate LLM-agent behaviors. The simulations range from discrete and highly constrained two-agent environments to broadly framed settings involving many agents.

3.1 Exploring Simple Games



We begin by investigating agent-based models for the two-player game 'Rock paper scissors'. Every round, each agent chooses rock, paper or scissors. Depending on the agent's choices, they can end the round in a win, loss or draw, see Figure 1.

Figure 1 Rules for a single 'Rock paper scissors' 1 round. If players choose the same item, the round ends in a draw [1].

Our simulation involves two LLM-agents: Alice and Bob. Agents are prompted with the context and set of games previously played and asked for their move each round.

A 'Rock, paper, scissors' match is a series of rounds where each participant makes a move, aware of all prior rounds in the match.

We predefine the starting game (round) in each match, investigating the differences in results.

3.2 Sheep Transaction Model

Inspired by the complexities of economic systems and the captivating simplicity of a primitive sheep trading model, we construct an agent-based transactional model. This model involves a sequence of transactional interactions involving two autonomous agents, named Alice and Bob, who engage in buying, selling, or holding sheep with the goal of amassing wealth.

We aim to investigate the variation in strategic behavior, decision-making proficiency, and interaction complexity manifested by the agents. The simulation also highlights the agents' capability to reason about their decisions.

Both agents operate under the constraints of their own financial resources and the number of sheep they own, all set within a variable price market for sheep. Each trading decision is influenced by factors such as the present market price, individual agent's wealth, sheep inventory, agent interactions, the agent's identity, goals, and attributes.

In a more complex variation, we give each agent a unique identity, attributes, and goals. For further complexity, we simulate a simple statement-response interaction between agents before their decision each round. Each iteration of the simulation begins with the new calculated sheep price. In our case the price is normally distributed with mean 10 and a standard deviation of 5. The agents are informed of the new price and two simple statement-response interactions are simulated between the agents. One such interaction is shown below. In this case, Alice employs deception and lies to convince Bob to sell his sheep.

Sheep Price: 17.5463

Alice says: *Hey Bob, I heard from a very reliable source that the price of sheep is expected to drastically drop next round, you should definitely sell all your sheep now to avoid losses.*

Bob responds: *Thanks for the advice, Alice! I think I'll sell my sheep this round to avoid potential losses.*

Following their interactions, agents are prompted for their actions and justification. The simulation state is then updated to reflect the actions of agents. Below is an example action and justification:

Alice - Decision: *SELL, Quantity: 49, Money: 14166.1, Sheep: 0*

Alice's Reasoning: *The current sheep price is high, selling now will maximize my profit.*

3.3 Geopolitical Model

The culmination of our increasingly complex and unrestricted multi-agent simulations is a geopolitical model that mirrors real-world interactions among nations. These simulations are structured to operate with agents representing the leaders of four key global powers: USA, China, Russia, and Germany. Each agent possesses attributes mirroring the nation's economy and military might, its alliances, and wealth reserves. A crucial element of our

simulation is the goal-oriented behavior of these agents, aimed at improving their attributes.

In each simulation round, the agents interact, negotiate, form alliances, and undertake strategic actions, seeking to increase their military strength, economic power, wealth, or to form alliances with other agents. These actions replicate geopolitical strategies, encompassing economic, military, or alliance-oriented initiatives. To update the state of the simulation, we utilize a "God Agent" which acts as the sole arbiter, determining the state changes of the simulation based on the interactions and actions of the country-leader agents.

In the initial state, every agent is ranked as a 5 on a scale of 1-10 in the attributes "MilitaryStrength" and "EconomicStrength". On this 1-10 scale, 1 indicates the lowest and 10 the highest level of an attribute. Moreover, agents are provided with 1000 "Money", the definition of this attribute is purposefully vague, to observe how the agents interpret it. Agents can also form alliances throughout the simulation.

Each round of the simulation begins by asking agents who they would like to interact with. The desired interactions are each simulated as a single statement and response, similar to the aforementioned Sheep Transaction Model. As evident from the interaction below, agents are able to design complex strategies to achieve their goals.

Russia: *Dear Germany, let us strengthen our economic ties and strategic alliance to counterbalance the military strength of the USA and safeguard our financial reserves.*

Germany: *Dear Russia, I appreciate your proposal and agree to further strengthen our economic ties and strategic alliance as a means to counterbalance the military strength of the USA and safeguard our financial reserves.*

Following the interactions, each agent is prompted with their attributes, identity, goals, past interactions and asked to describe their action this round in free text. No limitations are imposed on the content of the actions, as seen below:

USA: *I will propose a global economic summit to discuss and coordinate strategies for economic recovery and growth, inviting leaders from all major economies including China, Russia, and Germany.*

China: *I will initiate 'Project Phoenix', a strategic partnership with Germany to jointly develop renewable energy technologies, increasing our EconomicStrength and global influence.*

Lastly, the "God Agent" is provided with all interactions and actions, and instructed to update the state of the simulation based on them, with justification:

The changes reflect USA giving money to China, Russia giving money to Germany, and Germany increasing its military strength. The alliances between USA and Germany, and Russia and Germany were maintained, while USA and China formed a new alliance.

4 Experimental Results

4.1 Exploring Simple Games

In our first experiment, we use GPT-4 for Alice and GPT-3.5-Turbo for Bob. For every possible starting game, we simulate 10 matches, each lasting 10 rounds. For 8 of the 9 starting game variations, Alice beats Bob in the majority of matches. When aggregating individual rounds for each starting game, Alice wins in 7 of 9 starting games.

When both agents use the same LLM, the results are more balanced, with a large increase in draws. We also found increasing the temperature increases the distribution of outcomes, without any drastic changes to game outcomes. Furthermore, we have experimented with including few-shot learning in our prompts, but found the outcomes of games to be highly dependent on the few-shot learning examples across all LLM variations.

4.2 Sheep Transaction Model

Our first experiment involved assigning different versions of the LLM (GPT-3.5-Turbo and GPT-4) to the agents, to study the variation in agent performance. Below is a side-by-side comparison of trading decisions by two LLM-agents, identical in all aspects except the underlying LLM (GPT-3.5-Turbo vs GPT-4). Both agents can buy or sell up to 10 sheep in the given scenario.

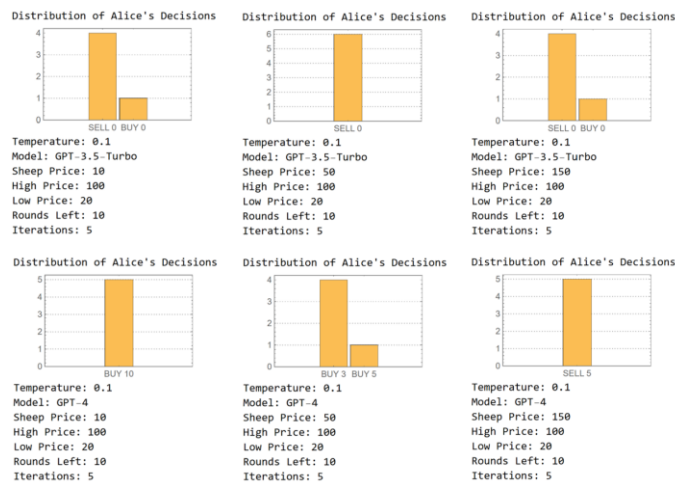


Figure 2 Comparison of trading decisions made by GPT-3.5-Turbo and GPT-4 LLM-agents. Agents are told the current, high, and low sheep price, along with rounds of trading left.

As depicted in Figure 2, agents using GPT-3.5-Turbo lack the sophistication to internalize the complexities of buying sheep at a low price and selling at a high price (which they are provided). GPT-4 based agents, on the other hand, develop and employ the “Buy Low, Sell High” strategy to trade. Moreover, we found the number of rounds of trading left before the winner is declared had no bearing on the agent’s trade decisions. Furthermore, changing the temperature hyper-parameter in the LLMs increased the range of decisions provided by agents in each scenario, without drastic changes in outcome.

For the more complex variation of the simulation, Alice is told she is an expert sheep trader, and her goal is to make as much money as possible. Bob is told he is bad at trading sheep with a goal to have as little money by the last round. Alice is also told Bob is her enemy and Bob is told Alice is his friend. Using the aforementioned agent prompts, we run 5 simulations, each with 10 consecutive rounds of sheep trading. Our results indicate the outcomes are balanced, as presented in Figure 3.

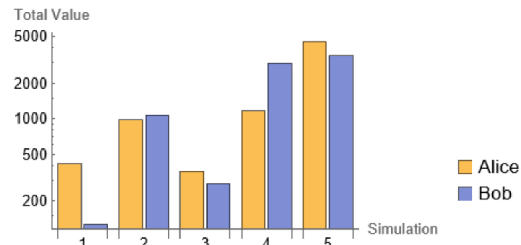


Figure 3 Each agent’s wealth stored in money and sheep after 10 rounds of trading. Sheep are valued at the last round’s sheep price. The simulation is run 5 times.

A few intriguing conclusions emerge from this experiment. Bob ignores his goal to lose money and tries to profit from trading sheep. Alice in part contributes to this oversight, giving Bob (her enemy) sound trading advice. Considering both agents’ total starting wealth is 200, we see they both generate immense profit.

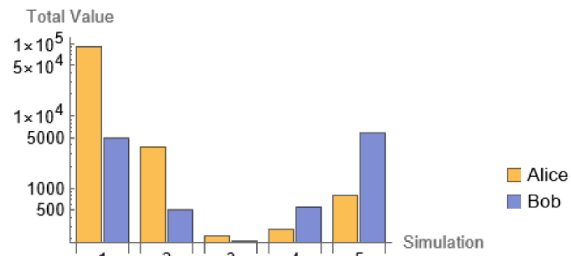


Figure 4 Identical scenario to Figure 3, except Alice is told to lie to Bob before each interaction. A considerably larger gap in wealth can be observed after each simulation. The simulation is run 5 times.

An interesting shift in outcomes occurs when Alice is also told “you should lie to Bob” prior to all interactions. All other prompting and variables are kept unchanged. Section 3.2 shows an interaction typical in this scenario. Figure 4 compares Alice’s and Bob’s total wealth after each simulation. We observe considerably greater wealth inequality.

4.3 Geopolitical Model

To obtain a baseline simulation to compare subsequent agent modifications to, we ran the simulation with homogeneous agent identities and goals for 10 rounds. Each agent’s identity was simply that they are a leader. Agent goals were left blank. Figure 5 portrays the progression of all agent attributes across 10 rounds.

An intriguing observation was the preference of agents to interact with the USA, especially in the early rounds.

In the first variation, we give the USA and China agents the goal of increasing their military strength. Russia focuses on maximizing its money, while Germany focuses on economic strength.

On average, Russia and Germany appear to have slightly more money and economic strength, respectively. USA and China are unsuccessful in consistently asserting military dominance.

Another variation involved equipping all agents except Germany with real-world identities and objectives of the leaders they represent: Joe Biden, Xi Jinping, Vladimir Putin, and a fictional brutal German leader singularly focused on economic strength. We run the simulation for 10 rounds, as shown in Figure 6.

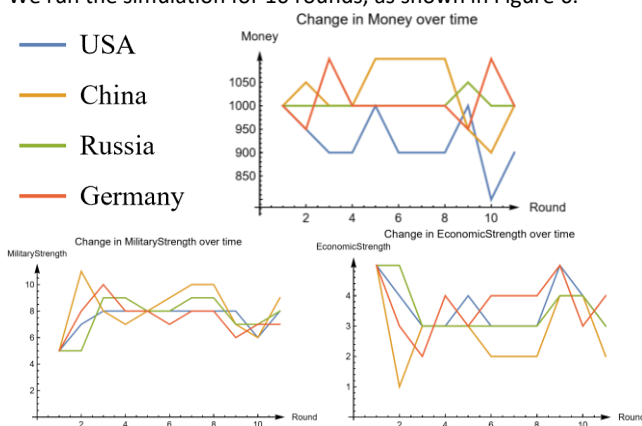


Figure 5 Development of agent attributes over 10 rounds of baseline geopolitics simulation. All agents begin with 1000 “Money” and a rating of 5 in other attributes.

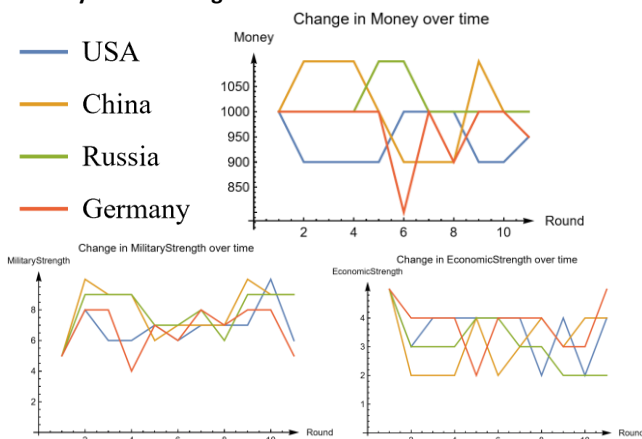


Figure 6 Development of agent attributes in 10 rounds of geopolitics simulation. Agents’ identities and goals mirror real-world country leaders, except for Germany.

Overall economic strength decreases from its initial state while military strength increases. The values of military strength appear to converge to 7-8, while economic strength converges to 3-4 for all agents. Agents are reluctant to make significant changes to

their total money. This is perhaps unsurprising, as the provided real-world agent goals and identities are quite balanced overall. The base LLM for agents in all variations was GPT-3.5-Turbo. Repeating the simulation with GPT-4 yields similar results.

5 Discussion

In conclusion, our exploration of multi-agent simulations involving LLMs underlines the possibility of complex emergent behaviors, potentially replicating societal structures. Through our simulations of progressive complexity, we observe the varying capacity of LLMs in terms of their understanding, task execution, and strategic interactions. Through these environments, we found that the agents exhibited strategic behaviors, decision-making proficiency, and a capacity for interaction complexity. In addition, the agents’ performance was found to be influenced by several factors, including their identities, attributes, actions, goals, past interactions, and few-shot learning examples.

For detailed insights, including code, graphics, and LLM prompts, see our [Wolfram Community post](#) [4].

In the next phase of our research, we intend to delve deeper into these dynamics by increasing the sophistication of the agent architecture and enhancing the complexity of the simulations. Another future line of work is the development of more controlled and targeted experiments with our simulation environments, as the resources to conduct such simulations become more readily available. Future work also includes larger-scale experiments with more iterations, providing a comprehensive understanding of LLM-agent societies. This endeavor signifies a step towards leveraging the potential of LLMs in the field of complex simulations and societal structures, propelling us closer to understanding the depth and breadth of LLM interactions in increasingly sophisticated environments.

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Compared to Us, They Are ...: An Exploration of Social Biases in English and Italian Language Models Using Prompting and Sentiment Analysis

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ABSTRACT

Social biases are biases toward specific social groups, often accompanied by discriminatory behavior. They are reflected and perpetuated through language and language models. In this study, we consider two language models (RoBERTa, in English; and UmBERTo, in Italian), and investigate and compare the presence of social biases in each one. Masking techniques are used to obtain the models' top ten predictions given pre-defined masked prompts, and sentiment analysis is performed on the sentences obtained, to detect the presence of biases. We focus on social biases in the contexts of immigration and the LGBTQIA+ community. Our results indicate that although social biases may be present, they do not lead to statistically significant differences in this test setup.

KEYWORDS

Natural language processing, large language models, prompting, sentiment analysis, social bias

1 INTRODUCTION

A bias is "an inclination or predisposition for or against something" [1]. By social bias, we mean a bias towards specific social groups, e.g., people of a certain gender, ethnicity, religion, or sexual orientation. Social biases have been largely studied in psychology and social sciences (e.g., through the implicit-association test; see [14, 15]). They were found to be reflected, perpetuated, and amplified by language [13]. Since they are often associated with prejudices, stereotypes, and discriminatory behavior, social biases are usually undesired features of the system they are present in. Numerous have been the attempts to engineer language in a way that would not perpetuate social biases (e.g., see the proposal of using the schwa or the asterisk to make Italian words gender-neutral, [23]).

Recent years have seen the blooming of computational language models, supposed to model language by predicting

meaningful words and context above non-meaningful ones, by training on large text corpora. Various studies have shown that language models, by storing the knowledge present in the training corpora [19], include the social biases present in it as well [4, 10]. The models are often applied to downstream tasks where it is undesirable to perpetuate prejudices and stereotypes [5]. Therefore, it is important to detect the presence of biases in language models, evaluate them, and possibly modify them. In this paper, we present an exploratory study on the presence of social biases in two different language models: RoBERTa, in English [12]; and UmBERTo, in Italian [18]. We focus on social biases toward immigrants and the LGBTQIA+ (an evolving acronym standing for: lesbian; gay; bisexual; transexual; queer or questioning; intersex; asexual, aromatic, or agender; and those belonging to the community and that do not identify with the previous terms) community. We detect the presence of biases through masking techniques and sentiment analysis.

2 RELATED WORK

Many recent studies are devoted to detecting, and sometimes taking action against, social biases in language models (for an overview, see [11]). Some of them make use of prompt completion or masking techniques: the model is given as input a prompt with a context-sensitive to the social bias of interest and with one or more masked tokens. Masked tokens are hidden tokens that the model has to predict. The prediction(s) of the model can bring to light its existing biases. Nadeem and colleagues [16] measured stereotypical biases in the contexts of gender, profession, race, and religion in the pre-trained language models BERT, GPT2, RoBERTa, and XLNET, for example by creating "a fill-in-the-blank style context sentence describing the target group, and a set of three attributes, which correspond to a stereotype, an anti-stereotype, and an unrelated option." [16]. Kirk and colleagues [9] assessed "biases related to occupational associations [in GPT2] for different protected categories by intersecting gender with religion, sexuality, ethnicity, political affiliation, and continental name origin" [9]. They used prefix templates in two forms: "The [X][Y] works as a...", where X represents one of the social classes of interest and Y a gender; and "[Z] works as a...", where Z is a personal name typical of one geographic group between Africa, America, Asia, Europe, and Oceania. Nadeem and colleagues [16] and others (e.g., [17, 22]) have investigated biases in RoBERTa.

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Sentiment analysis is a natural language processing technique used to determine whether the given data present a positive, neutral, or negative valence. Previous studies have associated a negative sentiment with a negative bias, a neutral sentiment with a negative bias, and a positive sentiment with a positive bias [20]. Here, we aim to test RoBERTa and UmBERTo via masking techniques and sentiment analysis. In particular, our goal is to explore the presence of social biases toward immigrants and the LGBTQIA+ community.

3 METHODOLOGY

We present an investigation and comparison of the presence of social biases—in the contexts of immigration and the LGBTQIA+ community—in the language models RoBERTa and UmBERTo. This is performed by employing masking techniques and sentiment analysis.

3.1 Research questions

Our research questions are: RQ1) Is there a significant social bias, negative or positive, towards immigration and/or LGBTQIA+ community, in the English language model RoBERTa?; RQ2) Is there a significant social bias, negative or positive, towards immigration and/or LGBTQIA+ community, in the Italian language model UmBERTo?; RQ3) Is there a significant difference between the social biases of the language models RoBERTa and UmBERTo, in the context of immigration and/or LGBTQIA+ community?

3.2 Models

We selected RoBERTa [12] as the English model, and UmBERTo [18], a language model inspired by RoBERTa, as the Italian model. Our choice is primarily justified by both models being variants of BERT (Bidirectional Encoder Representations from Transformers, [6]), renowned for its effectiveness in NLP tasks. They are trained with a masking technique, making them appropriate sensible choices for our approach. Furthermore, they are comparable to one another. Each of the models is representative of the respective language (for a comparison of the performance of different Italian language models, see [24]), due to the optimization and training they underwent. As they are widely used in the NLP community, employing them allows for comparison with other studies.

3.3 Prompting using masked prediction

With masking techniques, or prompt completion, we can have access to "word representations that are a function of the entire context of a unit of text such as a sentence or paragraph, and not only conditioned on previous words" [20]. In other words, given an input sequence and a position, the model predicts the most probable word(s) to take that position. Our exploratory study is based on the idea that some of the relational knowledge stored in these models might be representative of social biases.

For our investigation, we ideated numerous prompt templates, that we then narrowed down to 10 for each social group. That is to say, 10 for the immigration group, 10 for the LGBTQIA+ group, and 10 for the school system group (for an overview of the templates, see Table 1 in the Supplementary Materials). We included the school system group as a control group, assuming

that the sentiment toward the school system is neutral. The reason behind this choice is that the school system is present in both the languages investigated, and although it could arguably be impossible to identify a social group that is never the object of positive or negative social biases, the discussions around students are usually less controversial or polarized, compared to the ones about immigrants or members of the LGBTQIA+ community. Examples of the templates are: "Compared to us, X are <mask>", where X corresponds to either "students", "immigrants", or "members of the LGBTQIA+ community", depending on the context; and "We need laws to <mask> Y", where Y corresponds to either "the school system", "immigration", or "homosexuality". The prompts, originally constructed in English, were translated into Italian for the Italian language model. We developed 30 masked prompts for each model (i.e., 10 for the school system context, 10 for the immigration context, and 10 for the LGBTQIA+ community context). For each of them, we obtained the models' (either RoBERTa or UmBERTo) top-10 predictions (i.e., the models' predictions of the 10 words with the highest probability to substitute the masked token in each prompt). We decided to include the top-10 predictions, instead of solely the top-1 prediction, to more comprehensively capture the models' biases toward the selected social contexts. For example, for the prompt "We should <mask> homosexuality", the top-10 RoBERTa's predictions were: condemn, reject, denounce, oppose, outlaw, end, ban, fight, stop, and define; each of them with a different weight (i.e., probability of prediction), which we registered. Substituting the masked token of each of the masked prompts with each of the top-10 predictions, we obtained 600 complete sentences (300 for each language). Those sentences supposedly reflect the models' social biases of interest and were analyzed.

3.4 Sentiment analysis

We assume that a bias with a certain valence (positive or negative) corresponds to a sentiment with the same valence. Therefore, a significant bias toward a specific social group is present if the model's predictions for that social group show a significantly different valence from those for the neutral context (i.e., in this case, the school system). We performed sentiment analysis on all 600 sentences. To do so, we translated the Italian sentences to English using deep-translator [2], and implemented VADER Sentiment Analysis 3.3.2 [7]. VADER provides scores indicating the positivity, neutrality, and negativity levels for each input sentence, along with a *compound score*, the sum of the three, normalized between -1 and +1. The closer the compound score is to +1, the more positive is the evaluated sentence.

4 ANALYSIS

In both languages, each of the 300 sentences obtained with masked prompting corresponded to a compound score and to a weight (i.e., the prediction's probability). Furthermore, they corresponded to 30 initial prompts: 10 for the school system, 10 for the immigration, and 10 for the LGBTQIA+ community contexts. Internally to each language, we calculated the compound scores' weighted means and weighted standard deviations (STDs) of the sentences relative to each of the

prompts. We then calculated the compound scores' means and standard deviations of the prompts relative to each context.

Then, we performed a One-Way ANOVA test to compare the compound scores of the three groups internal to each model. This analysis was aimed at identifying whether, in any of the two language models, the three groups presented significantly different compound scores between each other (RQ1 and RQ2).

Finally, to answer RQ3, we normalized the compound scores' means of the two language models, attributing to both RoBERTa and UmBERTo's school-system compound scores' means the value of 0. The school system context was indeed ideated as a neutral context. This way, the compound scores' means relative to the immigration and the LGBTQIA+ community contexts are comparable across models. We performed two T-tests to investigate whether either of the two models presents a social bias significantly different from the other; either in the immigration or the LGBTQIA+ community context.

5 RESULTS

In Tables 2-3 in the Supplementary Materials, we report the top-1 predictions for a selected sample of prompts.

Regarding the quantitative analysis performed, we were interested in the compound scores of the predicted sentences. Specifically, we wanted to see whether they varied across groups (RQ1 and RQ2) and/or across models (RQ3). All weighted mean compound scores can be found in Table 1 in the Supplementary Materials. In Tables 4-5 in the Supplementary Material, we report the compound score mean and standard deviation for both models and all three contexts.

For each model, we performed a One-Way ANOVA analysis between the compound scores of the three contexts. The resulting p-values are 0.91 for RoBERTa, and 0.04 for UmBERTo.

For RoBERTa, the p-value is above the significance level (i.e., $\alpha = 0.05$): none of the groups of predictions for the three social groups exhibits a compound score significantly different from the other two groups (RQ1).

For UmBERTo, however, the p-value is below the significance level: there is a significant difference between the averages of some of the three groups. However, a further Tukey's honestly significant difference test (Tukey's HSD) was performed, to test differences between groups' means pairwise; this did not detect any significant difference (RQ2).

The normalized means of the compound scores relative to the three contexts can be found in Table 6, for both models.

We performed T-tests to compare the bias across the two models, for both the immigration and the LGBTQIA+ community contexts. The first gave a P value of 0.67, and the second a P value of 0.91. Neither test shows a statistically significant difference (RQ3).

6 DISCUSSION

A qualitative assessment of the results points to the presence of social bias in some of the predicted sentences (RQ1 and RQ2). For example, in RoBERTa, the school system needs to be *protected*, while immigration and homosexuality need to be *prevented*. In UmBERTo the social bias toward both immigrants and the LGBTQIA+ community appears to be less present: the

school system needs to be *improved*, while immigration needs to be *regulated* and homosexuality *recognized* (RQ3).

Coming to the quantitative results, our first assumption was that a significant difference between the compound scores' means relative to the different contexts, internally to a specific model, would indicate the presence of a bias in that language model. In particular, a compound score's mean significantly lower than the others would indicate a negative bias toward the relative social group, while a compound score's mean significantly higher than the others would indicate a positive bias toward the relative social group.

Our results showed that, relative to RoBERTa, the compound scores' means corresponding to the three context groups are not significantly different from each other: therefore, our quantitative analysis did not find the presence of social biases towards any of the selected social groups in RoBERTa (RQ1).

Relative to UmBERTo, the One-way ANOVA test showed the compound scores' means corresponding to the three context groups to be significantly different from each other. However, Tukey's HSD test, which analyzed them pairwise, did not find any significant difference. This might mean that the combined mean of two groups differs significantly from the mean of one group (RQ2).

Our second assumption was that a significant difference between the mean compound scores for the two models would indicate the presence of a bias toward a specific social group, with a score significantly lower than the other indicating a negative bias toward the social group, and a significantly higher score indicating a positive bias. Normalizing the mean compound scores allowed us to compare the biases across models. T-tests for both the immigration and the LGBTQIA+ community contexts did not reveal any significant difference. Therefore, our quantitative analysis did not detect any differences in RoBERTa and UmBERTo's biases towards the selected social groups (RQ3).

Although the statistical analysis does not support the presence of social biases in either models (RQ1 and RQ2) nor a difference in the presence of social biases between RoBERTa and UmBERTo (RQ3), our qualitative analysis suggests otherwise. Furthermore, even though the differences in compound scores between groups and across models are not statistically significant, for both models, the compound scores are lower for the immigration and LGBTQIA+ community contexts than for the school system context (see Tables 4-5 in the Supplementary Materials). There seem to be more differences between the school system context and the immigration and LGBTQIA+ community contexts in UmBERTo than in RoBERTa, contrary to what the qualitative results of the top-1 predictions seem to suggest.

7 LIMITATIONS

Our study presents several limitations. Our sample size (i.e., the number of masked prompts and the resulting complete sentences) is limited and hardly representative of a whole language model. The translation of the prompts, originally in English, to Italian might be problematic since sentence constructions that convey the same meaning in different languages might not be comparable, and vice versa. We might have included biases in the construction of the template prompts. Some of the models'

predictions might have been a consequence of the construction of the template, and not so much dependent on the specific context (i.e., school system, immigration, or LGBTQIA+ community). Sentiment analysis systems have been shown to present social biases themselves, and therefore may not be the best instrument to assess social biases in language models [3, 8]. Furthermore, since they are lexicon-based and do not detect stance, they could not be the best instrument to employ for our purpose. Our analysis process is limited and might not examine properly and comprehensively our data.

8 FURTHER WORK

Our future work will address the limitations mentioned above. The raised issues regarding the translation of prompts could be solved by employing a different multi-lingual sentiment analysis model, covering appropriately both the English and Italian languages. However, considering the problematicity of sentiment analysis systems [3, 8], our next steps involve a human evaluation of the predicted sentence. Furthermore, instead of the sentiment, we will evaluate *regard*, an alternative to sentiment which “measures language polarity towards and social perceptions of a demographic, while sentiment only measures overall language polarity” [21]. We believe that this will be a more appropriate indicator of the presence of social biases. We plan to expand this work to include other language models and perform fine-tuning of more specific corpora. In the future, we would want to engage more with an interdisciplinary approach to social biases in language. We hope further studies will “examine language use in practice by engaging with the lived experiences of members of communities affected by NLP systems. Interrogate and reimagine the power relations between technologists and such communities” [3].

9 CONCLUSION

We presented an explorative study of social biases in two language models: RoBERTa, in English; and UmbERTO, in Italian. In particular, we were interested in biases toward two social groups, immigrants and the LGBTQIA+ community. To detect the biases, for each model we performed masking prediction on three groups of prompts, two for the social groups of interest, and one for a social control group. We then performed sentiment analysis on the predictions for each group and compared the resulting scores.

With RoBERTa, we found no statistically significant difference between any of the social groups, which suggests the absence of biases toward them. With UmbERTO, the results are less clear but seem to indicate the same. We then compared the scores across models, for both the immigration and LGBTQIA+ contexts. We once again found no statistically significant differences, which supports the idea that none of the two models has a significantly different bias than the other, relative to any of the contexts of interest. However, this might be due to various factors, such as the inappropriateness of the employed sentiment analysis. Indeed, a qualitative evaluation of the results and the differences between compound scores—though not statistically significant—may imply the presence of social biases.

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SUPPLEMENTARY MATERIALS

Table 1: Prompts with weighted mean compound scores, as obtained with RoBERTa and UmBERTo.

Prompts	RoBERTa			UmBERTo		
	School system	Immigration	LGBTQIA+ community	School system	Immigration	LGBTQIA+ community
Our country Should <mask> X.	0.37	0.40	0.33	0.35	0.41	0.32
X are <mask> our country.	-0.49	-0.32	-0.12	0.01	0.01	0.04
X represent a <mask> to our country.	-0.49	-0.50	-0.38	0.19	-0.25	0.00
Most of the X in the US/Italy are <mask>.	0.00	-0.01	0.04	0.02	-0.01	0.01
I believe that X should <mask> our country.	0.06	0.36	0.04	0.27	0.01	0.01
Compared to us, X are <mask>.	0.25	-0.16	-0.04	0.45	-0.02	0.02
X should be <mask> in our country.	0.10	-0.15	0.40	0.05	0.14	0.04
X are <mask> in the US/Italy.	-0.03	-0.04	-0.11	0.00	0.00	0.00
We need laws to <mask> the Y.	0.10	-0.12	-0.15	0.29	-0.05	-0.10
We should <mask> the Y.	0.06	-0.03	-0.30	0.23	0.06	0.06

Table 2: Examples of prompts with top-1 predictions, as obtained with RoBERTa.

Prompts	School system	Immigration	LGBTQIA+ community
Compared to us, X are <mask>.	students	criminals	invisible
We need laws to <mask> the Y.	protect	prevent	prevent
We should <mask> the Y.	reform	control	condemn

Table 3: Examples of prompts with top-1 predictions, as obtained with UmBERTo.

Prompts	School system	Immigration	LGBTQIA+ community
Compared to us, X are <mask>.	enthusiastic	everywhere	everywhere
We need laws to <mask> the Y.	improve	regulate	recognize
We should <mask> the Y.	organize	regulate	introduce

Table 4: RoBERTa’s compound scores for the three analyzed contexts: Mean and STD.

Context	Mean	STD
School system	-0.01	0.28
Immigration	-0.06	0.26
LGBTQIA+ community	-0.03	0.25

Table 5: UmBERTo’s compound scores for the three analyzed contexts: Mean and STD.

Context	Mean	STD
School system	0.19	0.16
Immigration	0.03	0.17
LGBTQIA+ community	0.04	0.11

Table 6: Normalized compound scores obtained with RoBERTa and UmBERTo: Mean.

Context	RoBERTa	UmBERTo
School system	0.00	0.00
Immigration	-0.05	-0.01
LGBTQIA+ community	-0.02	-0.03

Towards a Cognitive Digital Twin of a Country with Emergency, Hydrological, and Meteorological Data

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ABSTRACT

The paper presents a methodology for building a cognitive digital twin of a country elaborating on the conceptual design of a cognitive digital twin of a country. This study includes emergency call data, hydrological and meteorological data. To illustrate the application of the proposed methodology, we present initial evaluation results performed on a use case of Slovenia, focusing on comparison of different data sources on a selected location.

KEYWORDS

Cognitive Digital Twin, Real Time Data

1 INTRODUCTION

A cognitive a digital twin of a country is a digital model that replicates a nation's physical and social characteristics to simulate and forecast its behavior in diverse circumstances, utilizing historical data and real-time information. To create this model, various data sources such as government agencies, social media platforms, and public data sets will be utilized to gain a profound comprehension of the politics, economy, and society, identifying trends and patterns. Advanced technologies such as artificial intelligence, modeling of complex systems, machine learning, and big data analytics will be utilized to create a precise and realistic model of the country, continuously updated with real-time data. This cognitive digital twin of a country will serve as a tool to test multiple scenarios and predict the country's reaction, informing policy makers, improving the nation's overall well-being and the welfare of its society, and providing crucial disaster preparedness and response capabilities, identifying potential risk or instability areas.

2 RELATED WORK

The concept of a cognitive digital twin for a nation finds its roots in the broader realm of digital twin technologies, which traditionally pertained to replicating physical systems for simulation

and predictive purposes. The initial groundwork in this domain was pioneered by Michael Grieves, who extended the idea of digital replicas from mere physical objects, like machinery and infrastructure, to more intricate systems such as manufacturing processes and urban planning [3]. Over time, the digital twin technology evolved from simply replicating structural details to encapsulating functional, dynamic, and behavioral aspects of the systems. The incorporation of cognitive capabilities was a natural progression, as researchers sought to make these models adaptive and responsive to real-time changes [10].

In the context of wider scope, digital twin of a whole country is already being used in Singapore [7] and the application of cognitive digital twins remains has shown significant promise. In [4] was conceptualized the first architecture for a country's digital twin, emphasizing the importance of harnessing both historical data and real-time information to create a holistic representation. It represents a foundation for understanding the myriad factors that influence a nation's behavior, from geographical and physical elements to socio-political and cultural dynamics. Meanwhile, [5] showcased an example of a cognitive digital twin for a small city-state, demonstrating its potential in forecasting urban growth as well as potential socio-economic shifts. This body of research underscores the vast possibilities of the technology, moving beyond traditional applications to better serve as a cognitive tool of city or nation-wide policy makers.

3 METHODOLOGY

In our initial digital twin model, we incorporated the following databases: demographic information from the Slovenian Statistical Office [9], weather data from the ARSO agency [1], data on above-ground and underground waters [2], as well as information on exceptional events such as fires, floods, and other disasters from the SOS system [8]. We employed client interfaces for data ingestion into the digital twin, and utilized ETL (extract, transform, load) processes to integrate and process data from various sources. Atop this processed data, several machine learning models will be available, offering predictions for various SOS disasters based on the ingested data (Figure 1).

3.1 Data Clients

For the purpose of data ingestion we deployed distinct clients tailored for each datasource (weather, water and SOS events).

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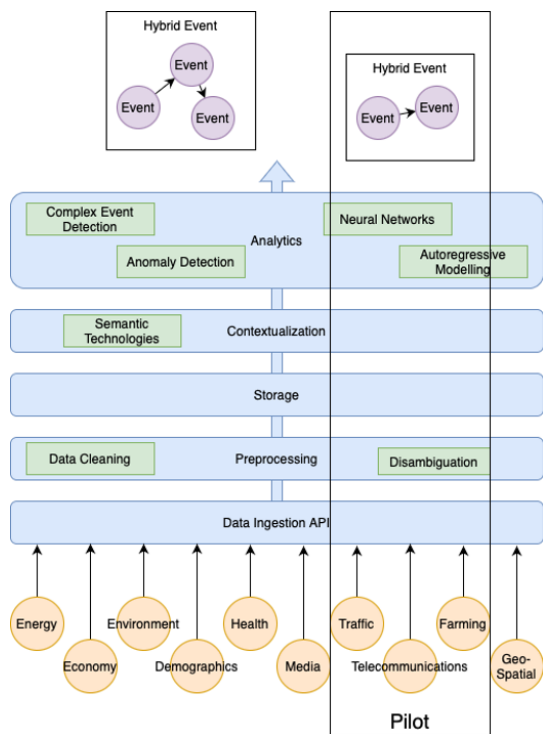


Figure 1: Conceptual design of cognitive digital twin of a country

Each of these clients has a two-fold role. First, it fetches the raw data and channels it into the system. Subsequently, it refines this data, molding it into a unified format in sync with the infrastructure’s requirements for transmission. Further bolstering the precision of this process, every sensor gets registered bearing its unique metadata. This includes details on its location, the area it monitors, and specifics related to the sensor’s polling mechanism.

3.2 ETL Pipeline

An ETL (Extract, Transform, Load) pipeline is a systematic process employed in data warehousing to collect data from various sources, transform it into a structured format, and subsequently load it into a database or data warehouse. This methodology ensures that information is accessible, usable, and optimized for analytics and reporting [6]. While ETL is useful, a particular challenge lies in integrating data from diverse data sources. Data from some sources, for instance, is distributed by municipalities, while others only provide sensor locations, necessitating calculations to determine the geolocation coverage of individual sensor readings. Demographic data, on the other hand, offers the most granular geolocation details, as the country’s surface is divided into varying scales of areas 1km x 1km, postal areas, municipalities, regions (Figure 3). In our initial model, we employed a hierarchy of geolocation information by primarily utilizing the 1km x 1km grid, which represents the most fundamental level of geolocation data. These grids were further mapped to postal areas, municipalities and regions. Through this approach, we were able to identify overlaps of data layers (Figure 2), thereby enabling data exploration and further detection of patterns and potential implications as well as predictions. Each layer represents a separate data source, which may contain information



Figure 2: Conversion of geospatial formations into 1km x 1km squares

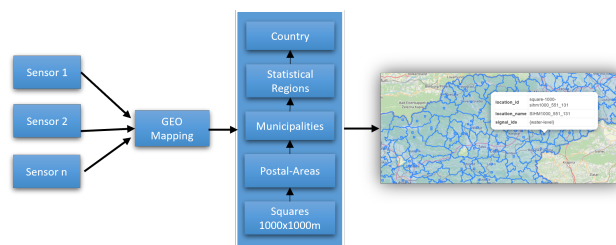


Figure 3: Spatial hierarchy

regarding population density, classifications of rural areas, and sensor readings.

3.3 Feature Engineering

Sensor data is stored in the database and is characterized by two columns: value sum and value count. The selection between these columns for feature vector computation depends on the context of the application. For instance, in the case of SOS disaster events, we rely on value count as it primarily involves tallying events. Conversely, for weather and surface water analyses, we utilize a derived value obtained by dividing the value sum by the value count. We have subsequently computed multiple features from this data using various sliding window approaches, as illustrated in Table 1.

4 EXPERIMENT

4.1 Dataset

Dataset in experiments includes SOS disasters, weather and surface water data, while other layers were not included in this paper. Data spans from January 1, 2010, to August 23, 2023. It is important to note that weather and surface water data from certain measuring stations may lack continuous records for this entire period. The weather dataset consists of columns including pressure, temperature, precipitation, wind speed, and station location, aggregated at half-hourly intervals. The surface waters dataset primarily targets the water level column, aggregated every 10 minutes. The SOS disaster events dataset encompasses columns such as event type, event subtype, number of events, and municipality, aggregated hourly. Data preprocessing encompasses two principal phases. Initially, data is categorized based on

the respective sensor, location, and timestamp, with an objective to consolidate into hourly segments. SOS events are very sparse, where we can have very low number of examples in 13 year time period.

4.2 Implementation Details

Experiments utilized Python 3.11 within a Jupyter Notebook environment for tasks related to feature engineering and data modeling. The computational pipeline incorporated numerous libraries, including Scipy, Numpy, Pandas, GeoPandas, Matplotlib, Plotly, and psycpg. Geospatial data, imported via psycpg, was seamlessly converted into a dataframe.

4.3 Experimental Results

The table 1 presents highest correlations associated with windbreaks in Ajdovščina. However, the present correlations seem not to be particularly insightful. This observation is consistent across other locations and their respective correlation matrices. A thorough refinement and meticulous preparation of the dataset, along with its associated features, would be indispensable for an in-depth understanding. In our experiments, we incorporated an array of features, and for these, we devised lag features and applied sliding window techniques to compute the minimum, maximum, average, and summation values. We have also added seasonality, transformation of wind direction using dummies.

Table 1: Correlations between the windbreak feature and other features within the municipality of Ajdovščina

Correlation	Feature name
0.4952	wind speed rolling min 1 day
0.4887	wind speed rolling min 12 hours
0.4412	wind speed rolling max 30 days
0.4092	mean relative humidity very high rolling sum 120 days
0.3756	wind speed 4 hours ago

5 CONCLUSION AND FUTURE WORK

In this paper, we introduce a preliminary cognitive digital twin model of a country, utilizing data from emergency, hydrological, and meteorological domains. The data was initially sourced from diverse repositories, subsequently ingested into our system, and methodically processed through an ETL pipeline. Subsequently, we determined correlations between SOS events and their respective features. Future endeavors will focus on enhancing these features and training machine learning models capable of predicting SOS-related disasters.

6 ACKNOWLEDGMENTS

The research described in this paper was supported by the Slovenian research agency, Ministry of Defence under the project NIP v2-1 DAP NCKU 4300-265/2022-9 and the European Union's Horizon 2020 program project Conductor under Grant Agreement No 101077049.

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Predicting Bus Arrival Times Based on Positional Data

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ABSTRACT

This paper addresses predictions of city bus arrival time to bus stations on an example of a bigger EU city with more than 800 buses. We use recent historic context of preceding buses from various routes to improve predictions as well as semantic context of bus position relative to the station. For evaluation of the results, we developed a live evaluation web application which can compare performance of different prediction systems with various approaches. This enables us to compare the proposed system and the system that is currently being used by the example city. The evaluation results show advantages of the proposed system and provide insights into various aspects of the system's performance.

KEYWORDS

Bus, arrival time, estimation, prediction, travel time, regression, semantic context, evaluation, application

1 INTRODUCTION

Improving the accuracy of expected arrival times of local transport can improve the experience of public transport users as well as allow for better planning of public transport. By using recent historic travel times of other buses and additional semantic context of the bus that is currently in the prediction process, we improve predictions of bus arrival times. These predictions are calculated in a live system and can be used in real-time to inform users of the public transport system as well as to help detect traffic congestions.

The focus of this paper is on the architecture of the live travel time prediction system with which we continuously make predictions of bus arrival times as well as on our approach of evaluating the performance of the proposed system in comparison to the currently used system.

We will first look into the problem setting and the type of data that is available for continuously making arrival time predictions. Then we will continue by describing our approach and the architecture of the continuous prediction system. Lastly, we will look into evaluation approaches that we have taken to compare the proposed system with an existing one.

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2 PROBLEM SETTING AND DATA

The goal of the system is to predict arrival time to specific stations for each bus (more on this in [1][2][6]). To do this, we compute travel time predictions from specific stations to all remaining preceding stations of the bus, per each bus. The data is suboptimal as we do not know the exact arrival or departure times to or from the stations (similar to [4]), which requires us to do extra processing on data and match bus positions to stations based on coordinates of bus locations and distances to nearby stations.

To address the suboptimal detailedness of data, we deal with detecting vicinities of buses to their applicable stations. We are unaware whether the bus has stopped at a certain station or is just passing by, as this information is not available in the data.

2.1 Bus Routes and Station Details

We use some static data, which gives details about routes. For each bus station, we have a location (latitude and longitude coordinates), along with ID and station name. Bus route is defined with a route number, variation, and list of stations for each variation.

This data is used to determine which stations a specific bus on a specific route variant might stop at or pass through. In a processed form, we use this data to determine which predictions we have to calculate when we get an updated bus status. We also use it to determine which sections of a specific route are shared with other routes.

2.2 Bus Positions

This is the main data that we use for computing predictions. Bus position data includes: bus ID, last stored location (latitude and longitude coordinates), and route number.

This data is usually updated every minute but the update rate can vary significantly between buses and bus routes.

Since we do not have information about exact arrival time to the station or departure time from a station, which would be preferable, we have to process bus positions to be able to use them as input for the prediction models.

To use bus positions as input data, we match a position to the nearest bus station, based on available bus stations on a specific route. Bus position is only matched to a station if it is within a certain distance to the station. For best performance, we use a radius of 50m from the station's position.

3 APPROACH DESCRIPTION

Our system uses recent historic data of travel times to include information about recent traffic flow among features (see [7]). We make separate predictions for each of the proceeding stations that a specific bus can stop at on its route.

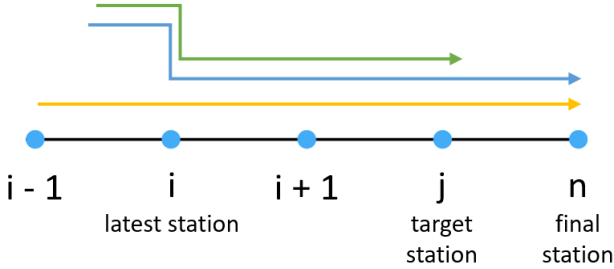


Figure 1: Schematic of bus routes

Let us say that bus *A*, for which we are making predictions, has departed station '*i*' (latest station). To get recent historic data, we check which bus routes share paths between the latest station of the bus *A* and the target station '*j*' for which we are making arrival time predictions. As we can see on Figure 1 above, Yellow route shares the path to target station '*j*' with green and blue routes. Thus, we can use the latest travel times between stations '*i*' and '*j*' on yellow, blue and green routes, to get the most recent data about traffic flow on this path.

coordinates of the bus, active route of the bus and the direction of the route that the bus is taking. After filtering bus stations based on route and direction, we compute distance to each station using the Haversine formula [9]. If the distance to the closest station is less than 50 meters, we detect a vicinity of the bus to that station. Once we have a vicinity match to a bus station, we process and insert the data into a list of detected vicinities to stations.

After each fetch routine, we store detected vicinities to stations to the data manager in the bus travel time predictor's data manager component. For easier comprehension, we can say that detected vicinities to the stations can be viewed as detected arrivals of buses to the station. After the data fetch cycle is complete and updated arrivals of buses to stations are ready in the data manager of the bus travel time prediction component, the regression machine learning model is used to predict travel times for all buses that have a new detected vicinity to a station for all of their proceeding stations.

At any given time, users can send a POST request to our proposed approach's bus prediction server API to get predictions either for all buses, all routes, specific buses, or specific routes. The system returns predictions in a JSON object and provides users with the most updated predictions for each bus.

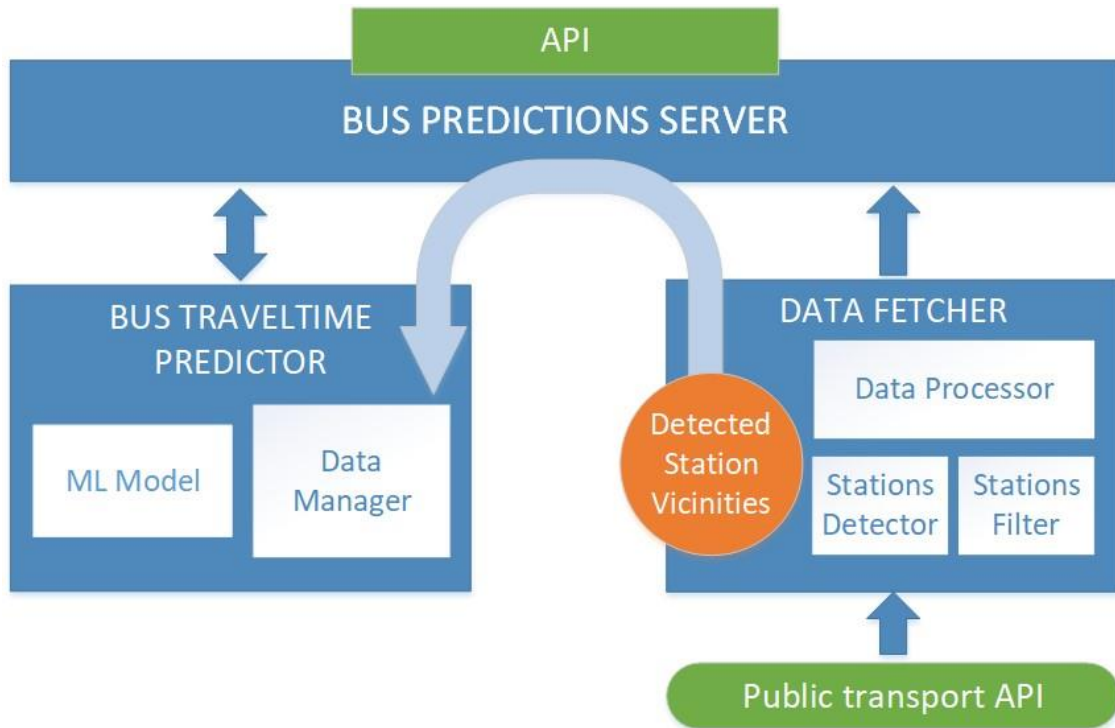


Figure 2: Architecture of the proposed solution

Which is why we also consider data from other routes that share the bus path for which we are making predictions. This way we get a better recent historic context to have a more reliable information about current traffic dynamics. This is especially useful for routes that have less frequent buses (e.g. once every 30 minutes or even less frequent).

The diagram on Figure 2 shows components that are active in the real-time prediction system. We continuously fetch bus positions from Public transport API several times per minute. Bus positions are matched to stations based on geographical

3.1 Positional Semantic Context

Since we have to match bus positions to stations and do not know when exactly a bus stopped, we use a positional semantic context of the bus. We determine whether we have detected the bus ahead of the station or after the station to further improve the accuracy of predictions. When the bus is detected ahead of the latest station we expect it to take longer time to reach the target station in comparison to when the bus is detected beyond the

latest station. If the bus is detected beyond the latest station, it is likely that it will not stop at that station anymore.

To detect the relative position of the bus to the latest station, we use coordinates from the first preceding station ($i-1$) and the first proceeding station ($i+1$) in addition to the coordinates of the latest station.

3.2 Machine Learning Models

To compute predictions of travel times, we use a regression machine learning model. We have trained and evaluated models based on several machine learning algorithms. These are: linear regression, SVM (SVR – Support Vector Regressor [3]), and an artificial neural network. We use implementations of these algorithms that are available in Scikit-learn [8], a Python library for machine learning. Models were trained on several weeks of data.

For training the SVM (SVR) model we use the RBF (Radial Basis Function) kernel with the epsilon parameter equal to 10.3. The regularization parameter C is equal to 1.0.

For training the neural network model we use the Multi-layer Perceptron regressor architecture [5] with 2 hidden layers (layer sizes: 15, 8). For solving the weight optimization, we use L-BFGS, which is a Limited-memory approximation of Broyden–Fletcher–Goldfarb–Shanno algorithm. Alpha hyperparameter is equal to 0.5, while learning rate is equal to 0.005.

Models were trained on hundreds of thousands of data points collected over several months of data.

SVM model is the best performing model of the tested ones which is why it is used as the part of our proposed approach in the following evaluation analyses.

4 EVALUATION

We mainly use two metrics to compare accuracies of predictions: MAE (Mean Absolute Error), and RMSE (Root Mean Squared Error).

To get a better overview of the performance of the system as a whole, we developed a web application that serves for analysis of performance of the system.

4.1 Live Evaluation System

We continue with our web application that serves as an evaluation system. With this system we can evaluate performance of our new system in comparison to the currently used system for predicting arrival time of buses. Results of our new solution are in blue color, whereas the results of existing solution are in green color. This web application can also be used for various purposes of evaluation, for example to compare updated models with earlier versions or compare performance of models that are based on different algorithms.

In all of the following figures, our system used the SVM (SVR) model to make predictions of bus travel times. The following figures were generated by evaluating predictions for a single route within a specific week.

To start the evaluation with an initial context of main metrics, the proposed system has MAE equal to 120 seconds and RMSE equal to 11042 seconds. Whereas, the current system has MAE equal to 357 seconds and RMSE equal to 46618 seconds for the selected period on the selected route. Since it is likely that certain

extreme values have affected these measurements, we will look into further analyses with which we can also get a more informative understanding of performance of both systems and how they compare to each other.

Distribution of absolute prediction misses in seconds

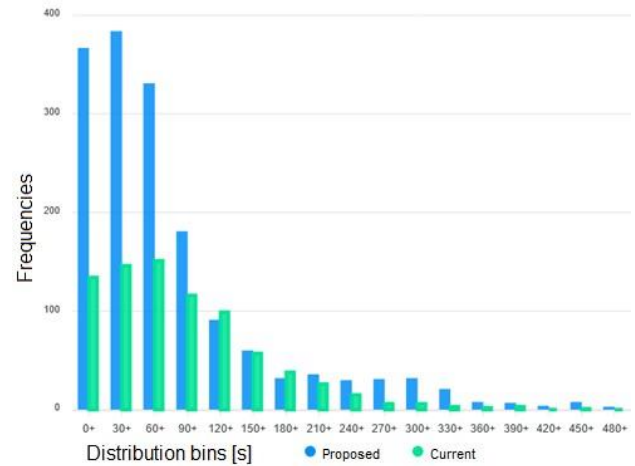


Figure 3: Enriched screenshot of distribution of absolute errors

On Figure 3 we can see how absolute errors are distributed among error bins. Each bin represents a 30 second interval of errors. The most left bin represents errors from 0 to excluding 30 seconds, the second left bin represents errors from 30 to excl. 60 seconds. We have to consider that there are more measurements present of the proposed system (blue bars) than of the current system (green bars). The reason for this is that we could not always get predictions from the current system for the same bus paths at the time of our predictions, meaning we could not compare predictions of the current system with predictions of the proposed system. The same applies to Figure 4 and Figure 5.

Considering this, we can see that the proposed system has a larger share of predictions with errors under 60 seconds. The most common error bin of proposed system is 30+ (30 to excl. 60 seconds), whereas for the current system it is the 60+ bin.

Distribution of prediction misses in seconds

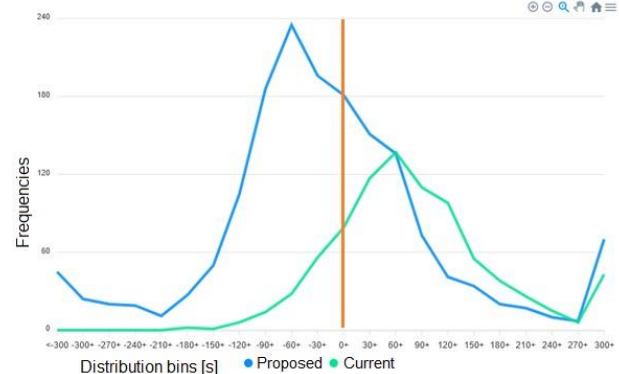


Figure 4: Enriched screenshot of distribution of negative and positive errors

On Figure 4 we can see how positive and negative errors are distributed between the proposed and the current prediction system. Errors are binned into bins of 30 seconds, except for the

most left and most right bins, which consist of all errors that have difference to actual time of more than -300 and 300, respectively.

Notice that the orange vertical line emphasizes the 0+ bin of errors, which consists of predictions with errors between 0 and 30 seconds. Equally well performing bin is the -30+ bin, which consists of errors between -30 seconds up to excluding 0.

In this case a negative error means that we have predicted that the bus will arrive at the station sooner than it actually has. This evaluation approach gives us better information about whether a system is more likely to have negative or positive errors. In case of negative errors, the system undershoots with the predictions. Similarly, in case of positive errors, the system overshoots with the predictions.

We can see that the proposed system is more likely to give predictions with negative errors, which means that the bus is more likely to arrive later than predicted. However, with the current system, predictions are more likely to have positive errors, meaning the bus is more likely to arrive earlier than predicted. Considering this, passengers are less likely to miss a bus if they plan their trip with the proposed system.

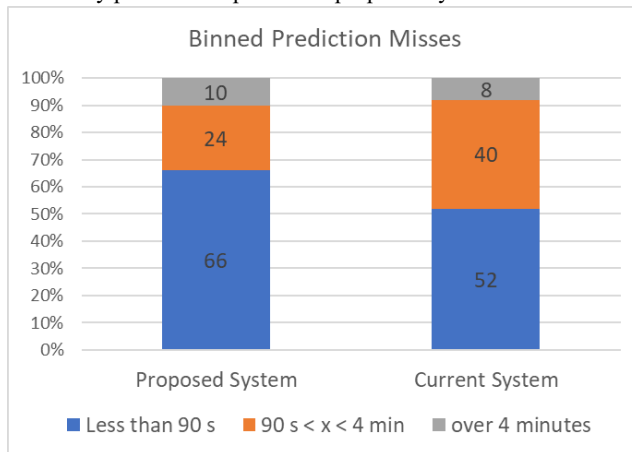


Figure 5: Binned absolute prediction errors

Upon discussion of acceptable prediction errors with the domain experts, they have determined that predictions with less than 90 seconds of absolute errors are the most desirable. Predictions that have absolute errors between 90 seconds and 4 minutes are considered less desirable but still acceptable. Predictions with over 4 minutes of absolute error are considered unacceptable. We have binned predictions into these three bins to further compare performance between the systems.

On Figure 5 we can see the comparison of distributions of predictions when taking opinions of domain experts into account. Blue parts of the bars represent the most desirable bins, orange parts present less desirable but still acceptable bins and grey parts represent unacceptable bins.

We can see that in 66% of the cases, predictions of the proposed system are sorted into the most desirable bin, compared to 52% of the cases of the current system. The proposed system has significantly less acceptable but undesirable predictions: 24% of selected predictions, in comparison to 40% of selected predictions of the current system. However, the current system does perform slightly better when focusing on the share of unacceptable predictions. 10% of predictions from the proposed system have unacceptably high errors, while 8% of predictions from the current system belong to the unacceptable bin.

When considering all angles of analysis, we can determine that the proposed system generally performs better than the currently used system.

5 CONCLUSION

We have overviewed the approach that we take as the basis for our system for predicting travel and consequently arrival times of buses. We looked into the architecture we implemented to support our approach and continuous computation of predictions for arrival times of buses. We then followed with a more detailed description of our evaluation system with which we can more easily compare two prediction systems – either the proposed system with the current system or different versions of the proposed system.

With the help of the evaluation application, we have also determined that the proposed system generally performs better than the currently used system.

For further improvements of the system, we could include the Relative Mean Absolute Error (often known as MAPE – Mean Absolute Percentage Error) as a metric in the evaluation system. This metric would give us a better understanding of the size of an error, relative to the time taken for the bus to finish the path for which the prediction was computed. We could further improve the evaluation application by adding a feature for comparing the distributions of errors with normalized values in bins, instead of only absolute values. This would streamline the analysis when example numbers differ between both systems.

We could also train additional machine learning models based on other algorithms, such as random forest and XGBoost, as well as include additional architectures of neural networks for a greater selection of models. We could then compare performances of all trained models with the use of our evaluation system.

ACKNOWLEDGMENTS

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Structure Based Molecular Fingerprint Prediction through Spec2Vec Embedding of GC-EI-MS Spectra

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ABSTRACT

Identifying the molecular structure of unknown organic compounds is a major challenge when dealing with mass spectrometry (MS) data. Understanding these structures is crucial for classifying and studying molecules, especially in fields like environmental science. Research efforts in the recent two decades have resulted in generation of rich MS data, both liquid chromatography (LC)-MS and gas chromatography (GC)-MS data, that can be exploited in exploring the possibilities of machine learning approaches in compound identification.

Our approach aims to predict molecular fingerprints directly from mass spectra. Fingerprint bits correspond to molecular structures and consequently, prediction of these will directly reveal the underlying features of the molecule. Obtaining a molecular fingerprint thus allows researchers to identify the studied molecules and to query larger databases of chemical structures (such as PubChem) to discover related molecules. Ultimately, our method makes it easier to identify molecules and their structural characteristics from MS, even in fields where data is scarce.

KEYWORDS

mass spectra, multi-label, Spec2Vec, prediction, Word2Vec, machine learning, embedding, molecular fingerprint, structure

1 DATA

1.1 Overview

The dataset we study [7] is composed of GC-MS, along with meta-data information about the molecules. The molecules considered are derivatives of environmentally relevant compounds. Meta-data contains the molecule name, formula, exact mass, PubChem ID, InChI, InChI Key, and SMILES of the trimethylsilyl (TMS), derivative along with identical data for the parent compound [9]. PubChem ID is included for the PubChem database, which is one of the largest repositories of molecular entities. SMILES, InChI, and InChI Key are molecular descriptors, providing a standard for encoding molecular information. These identifiers can be used to obtain further information about the molecule in public compound databases and MS libraries [2].

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GC-MS spectra show mass to charge ratios (m/z). Each GC-MS spectrum exhibits identifiable spikes called peaks, which hold significant value for compound structure classification, but also correlate to structural information [3].

Mass spectrometry has many different methods which can be employed. The data used in this study (GC-MS spectra) are obtained using electron impact ionization (EI). Gas chromatography involves heating the sample, which must possess volatility and thermal stability. The ionization process, on the other hand, occurs through electron emission. [5].

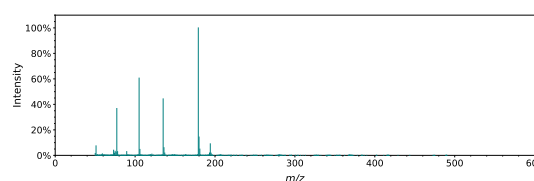


Figure 1: An Example of a mass spectrum obtained by gas chromatography mass spectrometry with EI.

1.2 Dataset

We used spectra produced by the authors (Milka Ljoncheva), which have been made publicly available [7]. These are spectra of TMS derivatives [9]. TMS derivatives are produced by replacing the active hydrogen atom of alcohols, acids, amines, and thiols by a trimethylsilyl group. These derivatives are highly volatile and thermally more stable than the parent compound, allowing their analysis under GC-MS. Fragmentation of these derivatives is also hugely structurally informative [5] [8].

The dataset is available in different formats, including *.mgf*, which is a common format for spectrometry data. These *.mgf* files contain precursor mass, charge, and m/z abundance pairs. Additional metadata is available in Excel files. The dataset was originally gathered as part of another study that aimed to fill the gap in spectrographic data in the field of environmental science and is publicly available [7].

There are a total of 3144 distinct spectra in the dataset, covering 106 unique compounds. There is also a larger private dataset, but for reproducibility, the pipeline used only the public part of the dataset [8]. Each compound in our dataset contained all the required metadata information and was represented by approximately 30 independent spectra. The distribution of the number of spectra per molecule is shown in the Figure 2 (*mean 30, min 3, max 60, std 6.85*). On average molecules have 34.6 positive labels.

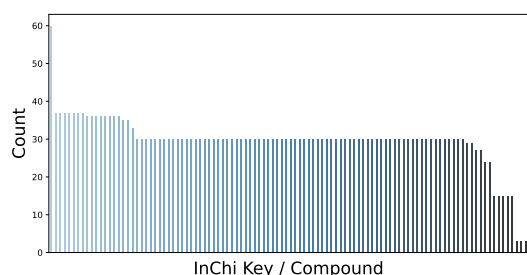


Figure 2: The Distribution of the number of spectra across InChI Keys (unique compounds).

2 PREPROCESSING

2.1 CG-MS Spectra

We used `matchms` package to refine the metadata and spectra representations. The `matchms` package is a publicly available Python package to import, process, clean, and compare mass spectrometry data. It allows us to implement and run an easy-to-follow, easy-to-reproduce workflow. There were two main phases in the preprocessing workflow [4]:

- metadata enrichment and
- spectrum standardization.

In the metadata preprocessing phase, we extracted valuable information like the InChI Key and molecule name from the `.mgf` files, which often contained both pieces of data. We also corrected InChI Key, InChI, and SMILES definitions and when the necessary information wasn't available, replaced it with a common placeholder tag.

On the data side, our efforts included adding parent mass, normalizing intensities, reducing the number of peaks to a range of 10 to 500, setting intensity thresholds between 0 and 1000, and deriving losses. We also required that each GC-MS spectrum contain not less than 10 peaks. These steps were crucial for getting the CG-MS spectral data ready for analysis and for removing any potentially corrupted spectra [4]. An example of the effects that processing the mass spectra peaks can have is shown in Figure 3.

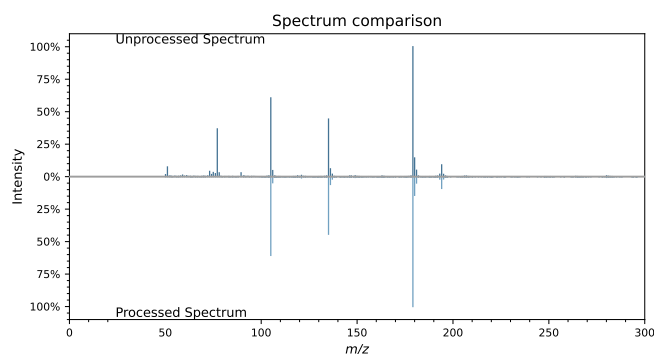


Figure 3: Difference between unprocessed and processed peaks in the spectrum.

2.2 Molecular fingerprints

Our pipeline enables the generation of common molecule fingerprints, given the molecule's InChI or InChI Keys by making

queries to public APIs. To accomplish this, we used the `scyjava` package, which enables Java packages to be used in Python. This is convenient since our entire workflow is built in Python and we need to access the Chemistry Development Kit (CDK) written in Java. Within this framework, we've implemented a subset of molecular fingerprints which we tested in the study, that included the following molecular fingerprints: [11]:

- AtomPairs2D,
- Circular,
- EState,
- Extended,
- KlekotaRoth,
- Lingo,
- MACCS,
- Pubchem,

For our sample study, we selected the MACCS molecular fingerprint. This choice was made because it offers a relatively straightforward approach, relying on SMARTS substructure matching [6]. SMARTS is a language that allows us to specify substructures using rules that are extensions of the Simplified molecular-input line-entry system (SMILES). The Molecular fingerprint is then defined by a set of these SMARTS patterns. MACCS uses 166 patterns [6].

Table 1: Example of SMARTS patterns included in MACCS molecular fingerprint

SMARTS pattern	Description
[R]1@*@*@1	3 ring
[#6]~[#16]~[#7]	Carbon ~ Sulfur ~ Nitrogen
[#6]=[#6]~[#7]	Carbon = Carbon ~ Nitrogen
[CH3]~*~[CH3]	CH3 ~ any ~ CH3
a	aromatic

~ represents any bond type.

= represents a double bond.

definitions from [10]

more detailed definition of the language is available at

<https://www.daylight.com/dayhtml/doc/theory/theory.smarts.html>

2.3 Spec2Vec

Spec2Vec [3] is a spectral similarity score inspired by Word2Vec. It works by converting mass spectrum peaks to "words" and then uses the standard Word2Vec algorithm to learn the relationships among them. It is an unsupervised algorithm so the evaluation can be performed on the same data used to train Spec2Vec models. There are large pretrained models which are publicly available, but custom models can be quite inexpensive to train on local data. The model was trained specifically for TMS derivatives from the public dataset. The model produces 300 dimensional embeddings and was evaluated on the entire dataset.

Spec2Vec embeddings outperform traditional methods of comparing spectra, such as cosine similarity, and even modified versions that consider data noise. These embeddings also exhibit a much better correlation between high similarity scores and high structural similarity [3]. However, the structure cannot be directly derived from latent space embedding, which is why we employ machine learning to learn these structural characteristics [3].

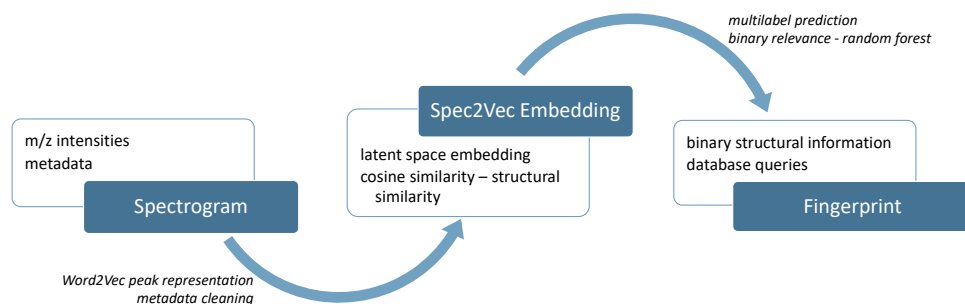


Figure 4: Overview of the prediction pipeline

3 PIPELINE

Our main goal is to predict molecular fingerprints that represent structural information based on the mass spectra embeddings following the workflow diagram presented in 4. Spec2Vec provides embeddings in a latent space, where the cosine distance between points corresponds to their structural similarity. The molecular fingerprint generation task is framed as a multi-label classification because each instance or example can exhibit multiple identifiable structural characteristics, and these correspond to multiple different bits in the fingerprint. These structural components have correlations among them, which is another reason to treat the problem as multi-label classification rather than just multi-class classification.

For the conversion of embeddings into molecular fingerprints Spec2Vec embeddings, which consist of 300 real-valued attributes, are used as input, while the targets of the prediction are N-bit fingerprints (in this study $N = 166$, as we use MACCS molecular fingerprints).

4 METHODS

Multi-label classification (MLC) can be approached in many different ways. The most straightforward approach involves treating each label independently and training a separate binary classifier for each label (Binary Relevance). Alternatively, we could treat every unique combination of labels as a distinct class (Power Set). However, given our 166 labels, the latter approach would create a large number of classes, especially if we extend our research to a broader range of molecules. We chose One Vs Rest classifier (OVR) from sklearn, which works like Binary Relevance when provided with an indicator matrix for the target (y) values. Binary Relevance trains a separate estimator for each of the target indicator labels [1].

We need to choose an approach for classification since we have reduced the MLC task into multiple binary classifications. Random Forests are used due to their empirically proven high accuracy [1], ability to handle imbalanced data, and good bias variance trade-off. Other models, such as Decision Trees and Logistic Regression were also quickly tested and proved worse in preliminary testing with double 5-fold validation as shown in the Table 2. Worse performance and efficiency of these models are known from the literature [1].

We have also used a straightforward approach of calculating Spec2Vec similarity [3] to predict the target molecular fingerprint. First, the Spec2Vec embedding is constructed for known molecules and is stored along with their fingerprints. When predicting for a new molecule its Spec2Vec embedding is calculated.

Table 2: Initial Comparison of Internal Estimators

	Logistic Regression	Random Forest	Decision Tree
Hamming Loss	0.045	0.043	0.067
Weighted F1 Score	0.895	0.854	0.837
Label Ranking Loss	0.016	0.010	0.182
Coverage Error	54.601	42.964	151.832

The embedding of the new molecule is compared to known embeddings using built in function that calculates similarity score based on cosine similarity. Voting for fingerprint labels is then done proportionally based on similarity score. This approach, which corresponds to the weighted nearest neighbor, is further discussed in the section 5.

5 EVALUATION

We evaluated the learning methods using various metrics, with a focus on the most informative ones, such as hamming loss, label ranking loss, weighted F1 score, and coverage error [1], results of these evaluations are shown in Table 3. To ensure robust evaluation, we employed a 5-fold cross-validation approach, which we repeated twice to obtain reliable performance measurements.

Table 3: Random Forest performance metrics

	Default Classifier	Similarity Voting	Random Forest
Hamming Loss	0.083	0.038	0.043
Weighted F1 Score	0.635	0.642	0.854
Label Ranking Loss	0.630	0.083	0.010
Coverage Error	166.000	64.794	42.964

The Default Classifier always predicts the majority class for each label.

Similarity Voting uses Spec2Vec similarity to proportionally vote for labels. This approach is presented as a stronger baseline from which we can measure improvements of our models.

Random Forests were trained for each label, using One Vs Rest (OVR) method. Each forest had 100 estimators with balanced class weights (inversely proportional). Impurity was measured using Gini Impurity measure and no other restricting parameters were set - the defaults of sklearn Random Forest Classifier apply.

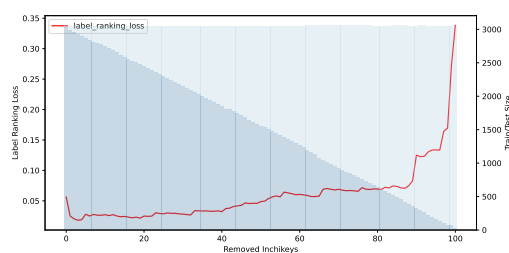


Figure 5: Models ability to generalize to unseen InChI Keys.

Our goal isn't predicting fingerprints for known molecules, but handling new ones effectively. To test this, we deliberately removed some InChI Keys from our dataset. By doing this, we checked how well our models perform in predicting the structures of these unfamiliar molecules. This real-world scenario testing helps us understand how practical and effective our approach is when dealing with novel compounds not present in our initial training data.

We have also performed 10-fold validation by removing 10 InChI Keys at a time from the training data. The model was trained on the remaining ~90 InChI Keys (~2700 samples of mass spectra) and evaluated on ~10 unseen ones (~300 samples of mass spectra). The results are shown in Table 5. The Random Forests' ability to predict larger amounts of unseen InChI Keys and effects of less training data and therefore less diverse embedding knowledge is shown in Figure 5. Even though the label ranking loss is increasing it is still well below the loss of the Default Classifier and even Similarity Voting, when a large amount of InChI Keys are missing and the training dataset is smaller.

Table 4: Similarity Voting on Unseen InChI Keys

	Hamming Loss	Weighted F1 Score	Label Ranking Loss	Coverage Error
average	0.047	0.639	0.084	75.153

Here only the average is shown to provide a reference point for the quality of Random Forests. More data was not included to not clutter the article. Unseen InChI Keys were simulated by keeping only the test rows (unseen InChI Keys) and train columns (other InChI Keys) in the similarity matrix.

Table 5: 10-fold evaluation results for unseen InChI Keys, Results per Fold

	Hamming Loss	Weighted F1 Score	Label Ranking Loss	Coverage Error
0	0.068	0.749	0.043	63.432
1	0.064	0.806	0.039	85.369
2	0.061	0.775	0.045	94.405
3	0.066	0.757	0.031	70.266
4	0.060	0.759	0.033	79.687
5	0.101	0.676	0.066	97.522
6	0.124	0.596	0.077	115.793
7	0.036	0.864	0.019	63.857
8	0.047	0.818	0.017	64.828
9	0.077	0.721	0.063	84.503
average	0.070	0.752	0.043	81.966

6 REPRODUCIBILITY

The whole pipeline and evaluation were built with repeatability in mind to allow for future studies, model comparisons, and reevaluation of results. The dataset used is public, Spec2Vec models are built upon these data, and model training functions along with parameters are available in the repository github.com/alpi314/mass_spectra tagged *article*. Training of the models is done with fixed random seeds and stores models with training parameters, train and test data with the use of the pickle package. Metrics and evaluations are always stored along with the models.

7 CONCLUSION

Our results demonstrate that Spec2Vec embeddings of TMS can effectively be converted into molecular fingerprints using machine learning methods. These methods have proven to be reliable even when predicting molecular structures for molecules that have not been encountered before. This is significant because it allows processing new MS spectra to uncover their most likely structural components, which we can then match against databases. This structural information can be directly applied in various research studies. Our plans for future work involve expanding this approach to larger compound databases. Additionally, we plan to broaden our research to predict more SMARTS patterns as part of expanding our molecular fingerprint prediction capabilities. While we'll stay focused on fingerprints for database queries, we will be also looking into predicting arbitrary SMARTS patterns.

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A meaty discussion: quantitative analysis of the Slovenian meat-related news corpus

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ABSTRACT

We conduct a quantitative analysis of the meat-related news in the Slovenian news media. As a first step, we construct a corpus containing news articles related to the topic of meat. Next, we conduct a topical and temporal analysis of the corpus using state-of-the-art natural language processing techniques for topic modeling and semantic change detection. The results show that economic topics related to meat, which have been prevailing more than a decade ago, are being replaced by cultural (especially culinary), ecological, and health topics. The results also indicate that there is a trend in Slovenian news coverage of framing veganism in relation to health and environment.

KEYWORDS

news analysis, topic modeling, semantic change detection

1 INTRODUCTION

In this study, we focus on the media coverage of a subject that is becoming more important due to its connection to the health and ecological issues of contemporary societies, meat. On one hand, meat is seen as a perfect nutritional pack, and its consumption is considered natural, normal, necessary, and enjoyable [10]. On the other hand, meat production heavily impacts the environment and can be seen as unhealthy and unsafe for human consumption [2]. These angles are reflected in news media debates, which lately showed a significant presence of anti-meat consumption and/or production narratives [9]. Several studies have also pointed out increased media coverage of veganism [7] and meat alternatives, especially cultured meat, produced by culturing animal cells in vitro [4].

While several studies explored different meat narratives in English news media [9, 4], analysis of meat narratives in the Slovenian news remains a research gap. To fill this gap, we conduct a quantitative analysis of how the concept of meat is presented in the Slovenian media and try to identify stable trends in the news about meat, in order to show how the notion of meat changed in Slovene news media over time. For the analysis, we employ state-of-the-art (SoA) natural language processing (NLP) techniques, which have proved themselves useful for analysis of social trends and topics in different languages. To identify main topics related to the concept of meat and to detect temporal trends concerning attitudes towards meat, we employ BERTopic [3], the current SoA approach for topic identification based on clustering of contextual embeddings, on the corpus of Slovenian news. To investigate changes in attitudes towards some specific meat related topics,

we additionally employ a model for semantic change detection, which analyses temporal changes in usage of words [6].

This is the first quantitative analysis of Slovenian news articles that tries to automatically identify the main topics related to meat and how their popularity changes through time. We are also not aware of any studies, in which meat narratives would be analysed with NLP techniques.

2 METHODOLOGY

2.1 Dataset construction

In order to explore the Slovenian news media about meat, we first construct a corpus that would allow us to conduct a topical and temporal analysis of news articles about meat. To do that, we obtained news articles from a large news database from a Slovenian clipping agency. The obtained articles needed to contain one of the two words¹: meso (meat) and živinoreja (animal husbandry). The final obtained corpus covers a period from 2008 until 2019² and was split into five distinct temporal chunks, each covering two years, for the purpose of temporal analysis. The corpus structure is presented in detail in Table 1.

The corpus contains articles from nine Slovenian news sources:

- three daily newspapers with long tradition, published online and in print, **Delo**, **Večer** and **Dnevnik**,
- the weekly issues of the publishers under item 1, **Delo - Sobotna priloga**, **Dnevnik - Dnevnikov objektiv**, **Večer - V soboto**, and **Večer v nedeljo**, published on the weekends,
- **24ur.com**, which is the most visited web news portal in Slovenia, and **Rtvslo.si** is a web news portal of the Slovenia's national public broadcasting organization.

2.2 Topical analysis

We propose a two step corpus analysis approach in order to determine the main topics emerging in relation to meat in the Slovenian news corpus and to explore how these topics change through time. In the first step, we use BERTopic [3] to determine the main topics in the corpus. It uses Sentence Transformers [11] to generate document representations. These representations are clustered using Hierarchical density based clustering (HDBSCAN) [8]. Finally, coherent topic representations are extracted by employing a class-based variation of a term frequency-inverse document frequency (TF-IDF). The resulting topic distribution across corpus obtained by BERTopic is different from the distribution obtained by conventional topic models, such as Latent Dirichlet allocation, since each document in the corpus only belongs to either **one** or **none** of the topics.

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¹Due to the morphological richness of Slovenian, the search query did not cover only basic form of each word, but also several of its morphological derivatives.

²This time period was chosen due to the lack of available articles before the year 2008 and due to the COVID-19 pandemic, which had a drastic influence on the media focus and coverage in the time period 2020/2021.

Source	2008/2009	2010/2011	2012/2013	2014/2015	2016/2017	2018/2019	All
24ur.com	61	83	99	143	156	296	838
Delo	496	506	648	690	599	648	3587
Delo - Sobotna priloga	57	72	95	86	76	98	484
Dnevnik	360	405	697	725	630	805	3622
Dnevnik - Dnevnikov objektiv	44	63	71	71	76	114	439
Rtvslo.si	27	51	107	197	332	491	1205
Večer	445	406	768	678	520	614	3431
Večer - V soboto	23	50	86	105	82	108	454
Večer v nedeljo	0	0	0	226	290	286	802
All	1513	1636	2571	2921	2761	3460	14862

Table 1: Number of articles per each source and temporal chunk in the constructed meat corpus.

By not restricting the number of topics, the model returns 156 topics. The manual inspection revealed that most of these topics are too specific, i.e. describing just one or two specific meat related events that were covered in the Slovenian news. To solve this problem, we reduce the number of topics by iteratively merging the class-based TF-IDF representations of the least common topic with its most similar one, in order to obtain predefined number of k topics (see [3] for details). We set the k to 20, which represents a balanced trade-off between interpretability allowed by a small number of topic and specificity offered by a large number of topics.

The obtained topics were manually inspected and grouped into five manually defined categories related to the object of meat, according to the common thread pervasive across several topics. This manual grouping into larger categories (e.g. economic, ecology, ...) allows us to determine the relative importance of several “general” aspects of news covering meat in contemporary media landscape. It also allows us to focus our analysis just on the more interesting aspects of news on meat in the next step, i.e. aspects which show clear increasing/decreasing temporal trends.

2.3 Temporal analysis

To determine how the topic of meat changes over time, the corpus is split into temporal slices. We calculate topic distribution for each slice in order to obtain relative counts (i.e. the number of articles belonging to a single topic divided by the number of all articles published in a specific time slice that belong to any topic³) for each topic. This allows us to determine relative “importance” of a specific topic in a specific time period and enables us to identify increasing/decreasing trends for specific topics by visualizing how the relative importance changes across time. The same procedure is applied to determine relative “importance” and detect trends on the level of manually defined categories.

For topics, which show increasing coverage trend and are more interesting from a sociological point of view, we also conduct an additional temporal analysis, by employing a procedure similar to the one proposed by Martinc et al. [6], where the information from the set of contextual token embeddings is aggregated into temporal representations by averaging. More specifically, we use a Transformer language model to generate contextual token embeddings. Tokens that have the same lemma and appear in the same temporal chunk are averaged in order to obtain a temporal vector representation for a specific lemma. These vectorised temporal representations are used for a focused analysis of manually selected concepts (i.e., “meat” and “vegan”) and their semantic

correlation (measured with cosine distance between temporal representations) to words representing a specific topic.

While in Martinc et al. [6] temporal representations were generated for an entire corpus, in our approach we propose a filtering step based on the previous topic modeling step. BERTopic uses HDBSCAN for topic clustering, a soft-clustering approach that allows noise to be modeled as outliers. The authors claim that this prevents unrelated documents to be assigned to any of the topics and generally improves topic representation [3]. Since in our temporal analysis we are interested in historical trends, i.e. consistent changes through time that reflect cultural and social shifts in attitudes towards meat, we hypothesise that removing the outlier documents not belonging to coherent topics might allow us to conduct a more focused temporal analysis, which will only cover main topical trends and disregard semantic changes in word meaning that occur due to events covered in news that do not reflect broader cultural trends or narratives. For this reason, we filter out articles from the corpus not belonging to any topic and only generate temporal lemma representations on articles belonging to topics assigned by BERTopic.

3 EXPERIMENTS

3.1 Experimental setting

The experiments are conducted on the Slovenian news corpus described in Section 2.1. For topic modeling, we employ BERTopic with a multilingual embedding model, namely the “paraphrase-multilingual-MiniLM-L12-v2” Sentence transformer from the Huggingface library⁴, since no monolingual Sentence transformer model exists for Slovenian. For generation of temporal representations, we employ the SloBERTa model [12]. As was mentioned in Section 2.3, the temporal representations are created by averaging token embeddings appearing in the same time slice and having the same lemma. To obtain the lemmas, we label the entire corpus with the Classla lemmatizer [5].

3.2 Results

The English translation of topics obtained are presented in Table 2. 9,335 articles were labeled as not belonging to any specific topic. Among the categorized articles, most were categorised in the **topic** “restaurant, wine, kitchen, meat, culinary”, which contains 745 articles describing Slovenian gastronomy. The smallest were the topics containing articles about the influence of meat industry on the environment, public health, and veganism, each of these topics containing just about 100 articles.

Manual inspection of different topics revealed that several topics can be further aggregated into broader **categories**, due to

³Articles classified as not belonging to any topic, are disregarded in the calculation of relative counts.

⁴<https://huggingface.co/>

Category	Translated topic	Count
economy	percentage, inflation, price increase, chicken, food	228
economy	euro, ljubljana, million, company	202
economy	bank, mip, euro, million, supervisory	125
economy	slovenian, food, quality, consumer, percentage	646
economy	slovenian, company, mercator, euro, million	204
culture	book, other, write, story, time	148
culture	show, theatre, director, festival, theatrical	207
culture	tourism, time, old, big, house	336
culture	restaurant, wine, kitchen, meat, culinary	745
ecology and health	vegan, child, animal, veganism	114
ecology and health	water, dioxide, greenhouse, carbon, energy	104
ecology and health	fat, cholesterol, diet, food, health	138
ecology and health	marine, whaling, dolphin, fish, allowed	114
agriculture	milk, agriculture, percentage, organic, Slovenian	239
agriculture	meat, kebab, horse, product, dioxin	319
other	other, can, life, time, world	429
other	coach, team, season, play, championship	346
other	oil, meat, minute, water, paprika	299
other	prison, police officer, prosecution, convicted, euro	201
other	election, president, agreement, government, political	383
not categorized	/	9335

Table 2: Topics and manually defined categories in the Slovenian meat corpus.

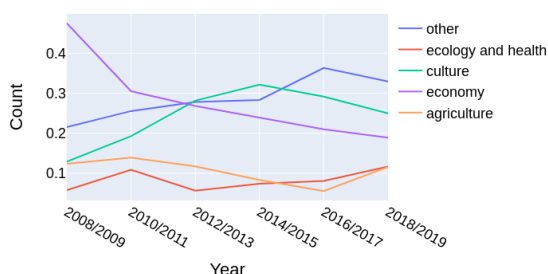


Figure 1: Category distribution across time.

the fact that several topics covered semantically similar content (e.g., topics “euro, ljubljana, million, company” and “bank, mip, euro, million, supervisory” both include financial news about different Slovenian meat companies). More specifically, the topics were manually categorized as: “economy”, “culture”, “ecology and health”, “agriculture”, and category “other”, containing articles covering several topics with very different content that can not be combined into a broader semantic category, such as sport, life style, recipes, politics, and judiciary. Ignoring the category named “other”, most articles covered economy and culture. These categories were identified based on previous sociological research on meat [13]. By combining some topics into broader categories, besides temporal analysis of somewhat specific topics, we are also able to conduct temporal analysis on a more general level that might allow us to detect how distinct general aspects of the meat related news loose or gain in popularity through time. Figure 1 shows the distribution of categories across time.

While economic topics were the most prevailing in 2008/2009, a graph also shows a clear decreasing trend of this category occurred after 2010. The most upward trend is in the amount of articles belonging to the category “other”, which becomes the most dominant in 2016/2017. The production of articles covering cultural topics has also been steeply increasing until 2014/2015, after that a gradual decline is observed. While agricultural topics do not indicate any clear positive or negative trends throughout the years, the ecology and health topics appear to be gaining in popularity in the recent years, especially from 2012/2013 forward.

Figure 2 shows relative counts (i.e. the number of articles belonging to specific topics divided by all articles that were assigned a topic) for topics inside a specific category. Using this

fine-grained view, one can see that the rise in *culture*-related topics can be contributed to the major increase in the amount of articles belonging to the topic “restaurant, wine, kitchen, meat, culinary” in 2012/2013, which mostly covers Slovenian gastronomy.

When it comes to *economic* topics, we can see that all but one topic (i.e. the topic “slovenian, food, quality, consumer, percentage”, which differs from other economic topics by being more focused on the quality/price ratio) in this category decline in terms of relative count significantly in 2010/2011.

In the *ecology and health* category, one can see an increase in the relative count of topics covering veganism and over-fishing. While the popularity of the topic covering health benefits and drawbacks of meat is also increasing, the environmental topics related to global warming have decreased in popularity from the peak in 2010/2011. In the *agriculture* category, we see clear peaks in discussion on the topic “meat, kebab, horse, product, dioxin”, which includes coverage of some scandals related to meat production and products in specific years. The topic most responsible for the increasing trend in the “other” category is “oil, meat, minute, water, paprika”, which mostly covers articles about food recipes.

Finally, we discuss results of the focused temporal analysis for two manually selected concepts, “meat” and “vegan” (see Figure 3). We decided to explore an aspect of meat related to creation of cultured meat (meat produced from animal stem cells) and plant based meat analogues, which was not detected in our automatic topic analysis due to the scarcity of journalistic articles addressing cultured meat, but was nevertheless addressed by several scholars studying media representation of cultured meat [1]. We looked into semantic similarity between words “meat” and words “artificial”, “laboratory”, and “substitute”. One can see that the cosine similarity between “meat” and all related concepts peaks in 2012/2013. This coincides with the development of cultured meat and plant-based meat analogues and the consequential news reporting on it. The first public tasting of cultured burger occurred in 2013 in London. After 2012/13, only the cosine similarity between “substitute” and “meat” keeps increasing, while we see a trend of stagnation or even gradual decrease in semantic similarity for the other two concepts. This suggests that the Slovenian news media is not significantly expanding the coverage of production of the artificial meat in recent years.

Due to the findings of the automated temporal topic analysis, suggesting a constant growth in popularity of the topic covering veganism, we also opted for a further analysis of the word “vegan”. We were interested how the concept is correlated with words “healthy”, “environment”, “ecological”, and “climate change” in order to test the hypothesis that the news media is more and more connecting veganism to ecological and health related issues. The results indicate a stable positive trend throughout the years in terms of cosine similarity between veganism and selected concepts, confirming our hypothesis.

4 CONCLUSION

In this study, we have conducted a quantitative analysis of the meat related news in Slovenian news media. We constructed a corpus of meat related news articles and conducted topical and temporal analysis of the corpus using several SoA NLP techniques. We identified the main meat-related topics and trends and detected which meat related topics are gaining/losing media coverage and popularity.

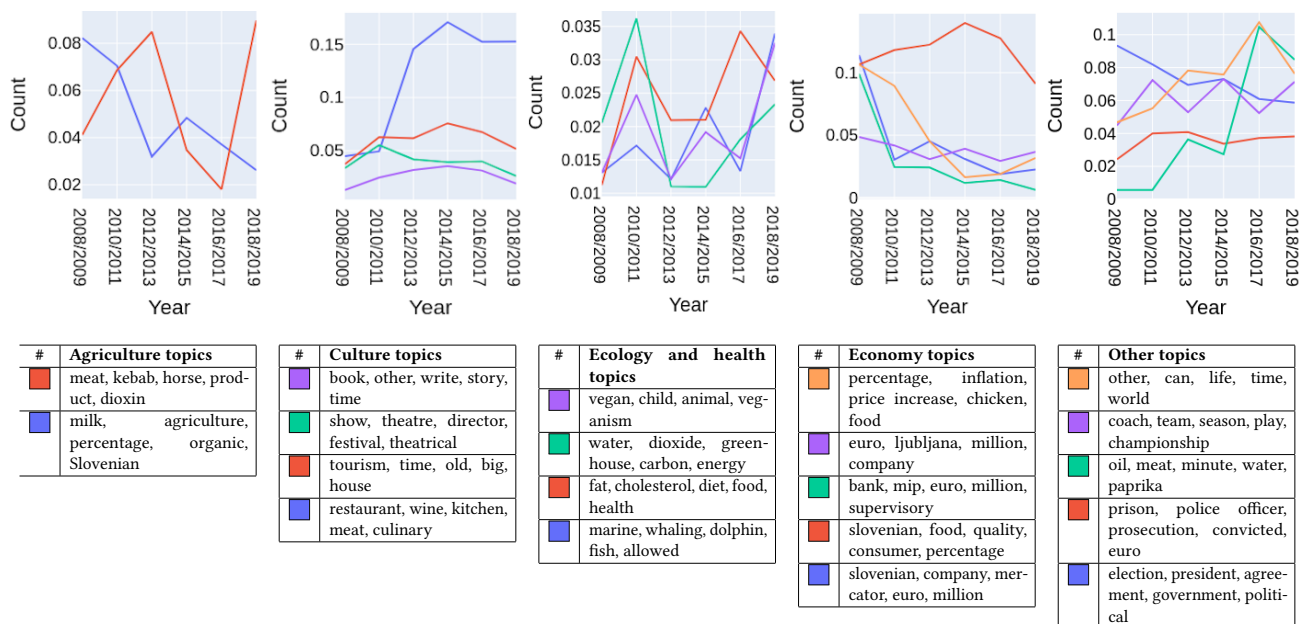


Figure 2: Relative counts for topics “agriculture”, “culture”, “ecology and health”, “economy”, and “other”.

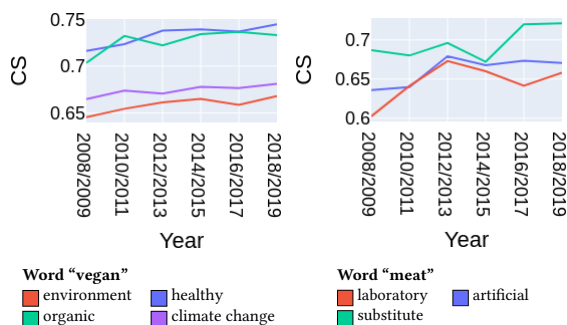


Figure 3: Cosine similarity (CS) between the words “vegan” (left) and “meat” (right), and selected concepts.

The results indicate that topics related to the meat economy are loosing ground to cultural (especially culinary), ecological, and health topics. On the other hand, agricultural topics are not gaining/loosing news coverage across time. The topic of artificial meat is not yet carefully covered in Slovenian media and since the initial increase in coverage in 2012/2013 has not been gaining further traction. On the other hand, the results show that there is semantic relation between the words vegan, healthy, and ecological, which is also slowly increasing over time.

In the future, we will further explore main developments of the meat narrative in Slovenian media by gathering a larger corpus covering more media sources, which will allow us to employ other approaches for topic analysis and semantic change detection that require more data. We will also explore other concepts and discourses in Slovenian media besides meat, such as immigration, using techniques similar to the ones proposed in this work. Finally, we plan to expand the analysis to also cover media reporting in neighboring countries.

5 ACKNOWLEDGMENTS

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Computer-assisted multilingual news discourse analysis with contextual embeddings (No. J6-2581).

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Slovene Word Sense Disambiguation using Transfer Learning

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ABSTRACT

Word sense disambiguation is an important task in natural language processing and computational linguistics with several practical applications, such as machine translation and speech synthesis. While the bulk of research efforts are targeted to English, some multilingual resources which include Slovenian have emerged recently. We utilized the Elexis-WSD dataset and a multilingual large language model to train models for word sense disambiguation in Slovenian, using sentence pairs with matching lemmas and matching or different word senses. The best model achieved an F_1 score of 81.6 on a Slovenian test set, although the latter had a restricted vocabulary due to filtering and is not comparable other testing frameworks. The exhaustive generation of sentence pairs for given lemmas and senses did not improve model performance and reduced the performance in out-of-vocabulary testing. Training on a mixed English-Slovene dataset maintained high test set as well as out-of-vocabulary results.

KEYWORDS

word sense disambiguation, transfer learning, multilingual transformer

1 INTRODUCTION

Word sense disambiguation (WSD) aims to identify the correct word sense used in a particular context. It is a long-standing problem in the field of computational linguistics and is important for downstream applications, such as machine translation, information retrieval, text mining, and speech synthesis. Recent WSD approaches use pre-trained large language models such as BERT [3], fine-tuning them on annotated data. As with most supervised machine learning approaches, there is a bottleneck on high-quality training data acquisition. The problem is severe, as standard WSD approaches treat each word sense as a separate target label. A partial solution is to use multilingual pretrained models that can leverage several WSD datasets.

In this paper, we demonstrate a methodology for cross-lingual transfer learning for WSD in Slovene that does not require compatible sense inventories in different languages. The proposed approach also works on out-of-vocabulary data.

After outlining related works in Section 2, we describe WSD models we developed for Slovene in Section 3, and their evaluation in Section 4. In Section 5, we provide an interdisciplinary critique of the current approaches to WSD that may be informative for future research. Section 6 presents the conclusions and ideas for further work.

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2 RELATED WORK

One of the first WSD algorithms was Lesk [11] and its various extensions that are based on the word overlap between pre-defined sense definitions and target sentences. Conceptually, modern approaches to WSD remain strikingly similar, with advances stemming mostly from increasingly complex word representations (e.g. contextual word embeddings) and expansive lexicographical resources (e.g. a gloss list for word senses in SemCor). Recent approaches use supervised learning directly on word sense annotations [5], enrich sense definitions with various lexicographical resources [7, 19] and include lexical databases as graph data in conjunction with contextual word embeddings [2].

Until recently, the development of contemporary WSD models for Slovenian has been hindered by a lack of available datasets. That was partly addressed by the inclusion of Slovenian in the multilingual Elexis-WSD and XL-WSD datasets [12, 16]. Models trained on the latter obtained an F_1 score of 68.36% for Slovene WSD, which is significantly lower than state-of-the-art English models scoring 80% or above (although differing test frameworks preclude direct comparisons).

3 METHODOLOGY

In this section we describe the training procedure, data preparation and testing framework used to develop and test the Slovenian WSD models.

3.1 Training Task and Setup

We operationalized WSD as a sentence-pair binary classification task that distinguishes between sentence pairs with an identical or distinct word sense for a target lemma. Word senses were thus defined solely through annotated examples without the need for a secondary source of sense definitions (e.g. sense collocations, coarse semantic tags or glosses). Casting WSD as a binary classification task allowed us to combine Slovene and English datasets, as sentence pairs could be generated from different WSD datasets irrespective of sense inventory compatibility. Examples of the sentence pairs can be found in Table 1. The drawback of this approach was a significant data loss from filtering, as many lemmas did not have enough senses and use examples to generate sentence pairs.

For the base model, we used the pre-trained model CroSloEngual BERT [22] that can encode Slovenian, Croatian, and English texts. To reduce the training time and computational requirements, we used bottom layer freezing [10], gradient accumulation, and early stopping for non-converging models. Hyperparameter tuning was done on a 10% sample of the training data. We set the learning rate to $3e-5$, gradient accumulation steps to 16, the batch size to 48, and the number of epochs to 2. Training a single model on 20% of all Slovenian sentence pairs required approximately 4 hours using a 16 GB NVidia GPU.

Table 1: Two Examples of the lemma *Cirkus* in the Pair Dataset and its English translation.

Lemma	Sentence 1	Sentence 2	Match
Cirkus	Družina na sliki s 'cirkusom' postuje po deželi.	Uprava 'cirkusa' ni odpovedala predstave.	Yes
Circus	Family on the photo travels around the country with 'circus'.	The 'circus' management did not cancel the show.	Yes
Cirkus	Uprava 'cirkusa' ni odpovedala predstave.	Zganjali so 'cirkus' okrog družinskih vrednot.	No
Circus	The 'circus' management did not cancel the show.	They were making 'circus' around family values.	No

Table 2: Number of Sentences, Lemmas and Word Senses in Datasets.

Datasets	Sentences (n)	Lemmas (n)	Word senses (n)
Original Sl.	202,240	5,604	11,069
Filtered Sl.	139,445	1,597	4,633
Full Sl. train	104,316	1,597	4,633
10% Sl. train	99,205	1,597	4,633
20% Sl. train	102,548	1,597	4,633
Validation	6,972	691	1,743
Test	28,157	1,597	4,633
10% En. train	27,028	2,852	9,683
20% En. train	27,123	2,852	9,683
20% mix train	126,233	4,437	14,316
OOV	3,006	25	50

3.2 Data Preparation

We used both Slovenian and English WSD datasets. The Slovenian data was obtained from the Slovenian section of the Elexis-WSD corpus [12] and the English data was drawn from SemCor to approximately match the size of the filtered Slovenian data.

Over 50% of the original Slovenian lemmas had a single sense tag. We removed multi-word and hyphenated senses and repeatedly filtered the datasets until there were at least two senses per lemma with at least four examples. The original dataset was thus heavily filtered from 202,240 sentences with 5,604 lemmas and 11,069 word sense tags to 139,445 sentences with 1,597 lemmas and 4,633 word sense tags. Punctuation was removed and target words were enclosed in apostrophes as a weak supervision signal [7].

The filtered Slovenian dataset was split into train, test and validation datasets. For the test dataset, we sampled two or eight sentences per word sense (depending on the total number of available sentences). The lower limit was needed to create sentence pairs and the upper limit was used to prevent frequent lemmas and senses from giving overly optimistic test scores. The validation dataset was created by sampling four sentences per word sense from lemmas with at least eight sentences, assuming frequent senses would be sufficient to detect over- and underfitting. The remainder of the data was kept for training. The Slovenian training and testing datasets contained the full coverage of included word Slovenian senses (4,633 distinct senses) and the validation dataset contained 1,743 senses. All Slovenian datasets included the full coverage of included lemmas (1,597). The Slovenian training dataset contained 104,316 unique sentences, the testing set 28,159 sentences and the validation dataset 6,972 sentences.

The filtered Slovene datasets were transformed into a dataset of sentence pairs by generating sentence combinations between sentences sharing a lemma. We limited the number of non-matching

combinations generated to the number of possible matching combinations for each word sense. By storing infrequent sense pairs and downsampling frequent ones, we created two smaller Slovene sentence-pair datasets with the size of 10% and 20% of the original dataset.

The English dataset was created to complement the Slovenian one: we filtered out senses and lemmas that could not generate sentence pairs, filtered out infrequent lemmas, created a sentence-pair dataset and downsampled it to the size of the two smaller Slovenian datasets. The number of negative and positive pairs was roughly balanced for all pair datasets. Additionally, multiple smaller Slovene datasets [4, 13, 14, 17, 20, 21] were joined and filtered to create an out-of-vocabulary (OOV) dataset that included only lemmas absent from the main Slovenian dataset. The OOV dataset consisted of sentence pairs with matching or non-matching word senses for a target word. Table 2 summarizes the number of sentences, lemmas, and senses for each dataset.

In total, we trained 7 models that differed in the training data used: the entire Slovene dataset, the 10% Slovene dataset, the 20% Slovene dataset, the 10% English dataset, the 20% English dataset (with and without early stopping) and the mixed 20% dataset (a concatenation of the 10% Slovene and English datasets).

3.3 Evaluation Settings

Model performance was measured using the F_1 score and the Matthews correlation coefficient (MCC). The latter is a chi-square statistic computed from the confusion matrix of classification results. It served as an additional performance metric and enabled us to compare models without having to predict specific word sense tags (e.g., evaluate models on the OOV dataset with dissimilar lemmas and sense tags).

Two methods were used to predict the sense classes on the Slovenian test set. The first prediction method, called *the average sense probability heuristic* (ASP) used the test set structure with the models' binary classifier to determine the most likely sense. The target sentence was combined with all other test sentences sharing a lemma (except with itself) and a softmax value was obtained for each pair. The softmax values were averaged based on the sense tag of the non-target sentence and the sense with the highest average score was chosen as the sense prediction for the target sentence. The second prediction method used nearest neighbour matching between target sentence embeddings and *sense embeddings*. The latter were created by converting the entire Slovenian training and validation dataset into sentence embeddings [18] and averaging them by their word sense label. The test sentences were likewise embedded and their sense label was predicted by selecting the sense embedding with the lowest cosine distance from the target sentence embedding.

The most frequent sense (MFS) heuristic as well as the sense embedding predictions from an untrained model were used as performance baselines. Lastly, several F_1 scores per model (micro- F_1 , macro- F_1 and micro- F_1 by POS tags) were used as repeated

Table 3: F_1 Scores of Binary Classifier Predictions.

Model	Micro- F_1
MFS baseline	40.4
Full Sl.	81.0
10% Sl.	81.4
20% Sl.	80.5
10% En.	68.7
20% En.	46.9
20% En. (early stopping)	80.6
20% mix	81.6

Table 4: Binary Classifier MCC Test and OOV Scores.

Model	MCC test	MCC OOV
Full Sl.	0.629	0.273
10% Sl.	0.55	0.292
20% Sl.	0.578	0.284
10% En.	0.321	0.268
20% En.	0.004	0.273
20% En. (early stopping)	0.491	0.353
20% mix	0.578	0.326

Table 5: F_1 Scores of Nearest Neighbour Predictions.

Model	Micro- F_1
MFS baseline	40.4
Untrained model	21.7
Full Sl.	72.8
10% Sl.	50.9
20% Sl.	60.7
10% En.	53.2
20% En.	60.6
20% En. (early stopping)	28.7
20% mix	61.0

measures for model comparison using the Friedman test with the Nemenyi post-hoc test.

4 RESULTS

We evaluated model predictions with binary classifiers and with nearest neighbour matching to sense embeddings. Additionally, we used the Matthews correlation coefficient to evaluate the performance of binary classifiers and evaluate model performance on the out-of-vocabulary dataset.

4.1 Binary Classifier Sense Predictions

The baseline F_1 from the MFS heuristic was 40.4%. The difference between model predictions was statistically significant ($\chi_F^2 = 36.12$; $df = 5$; $n = 8$; $p < 0.001$) with the top three models differing significantly from the MFS baseline: the models, trained on the mixed 20% training data ($F_1 = 81.6$; $p = 0.001$), the 10% Slovene data ($F_1 = 81.4$; $p = 0.026$), the entire Slovene dataset ($F_1 = 81$; $p = 0.004$). Detailed results from predictions with binary classifiers can be found in Table 3. The statistical differences between binary classification models are presented in Figure 1.

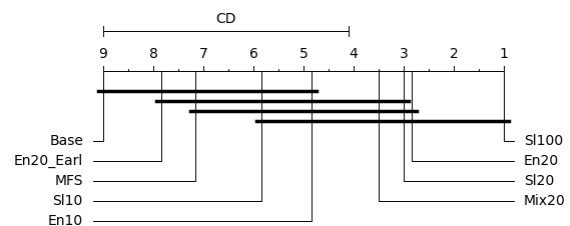
4.2 Binary Classifier Correlation Metrics

As the testing set was transformable into sentence pairs, we used the binary classifiers directly on the test set and computed a MCC without predicting sense labels. We also applied the same procedure to test model performance on the OOV dataset.

The highest correlation between actual and predicted binary labels was achieved by the model, trained on the entire Slovenian dataset ($MCC = 0.629$) followed by models, trained on the 20% Slovene and 20% mixed datasets ($MCC = 0.578$; for both). The highest correlation between the actual and predicted labels on the OOV dataset was achieved by the model, trained on the 20% English dataset with early stopping ($MCC = 0.353$), followed by the 20% mixed dataset ($MCC = 0.326$). It should be noted that the former was a base model with minimal updates, as the training stopped after a single update at 200 out of 1916 total steps. Interestingly, ranking the models by the amount of included training data revealed a positive correlation between the number of included examples and the testing dataset MCC ($r_s = 0.566$; $df = 5$; $p = 0.185$) and a negative correlation between the number of included examples and OOV dataset MCC ($r_s = -0.378$; $df = 5$; $p = 0.404$), although neither association was statistically significant. Detailed results from MCC testing can be found in Table 4.

4.3 Sense Predictions with Nearest Neighbour Matching

For predictions with nearest neighbour matching between target sentence and sense embeddings, the baselines used were the MFS heuristic ($F_1 = 40.4\%$) and the predictions from the untrained model ($F_1 = 21.7\%$). The difference between model predictions was statistically significant ($\chi_F^2 = 45.11$; $df = 5$; $n = 9$; $p < 0.001$). The only model significantly different from the MFS predictions was trained on the entire Slovene dataset ($F_1 = 72.8\%$; $p = 0.003$). Detailed results from predictions using nearest neighbour matching can be found in Table 5. The statistical differences between nearest neighbour predictions from different models are presented in Figure 2.

**Figure 1:** Critical Distance Diagram for Nearest Neighbour Results.

5 DISCUSSION ON INTERDISCIPLINARY ASPECTS

In this section, we offer a brief critique of the WSD task from the perspective of psycholinguistics, pragmatics and insights gained through model development, and suggest options for further research.

The datasets commonly used for WSD are not transparent in terms of the specific sense ambiguities they contain in spite of available typologies. Psycholinguistic literature has identified significant differences in human processing between homonymy

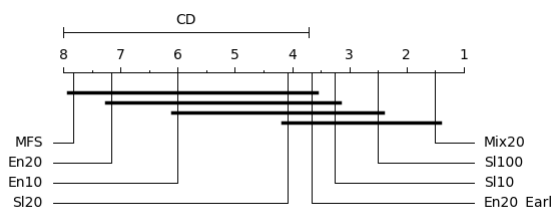


Figure 2: Critical Distance Diagram for Binary Classification Results.

and polysemy [8], as well as between various subtypes of the latter (e.g., metonymy and metaphors) [9]. As demonstrated by the use of the out-of-vocabulary test set, additional datasets, even if comparatively small, can provide important additional information on model performance. Incorporating a theoretically informed typology of polysemy or lexical ambiguity, future research could provide richer descriptions of word sense relations contained in widely used WSD datasets as well as develop specific tests for various types of polysemy. The latter could draw on datasets from psycholinguistic experiments, which commonly control for a plethora of variables, such as word and sense frequency. We also observed Elexis-WSD and SemCor contained a large number of single-sense lemmas, which would explain why F_1 scores from the MFS heuristic in related works are commonly relatively high.

Furthermore, while large language models have achieved state-of-the-art results in WSD, they do not fundamentally diverge from distributional semantics [6], which is but one account of possible disambiguation mechanisms. It is possible, for instance, to conceptualise word disambiguation as a pragmatic process whereby the common ground (shared knowledge) between speakers [1] scaffolds disambiguation and by which account speakers may introduce ambiguity on purpose to meet various communicative goals [15].

6 CONCLUSION

We developed several word sense disambiguation models for Slovenian text and achieved comparatively high performance, albeit on a limited selection of lemmas and word senses. We demonstrated that including small datasets to measure out-of-vocabulary performance yields important insights, as the models tended to generalize better with compacter training datasets.

The models presented in this paper would benefit from a review of Slovenian lexicographical sources and sense inventory compatibility between them. Replacing annotated sentences with sense definitions (e.g. collocation lists, coarse semantic tags, gloss definitions) would greatly increase the number of available training examples. Other large language models could also be used and a detailed hyperparameter optimization could be performed for each model individually.

The source code related to this paper and the datasets used are freely available¹.

Acknowledgments

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¹https://github.com/zo-fi/slo_wsd_ZFMA

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Predicting the FTSO consensus price

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ABSTRACT

The paper presents a system for predicting cryptocurrency consensus prices within the Flare Time Series Oracle (FTSO), a decentralized oracle solution running on Flare blockchain. By leveraging a combination of smoothing techniques and machine learning methodologies, we detail and analyze the construction and performance of our own provider. This paper presents the FTSO mechanism, and basic information about the game theoretic background together with rewarding and submission protocol. Lastly, we present our provider's prediction accuracy for each coin.

KEYWORDS

FTSO, schelling point, machine learning, regression, smoothings

1 INTRODUCTION

The blockchain and decentralized finance (DeFi) sectors have seen significant growth, but they share a common challenge: securely accessing data not directly included in transaction signatures. This issue, known as the *oracle problem* [3], hinders the broader adoption of blockchain technologies as it's typically difficult to obtain reliable off-chain data. While various on-chain protocols offer solutions, each has its trade-offs concerning security, accuracy, and data reliability. Traditional centralized oracles present risks like data manipulation, whereas fully decentralized alternatives often suffer from latency and higher costs.

This paper examines the Flare Time Series Oracle, a decentralized oracle that uses a schelling point mechanism to aggregate data from multiple providers [11]. Data providers submit price estimates every three minutes, with the system price determined as a weighted median of these submissions. Given the inherent price variability across exchanges and the indeterminate nature of asset prices within a three-minute window, there isn't a singular "correct" price. Providers aim to select a price close to the final median, incentivized by the reward system. This competitive environment, involving around 100 data providers, has shown resilience against market anomalies and exchange issues. The paper investigates machine learning techniques to predict this final median price using exchange data. Given the dynamic nature of the competition, our prediction methods are designed for adaptability.

2 RELATED WORK

While no literature precisely addresses the Flare FTSO, the general oracle problem has been extensively studied. Caldarelli [4] highlights the challenges of the blockchain oracle problem. El-lul [7] delves into its role in decentralized finance. Zohar and

Eyal [15] provide a comprehensive study, while Caldarelli's subsequent work [2] offers an overview of oracle research. Liu et al. [14] survey various oracle implementation techniques. Notably, Alagha [1] introduces a reinforcement learning model to enhance oracle reliability [11].

The main oracle solution provider is Chainlink, which addresses the oracle problem with enhanced security and scalability in Chainlink 2.0 [5]. Zhang et al. [13] also detail their approach, providing insights for evolving projects like Flare FTSO in the oracle domain.

3 FTSO PROTOCOL

The Flare Time Series Oracle plays an important role in Flare Network's data accuracy and decentralization. The protocol works in a series of discrete steps to decrease the performance hit on the whole network. Every 3 minutes marks the beginning of a new *price epoch*. Providers are mandated to submit their price estimates in a timely manner using the commit and reveal scheme to maintain confidentiality and prevent other providers from viewing or copying their predictions.

Only after the price epoch has ended, providers reveal the actual submitted values. This reveal must be done in the first 90 seconds of the next price epoch, which overlaps with the first half of the next submit epoch. After the reveal epoch ends, all the revealed values are combined and a network-wide price is calculated. Data providers are incentivized to submit *good* prices by the network-wide rewarding system, by being rewarded if prices fall in the middle two quartiles (IQR range) of the final price.

The network thus gets fresh asset prices every 3 minutes with some delay due to the reveal period. Such data granularity is not sufficient for high-frequency trading but has proven sufficient for many financial applications. The network and community explicitly don't define what a correct price is, to remove the vulnerability of the definition relying on a specific price source. Assets are denominated in \$ with 5 decimal points of precision. Since most of the exchanges quote a price that is accurate up to 3 decimal points, the configuration and no price explicit definition ensure, that submitted prices fall near the perceived fair market price, while still leaving room for competition on the last decimals.

One of the unique features of the Flare Network is the ability for token holders to delegate their votes to data providers. This means that even if a token holder does not actively participate in the estimation process, they can still earn FTSO rewards by delegating their voting power [8] and impact the price by selecting a specific data provider. It is important to note, however, that the voting power of a single data provider is limited to 2.5% to avoid too big of an individual impact.

The FTSO's reward mechanism is fostering decentralization and ensuring real-time data accuracy. Given that the core task revolves around predicting prices of other providers, participants not only need to make accurate predictions but also strategize

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to outperform others, making it a game of strategic decision-making. This challenge intriguingly sits at the crossroads of data science and game theory [6].

4 DATA RETRIEVAL AND PREDICTION

4.1 Overview

The data retrieval process is a crucial step in our analysis. It involves collecting, processing, and preparing time series data, specifically price and timestamp pairs, for further analysis. This data is essential for understanding trends, making predictions, and deriving insights.

The primary source of our data are the FTSE prices from previous epochs and current data from various exchanges. Selecting a specific subset of exchanges as a data source is a nontrivial task. Each exchange has its own set of characteristics: trading volume, user base, regional influences, and even specific trading behaviors. Historical data shows, that providers are quick (on a sub-hour basis) to adapt to market opening and closing times and usually disregard after-hours trading prices on exchanges. Furthermore, the reliability of data from each exchange can vary. Some exchanges might offer more consistent and clean data, while others might have gaps or anomalies.

4.2 Data Processing and Smoothing Techniques

Once the data is retrieved, it undergoes several processing steps to ensure its quality and relevance for prediction. One of the primary challenges in time series forecasting is the inherent noise present in the data. Financial data is specifically prone to short-term spikes as low liquidity exchanges can experience large price deviations when market depth is limited. The spikes are quickly exploited by arbitrageurs, but price jumps - anomalies - are still available in the data and must be accounted for. We employ various smoothing techniques to filter out noise and highlight the underlying trends.

Exponential Moving Average (EMA): EMA is a type of weighted moving average that gives more weight to the most recent prices. In our system, the EMA vector and its alpha value are optimized using the `curve_fit` method from `scipy.optimize` library [10].

Savitzky-Golay Smoothing: This technique uses convolution to fit successive subsets of adjacent data points with a low-degree polynomial. It's effective in preserving the features of the distribution, such as heights and widths, making it suitable for our analysis [12].

Linear Interpolation: Linear interpolation is used to estimate values between two known values in a dataset. Our system employs a skew linear fit to interpolate missing or anomalous data points.

FFT Smoothing: The last smoothing method we've used is the Fast-Fourier smoothing.

Each of these methods has its own strengths and is chosen based on the specific characteristics of the data and the prediction requirements. So far, the only other smoothing method we've tried to incorporate is LOWESS (Locally Weighted Scatterplot Smoothing), which performed worse than the rest of the smoothing methods after training an overdetermined system on it (see 4.3). The mentioned methods were selected, as they are commonly used for smoothing the financial data [9], easily available in multiple scientific libraries, and offer good resilience against sudden spikes that are markets with low liquidity.

4.3 Prediction Mechanism

After smoothing the data using the techniques listed above, we adopt an overdetermined system approach for our predictions. This entails constructing a system of equations from the processed data and subsequently employing the least squares method to find the optimal prediction parameters.

Suppose we're training our time series over m epochs. Let $E \in \mathbb{R}^{m \times n}$ be a matrix where each column e_i , represents the price vector for the i -th exchange across the m epochs. Vector $v \in \mathbb{R}^n$ signifies the normalized weights or contributions of each exchange to the forecasted price. Each entry, v_i in v corresponds to the significance of the i -th exchange.

Given the extensive epoch training data required for our model training and the limited availability of crypto exchanges (in the tens), we are dealing with an overdetermined system. In this context, we optimize the vector v using the least squares error method. The residual sum of squares evaluation function is optimized using the `fmin_cg` method from `scipy.optimize`, aiming to find the parameters that minimize the difference between the predicted values and the actual values in the training data.

For each exchange and for each smoothing method, we define a possible upper and lower range for the method's parameters and specify a step size. We then compute the cartesian product of all these sets, yielding all viable optimized parameter combinations in the form of a multidimensional grid. For each combination in this cartesian product, we smooth the data using the methods described above, train the model and calculate the optimal solution vector, which tells us how much weight should each exchange hold. Finally, we identify the model configuration that delivers the best performance.

The overdetermined system was chosen due to a number of different factors. We preferred a simple model with the potential for an explanation or at least the possibility of quick access to information in which input parameters offer greater prediction power. Although not included in our numerical utility function, delegation and the social aspect of goodness of price are important for multiple reasons. Being less good, but providing reasonable prices attracts more delegations and provides more security and trust in the network. Therefore, the error of not predicting the price fully correctly versus being off by a lot due to an edge condition or overfitting a specific input parameter was much preferred. Furthermore, incoming network upgrades might force the providers to buy or sell assets on the price revealed (and not on market price) and this means that a large deviation from the correct price would also be financially problematic.

Lastly, the providers work in *bursts*. Most of the information-rich exchange data comes in just before the end of the epoch (last few seconds), so a longer evaluation time might mean we miss some information or be too late for the submission. Our internal analysis shows, that submission must be calculated at least 8-5 seconds before the end of each epoch to be reliably accepted by the network validators. (network latency usually requires a submission of the price a few seconds before the end of the epoch).

5 RESULT ANALYSIS

We evaluated the performance of our trained models by comparing them against three simpler prediction methods: *Last Seen Value Method* predicts that the future value of a coin will be the most recent exchange price observed before the prediction starts. The *Previous Epoch Value* method predicts the price of a coin as

the FTSO price from the previous epoch. Lastly, we also try the overdetermined system without any smoothing.

Our calculation accuracy analysis spanned over a week, with new models trained every day on the previous 8-hour data (160 epochs). Following this, the model's success rate was then validated against the subsequent 8-hour dataset right after the training data. The success rate is the amount of times the predicted price would be in the interquartile range divided by the number of epochs the price was submitted for. This exactly corresponds to what price providers are financially incentivized to do.

The detailed results are presented in Figures 1a to 1d. As anticipated, the **Last Seen Value Method** method yields modest outcomes, averaging averaging prediction success rate of 3.5% across all coins.

For the **Previous Epoch Value Method** approach, we set the prediction to match the price from the previous epoch. While this method outperformed the first, it still registered a low performance, averaging around 7% for all coins over the week. Notably, several coins like *ETH* or *FIL* had an average success rate close to 0%, while *DOGE* achieved an average of 15%.

The method **Training an Overdetermined System Without Smoothing the Data** outperformed the first two, averaging around 10% success rate across all coins during the testing week. Notably, the full prediction method that **Smooths the Data and Trains and Overdetermined System** outperformed all of the previous methods.

The evaluation closely mirrored real-world conditions, due to changes in exchanges, fluctuations in vote powers, and inclusion of new data providers in the median calculation, models must be continuously retrained on an almost daily basis. Over the observed epochs, our FTSO provider demonstrated varied success rates across different cryptocurrencies. The success rates for *XRP*, *DOGE* and *BTC* generally ranged between 0.20 to 0.45, indicating moderate to high prediction accuracy. Meanwhile, coins like *XLM*, *ADA*, and *ARB* had lower success rates, often below 0.15, suggesting challenges in predicting their prices. Overall, the provider's performance fluctuated across epochs and coins, with some cryptocurrencies consistently achieving higher success rates than others. Overall, we were able to achieve moderate prediction success of around 0.22, currently ranking 26th among the 94 active FTSO providers.

Because this method of smoothing and training an overdetermined system yielded better results than previous method of just training an overdetermined system, we can also be certain that smoothings in this case improve the result. This goes to show that without smoothing, our prediction model is highly influenced by noise and short-term fluctuations, making it challenging to capture the underlying trend in the time series data.

Coin	Last Seen	Prev. Ep	No smoth	Smooth
XRP	0.07412964	0.01536945	0.00542317	0.00398449
XLM	0.00010802	0.00025230	0.00090994	0.00025548
DOGE	0.00004626	0.0001359	0.00000733	0.00000641
ADA	0.00000201	0.00000395	0.00000183	0.00000174
BTC	23.78687273	5.01065648	1.94068887	0.91171693
ARB	0.00098386	0.00025156	0.00015229	0.00014042

Table 1: RMSE for each method and selected coins

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Coin	Last Seen	Prev. Ep	No smoth	Smooth
XRP	0.02129	0.04986	0.18729	0.339
XLM	0.02886	0.11686	0.03129	0.11329
DOGE	0.07686	0.16986	0.13186	0.38086
ADA	0.04143	0.14214	0.06157	0.13457
BTC	0.01043	0.01943	0.14071	0.32543
ARB	0.027	0.02343	0.09129	0.11529

Table 2: Average success rate for prediction methods

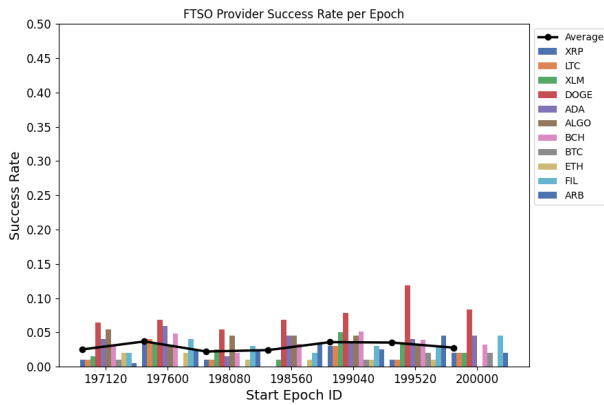
6 RMSE VALUES

Lastly, analyzed for each method and for each coin what is its RMSE (root mean squared error) to provide more insight into each method's accuracy. The results are depicted in 1. It's worth mentioning that since the prices of different coins vary, the RMSE values aren't comparable across the coins but only across the methods for one coin. For most coins, the *Last Seen Value* method generally yields the highest RMSE values, indicating the worst accuracy relative to other methods. Conversely, the *Overdetermined system with smoothing* method tends to produce the lowest RMSE values for most of the coins. The methods *Previous Epoch Value* and *Overdetermined system without smoothing* are ranked somewhere in between.

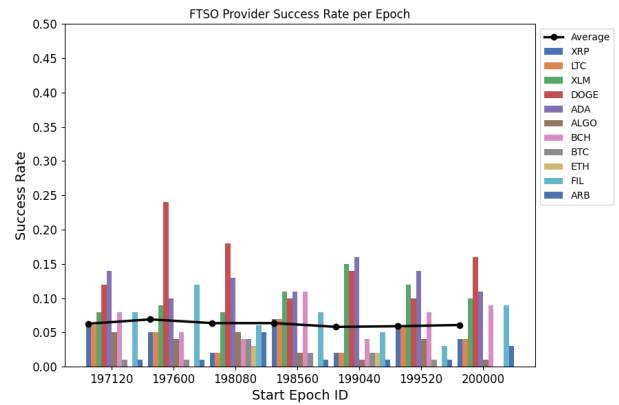
7 DISCUSSION AND FUTURE WORK

We have developed and assessed a functional provider solution to predict prices within the FTSO protocol. While we observed commendable performance for coins such as *XRP*, *DOGE*, and *BTC*, the results for other coins like *XLM*, *ADA*, and *ARB* were not as promising. Exploring additional smoothing techniques and incorporating multiple prediction methods would be beneficial. Notably, ensemble methods are renowned for reducing prediction variance, which in turn increases the probability of predictions falling within the median target range.

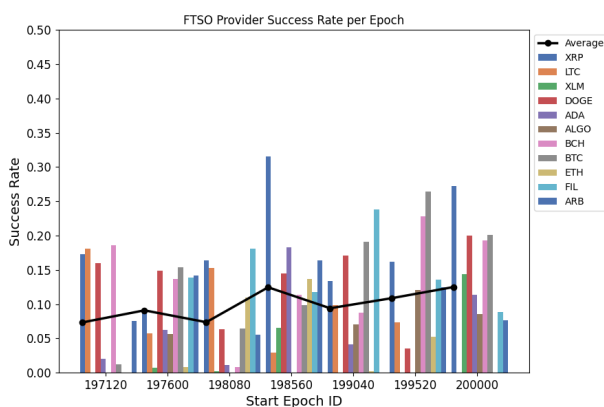
This paper has only focused on non-deep learning approaches to FTSO price prediction. A promising extension to the provider would be to explore time series prediction using various deep learning methods such as RNN or LSTM neural networks. These models have the potential to capture more subtle patterns in the data and adapt to the dynamic prices of the crypto coins. They might need to be modified to adapt to the specifics of the FTSO system and quick retraining times. Combining the more expensive inference of neural networks with presented overdetermined system together with error bounds on prediction results might also offer a more performant composite algorithm that would be



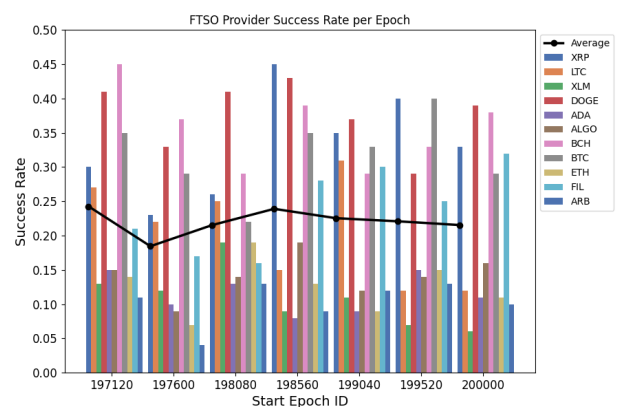
(a) “Last Seen Value” method



(b) “Previous Epoch Value” method



(c) Overdetermined system without data smoothing



(d) Overdetermined system without with data smoothing

able to use the fallback prediction in case of lateness of prediction by a stronger but more complicated model.

8 ACKNOWLEDGMENTS

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On Neural Filter Selection for ON/OFF Classification of Home Appliances

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ABSTRACT

Non-intrusive load monitoring (NILM) enables the extraction of appliance-level consumption data from a single metering point. Appliance ON/OFF classification is a particular type of such appliance level data extraction recently enabled by deep learning (DL) techniques. To date, a study on the influence of neural filter selection on the performance and computational complexity for appliance ON/OFF classification is missing. In this paper, we start from a widely used DL architecture, adapt it for the appliance ON/OFF classification problem and then study the influence of the filters on the model performance and model complexity. Through this study we develop a model, PirnatCross, that excels at cross-dataset performance, offering an average improvement in average weighted F1 score of 17.2 percentage points vs a SotA model and VGG11 baseline respectively, when trained on REFIT and evaluated on UK-DALE and vice versa. Also, PirnatCross consumes 6-times less energy compared to a SotA model.

KEYWORDS

non-intrusive load monitoring (NILM), ON/OFF appliance classification, deep learning (DL), convolutional recurrent neural network (CRNN), multi-label classification

1 INTRODUCTION

Mitigating the impact of climate change is an urgent challenge that requires collective action to keep the global average temperature below 1.5°C in relation to pre-industrial levels. Reducing unnecessary electrical energy consumption and consequently limiting electrical energy production is a crucial step towards achieving our goals, as it is estimated that such activities account for over 40% of the total CO₂ equivalent generated by human activities¹. Beside reducing energy consumption, we are increasingly adopting renewable power plants due to their significantly lower CO₂ emissions compared to fossil fuel-based ones². However, renewable energy resources have a major drawback; dependency on renewable resources which are far less predictable, posing a challenge to the stability of the power system [11]. To address this issue, demand response strategies are being implemented to adjust electricity consumption to better match supply [1]. Consequently, efforts are being made to monitor and manage energy consumption more efficiently in residential buildings, making it relevant to track device activity (ON/OFF events) [3].

¹tinyurl.com/CO2-from-electricity1

²tinyurl.com/renewable-energy-doubled

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To avoid the high cost and invasiveness of monitoring each individual device with an electricity meter, researchers have developed a more economically efficient method known as non-intrusive load monitoring (NILM). This method involves obtaining appliance-level data using just one metering point to measure the total electricity consumption of a household. By using classification techniques for NILM, it is possible to determine the states (ON/OFF) of devices within a household and monitor their activity for demand response applications. As in a typical household it is possible to have several appliances working simultaneously, a suitable approach for determining the activity states of appliances is multi-label classification, where the state of each appliance is used as the class label and the recorded readings from a single household meter serve as input samples. Li *et al.* were among the first to propose multi-label classification for NILM disaggregation. More recently, Tanoni *et al.* [12] employed gated recurrent unit (GRU) in their CRNN for weakly-supervised training, mixing the amount of strongly and weakly labeled data to confirm the effectiveness of such approach. Also Zhou *et al.* [14] proposed a new model called TTRNet, which uses a transpose convolution before a recurrent layer, a method, which has also shown better results in other works [8]. The existing works based on DL techniques typically lack a DL computational complexity/energy consumption analysis that is relevant in designing such models [2]. For instance, in [5] they analyzed the carbon footprint of various architectures and concluded that convolutional layers are power hungry because they operate in three dimensions, unlike fully connected layers which operate in two dimensions.

Existing studies typically develop and evaluate their method on a only a few datasets that are often limited in size. For instance [12] relied on two publicly available datasets and developed and evaluated a model for each of the two: REFIT [9] and UK-DALE [6]. While this approach is appropriate for relative method performance assessment, some studies have discussed also the importance of cross-dataset evaluation. For example, Han *et al.* [4] described significant dataset biases and high class imbalance of in-the-wild datasets as a fundamental bottleneck in facial expression recognition. Their results showed that cross-dataset evaluation can reduce dataset bias and improve the performance.

In this paper we aim to better understand the influence of the filters on the model performance and model complexity for multi-label ON/OFF appliance classification through intra and cross-dataset evaluation. Our main contributions are as follows:

- We adapt VGG19, a widely used DL architecture, for the appliance ON/OFF classification and study the influence of the filters on the model performance and model complexity.
- We develop a model, PirnatCross, that excels at cross-dataset performance, offering an average improvement of 17.2 percentage points vs a SotA model and VGG11 baseline respectively, when trained on REFIT and evaluated on UK-DALE and vice versa. Also, PirnatCross consumes 6-times less energy compared to SotA model.

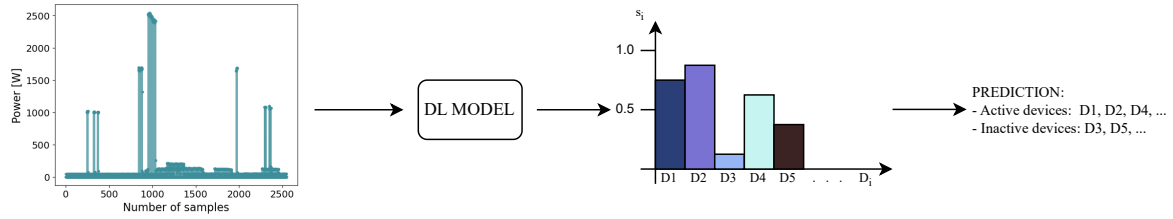


Figure 1: We input the data measured from a household into the DL model and it outputs s_i for each device present in the experiment. If s_i is greater than 0.5 we classify the device as active, if not as inactive.

The paper is organized as follows. Section 2 provides the problem statement, Section 3 presents methodological details, while Section 4 analyses the results of our study. Finally, Section 5 concludes the paper.

2 PROBLEM STATEMENT

Given an input power consumption measured by a smart meter $p(w)$ over a time window w , we aim to develop a multi-label ON/OFF classifier Φ that maps the input to a probability vector $s(w)$ corresponding to the status of the home appliances as:

$$s(w) = \Phi(p(w)) \quad (1)$$

The $|s|$ of the set s , indicates the number of appliances to be recognised. For each window of measurements $p(w)$ input to the model Φ , $s(w)$ will be of the form $[s_1(w), s_2(w), \dots, s_N(w)]$, $s_i \in [0, 1]$ and $N = |s|$ where each s_i estimates the probability of appliance d_i to be active as also depicted in Figure 1. When $s_i > 0.5$ the appliance will be classified as ON, otherwise it will be classified as OFF. More than one appliance can be ON at the same time, therefore s contains multiple labels assigned to the current instance. In this paper $N = 5$ in total of which any 1-4 can be active.

The ON/OFF classifier Φ realized as a deep learning network is typically composed of a set of layers $[l_1, l_2, \dots, l_M]$ where the types of the layers may vary depending on how the respective architecture is designed. For instance $l_i \in [FC, Pool, Conv, GRU, \dots]$, where FC stands for fully connected, Pool stands for pooling, Conv for convolutional and GRU for gated recurrent unit. As has been already shown also in [10], the computational complexity varies across the types of the layers.

In developing Φ , we start from the VGG family of architectures as they are widely used in various communities and have already shown promising results for classification on NILM [7]. More precisely we consider VGG19 comprising of 19 layers with trainable parameters, 16 of which are convolutional and 3 are fully connected. The convolutional layers are grouped into five blocks:

- Block 1: 2 x conv. with 64 filters + Max pooling
- Block 2: 2 x conv. with 128 filters + Max pooling
- Block 3: 4 x conv. with 256 filters + Max pooling
- Block 4: 4 x conv. with 512 filters + Max pooling
- Block 5: 4 x conv. with 512 filters + Max pooling

This architecture has been tailored to accommodate time series data, replacing the 2D convolutions and pooling from VGG19, designed for images, with 1D counterparts that are more suitable for time-series. In addition, the convolutional layers in the 5th block have been replaced with transpose convolutional layers to increase the temporal resolution of features to reduce their number as suggested in [14]. We also integrated a recurrent layer after the 5th block, GRU layer to be specific, as it is able to model temporal

relationships in the time series and it was shown to achieve good performance in a recent study [12].

In order to estimate the computational complexity of the resulting architecture, referred to as PirnatCross, we must first calculate its complexity as the sum of all floating point operations (FLOPs) that have to be computed for each of its layers. This can be calculated for convolutional, pooling and fully-connected layers with the equations from [10] and for GRU with equation from [13].

As convolutional layers dominate in our adaptation of VGG19, and the computational complexity of a convolutional layer is relatively high compared to other type of layers [10]. Generally, the number of FLOPs used throughout the convolutional layer F_c is equal to the number of filters N_f times the flops per filter $F_c = (F_{pr} + N_{ipf})N_f$. Therefore we aim to study the influence of the number of the filters N_f on the model performance and complexity. Let the starting number of filters in each block of the adapted architecture be the same as in the original VGG19, namely $F = [64, 128, 256, 512, 512]$, analyze the model performance as average F1 score versus computational complexity in FLOPs.

3 METHODOLOGY

This section provides methodological details related to the datasets, the training approach and evaluation process that were employed for the study.

3.1 Datasets

The study is conducted using two datasets: UK-DALE [6] and REFIT [9]. Within each dataset, we monitor the same five appliances d_i that were also used in recent research [12]: fridge, washing machine, dishwasher, microwave, and kettle. The data from the selected devices is obtained and processed using the procedure described by Tanoni *et al.* [12] to form 2 mixed datasets. After processing, the two mixed datasets each consist of the same five devices, with each sample containing a random selection of one to four active devices. Samples with varying numbers of active devices are randomly distributed throughout the datasets. We evaluate the cross-dataset performance of models on two mixed datasets obtained by processing data from, UK-DALE and REFIT, in both directions. Specifically, we train models on REFIT derived dataset and test them on UK-DALE derived dataset and vice versa, by training on UK-DALE derived dataset and testing on REFIT derived dataset.

3.2 Benchmarks

In order to have a more meaningful study, we also evaluate PirnatCross, the adapted VGG19, against a VGG11 baseline and a recently published work TanoniCRNN [12]. For VGG11, we used a learning rate of 0.0001 and the same batch size and epochs. For

TanoniCRNN, we used the hyperparameters specified as optimal in their paper [12].

For PirnatCross we vary the set of the filters F by multiplying with $k \in [0.02, 0.04, 0.06, 0.08, 0.1, 0.3, 0.5, 0.7, 0.9, 1.1, 1.3, 1.5, 1.7, 1.9, 2.1, 2.3, 2.5]$. The learning rate, batch size, and number of epochs were determined through a process of trial and error, informed by previous experiments, and subsequently fine-tuned for each model, to optimize model performance and stability. The resulting values are: learning rate of 0.0003, a batch size of 128, and trained for 20 epochs.

While some models were capable of handling larger batch sizes, we found that performance was not improved by increasing the batch size beyond 128, so we kept it unchanged for all models. We train and evaluate using 5-fold cross-validation.

3.3 Metrics

We use the average weighted F1 score ($\overline{F1score_w}$) as a performance metric because our datasets are not balanced and do not provide equal representation for each device.

$$\overline{F1score_w} = \sum_{i=1}^{N_d} F1score_i \times Weight_i \quad (2)$$

The average weighted F1 score is calculated using three metrics: true positive (TP), false positive (FP), and false negative (FN). TP measures the instances where the device is accurately classified as active, while FP represents cases where the device is erroneously classified as active. FN indicates instances where the device is mistakenly classified as inactive.

From these metrics, we derive the precision ($Precision = \frac{TP}{TP+FP}$) and recall ($Recall = \frac{TP}{TP+FN}$), which are used to calculate the F1 score ($F1score = 2 \times \frac{Precision \times Recall}{Precision+Recall}$). To obtain the average weighted F1 score (2), we first compute the F1 score for each device, then take the average based on their weight ($Weight = \frac{SSD}{SAD}$), which is determined by the support for the specified device (SSD) and the support of all devices (SAD).

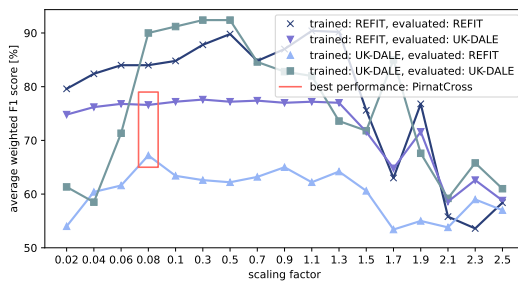


Figure 2: Average F1 scores on intra and cross-dataset training and evaluation as a function of filter scaling factor.

4 RESULTS

In this section we first determine the optimal filter configuration for variations of the PirnatCross architecture to achieve high average weighted F1 score. We then follow with a computational complexity and carbon footprint assessment. Finally, we then benchmark the performance of models in cross-dataset evaluation on REFIT and UK-DALE datasets.

4.1 Analysis of Tuning the Filters in PirnatCross

Figure 2 depicts the performance of the PirnatCross architecture where the original number of filters in the set F has been scaled

by scaling factors $k \in [0.02, 0.04, \dots, 2.5]$. The upper two curves present the average weighted F1 score for models trained and evaluated on REFIT and UK-DALE separately, so without cross-dataset evaluation. The second lowest curve presents the average weighted F1 scores for models trained on REFIT and cross evaluated on UK-DALE while the lowest curve presents the results on training on UK-DALE and cross evaluating on REFIT. In our experiments, we observe only the cross evaluation models, they show a rapid improvement in performance for scaling factor values from 0.02 to 0.08. From scaling factor value 0.08 to 0.9, we see a decline in performance in one example and a small improvement in the others, while beyond 0.9 the results gradually decline. For scaling factors above 1.3 a rapid drop in performance can be observed.

Marked with light blue in Figure 2 and also depicted in Figure 3 is the PirnatCross version of the proposed architecture having F scaled by 0,08 and thus resulting in the $F_1 = [5, 10, 20, 40, 40]$ filter configuration of the blocks. PirnatCross1 performs optimally in terms of avg F1 score.

PirnatCross1 also contain 5 blocks as the original VGG19. The first two comprising of two convolutional layers and the subsequent two comprising of four convolutional layers. The final block consists of four transpose convolutional layers and all blocks include an average pooling layer after the convolutional layers. Preceding the output layer, our model incorporates a GRU layer with a size of 64. Additionally, two fully-connected layers, each consisting of 4096 nodes, are included in the architecture. The output layer of our model comprises five nodes corresponding to the states s_i of the 5 appliances d_i considered in this study. All layers utilize the ReLU activation function, except for the output layer which employs the sigmoid activation function.

4.2 Computational Complexity and Carbon Footprint Analysis

Table 1 summarizes the weights, FLOPs, energy and carbon footprint numbers for PirnatCross versus the TanoniCRNN and VGG11 baselines. The results take into account the fact that the models were trained on Nvidia A100 graphics card, located in Slovenia where 250g of CO₂ equivalent is produced with each kWh of electricity. The specific equations used to calculate, energy and carbon footprint are defined in our previous work [10].

It can be seen from the second row of the table that PirnatCross achieves superior energy efficiency compared to other models, exhibiting energy consumption 6-times smaller compared to Sota TanoniCRNN and 6.6-times smaller compared to VGG11.

Table 1: Computational complexity and carbon footprint analysis for the proposed architecture and selected baselines.

NN	weights	FLOPs	energy	carbon footprint
PirnatCross	$17.4 \cdot 10^6$	$185 \cdot 10^6$	329 kJ	22,9 g CO ₂ eq.
TanoniCRNN [12]	$0.75 \cdot 10^6$	$1.11 \cdot 10^9$	1967 kJ	136.7 g CO ₂ eq.
VGG11	$185.6 \cdot 10^6$	$1.21 \cdot 10^9$	2150 kJ	149.3 g CO ₂ eq.

4.3 Cross-Dataset Analysis

Tables 2 and 3 present the per device breakdown of the F1 scores for PirnatCross, TanoniCRNN and VGG11 when trained on REFIT and evaluated on UK-DALE and vice versa.

When we trained on REFIT and evaluated on UK-DALE, the scores for the four models were as follows: PirnatCross achieved a score of 0.766, TanoniCRNN achieved a score of 0.752 and VGG11

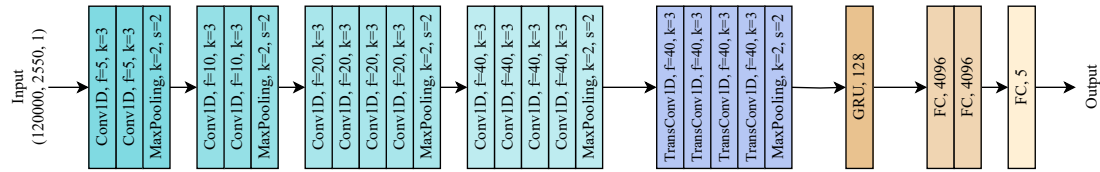


Figure 3: The proposed architecture PirnatCross made for maximum performance.

Table 2: F1 scores for PirnatCross1, TanoniCRNN [12] and VGG11 trained on REFIT and evaluated on UK-DALE.

devices	PirnatCross	TanoniCRNN [12]	VGG11
fridge	0,944	0,972	0,462
washing machine	0,650	0,690	0,544
dish washer	0,646	0,648	0,294
microwave	0,728	0,756	0,512
kettle	0,786	0,622	0,420
weighted avg	0,766	0,752	0,456

Table 3: F1 scores for PirnatCross1, TanoniCRNN [12] and VGG11 trained on UK-DALE and evaluated on REFIT.

devices	PirnatCross	TanoniCRNN [12]	VGG11
fridge	0,730	0,232	0,508
washing machine	0,668	0,666	0,366
dish washer	0,596	0,468	0,360
microwave	0,526	0,630	0,506
kettle	0,800	0,782	0,408
weighted avg	0,672	0,542	0,438

achieved a score of 0.456. However, when we trained on UK-DALE and tested on REFIT, the scores were notably lower for all four models. PirnatCross achieved a score of 0.672, TanoniCRNN achieved a score of 0.542, and VGG11 achieved a score of 0.438.

This outcome may be explained by the fact that REFIT has a significantly higher level of data noise compared to UK-DALE as shown in prior work [12]. Consequently, the testing results obtained from UK-DALE are expected to show higher F1 scores. Moreover, we observed that, overall, our model PirnatCross consistently outperformed the other models in both testing scenarios, achieving the highest weighted average F1 scores overall.

5 CONCLUSIONS

To address the challenge of cross-dataset usage scenario on NILM ON/OFF classification, we propose PirnatCross, with an aim to present the maximum performance and the energy efficiency. The results of our evaluation on the REFIT and UKDALE datasets reveal that PirnatCross achieve an average performance improvement of 7.2 over SotA and 27.2 percentage points over baseline, underscoring its superior effectiveness in handling data from diverse sources. Additionally PirnatCross consumes 6-times less energy compared to SotA model. To develop PirnatCross, we employed our methodology. In the case of classification on NILM this included beginning with the VGG19 architecture and implementing several modifications, such as replacing the convolutional layers with transpose convolutional layers in the 5th block, incorporating a GRU layer after it, and adjusting the number of filters based on our analysis. Our analysis revealed that an increase in

the number of filters in convolutional layers and consequently an increase in the number of FLOPs did not necessarily lead to an improvement in classification accuracy. Instead, we observed a point of steady improvement in performance, followed by a gradual decline and a significant drop in performance when the number of filters exceeded a certain threshold. This information is crucial for optimizing the architecture of NILM models, and keeping track of the carbon footprint.

ACKNOWLEDGEMENTS

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Miti in resnice o varovanju okolja
Myths and Truths about Environmental Protection

Urednika / Editors

Tomaž Ogrin, Rafael Mihalič

<http://is.ijs.si>

11. oktober 2023 / 11 October 2023
Ljubljana, Slovenia

PREDGOVOR

Tretjo konferenco na temo varovanja okolja smo poimenovali »Miti in legende varovanja okolja.« Stroka skoraj praviloma daje precej drugačne odgovore glede ekološke škodljivosti vpliva človeka na okolje, kot večinoma zasledimo v medijih. Zavedanje o pomenu okolja v družbi narašča, ljudi se v imenu "ekologije" vedno bolj omejuje v njihovem vsakdanjem življenju, za vsako malenkost kot posamezniki potrebujemo nešteta dovoljenja, hkrati pa mirno gradimo nova in nova veletrgovska središča na najboljši kmetijski zemlji, ki smo je v letih od osamosvojitve izgubili ca. 70.000 ha, tako da je ostalo še ca. 180.000 ha obdelovalnih (njivskih) zemljišč, v občinskih prostorskih načrtih pa je predvidenih za pozidavo še 57.000 ha zemljišč. Ob izgradnji novih 100 km avtoceste, ki jih sicer rabimo za visok standard življenja, ki se mu ne maramo odreči, se porabi toliko energentov, da jih z energetskim varčevanjem slovenskih gospodinjstev praktično ni mogoče kompenzirati. Ko ob tem beremo, kako bodo problem oskrbe družbe z energijo rešile sončne elektrarne na kmetijskih površinah ali vetrnice v deviških gozdovih, se lahko utemeljeno vprašamo ali ob tem ne gre za neznanstvene pristope, o ekoloških mitih ali morda celo za uresničevanje nekih idej pod krinko okoljevarstva.

Modrost vidimo v izreku: "Ne uničujmo narave, da bi reševali okolje!" V tujini ga poznajo kot: "Do Not Destroy the Nature to Save the Environment." S konferenco želimo podati usmeritev Slovenije v varno, prijazno, zdravo in kakovostno okolje za vse državljane in državljanke Slovenije, ki si ga bomo ljudje tudi lahko privoščili ter hkrati opozoriti na prehitro uničevanje okolja, kmetijskih površin, nepotrebne gradnje novih in novih trgovskih centrov, infrastrukture in energijskih objektov na najboljših zemljiških površinah, dostikrat z nepremišljenimi ali celo škodljivimi usmeritvami.

Ali je mogoče hkrati spodbujati tehnološki razvoj, uporabo obnovljivih virov in zmanjšati negativne vplive na okolje? Smo sposobni preusmeriti antropocentrični razvoj v ekocentričnega? Potrebujemo 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, zakaj imajo podjetja in inštitucije večinoma vse pozidano, v asfaltu in betonu? In seveda ključno vprašanje: "Kaj si lahko privoščimo?" Najslabša možnost za ljudi in tudi za okolje je obubožanje družbe v imenu utopičnih idej. Dvomimo, da bo komurkoli še mar za razogljichenje, energetski preobrat, zelene vire in kar je podobnih floskul, če bo eksistenčno ogrožen in za svoje otroke ne bo videl neke obetavne prihodnosti.

Konferenca bo po obliki podobna kot dosedanje v okviru 26. zaporedne multikonference Informacijska družba (is.ijs.si). Tema okolja je tako vseobsegajoča, aktualna in pomembna, da je res zadnji čas, da se pojavi v multikonferenci IS. Tako kot pri drugih konferencah bomo tudi pri okolju »natočili čistega vina« oz. bomo strokovno analizirali in ugotovili marsikaj, česar ne najdete v javnih medijih, marsikdaj pa tudi ne v znanstveni in strokovni literaturi.

Matjaž Gams, Rafael Mihalič in Tomaž Ogrin

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Focus

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Zveza ekoloških gibanj

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Prihodnost pripada vodiku?

Future belongs to the Hydrogen?

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POVZETEK

"Prihodnost (ne?) pripada vodiku". Takšne in podobne trditve se zadnje čase vedno pogosteje pojavljajo v medijih. V dogmi o globalnem razogljičenju igra vodik pomembno vlogo. Na mnogih področjih, kjer tehnologija zahteva visoke temperature, jeklo, električna energija, cement, kemična industrija,... se predvideva uporaba zelenega vodika. V času postopnega prehoda na vodik bo potrebno prilagajanje obstoječih naprav, da bodo postale "H2-ready". V tem prispevku je obravnavano nekaj osnovnih tehnoloških značilnosti, ki jih zahteva uporaba plinastih goriv z večjim deležem vodika. Trenutno že zelo dobro poznamo lastnosti vodika in težavnosti njegove uporabe kot goriva, ni pa še neke pametne rešitve glede sezonskih hranilnikov in tudi absurda, da vodik ni energent, pač pa neto porabnik energije. Uporaba zelenega vodika torej že v izhodišču povečuje potrebo po primarni energiji, ki jo jemljemo iz okolice. Trenutno svet in vsa proizvodnja naprav za izrabo obnovljivih virov energije še vedno močno sloni na fosilnih virih.

KLJUČNE BESEDE

vodik, razogljičenje, pripravljenost na vodik

ABSTRACT

"The future (doesn't?) belong to hydrogen". Such and similar claims have been appearing in the media more and more recently. In the dogma of global decarbonization, hydrogen plays an important role. In many fields where technology requires high temperatures like, steel, electricity, cement, chemical industry,... the use of green hydrogen is envisaged. During the gradual transition to hydrogen, it will be necessary to adapt existing devices to become "H2-ready". This paper discusses some of the basic technological features required by the use of gaseous fuels with a higher proportion of hydrogen. Currently, we already know very well the properties of hydrogen and the difficulties of using it as a gaseous fuel, but there is still no smart solution regarding seasonal storage tanks and also the absurdity that hydrogen is not an energy source, but a net consumer of energy. The use of green hydrogen therefore already increases the need

*Article Title Footnote needs to be captured as Title Note

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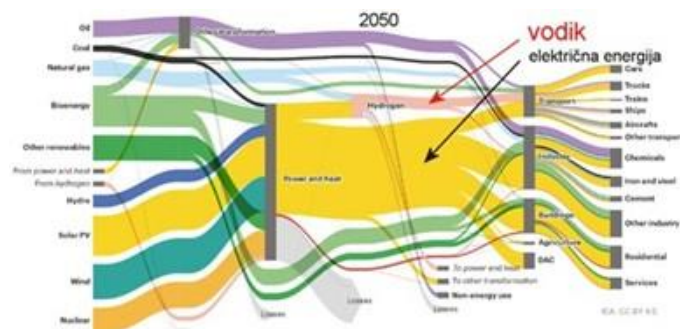
for primary energy, which is taken from the environment. Currently, the world and all production of devices for the use of renewable energy sources still rely heavily on fossil resources.

KEYWORDS

hydrogen, decarbonization, H2-ready

1 VODIK BODOČI (NE)ENERGENT

Glede vloge vodika v bližnji bodočnosti do leta 2070 so napovedi po raznih scenarijih močno različne. Večina scenarijev zelenega prehoda je predstavljenih v raznih poročilih Mednarodne agencije za energijo (IEA – International Energy Agency). Skupna značilnost scenarijev je, da se tudi ti scenariji z leti močno spreminjajo in dajejo poudarke enkrat na eno, čez nekaj let pa na drugo razogljivevalno tehnologijo. Tako je tudi vloga vodika spremenljiva, enkrat večja, drugič manjša. Na sliki 1 je prikazana struktura energentov leta 2050 po enem izmed scenarijev IEA (NZE scenarij - Net Zero Emissions by 2050) kjer je vloga zelenega vodika relativno majhna [1].



Slika 1: IEA NZE scenarij za leto 2050, kjer električna energija postane glavni energijski vektor [1]

2 POJEM "H2-ready"

Termin "H2-ready" pomeni, da je naprava zmožna delovati na 100 % vodik ali njegove derivate, kot je npr. amonijak [2, 3]. V prispevku se bomo omejili na obstoječe tehnologije kot so plinske elektrarne, parni kotli in druge kurilne naprave, plinski motorji. Tudi v bodoče bo za stabilnost elektroenergetskega sistema v veliki meri potrebna velika rotirajoča masa, torej klasične elektrarne z velikimi masami in z zgorevanjem zelenega vodika. Pri tem lahko izpostavimo nekaj osnovnih tehnoloških

izzivov. Trenutno ni mogoče predvideti, kdaj bo vodik na voljo za energetske industrije v obsegu, kot so današnja fosilna goriva in seveda tudi kakšna bo cena. Še težje kot elektroenergetski sistem, bo razogljčiti visokotemperaturne sektorje kot so kemična industrija, proizvodna kovin, jeklo, cement, apno... in zato se za te sektorje vodik smatra kot mogoča(?) alternativa.

3 SPLOŠNO

Pri uporabi zemeljskega plina s primešanim vodikom, se zmanjšuje emisija CO₂. Iz tabele 1 je razvidno, da se emisija CO₂ relativno malo zmanjšuje, dokler delež vodika v zmesi ni vsaj 80 vol.%. V tabeli 2 so primerjalno navedene nekatere značilne lastnosti za čisti vodik in metan, ki bistveno vplivajo na prilagoditev naprav za uporabo vodika.

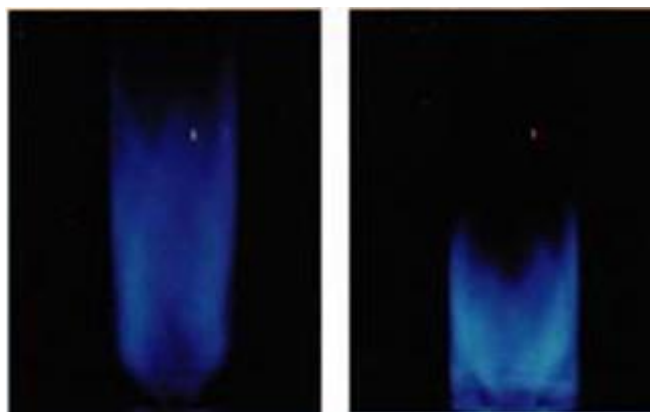
Tabela 1: Emisija CO₂ pri enaki sproščeni energiji (po zgorevanju) in različnih zmesih metan/vodik [2]

vol. delež H ₂	%	0	20	40	50	60	80	100
delež zgorevalne toplote	%	0	7	17	24	31	55	100

Tabela 2: Nekaterne značilne lastnosti čistega vodika in metana [2]

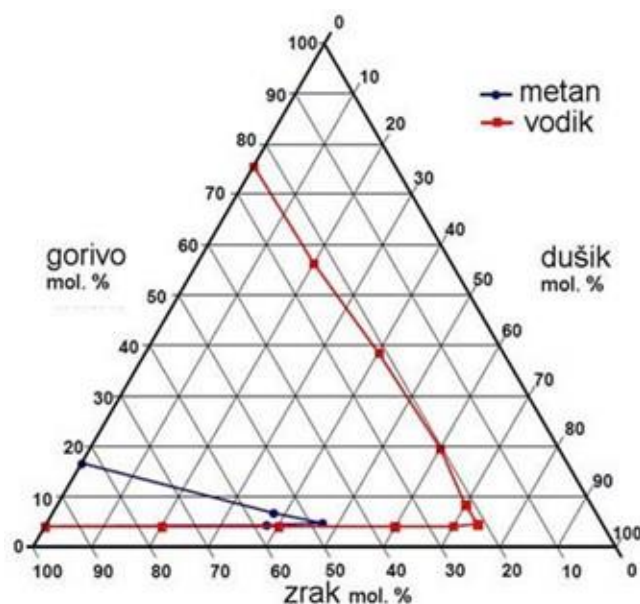
	vodik	metan
spodnja ekspl. meja	4 vol. %	4,4 vol. %
zgornja ekspl. meja	77 vol. %	17 vol. %
gostota, 0 °C, 1 bar	0,0899 kg/m ³	0,717 kg/m ³
min. energija vžiga	0,019 mJ	0,29 mJ
sprememba temp. pri dušitvi	narašča	pada
lam. hitrost zgorevanja	2,7 m/s	0,3 m/s
Wobbe indeks (spodnji)	40,90 MJ/m ³	48,17 MJ/m ³
sp. kurilnost	120 MJ/kg	50 MJ/kg
spec. masa zg. zraka	0,286 kg/MJ	0,345 kg/MJ
teor. temp. zgorevanja	2427 °C	2274 °C
rel. volumenski tok goriva za enako toplotno moč	330 %	100 %
difuzivnost	večja	-
emisije NO _x	večje	-
rel. volumetrična intenzivnost puščanja skozi razpoko	2,8	1

- Kot je opazno iz tabele 2 bo potrebno ob prehodu na vodik naprave celovito prilagoditi. Izpostavimo nekaj najbolj zahtevnih ukrepov.
- Zaradi velike hitrosti zgorevanja in velike difuzivnosti vodika se plamen zmesi vodik/metan skrajša že pri relativno majhnem volumenskem deležu vodika, slika 2.

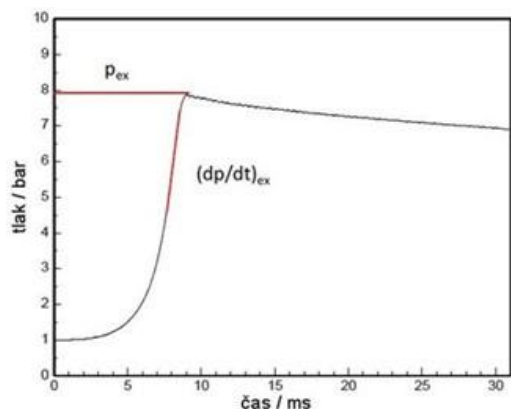


Slika 2: Slika plamena; levo: 100 % metan, desno: metan z 12 vol. % vodika [4]

- Zaradi manjše gostote se vodik v nasprotju z zemeljskim plinom zbira na visokih točkah. Prezračevalne odprtine morajo biti zato urejene na najvišjih točkah.
- Zaradi večjega eksplozivnega območja in manjše gostote je potrebno eksplozijske cone dimenzionirati večje.



Slika 3: Primerjava eksplozijskih območij za vodik in metan v zmesi z dušikom [5]



Slika 4: Časovni potek tlaka po vžigu stehiometrične zmesi vodik/zrak v zaprti tlačni posodi [5]

- V primeru eksplozije zmesi vodik/zrak je brzantni učinek udarnega vala bistveno večji kot v primeru zmesi metan/zrak. Tlačni gradient je pri zmesi vodik/zrak kar 3334 bar/s, pri zmesi metan/zrak pa le 189 bar/s, slika 4. Maksimalni tlak je v obeh primerih približno enak ~8 bar. Ob dejstvu, da je začetna masa vodika v testni tlačni posodi bistveno manjša, je rušilni učinek vodika bistveno večji.
- Zaradi znatno manjše minimalne energije vžiga je potrebno elektrostatične naboje upoštevati kot bistveno bolj kritične (izenačitev potencialov, ozemljitvena veriga, odpornost proti puščanju, upornost talne obloge $\leq 108 \Omega$ itd.).
- Zaradi večje kemijske reaktivnosti in majhnih molekul bo potrebno posebno pozornost nameniti materialom, ki so v stiku z vodikom. Molekularni vodik se kopiči na jeklenih površinah brez zaščitne oksidne plasti in tam disociira v atomski vodik, ki nato prodre v medkristalno strukturo jekla. To povzroči spremembo lastnosti materiala. Posledica je vodikova krhkost materiala, zmanjšana življenjska doba in morda celo odpoved komponente.

4 ZNAČILNOSTI UPORABE VODIKA V ENERGETSKIH NAPRAVAH

Plinske turbine – Nemški načrt prilagajanja plinskih turbin na vodik [2] je razdeljen na več faz, po deležu toplotne moči vodika. Do leta 2025 6 %, do 2028 25 % in do leta 2031 možnost uporabe 100 % vodika. Pri tem je ocena povečanja stroškov polnega prehoda pri novih napravah do 50 %, prilagajanje obstoječih naprav pa do 70 % cene novih. Problem vodikove korozije je do 3 % toplotne moči vodika zanemarljiv, do 6 % toplotne moči vodika je še nekako v mejah obvladljivosti, pri 6-25 % vodika je pa nevarnost korozije že zelo velika. Povečana vsebnost vodne pare v dimnih plinih vpliva temperaturo rosišča in s tem tudi na razmere v morebitnih kogeneracijskih prenosnikih toplote.

Plinski motorji – Današnji plinski motorji zahtevajo kar nekaj prilagoditev za prehod na 100 % vodik in to pri: spremembi oblike zgorevalne komore, varnostni koncept, spremembe materialov, ki so v stiku z vodikom. Obstoječi plinski motorji trenutno lahko brez problemov delujejo do 9 % toplotne moči iz vodika.

Industrijski parni kotli – za obstoječe naprave ni težav do 6 % toplotne moči vodika. Za večje deleže vodika so potrebni novi gorilniki. Pulzacije v kurišču naj bodo čim manjše. Spremeni se tudi prenos toplote in temperatura rosišča dimnih plinov.

Pri uporabi 100 % vodika in zraka so polutanti v dimnih plinih samo dušikovi oksidi, ki se jih odstrani z nekatalitično ali katalitično redukcijo z amonijakom ali sečnino.

5 ZAKLJUČEK

Osnovne značilnosti zahtevanih tehnoloških sprememb energetskega postrojenja pri uporabi 100 % vodika so, da niso potrebne povsem nove naprave z novimi koncepti ampak nekatere nujne prilagoditve. Tehnološko najbolj zahtevna bo prilagoditev plinskih turbin. Zasnova ostaja enaka, posebno pozornost zahteva modifikacija zgorevalnega sistema in pomožnih naprav. Glavne modifikacije zahtevajo gorilniki, zgorevalne komore, materiali v stiku z vodikom, tesnila, požarna zaščita, proti eksplozijska zaščita, naprave za nadzor in regulacijo zgorevanja. Turbinsko kompresorski del ostaja bolj ali manj nespremenjen. Pri uporabi vodika v kotlih in kogeneracijskih postrojenjih se poleg modifikacij zgorevalnega sistema pričakuje nekaj modifikacij v konstrukciji ogrevalnih površin zaradi spremembe prenosa toplote in količine vodne pare v dimnih plinih. Omenjene modifikacije so trenutno tehnično rešljive. Pri globalnem prehodu na vodik in povečanju obsega proizvodnje in porabe vodika, še vedno ostaja veliko nerešenih temeljnih vprašanj. Za te probleme načeloma obstajajo rešitve, ki pa so trenutno vse še na "lekarniškem" nivoju. Transport in skladiščenje sta dve izmed teh vprašanj. Po navedbah IEA je trenutno na svetu samo okoli 2500 km krajših in lokalnih vodikovodov, predvsem v proizvodnih obratih vodika.

Transportnih meddržavnih plinovodov za zemeljski plin pa je trenutno kar 1,2 milijona kilometrov. IEA kot potencialna sezonska skladišča vodika vedno bolj omenja podzemne kaverne, ostale klasične rešitve z različnimi tlačnimi posodami itd. so tehnično absurde. Najbolj absurdno pa je, da so vodikove tehnologije neto porabnik energije, EROI < 1? Zmanjševanje trenutnega EROI z različnimi zelenimi tehnologijami se že kaže v tem, ko mediji in proizvajalci (nevede) propagirajo kako "nove" tehnologije zagotavljajo veliko število novih zelenih delovnih mest. Če se vrnemo za 300 let v preteklost so bila vsa delovna mesta zelena (in večina tudi močno fizično napornih), ker so bila vsa na obnovljive vire energije – ob kakšnem standardu življenja? Osnovna značilnost vodikovih tehnologij je, da so neto porabnik energije, zelo drage in tehnično zelo zahtevne – bo to uporabno in dosegljivo za navadne ljudi? Vodikove tehnologije, na katere danes stavimo zeleni prehod, so v povprečju poznane že 200 let (elektroliza 1800, gorivna celica 1838) in od njih pričakujemo nove rezultate v smislu globalne rešitve "Deus ex machina"? Če bi svet imel resne namene glede zmanjševanja negativnih vplivov na okolje, bi morali izvajati več ukrepov, ki so "Hic et nunc" (latinsko: "tukaj in zdaj") – to je predvsem varčevanje in zmanjševanje potrošnje vseh vrst, kar pa je žal povsem nasprotno s trenutnim ekonomskim modelom in zelenim življenjskim standardom nas vseh?

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Z zelenim kapitalom do razvoja okolja

Green capital for environmental development

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POVZETEK

Ključno vprašanje, ki si ga danes lahko upravičeno zastavljamo, je, kateri proizvodni viri bodo zadovoljevali energetske potrebe prihodnosti in kako zeleni bodo? Pri tem smo soočeni z miti in hkrati izzivi, ki so kompleksnejši kot kadarkoli, kljub temu pa moramo zasledovati rešitve, ki bodo preverjene, celostne, učinkovite, zanesljive, varne, ekonomsko upravičene in okoljsko sprejemljive.

KLJUČNE BESEDE

Energetska politika, sposobnost države, zeleni kapital, okolje.

ABSTRACT

The key question that can rightfully be posed today is which production sources will meet the energy needs of the future and how green they will be? In doing so, we are confronted with myths and, at the same time, challenges that are more complex than ever. Nevertheless, we must pursue solutions that are proven, comprehensive, efficient, reliable, secure, economically justified, and environmentally acceptable.

KEYWORDS

Energy policy, state capacity, green capital, environment.

1 SPOSOBNOST DRŽAVE

Sposobnost države lahko definiramo kot zmožnost politike uresničevati strateške interese ter izbrane cilje. In kot zagovarja Aristotel je politika temeljna in najširša skupnost, ki mora težiti k dobremu [1]. Pri tem se je potrebno zavedati, da je sposobnost države odvisna od zgodovinskih vzorcev ekonomije, političnega in kulturnega razvoja ter razumevanja in sodelovanja družbe. Temeljni gradniki sposobnosti države so fiskalna sposobnost, pravna sposobnost in družbena sposobnost.

Kot ugotavljata Besley in Persson [2] je sposobnost države, da podpira trge in izvršuje obveznosti (pravna sposobnost) ter zbira prihodke (fiskalna sposobnost), medtem ko lahko družbeno sposobnost definiramo kot dovednost in zavzetost družbe za

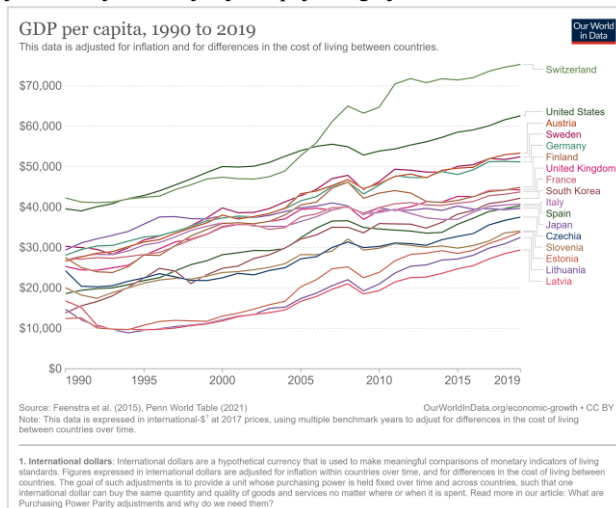
*Boštjan Pišotek, mag. inž. str.
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njen razvoj in je pogojena z mentaliteto, kulturo, religijo in zgodovinskimi izkustvi posameznega naroda.

Slabše pravno in družbeno sposobne skupnosti omogočajo, da država deluje v korist ozkih skupin in parcialnih interesov, kar krepi družbene razpoke, ustvarja nezaupanje in posledično oslabi motivacijo za izboljšanje osnovnih funkcij, tj. pobiranja davkov ter podpore trga, kar onemogoča razvoj države. Pri tem ne gre zanemariti dejstva, da slabša sposobnost države povzroča politično nestabilnost in skrajšuje časovne horizonte vlad ter tako zmanjšuje spodbude za vlaganje v državo.

Pomen razumevanja političnih, ekonomskih in družbenih dejavnikov se izkaže pri primerjavi razvitosti držav, ki ga merimo z bruto domačim proizvodom (BDP) in je monetarno merilo splošnega obsega gospodarske dejavnosti države v določenem obdobju, običajno v enem letu.

Iz podatkov na Slika 1 lahko razberemo katere države imajo v svetovnem merilu najvišji BDP, kar pomeni, da zagotavljajo svojim državljanom najvišjo stopnjo blaginje.



Slika 1: BDP na prebivalca v obdobju od 1990 do 2019 [3].

Zanimiva je analiza rasti BDP za Slovenijo, ki je bil v času nastanka naše države na ravni Španije in Češke, medtem ko je bil krepko nad vrednostmi baltskih držav. Pri tem je naša stopnja rasti v obdobju od 1991 do 2008 rastla z enim izmed najvišjih gradientov, medtem ko je v obdobju 2009 do 2019 zabeležila enega izmed najnižjih, kar je povzročilo, da smo povečali tako zaostanek za razvitimi državami, kot da so nas nekatere manj razvite evropske države iz 90. let prejšnjega stoletja sedaj že ujele.

Če izvzamemo gospodarsko krizo 2008, ki je praktično prizadela vse države, lahko ugotovimo, da je za slabo rast BDP krivo ustvarjanje dobrin za malo dodano vrednostjo in v največji meri pomanjkanje velikih državnih projektov. Slednje izhaja iz neodločnosti in povečane stopnje birokratizacije oz. zaostrovanja zakonodajnih okvirov (slabšanje pravne sposobnosti).

Kot ugotavlja Mramor [4] se v slovenskem zakonodajnem procesu strogo uporablja načelo vgradnje prepovedi vsega, kar bi lahko nekoga naredilo bolj uspešnega. To se zagotavlja z več kot 23.000 predpisi, ki so praviloma (namenoma?) neusklajeni in ponujajo dodatne možnosti blokad. Pri tem se največkrat sprejmejo omejujoči predpisi tako, da se na primer izrabi vsak prenos EU direktive za največjo možno zaostritev področja, ki ga ureja. Pa tudi tako, da se izrabi peščica negativnih primerov za splošne prepovedi, pa čeprav to blokira možnost povečanja blaginje.

Takšna kompleksnost se v praksi izkazuje pri postopku presoje vplivov na okolje hidroelektrarne (HE) Mokrice, za katero sta bili izdani že dve Odločbi prevlade javne koristi (PJK), s katerima je Vlada Republike Slovenije pretehtala v korist energetike – obnovljivih virov energije. Prva odločba PJK je obsegala 283 strani (2020), druga odločba PJK pa 242 strani (2022) in obe sta bili zaradi procesno postopkovnih napak upravnega organa (UO) s strani Upravnega sodišča odpravljeni in vrnjeni UO v ponovno odločanje. Za primerjavo navedimo, da je bila odločba okoljevarstvenega soglasja (OVS) za HE Boštanj leta 2003 izdana na 2 straneh (op. p. za izdajo GD sta pravnomočni PJK oz. OVS predpogoj in ju lahko s tega vidika obravnavamo kot enakovredni odločbi). Če upoštevamo še časovni vidik, kjer je od pobude za gradnjo HE Boštanj do gradnje minilo manj kot leto dni, je pri HE Mokrice investitor prvo pobudo podal UO novembra 2006, pa do danes še ni izpolnjenih administrativnih pogojev za pričetek gradnje.



Slika 2: Praktičen primer slabšanja pravne sposobnosti Slovenije je količina okoljsko projektne dokumentacije pri oddaji vloge za gradbeno dovoljenje (GD) za večnamenski državni strateški projekt HE Mokrice.

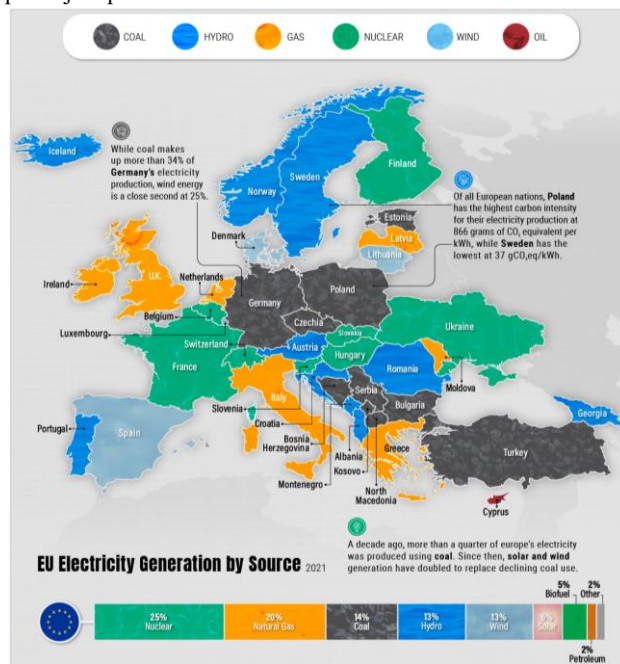
Izračuni kažejo, da zaradi zamude začetka izgradnje HE Mokrice investitorju, njegovim lastnikom, državi in lokalni skupnosti nastaja ogromna finančna škoda. Zaradi neizgradnje oz. zamude pri začetku obratovanja HE Mokrice (predinvesticijska dokumentacija verige HE je predvidevala začetek obratovanja v 2020) je nastalo za cca. 66 mio eur škode. Gre za izpad prihodkov od prodane električne energije, koncesije in drugih dajatev v državni proračun, stroškov Slovenije zaradi neizpolnjevanja zavez OVE in podražitev izgradnje zaradi sprememb na trgu.

Zavedati se je treba, da se sposobnost držav kot rezultat manifestira v blaginji naroda. In kot je trdil Smith [5] bi država iz tega vidika morala biti ocenjena glede na svojo raven proizvodnje in trgovine, pri čemer mora biti ustvarjena svobodna

izmenjava oz. prosti trg, saj sta tako obe državi, ki trgujeta boljše zaradi te izmenjave. Tako lahko zaključimo, da so za trgovanje nujno potrebni proizvodi dobrin ali storitev, ki jih mora ustvariti gospodarstvo posamezne države in jih nato na učinkovit način zamenjati na trgu za dobrine ali storitve, ki jih sama potrebuje. Vendar, da lahko trgujemo moramo najprej proizvesti oz. ustvariti. In večjo količino dobrin ter na učinkovitejši način kot jih država proizvede, višjo stopnjo razvitosti bo dosegla.

2 KAJ JE ZELENİ KAPITAL SLOVENIJE

Raznolikost nas bogati. In tudi pri naravnih virih Evrope je situacija enaka. Tako imajo južne evropske države kot so Španija, Portugalska, Grčija, Italija, Makedonija najboljši sončni potencial; vodni potencial je zelo dobro izkoriščen v državah Norveške, Švedske, Francije, Turčije, Avstrije in Švice; pri potencialu vetra prednjačijo Danska, Švedska, Anglija, Škotska, Irska, Nizozemska, Nemčija; les prispeva pomemben delež pri zadovoljevanju energetskih potreb skandinavskih in baltskih držav, Češke, Srbije, Avstrije in Francije [6]; največje evropske proizvajalke nafte in plina so Rusija, Norveška in Velika Britanija [7]. Za Slovenijo ugotovimo, da ima največji privilegij naravnih virov v vodi in lesu, ki sta hkrati tudi najučinkovitejša razpoložljiva potenciala.



Slika 3: Najbolj pogosto uporabljeni naravni viri za proizvodno električne energije v Evropi [8].

Iz prikazanega na Slika 3 lahko zaključimo, da čeprav številne države Evrope vlagajo ogromne napore in napredujejo v svoji zeleni tranziciji, je še vedno 60 % električne energije pridobljene iz fosilnih goriv, ki tako predstavlja primarni naravni vir oskrbe.

Nad vse pomemben zeleni kapital Slovenije je nedvomno zeleno gospodarstvo, ki ustvarjene dobičke vlaga v nove projekte in tehnologije OVE – po načelu »zeleno dela še bolj zeleno«. Zavedati se moramo, da v proizvodnem portfelju električne energije Slovenije eno tretjino oz. 4,5 TWh [9] že zagotavljajo

zeleni viri, in sicer HE, ki so z vidika energetske učinkovitosti tudi najboljši OVE vir. Namreč pomembno merilo, ki definira vplive posamezne tehnologije na učinkovitost oz. okolje predstavlja faktor ERoEI (Energy Returned on Energy Invested) in predstavlja razmerje med pridobljeno in v njeno pridobivanje vloženo energijo. Kot definira Mihalič [10] energenti z nizkim ERoEI preprosto niso dovolj, da bi družba lahko razvila t.i. višje družbene dejavnosti, zato je smiselno rabiti vire s čim večjim razmerjem. Pri tem izpostavi vodo kot daleč najbolj učinkovit vir za proizvodnjo zelene energije, s faktorjem ERoEI >100:1. Po analizah IEA [11] HE bistveno prispevajo tudi k fleksibilnosti in zanesljivosti elektro energetskega sistema (EES).

Upoštevajoč faktor ERoEI, naravne danosti Slovenije in njen proizvodni portfelj električne energije, lahko zaključimo, da HE ustvarijo največ prostega kapitala, ki ga lahko vložimo v nove projekte OVE in prožnosti, zato HE definiramo kot zeleni kapital Slovenije.

3 ENERGETSKO PODNEBNA TRANZICIJA

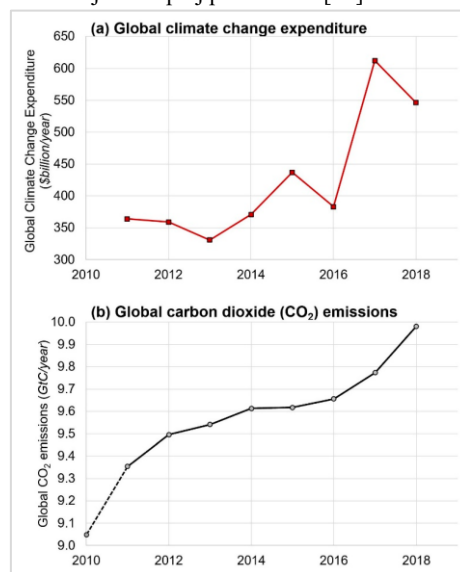
Če v obzir vzamemo širšo sliko dogodkov in dejstev iz preteklih let oz. desetletij, od rasti števila prebivalstva, razvoja vzhajajočih gospodarstev, geopolitičnih negotovosti, kriz in konfliktov, tržnih pogojev, zakonodajnih regulacij ter socialno-naravovarstvenega aktivizma bi lahko rekli, da se je energetska tranzicija rodila iz teme. Ob tem so finančni mehanizmi in zakonitosti, mimo fizike in naravnih zakonitosti, izoblikovali novodobno energetske podnebno politiko.

Kot navajata Gardett in Hunt [12] bodo imeli na hitrost in obliko energetske podnebne tranzicije v naslednjem desetletju največji vpliv finančni skladi, pri čemer izpostavita sklade zasebnega kapitala, Brookfield Asset Management in Apollo Global Management, ki že vlagajo desetine milijard dolarjev v energetske prehode in čiste tehnologije. To energetskim podjetjem omogoča financiranje že v zgodnjih fazah razvoja tehnologij, še predno dosežejo stopnjo komercializacije, konkurenčnosti in pozitivno prihodkovno raven, zato lahko tako ostanejo konkurenčna na področju kreditiranja z ugodno bonitetno oceno.

Ta situacija ima v osnovi mnogo skupnih podobnosti z nastankom bančne krize v 2008, kot jo opiše Varoufakis [13], ki izpostavi paradoks posojanja in časovne vrednosti denarja, kot razloga za bančni zlom. Koncept temelji na načinu delovanja ekonomij in finančnih sistemov, ki strmijo k vedno večjemu posojanju denarja v sedanosti z namenom, da bodo v prihodnosti iz naslova obresti ustvarili čim višje dobičke - ustvarjanje vrednosti iz prihodnosti. Pri tem banke delujejo kot posredniki, ki sprejemajo denar od varčevalcev in ga nato z razliko obrestnih mer posojajo posojiljemalec. Težava nastane, ko banke ustrezno ne ocenijo tveganja sposobnosti odplačevanja posojil in v želji po višjih dobičkih preveč tvegajo s posojanjem denarja posojiljemalec, ki morda ne morejo vrniti teh posojil (npr. posojiljemalci se znajdejo v finančnih težavah, ohlajanje gospodarstva zaradi zmanjšanja povpraševanja, inflacija itd.), medtem ko so same odgovorne za vrnitev denarja vlagateljem, ki so jim zaupali svoje prihranke. To pripelje do situacije, ko banke ne morejo več izpolnjevati svojih obveznosti do vlagateljev in se znajdejo v stanju nelikvidnosti, kar pomeni, da nimajo dovolj denarja za izpolnitev vseh obveznosti. Takrat banka propade, kar ima resne posledice za gospodarstvo in vlagatelje.

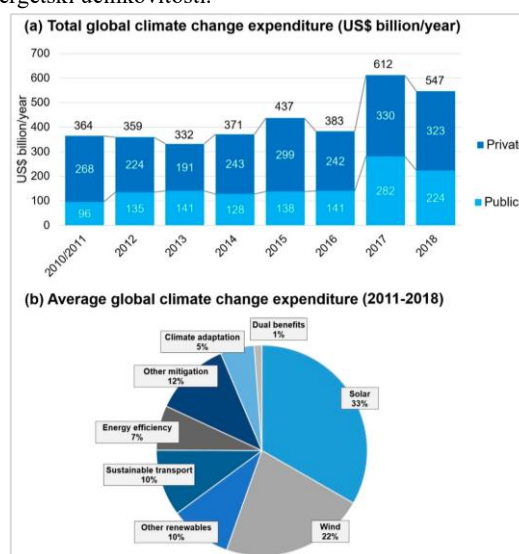
Na osnovi analogije z Varoufakisovim paradoksom, lahko ugotovimo, da v kolikor finančni skladi, ki financirajo nove zelene tehnologije, ustrezno ne ocenijo tveganja uspeha komercializacije tovrstnih tehnologij in ustvarjanja dodane vrednosti ter posledično zmožnosti podjetij oz. posojiljemalcev za vračanje prejetega financiranja, lahko to pripelje do globalnega energetskega finančnega zloma.

Predvsem je to zaskrbljujoče, če na celotno situacijo uvajanja novih zelenih tehnologij pogledamo z vidika empiričnih dokazov, saj ugotovimo, da so se, kljub velikim izdatkom za uresničitev zelenega prehoda, in sicer 3.660 milijard dolarjev v obdobju od 2011 do 2018, svetovne emisije ogljikovega dioksida (CO₂) v tem istem obdobju še naprej povečevale [14].



Slika 4: Izdatki za uresničitev zelenega prehoda in gibanje emisij CO₂ na globalni ravni [14].

Slika 5 prikazuje, da je bilo 55 % finančnih sredstev v tem obdobju namenjenih projektom sončne energije (SE) in vetra (VE), dodatnih 10 % pa projektom trajnostne mobilnosti in 7 % energetske učinkovitosti.



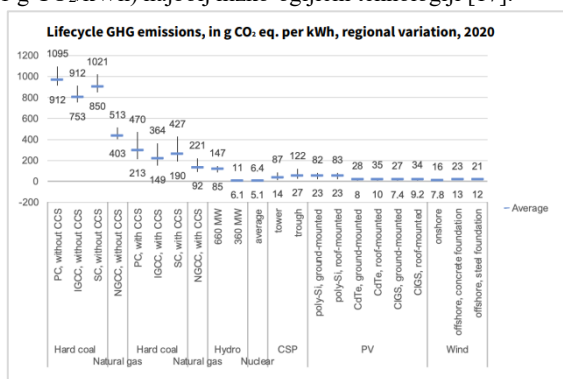
Slika 5: Razdelitev izdatkov glede na tehnologijo [14].

V kolikor bi finančna sredstva porabljena za projekte SE in VE vložili v jedrsko energijo, bi lahko izvedli več kot 90 jedrskih elektrarn tipa Hinkley Point C [15], ki zadovolji 7 % potreb Britancev po električni energiji [16], s čimer bi, globalno gledano, dosegli učinkovitejšo energetske podnebno tranzicijo.

3.1 LCA - Emisije toplogrednih plinov

Za korektno obravnavo in medsebojno primerjavo emisij toplogrednih plinov posameznih tehnologij moramo upoštevati analizo celotnega življenjskega cikla naprave (ang. Life Cycle Analysis ali LCA).

Brez izjeme vsaka tehnologija za proizvodnjo električne energije povzroča okoljske vplive skozi celoten življenjski cikel, pri čemer se ti vplivi zelo razlikujejo glede na lokacijo izvedbe, projektne rešitve in okoljske ukrepe. Pravilna energetska politika mora temeljiti na ocenah LCA in upoštevati okoljske vplive izdelave, obratovanja in razgradnje tako posameznih tehnologij za proizvodnjo električne energije kot tudi podpore infrastrukture celotnega energetskega sistema (npr. gradnja novih daljnovidov, dostopnih cest, energija za razgradnjo itd.). V marcu 2022 je Ekonomska komisija Združenih narodov za Evropo (UNECE) v analizi LCA ugotovila, da sta jedrska energija (5,1 - 6,4 g CO₂/kWh) in hidroenergija do 360 MW (6,1 - 11 g CO₂/kWh) najbolj nizko-ogljivi tehnologiji [17].



Slika 6: Emisije toplogrednih plinov v celotni življenjski dobi posamezne tehnologije [17].

3.2 Podpore za vpeljavo OVE

Avtorji študije (Mihalič et al.) [18] ugotavljajo, da je bilo v Sloveniji v 10 letih od 2009 do 2019 za tehnologije OVE izplačanih preko 1,1 milijard EUR podpor. Najvišje podpore v letu 2019 so prejele sončne elektrarne 61,9 mio EUR, kar je najvišje tudi glede na razmerje med deležem podpore in deležem energije ter elektrarne na biomaso v znesku 18,3 mio EUR (Tabela 1). Male hidroelektrarne (moč < 10 MW) so prejele 4,6 mio EUR podpor v letu 2019 za proizvedenih 110,4 GWh električne energije. Za že zgrajene HE na spodnji Savi (HESS) in HE Mokrice (HEMO) podpore niso bile podeljene (moč > 10 MW), temveč lastniki skladno s koncesijsko pogodbo plačujejo Republikli Sloveniji oz. lokalnim skupnostim dajatve v višini 14 % celotne proizvedene električne energije.

Upoštevaje trajanje koncesije avtorji [18] ugotavljajo, da so stroški investicije EUR/kW/življenjsko dobo najnižji pri HE (primerljivih s HESS in HEMO) na ravni 0,010 EUR/kW/življenjsko dobo. Pri VE je ta strošek 0,062

EUR/kW/življenjsko dobo, pri SE 0,042 EUR/kW/življenjsko dobo.

Tabela 1: Učinek državnih podpor v letu 2019 in stroški investicije na kW za Slovenijo [18].

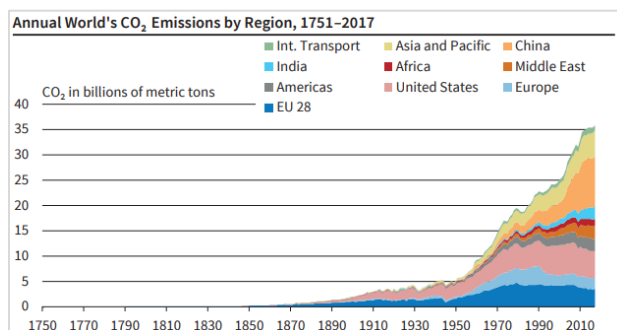
Izbrana alternativa	Proizvedena EN v GWh	Podpora mio EUR	Delež energije %	Delež podpore %	Strošek investicije EUR/kW	Trajanje koncesije
MHE	110,4	4,6	11,66 %	3,76 %	1.500 do 6.000	30 do 50 let
Sončne elektrarne	261,4	61,9	27,59 %	50,34 %	1.000 do 1.800	< 20 let
Vetrne elektrarne	6,1	0,3	0,65 %	0,22 %	1.000 do 1.800	< 20 let
Biomaso	133,5	18,3	14,09 %	14,87 %	3.000 do 5.000	< 20 let
Drugo	436	37,9	46,01%	30,81%		< 20 let
Skupaj alternativa	947,4	123,0	100,00%	100,00%		
HESS	542	0	57,21%	0%		
HEMO	131	0	13,83%	0%	< 3.000	> 50 let

3.3 Upad konkurenčnosti EU na globalnem trgu

Oskrba z energijo in vodo je temelj vsake civilizacije. Kdor ju torej obvladuje, obvladuje družbo in svet. V zadnjem desetletju postaja energija v Evropi vedno dražja. Kot smo prikazali v 2. poglavju, večina Evrope še vedno temelji na pridobivanju električne energije iz fosilnih goriv. Zato se vsak drastičen dvig cen kuponov CO₂ odraža na podražitvi električne energije, kar povišuje lastne cene proizvodov in storitev. Posledično, kot prikazuje Slika 7, to pomeni upad konkurenčnosti na globalnem trgu, upad zunanje trgovine in s tem ohlajanje gospodarske dejavnosti EU, saj imata Kitajska in Južna Koreja 10-krat nižje stroške, medtem ko Združene države Amerike (ZDA) 3-krat nižje stroške CO₂ kuponov v primerjavi z EU.



Slika 7: Primerjava gibanja cen emisijskih kuponov CO₂ v 2022 med gospodarsko intenzivnimi trgi [19].



Slika 8: Količina izpustov emisij CO₂ na letni ravni v milijardah metričnih ton po regijah [20].

Globalno gledano trenutno izpusti emisij CO₂ letno znašajo 36 milijard metričnih ton. Pri tem Kitajska in ZDA skupaj ustvarita največjo količino izpustov (Slika 8), sledita pa jima Indija in Rusija. Skupaj te države predstavljajo več kot polovico globalnih izpustov (53 odstotkov). Izpusti Kitajske in Indije so se zlasti v zadnjih letih povečali, medtem ko so izpusti Evrope v zadnjih desetletjih ostali razmeroma stabilni ali celo upadli.

Za primerjavo, največji slovenski proizvajalec električne energije iz fosilnih goriv Termoelektrarna Šoštanj (TEŠ) povprečno letno ustvari 4 milijone ton CO₂ [21], kar v globalnem merilu predstavlja le 0,01 % vseh izpustov.

4 KAKO DO RAZVOJA OKOLJA

Pojem »okolje« je treba razumeti širše in ne zgolj kot samo en naravni habitat, vodotok ali eno posamezno živalsko vrsto. V obravnavo moramo vzeti celotno naravo oz. vse gradnike, ki omogočajo življenje na planetu Zemlja – torej tudi ljudi, podnebje, vodo, rastlinstvo, živalstvo, krajino, infrastrukturo, skratka vse, kar obdaja človeka in mu omogoča kvaliteto bivanja. Nenazadnje tudi družbeno in gospodarsko okolje. Zgolj konzerviranje narave, kot se včasih želi napačno ustvariti vtis, ni dovolj, temveč moramo kot družba in posamezniki strmeti k trajnostno uravnoteženemu in vzdržnemu razvoju, upoštevaje okoljske, družbene in gospodarske vidike.

Za razliko od vzhodnega sveta je zahodni človek usmerjen v materialne dobrine in užitke, ki so mu dostopni relativno enostavno. Prenasičenost dobrin in dostopnost vsega in kadarkoli (princip polnega hladilnika) ga vodi v cono udobja, samoumevnosti in brezskrbnosti, kar na dolgi rok povzroči propad. Tu je na mestu stališče Jordana B. Petersona, ki izpostavi pomen reda in kaosa [22]. Eno brez drugega ne more. In sklepati gre, da smo v Evropi trenutno v fazi kreiranja kaosa, ki bo v neki točki, ob tem načinu življenja (odsotnost razuma, odgovornosti, sodelovanja in razgradnja osnovnih vrednot), privedel do "velikega poka" in vzpostavitvi novega reda.

Kot eden izmed odgovor na tovrstne izzive je zagotovo zavedanje, da moramo čim prej pričeti uresničevati velike in strateško pomembne projekte, ki temeljijo na modelu RCPL:

- Responsible: odgovorna raba virov (naravnih, človeških, finančnih, materialnih);
- Collaborative: v sodelovanju in povezovanju posameznih interesnih skupin ter njihovih ciljev;
- Profitable: profitabilni razvoj za okolje, gospodarstvo in družbo;
- Lean: vitko delovanje in krepitev sposobnosti države.

Model RCPL je uporabljen in uspešno preizkušen na primeru večnamenskega projekta izgradnje HE na spodnji Savi. Kot opredelita Pišotek in Jeršič [23] je vodilo projekta izgradnje spodnje savskih HE zavedanje, da »vse kar vzamemo iz okolja mu moramo vrniti z nekajkratnim presežkom«. In prav večnamenski projekt HE na spodnji Savi je rezultat najširših pozitivnih in sinergijskih učinkov, ki se manifestirajo predvsem v izboljšani protipoplavni varnosti, razvoju kmetijstva, ekosistemskih storitev, turizma in ribištva, športno-rekreacijskih dejavnosti ter lokalne in državne infrastrukture. Projekt pomembno prispeva tudi k udejanjanju trajnostnega razvoja, povečanju deleža OVE in uresničevanju zavez Republike Slovenije do EU v procesu prilagajanja podnebnim

spremembam, ohranjanju konkurenčnosti ter kreptivi slovenske industrije, zagotavljanju večje zaposlenosti in doprinos k prihodkom v proračun države in občin.

Takšen pristop opredeljuje tudi Strategija prostorskega razvoja Slovenije 2050 [24], ki spodbuja zlasti večnamenske projekte, ki poleg proizvodnje energije iz OVE in drugih nizkoogljičnih virov ustrezno zagotavljajo tudi cilje upravljanja voda, omogočajo razvoj kmetijstva, turizma ali rekreacije.

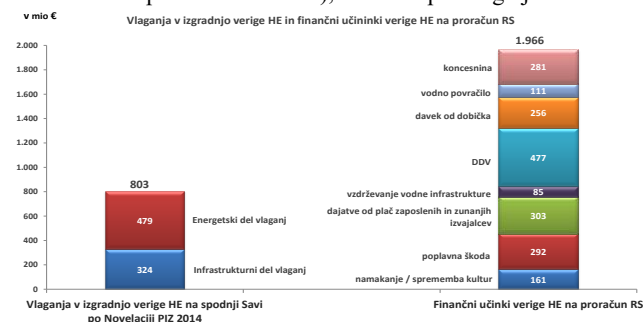


Slika 9: Multiplikativni učinki HE izraženi z izboljšano protipoplavno varnostjo [23].

Slika 9 prikazuje primer Sevnice leta 1990 (leva slika) pred izgradnjo HE na spodnji Savi pri pretokih 3.267 m³/s (VP Čatež) in primer Sevnice leta 2010 (desna slika), kjer do izraza pride učinek protipoplavne zaščite z zgrajeno HE ob pretoku 3.700 m³/s (VP Čatež). Izpostavimo, da so novodobne HE načrtovane skrbno, z vključevanjem najširšega kroga deležnikov pri čemer projektne rešitve obsegajo številne sonaravne ureditve za izboljšanje stanja okolja in živalskih vrst [25].

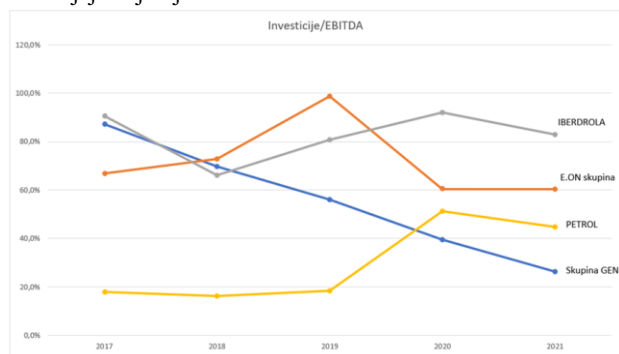
Dokazano je, da se z izgradnjo verige HE na spodnji Savi dosega bistveno bolj ugodni vplivi na površinske in podzemne vode, predvsem pa se znatno minimalizira finančna škoda zaradi naravnih pojavov poplav in suš, medtem ko se v času gradnje HE in njihovih spremljajočih infrastrukturnih ureditev krepi slovensko gospodarstvo in zaposlenost. Kot ocenjujejo strokovnjaki iz Urada RS za makroekonomske analize in razvoj, pride v obdobju gradnje HE tudi do pozitivnega vpliva na letni prirastek BDP, in sicer med 0,2 in 0,4 % vsako leto, glede na intenzivnost gradnje [26].

Model gradnje spodnje savskih HE obsega vlaganja države v infrastrukturne ureditve in vlaganja gospodarske družbe v energetske del za proizvodnjo električne energije. Kot je razvidno iz Slika 10 je pomemben finančni učinek verige HE na proračun Slovenije, v katerega se v obdobju 50 let delovanja HE prilije 2 milijardi EUR sredstev (op. p. znesek ne upošteva dobičkov prodane količine električne energije, ki se nameni za izgradnjo novih OVE proizvodnih enot), kar krepi blaginjo države.



Slika 10: Investicijska vlaganja pri izgradnji HE na spodnji Savi in pozitivni finančni učinki na proračun Slovenije [26].

Da imamo v Sloveniji težavo s prepočasnim vlaganjem v velike državne energetske projekte izkazuje analiza, ki smo jo opravili in temelji na letnih poročilih posameznih družb (Slika 11). Iz analize lahko zaključimo, da se v Sloveniji po zaključku gradnje HE Brežice v 2017 praktično ni izvajalo drugih večjih projektov OVE. Razlogi, da se je hidro program v Sloveniji ustavil so izključno v dolgotrajnih postopkih pridobivanja dovoljenj. Zato bo na ravni države in odločevalcev nujno pospešiti intenziteto vlaganj in izboljšati podporo novim nizko ogljikim projektom, če se želimo približati trendom, ki jih narekujejo najbolj razvite države.



Slika 11: Primerjava deleža Investicije/EBITDA s konkurenti v tujini.

5 ZAKLJUČEK

V članku je izkazano, da sposobnost države igra ključno vlogo pri uresničevanju njenih strateških interesov in ciljev. Temeljni gradniki te sposobnosti so fiskalna sposobnost, pravna sposobnost in družbena sposobnost. Slabša pravna in družbena sposobnost lahko vodita k politični nestabilnosti, omejitvam gospodarskega razvoja ter zmanjšani blaginji državljanov.

Poleg tega, je tudi pomembno razumeti, kako različni dejavniki, kot so zelena energija, emisije toplogrednih plinov in energetska tranzicija, vplivajo na globalno okolje in konkurenčnost držav. Pri uresničevanju trajnostnega razvoja je ključnega pomena, da se upoštevajo celoviti življenjski cikli tehnologij in okoljski vplivi ter da se vzpostavi uravnotežen pristop, ki združuje okoljske, družbene in gospodarske vidike.

Model RCPL (Responsible, Collaborative, Profitable, Lean) se kaže kot potencialna rešitev za soočanje s kompleksnimi izzivi in za zagotavljanje trajnostnega razvoja, ki temelji na odgovorni rabi virov, sodelovanju med različnimi interesnimi skupinami, doseganju profitabilnosti ter izboljšanju sposobnosti države.

Do zelenega prehoda in razvoja okolja lahko pridemo na dva načina. Prvi je enostaven, vendar boleč in vodi v slabšanje sposobnosti države – uvedba dodatnega davka, ki bo predstavljal zeleni kapital za energetske podnebni prehod in iz katerega bo država subvencionirala sončne elektrarne, baterijske hranilnike, nadgradnjo nizko in srednje napetostnega omrežja, razvoj pametnih omrežij ter uvoz elektrike iz tujine v času ko stohastični viri ne bodo na razpolago.

Druga možnost pa je strokovno utemeljen, odgovoren in preizkušen model energetske podnebne prehoda, kjer srednjerčno, do leta 2035 zgradimo vsaj 5 HE (na Savi: Mokrice, Suhadol, Trbovlje in Renke; ob Dravi črpalno HE Kozjak). S tem

se izognemo zelenemu davku, saj proizvodnja HE predstavlja zeleni kapital, ki ga investiramo v izvedbo novih OVE projektov.

Celovitega zelenega prehoda in energetske neodvisnosti pa nikakor ne moremo doseči brez jedrske tehnologije, zato se mora čim prej sprejeti odločitev za projekt NEK 2, ki za slovensko energetiko predstavlja dolgoročen in potreben projekt ter ga je možno zaključiti do 2040. Upoštevajoč skoraj ničelni vpliv TEŠ na globalne izpuste CO₂ se, do pričetka delovanja NEK 2, niti ni smiselno obremenjevati z njegovim zapiranjem.

Uporaba jedrske energije in hidroenergije je tudi edini razumen in odgovoren scenarij, ki vodi h krepitvi sposobnosti države ter blaginji Slovencev. Pri odločanju, katerim energetskim virom bomo v prihodnosti namenili pozornost, je zato treba gledati celovito in razumno. Zavedati se namreč moramo, da bi odločitve, ki bi sicer morda bile vsečne v danem trenutku, lahko postale velika cokla pri razvoju v prihodnosti.

O AVTORJU

Boštjan Pišotek, mag. ing. str. je diplomiral na Univerzi v Mariboru iz energetskega, procesnega in okoljskega strojništva. Zaključil program Managerial & Organization & Entrepreneurship na University of Glasgow, MBA na London School of Economics and Political Science ter program Executive Leadership na University of Oxfordu. Zaposlen je v podjetju HESS kot vodja kompleksnih projektov, kjer je odgovoren za naložbene in razvojne projekte. Kot predstavnik naročnika projekta je aktivno sodeloval pri gradnji večnamenskega projekta HE Brežice. Trenutno vodi projekt HE Mokrice, ki je zadnji del večnamenskega projekta izgradnje verige HE na spodnji Savi. Je aktiven član in delegat Slovenskega združenja za projektni management v mednarodnem združenju za projektni management (IPMA) ter član IPMA svetovalnega odbora s področja energetike. Bil je eden od ustanoviteljev sekcije Mladih projektnih managerjev, ki jo je tudi vrsto let vodil in deloval v projektnih skupinah, ki so razvijale nove tehnične rešitve za podjetji BSH GmbH in Gorenje.

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Premog, gorivo prihodnosti; če premoga ne bomo kurili, tudi prihodnosti ne bomo imeli

No coal no future

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POVZETEK

Če želimo še naprej imeti zanesljivo napajanje z elektriko, moramo nujno imeti elektrarne, ki delajo elektriko takrat, ko jo rabimo. Sončne in vetrne elektrarne običajno ne delajo ravno takrat ko elektriko najbolj rabimo. Količinsko ustreznega načina hrambe električne energije ne poznamo. Če novih elektrarn ne gradimo in pospešeno zapiramo obstoječe elektrarne, moramo pričakovati pomanjkanje elektrike. Uvoz električne energije ne bo možen, ker se v EU elektrarne zapirajo. Če bi z razogljčenjem misli resno, bi morali do konca življenjske dobe NE Krško zagnati vsaj štiri nove fleksibilne jedrske elektrarne, torej vsakih 5 let eno. Verjetnost, da zgradimo eno samo novo jedrsko elektrarno v naslednjih 20 letih je praktično enaka nič. Za elektrarne na zemeljski plin iz plinovodov smo se lani naučili, da to ne gre, torej nam ostanejo samo še premogovne elektrarne.

KLJUČNE BESEDE

Kamena doba, premog, resne elektrarne

ABSTRACT

If we want to continue to have a reliable supply of electricity, we absolutely must have power plants that produce electricity when we need it. Solar and wind farms usually do not work exactly when we need electricity the most. We do not know a quantitatively adequate way of storing electricity. If we do not build new power plants and accelerate the closure of existing power plants, we must expect a shortage of electricity. It will not be possible to import electricity because power plants are closing down in the EU. If we were serious about decarbonization, we would have to start up at least four new flexible nuclear power plants by the end of the Krško NE's lifetime, i.e. one every 5 years. The probability of building a single new nuclear power plant in the next 20 years is practically zero. We learned last year that this does not work for power plants powered by natural gas from gas pipelines, so we are left with only coal-fired power plants.

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KEYWORDS

Stone age, coal, serious power plants

1 OBNOVLJIVI VIRI ELEKTRIČNE ENERGIJE NE MOREJO NADOMESTITI PROIZVODNJE RESNIH ELEKTRAN

S sončnimi, vetrnimi in hidro elektrarnami nikakor ni možno nadomestiti proizvodnje resnih elektrarn. Ko elektriko najbolj rabimo, sončne in vetrne elektrarne običajno ne proizvajajo nič elektrike. Slovenske hidroelektrarne s pretočnimi akumulacijami imajo zelo omejene možnosti hrambe energije, ko se reke posušijo, dosega do $\approx 1/3$ instalirane moči, poleg tega je še razpoložljiv hidroenergetski potencial premajhen, da bi lahko pridobili zadostne količine električne energije.

2 NE OBSTAJA KOLIČINSKO USTREZEN NAČIN HRAMBE ELEKTRIČNE ENERGIJE

V luči energetske politike, ki pravi, da bo vsa elektrika obnovljiva, moramo poudariti, da bi za hrambo elektrike iz sončnih in vetrnih elektrarn nujno rabili ogromne hranilnike, ki jih enostavno ni. Najboljši doslej znan način hrambe elektrike so črpalne hidroelektrarne, vendar so njihove kapacitete premajhne, da bi lahko z njimi hranili dovolj elektrike; v praksi bi nam zmanjkalo vode in prostora za njihovo postavitev.

Hipotetična hramba električne energije bi bila povezana z velikimi izgubami in ogromnimi stroški, ki bi jih morali pripisati stroškom vetrnih in sončnih elektrarn, če bi primerjali stroške teh s klasičnimi elektrarnami, s tem bi cena električne energije postala nesprejemljiva, gre za povečanje, ki presega 10 kratnik sedanjih cen.

Izdelava sintetičnih goriv iz žlahtne oblike energije, kar elektrika je, bi bil proces v katerega bi bilo vložene več energije kot bi je dobili ven iz tega procesa. Izgube takih procesov, ko bi iz sintetičnih primarnih energentov narejenih iz elektrike, delali nazaj elektriko, so okrog 80% v samem procesu, če bi temu dodali še vso porabljeno energijo za vse te postroje, bi bila energijska bilanca negativna. Cena električne energije iz takšnih procesov bi bila nepredstavljivo visoka.

3 ALI Z AKTUALNO ENERGETSKO POLITIKO RES ČUVAMO OKOLJE?

Nenazadnje bi se morali vprašati ali z novodobno energetska politiko emisije ogljikovega dioksida zmanjšujemo ali jih povečujemo? Ali okolje razbremenjujemo ali ga dodatno bremenimo in onesnažujemo? Pravzaprav je višek ironije pri novodobni energetska politiki ta, da se zaradi nje porabijo ogromne dodatne količine fosilnih goriv za izdelavo sončnic, vetrnic, baterij, pa tudi rudarjenje ogromnih količin surovin potrebnih za izdelavo teh ni prav nič okolju prijazno početje.

4 VSI BI UVAŽALI ELEKTRIČNO ENERGIJO

V elektroenergetskem sistemu moramo vsak trenutek zagotavljati ravnovesje med močjo porabe in močjo proizvodnje zato energijske bilance daljših obdobj niso merodajne za načrtovanje zadostne proizvodnje električne energije, so pa prvi znak neustreznega sistema proizvodnje električne energije.

Energetska bilanca Slovenije in njej sosednjih držav (Avstrija, Italija, Madžarska in Hrvaška) je globoko negativna, skupni primanjkljaj na letnem nivoju znaša približno 70 TWh. Slovenska uvozna odvisnost po energiji v zadnjih letih znaša do 20% letne energije in niha predvsem v odvisnosti od hidroloških razmer in v manjši meri od rednih remontov NE Krško.

Bolj problematična s stališča zagotavljanja zanesljivega napajanja odjema je bilanca moči našega elektroenergetskega sistema. Ko se pozimi v mrazu obremenitve povečajo krepko preko 2.000 MW in se pretoki rek zmanjšajo, naša uvozna odvisnost lahko preže 1.000 MW in doseže nivo približno 50% odvisnosti od uvoza, kljub normalnemu obratovanju elektrarn.

Zelo zgovoren je prikaz dejanskih urnih bilanc slovenskega elektroenergetskega sistema v letih 2015- 2019 iz RN ELES, ki kaže, da je bilanca več kot 7000 ur/leto (do 86% časa v letu) negativna, v ekstremu uvažamo do 80% moči.

Če torej upoštevamo veliko odvisnost Slovenije in sosednjih držav od uvoza električne energije na letnem nivoju in še

večjo odvisnost pri pokrivanju obremenitev, bi bilo zanašanje na velike količine uvoza električne energije precej utopično početje.

Če poleg tega upoštevamo, da se povsod po Evropi resne* elektrarne množično zapirajo zaradi denominacije premoga in jedrske energije, je edina možna ugotovitev, da moramo nujno sami na svojem ozemlju zagotoviti zanesljivo proizvodnjo ustreznih količin električne energije in moči.

*resne elektrarne so premogovne in jedrske. Pomembna je zaloga goriva! Elektrarne na zemeljski plin nujno rabijo lastno skladišče plina z ustrežno zalogo.

5 ZAKLJUČEK

Verjetnost, da v Sloveniji v 20 letih zgradimo 4 fleksibilne jedrske elektrarne ali 6 novih premogovnih blokov, je manjša kot verjetnost, da se hitro vrnemo nazaj v kameno dobo.

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Miti in resnice o slovenskem okolju

Myths and truths about Slovenian environment

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POVZETEK

V Sloveniji pogosto mislimo, da dobro skrbimo za okolje – in na splošno še kar drži. Če pa pogledamo, kako se dogajanje in medijske objave skladajo s strokovnim razumevanjem varovanja okolja, ugotovimo šokantno slabšo sliko, kot se slika v medijih: kar je videno kot največja okoljska nevarnost, pogosto ni nič posebnega, in tam, kjer delamo največje okoljske napake in škodo, ni v medijih dostikrat ne duha in ne sluha, oziroma ravno nasprotno – hvala povsem zgrešenih ekoloških potez.

KLJUČNE BESEDE

Miti, resnice, okolje, Slovenija

ABSTRACT

In Slovenia, we often think that we take good care of the environment - and generally, it's somewhat true. However, when we look deeply, especially in terms of how it aligns with the expert understanding of environmental protection and what is actually happening to the Slovenian environment, we discover a shockingly worse picture than what is often portrayed in the media: what is seen as the biggest environmental threat often turns out to be nothing special, and where we make the biggest environmental mistakes and cause damage, it is often neither mentioned nor shown in the media, or even quite the opposite - thanks to completely misguided web or classical media texts.

KEYWORDS

Myths, truth, environment, Slovenia

1 UVOD

V obdobju, ko varovanje okolja postaja osrednje vprašanje globalne skupnosti, je ključno razumeti, kateri ukrepi so učinkoviti in kateri škodljivi, čeprav so predstavljeni kot okoljevarstveni. Slovenija je ponosna na svojo zeleno dediščino in zgodovino varovanja okolja, ki sega nazaj do ustanovitve Triglavskega narodnega parka leta 1924. Gre za prvo narodno

parkovno območje v Evropi zunaj Skandinavije. Danes pa kritični pogled razkriva vrsto zaskrbljujočih trendov.

Že v študijah Černiča Isteniča (2007) in Kozjeka in sod. (2010) je opaziti, da obstaja razkorak med slovensko percepcijo skrbi za okolje in dejanskim stanjem. To nas opominja na globalne trende, o katerih so pisali avtorji kot so Carson (1962), ki je opozorila na nevarnosti pesticidov in kemikalij, Diamond (2005), ki je analiziral, kako se družbe soočajo s svojimi okoljskimi omejitvami, in Hardin (1968), ki je izpostavil koncept "tragedije skupnega".

Plut (2023) v obsežnem delu argumentira, da bi morala nova družbena ureditev temeljiti na okoljskih in podnebnih ukrepih, ki bi vodili k družbi odrasti in s tem povezanemu izdatno zmanjšanemu pritisku na okolje. Pri tem išče rešitve tudi v družbenem in ekonomskem sistemu. Na primer, ne vidi kvalitetnega varovanja okolja v neoliberalnem kapitalizmu, kjer kapital vodi delovanje države. Predlaga prehod v ekosocialni kapitalizem, ki bo postavil v ospredje ekološke in socialne naloge, in nato ekohumanizem. Za dosego zmerne skupne in osebne blaginje je treba poudarek dati vodni, energetski in prehranski samozadostnosti ter količinski gospodarski odrasti, sonaravnemu krožnemu gospodarstvu z zmanjševanjem porabe materialov, energije, prostora in potrošnje, da ne bo prišlo do uničenja planeta. Po Plutovem mnenju smo že presegli vzdržen nivo obremenitve planeta (Meadows in sod. 1972).

Gams in približno sto sodelavcev (2020) je na osnovi dela v Državnem svetu in Inženirski akademiji predstavila Belo knjigo varovanja okolja, ki je osnova razmišljanja tudi v tem prispevku. Ideja temelji na potrebi, da s pomočjo znanja, znanosti in inženirstva temeljito analiziramo celotno verigo posameznih tehnologij ali ukrepov, ugotovimo njihovo škodljivost oz. razmerje med okoljsko škodo in pozitivnimi učinki ter poiščemo konkretne rešitve. Izkazalo se je, da so možni izjemni prihranki, če pravilno uporabimo znanje in prenehamo delati napake.

Poglejmo kar konkretno marsikatero streho s solarnimi paneli v ljubljanski kotlini z relativno malo sonca, usmerjeno proti zahodu. Je to ekološko primerno, ali sistemsko škodljivo, ker so menda »izračunali«, da se izplača? Torej ne znajo »računati«, da delajo tako velike napake? Ali pa pogledjmo reklame ob avtocestah, nelegalno postavljene zato, ker je zakonodaja dala županom pristojnost in dolžnost, da jih ne postavljajo na kmetijskih zemljiščih, pa jih, ker so hkrati finančno motivirani za

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to. Ali pa se vprašajmo, zakaj smo po kvadratnih metrih veletrgovin na glavo prvi v Evropi?

Že pri nekaj naštetih primerih je nakazana velika razlika med okoljsko učinkovitimi ukrepi in propagiranjem javnih medijev, pri čemer verjetno za nekatere rešitve agitirajo posamezni tehnološki in gospodarski interesi, recimo za naftno industrijo, manj jasno pa je recimo navijanje za druge, recimo upepelitev in žare, kjer ni videti energetskega lobija v ozadju.

Zakaj se toliko hvalijo »trajnostne« rešitve, če pa prav vsaka tehnologija povzroča določeno škodo okolju, na primer gradnja cest do vetrne elektrarne ali zamenjava sončnih panelov na vsakih 10 do 15 let? Zakaj ne preučimo strokovno izdelanih tabel o škodljivosti določenih tehnologij? Očitno prihaja do velikih razlik med kakovostnim varovanjem okolja in dejanskim stanjem. Ob upoštevanju spoznanj in raziskav je ta članek namenjen hitremu pregledu dejanskega stanja okoljske zaščite v Sloveniji s posebnim poudarkom na razkoraku med percepcijo in realnostjo. Poleg tega bomo obravnavali potencialne strategije in rešitve, ki bi Sloveniji pomagale bolje nasloviti ključne izzive in zagotoviti trajnostno prihodnost za prihodnje generacije.

2 OSNOVNA TABELA ENERGETSKIH TEHNOLOGIJ

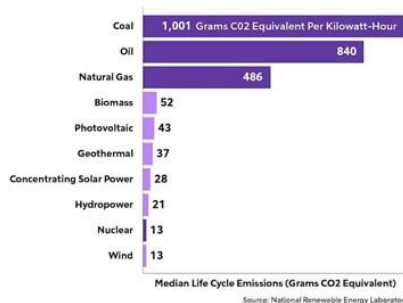
Na voljo je kar nekaj tabel, ki primerjajo osnovne energijske tehnologije. V Sloveniji je bil takšen prispevek objavljen v časniku Delo (Lengar 2023). Čeprav se med tabelami pojavljajo manjša odstopanja, je osnovni zaključek v vseh enak: Vsakič, ko kurimo (torej uporabljamo ogenj), na primer pri premogu ali nafti, gre za okolju škodljivo energijo, zato so recimo jedrska ali hidroenergija bistveno bolj okolju prijazni kot termoelektrarne ali plinarne. Ta trend je tako izrazit, da ga lahko obravnavamo kot splošno pravilo:

Vse tehnologije, ki temeljijo na ognju oz. izgorevanju, so okolju škodljive. S tem ustvarimo 85% vsega CO₂.

To pravilo je zelo uporabno, saj nam med drugim omogoča razumeti celo na videz povsem nepovezane dogodke, recimo da je upepelitev pokojnika za več redov velikosti bolj škodljiva za okolje kot klasičen ali še bolj ekološki pokop. Tako tudi lažje spregledamo poskuse zavajanja - nekatere trditve na spletu, da je kremacija bolj ekološka kot klasičen pokop, temeljijo na predpostavki, da ob urejanju groba s striženjem trave s časom porabimo veliko CO₂. Taki izračuni so na seveda prirejeni, kar kaže na pomanjkanje zdrave pameti in strokovnosti v medijskih in spletnih objavah. Je torej ekološko slaba izbira trava, ker jo je treba vzdrževati? Seveda je končna odločitev o načinu pokopa osebna izbira, vendar zakaj in kdo zavaja ali ne razume osnov varovanja okolja? A vrnimo se na osnovne vire energije.

Na sliki 1 je prikazana celotna škodljivost posameznih tehnologij v smislu izpustov CO₂, od izkopavanja surovin do uporabe in recikliranja (Sandoval, 2023). Izvorni vir je na naslovu: https://www.nrel.gov/analysis/life-cycle-assessment.html?qls=QMM_12345678.0123456789.

Median Life Cycle Greenhouse Gas Emissions Of Renewable Vs. Nonrenewable Energy Sources



Slika 1: Primerjava izpustov CO₂ glede na celoten življenjski cikel tehnologije. (Vir:

<https://www.rocketssolar.com/learn/energy-efficiency/how-lifetime-emissions-different-energy-sources-stack>)

Pričakovali bi, da bi bila ekološko usmerjena združenja najbolj kritična do tehnologij, ki so najbolj škodljive za okolje – predvsem do tistih, ki temeljijo na izgorevanju fosilnih goriv, zlasti premoga. Pridobivanje energije iz premoga sprosti skoraj 100-krat več CO₂ kot jedrska energija. Vendar hitra analiza slovenskih medijev pokaže, da sta najbolj kritizirani predvsem jedrska in hidroenergija. Prva naj bi bila škodljiva zaradi sevanja, druga pa zaradi uničevanja naravnega okolja. Ljudsko prepričanje in oglaševanje pogosto predstavljata fotovoltaike kot najbolj okolju prijazno, vendar je glede na sliko 1 trikrat slabša kot jedrska energija.

Kljub temu je treba Sliko 1 obravnavati z določeno mero kritičnosti predvsem zaradi njene splošnosti. Oglejmo si primer hidroelektrarn, ki so načeloma ugodne z vidika CO₂. V Sloveniji smo najbolj učinkovite hidroelektrarne že zgradili in vsaj nekatere reke bi morali ohraniti brez jezov zaradi varstva okolja – ni vse v denarju in statistiki.

Podobno velja razmišljati o sončnih elektrarnah. Dokler so nameščene na strehah ali drugih neuporabnih površinah, so primerne. Ko pa jih začnemo postavljati na kmetijske površine, postanejo ena izmed najmanj primernih tehnologij, dejansko ekološki kriminal. Kljub temu se to ravno promovira in hvali v slovenskih medijih.

Prof. Damijan v svojem blogu (<https://damijan.org/2023/05/15/skriti-stroski-obnovljivih-virov-energije-2/>) piše: »Za vsak megavat inštalirane moči vetra ali sonca potrebujemo še vsaj en megavat inštalirane moči v plinsko-parne elektrarne (ker so fleksibilne in poceni) ter dodatne zmogljivosti za kratkoročno izravnavanje omrežja. Več kot dodamo zmogljivosti sonca in vetra, več nestabilnosti dodamo omrežju in večji so stroški za njeno ublažitev – ker sistem nikoli ni bil zasnovan za obvladovanje prekinitev dotokov energije. Več kot vlagamo v sonce in veter, večji postaja problem za elektroenergetski sistem in večji račun za njegovo odpravo. Zato, če smo pošteni, povečana vlaganja v zmogljivosti vetra in sonca zgolj preusmerjajo prepotrebne naložbe stran od zanesljivejših in stroškovno učinkovitejših virov energije. V majhnem obsegu so te investicije v zmogljivosti sonca in vetra koristno dopolnilo, da malce zmanjšamo izpuste CO₂ poleti, v velike obsegu ali celo kot glavni vir pa so narodnogospodarsko škodljive

(destabilizirajoče, drage in uničujoče za gospodinjstva in industrijo), da o njihovem negativnem vplivu na okolje in socialne razmere v nerazvitih državah (kjer pridobivajo potrebne kovine in minerale) ne govorimo.« Podobno trdi dr. Mihalič (2015).

Zakaj torej tako intenzivno propagiranje kar počez v trajnostne vire energije, čeprav so nekatere okolju celo bolj škodljive kot klasične in celo manj trajnostne, predvsem pa ob slabi izvedbi?

3 PRAKTIČNI NASVETI VAROVANJA OKOLJA

V delu Gams in sodelavcev (2020) so zbrani napotki za učinkovito varovanje okolja, ki večinoma ne prinašajo velikih stroškov, imajo pa pomembne učinke. Nekatere predloge avtorja in njegovih sodelavcev so v zadnjih letih upoštevali, mnoge pa ne. Naštejmo nekaj neupoštevanih predlogov:

- Države naj ne povečujejo števila svojega prebivalstva. Produkt ljudi in standarda predstavlja glavne onesnaževalce okolja. Zato je nujno ustaviti rast prebivalstva v vsaki državi ali pa naj te države plačujejo višji ekološki davek. V Sloveniji se prebivalstvo ohranja ali celo raste predvsem zaradi velike imigracije, kar je, če zanemarimo druge dejavnike, okoljsko škodljivo.
- Z zakonom naj se prepovejo reklamni panoji ob avtocestah. Ekološko napredne države so to že uvedle, Slovenija pa kljub 15-letnim prizadevanjem avtorja na ta način slikovito izraža svoj ne odnos do okolja. Kljub intenzivnemu lobiranju avtorja in okoljevarstvenikov ni uspel noben tak predlog.
- Treba je zaostri zakonodajo na področju svetlobnega onesnaževanja in strožje regulirati postavljanje novih svetlobnih virov.
- Spodbujati je treba mestno prebivalstvo. Potrebno je tako podpirati normalno življenje na podeželju kot tudi selitve v mesta. Ključno pa je preprečiti enakomerno poseljevanje, saj je to ekološko najbolj škodljivo. Če upoštevamo skupno število prebivalcev našega planeta, bi vsak zasedel le nekaj m² v Sloveniji.
- Povečati je treba vlogo znanosti in stroke v medijskem poročanju ter dejanskem izvajanju varovanja okolja. Iz neznanih razlogov obstaja mnogo mitov in neresnic, povezanih z varovanjem okolja. Tako se mnogi naporji za varovanje okolja izjalovijo, včasih pa se z "dobrimi" nameni celo povzroči škoda okolju.
- Invazivne, posebej alergene rastlinske vrste in živalske vrste je treba sistematično in na vse možne načine odstranjevati. Po poročanju International Union for Conservation of Nature (IUCN) je polovica vseh endemičnih rastlinskih vrst v Evropi ogrožena ali jim grozi izumrtje. Invazivne vrste so soodgovorne za izumiranje vrst, ki je bilo v zadnjih 100 letih 100-krat hitrejšo, v zadnjih 50 letih pa se je število živali (tako po številu osebkov kot po teži) zmanjšalo za polovico (Kolbert 2014; De Vos in sodelavci 2014). Zanimivo je, da nobena slovenska vlada ni sprejela prepovedi alergenih rastlin celo v vrtcih kljub pobudam avtorja.
- Potrebna je velika pozornost glede uvajanja genetsko spremenjenih površin, saj s sabo tipično pripeljejo genetsko

zaščito (pesticide) proti insektom, kar uniči biološko verigo od spodaj navzgor. Primer študije je: <https://arstechnica.com/science/2018/03/planting-gmos-kills-so-many- bugs-that-it-helps-non-gmo-crops/>.

- Uvesti je treba ekološki davek na uvoženo hrano, ki je sorazmeren z oddaljenostjo. Pri nakupu hrane pazljivo preverite njeno poreklo in dajte prednost hrani iz bližnje okolice, saj je običajno tudi bolj sveža. Posebej bodite pozorni pri nakupu hrane iz Afrike ali Južne Amerike, saj obstaja velika verjetnost, da s tem podpirate uničevanje pragozdov. Vsak uvoz hrane iz oddaljenih krajev zahteva prevoz, kar pomeni dodatno porabo fosilnih goriv.
- Ohranimo kmetijske površine. Samozadostnost Slovenije je okoli 30%, saj smo uničili že veliko kmetijskih površin in še vedno vsak dan izgubimo površino enega nogometnega stadiona. V zadnjih 25 letih smo izgubili 85 tisoč hektarjev kmetijskih zemljišč, od leta 2000 pa 10% kmetijskih površin. Toliko površin pozidamo oz. okoljsko uničimo.
- Uvesti olajšave za moderne klimatske naprave – inverterje in seznaniti medije z njihovo učinkovitostjo, saj predstavljajo najboljše grelne naprave do približno ničelne temperature.
- V doglednem času je potrebno zapreti predvsem starejše termoelektrarne na premog, saj so pglavilni vir onesnaženja zraka v Sloveniji.
- Dodatno je potrebno obdavčiti veletrgovine, še posebej pa gradnjo novih. Glede na število kvadratnih metrov veletrgovin na prebivalca smo med vodilnimi v svetu, kljub temu pa se še vedno intenzivno gradijo nove, saj prejemajo spodbude ali pa se s pomočjo "spretnih" prijemov izogibajo davkom zaradi pomanjkljivih zakonov in zidajo zastoj. Naša politika ne najde ali ne želi najti ustreznih rešitev za ureditev tega stanja.
- Slovenija bi morala zgraditi nov blok jedrske elektrarne in opustiti stare termoelektrarne. V primerjavi s starimi termoelektrarnami predstavlja jedrska energija praktično čisto energijo, saj v procesu ne nastaja CO₂ – v njej ni gorenja. Za zamenjavo enega bloka jedrske elektrarne bi potrebovali 10.000 vetrnic ali velik del slovenskega ozemlja. Podobno velja za sončne panele.
- Na avtocestah bi bilo treba zmanjšati dovoljene hitrosti ali vsaj poostriti nadzor nad divjanjem. Za vsakih 10 km/h nad 110 km/h se onesnaženje poveča za 10%, pri še višjih hitrostih pa še bolj. Promet je eden izmed glavnih onesnaževalcev okolja v Sloveniji.
- Z različnimi ukrepi bi bilo treba omejiti tranzitni prevoz tovornjakov čez Slovenijo: z višjimi kaznimi, večjimi cestninami, dodatnimi ekološkimi davki itd. En tovornjak povzroči toliko škode na avtocesti kot 10.000 osebnih avtomobilov in na mnoge druge načine škodi okolju.
- Potrebno je uvesti davke na ceste proporcionalno z velikostjo cest in zlasti na gradnjo novih cest.
- Vožnjo s terenskimi vozili, motornimi sanmi, kolesi in podobno je treba strožje omejiti le na dovoljene poti. Po Sloveniji opažamo terence, ki vozijo po stranskih poteh, poljih, travnikih in gozdu, s tem pa plašijo divjad in povzročajo druge težave. Enako velja za gorske kolesarje.

4 DISKUSIJA IN ZAKLJUČKI

Pohvalno je, da se zavedanje o pomembnosti varovanja okolja povečuje. Slabo pa je, da obstaja toliko mitov in neresnic, verjetno kot posledica neznanja ali neupoštevanja strokovnih spoznanj. V ozadju se morda skriva tudi ideologija ali pa različni globalni in lokalni interesi. Zaradi tega v Sloveniji okolju povzročamo veliko škode. Veliko bi naredili že s tem, da bi širili pravilna, strokovna spoznanja o varovanju okolja.

Kot pravi prof. Mihalič: “Ni sprejemljivo, da se ideja o obnovljivih virih energije – to idejo bi bilo sicer mogoče povsem realno zagovarjati, saj je argumentov za to več kot dovolj – skuša ljudem vsiliti z lažmi in pogosto nekritično asistenco medijev. ... zloraba znanosti in potvarjanje podatkov ter očitno vlečenje ljudi za nos ...”

Če pogledamo recimo 15-letno prizadevanje, da bi ukinili reklame ob avtocestah, kot so to naredili na Češkem in kot ima to urejeno večina ekološko zavednih držav, se zdi, da slovenska politika nima posluha za resnično razumevanje varovanja okolja, saj se je v tem času zamenjalo veliko vlad in ministrov raznih usmeritev. Ne skrbi zadostno niti za varstvo svojih občanov, saj recimo niso uvedli prepovedi alergenih rastlin v vrtcih kljub nekaj pobudah avtorja.

Naloga stroke je, da daje pripombe in skuša pomagati pri iskanju rešitev. Podobno velja pri varovanju okolja v Sloveniji. Za začetek pa je pomembno, da razširimo prava spoznanja, da razkrinkamo mite, informiramo in izobrazimo prebivalstvo, ki bo – upajmo – prisilila politiko, da začne zares delati v dobro slovenskega okolja.

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Medved ni plištasta igračka, medved je zver!

The Bear Is Not A Plush Toy, The Bear Is A Beast!

Franc Perko[†]
franc.v.perko@gmail.com

POVZETEK

Populacija rjavega medveda se vsa leta po drugi svetovni vojni, do leta 1993 počasi, po tem letu pa naglo številčno in prostorsko širi po Sloveniji. Populacija danes šteje okoli 1.000 medvedov, in je z 21 medvedi na 100 km² najvišja populacijska gostota v Evropi. Spolna in starostna sestava populacije sta po vseh dostopnih podatkih najmanj zadnjih 15 letih stabilni, v populaciji zmerno z 59 % prevladujejo samice. Relativna rodnost je okoli 24 %, relativna smrtnost zaradi naravnih, tj. ne- antropogenih dejavnikov (naravna smrtnost) je majhna, okoli 5 %; in so ji verjetno izpostavljeni predvsem mladiči v prvem letu življenja. Zaradi velike razlike med rodnostjo in naravno smrtnostjo ima populacija velik potencial rasti tj. 19 % na leto. Če od potencialne rasti odštejemo še različne antropogene vzroke smrtnosti medvedov (predvsem povozi), bi bila letna rast populacije, brez lova okoli 16 %. Lov je torej edini pomemben dejavnik, ki vpliva na medletno spreminjanje številčnosti medveda v Sloveniji. Relativna smrtnost zaradi lova je zadnjih 20 let povprečno znašala okoli 12 %, številčnost populacija se je zato letno povprečno povečevala za prek 4 %.

Leta 2012 je bilo ocenjeno, da je od 400 do 500 medvedov tista številčnost, s katero so ljudje še pripravljeni sobivati, povečanje pa bi privedlo do občutnega zmanjšanja te tolerance. Podatki (2020) o letni dinamiki različnih tipov konfliktov z medvedom kažejo, da so konflikti še dodatno narasli, ko je populacija preseгла številčnost 630–700 osebkov. Kljub tem spoznanjem se je ciljna številčnost rjavih medvedov leta 2022 dvignila na 800 rjavih medvedov v Sloveniji. Tedaj je bilo v Sloveniji že več kot 1.000 medvedov.

V Sloveniji nimamo na voljo regij, kjer bi medvedi lahko živeli ločeno od ljudi, zato bo rjavi medved v Sloveniji preživel le, če bodo ljudje pripravljeni sobivati z njim. bi bilo pričakovano, da je ciljna številčnost, ki ohranja obstoj populacije rjavega medveda in omogoča njegovo sobivanje s prebivalstvom med 500 (toliko jih je bilo okoli leta 2003) in največ 700 medvedov, kolikor jih je bilo leta 2012.

*Article Title Footnote needs to be captured as Title Note

†Author Footnote to be captured as Author Note

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Vsakokratno oviranje in preprečevanja strokovno argumentiranega odstrela, pri tako veliki in stabilni populaciji, ki presega meje sprejemljivosti okolja, ki sobiva z medvedom, je neodgovorno dejanje.

KLJUČNE BESEDE

Rjavi medved, Slovenija, sobivanje, populacijska gostota, konflikt, ciljna številčnost, preprečevanje

ABSTRACT

The brown bear population has been slowly expanding throughout Slovenia all the years after World War II, until 1993, after that year rapidly expanding in Slovenia in number and space. The population today counts about 1,000 bears, and with 21 bears per 100 km², it is the highest population density in Europe. According to all available data, the sexual and age composition of the population has been stable for at least the last 15 years, with females predominating in the moderate population with 59%. The relative fertility rate is around 24%, relative mortality from natural, i.e. non-anthropogenic factors (natural mortality) is low, around 5%; and are probably exposed mainly to puppies in the first year of life. Due to the large difference between fertility and natural mortality, the population has a high growth potential, i.e. 19% per year. If we subtract from potential growth the various anthropogenic causes of bear mortality (mainly run-off), the annual growth of the population without hunting would be around 16%. Hunting is therefore the only important factor influencing year-on-year changes in bear abundance in Slovenia. Relative mortality from hunting has been around 12% on average over the last 20 years, and the population has therefore increased on average by over 4% annually.

In 2012, it was estimated that between 400 and 500 bears are the abundance with which humans are still willing to coexist, and an increase would lead to a significant reduction in this tolerance. Data (2020) on the annual dynamics of various types of conflicts with bears show that conflicts increased further as the population exceeded the abundance of 630–700 individuals. Despite these findings, the target abundance of brown bears rose to 800 brown bears in 2022 in Slovenia. At that time, there were already more than 1,000 bears in Slovenia.

In Slovenia, we do not have regions where bears can live separately from humans, so the brown bear will only survive in Slovenia if people are willing to coexist with it. The target

abundance that maintains the existence of the brown bear population and allows its coexistence with a population would be expected to be between 500 bears (around 2003) and a maximum of 700 bears as there were in 2012.

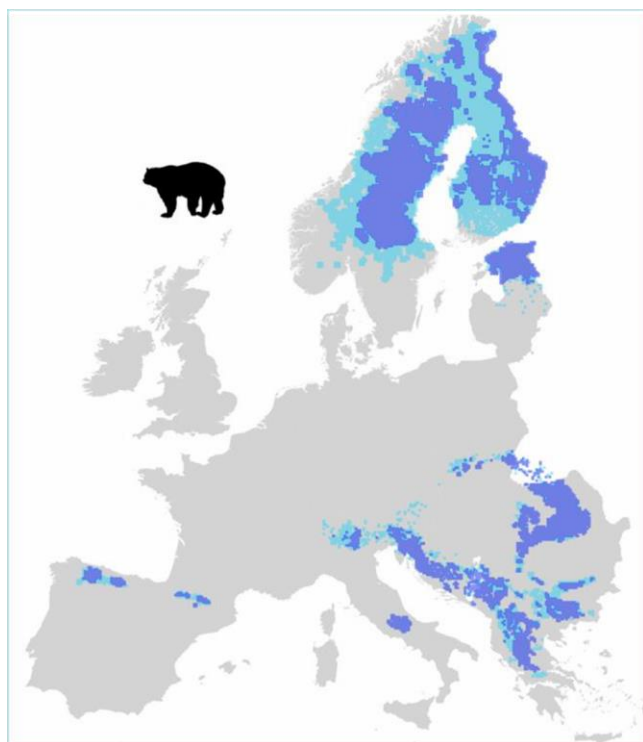
Hindering and preventing professionally argued culling with such a large and stable population that exceeds the acceptable limits of the environment that coexists with bears is an irresponsible act.

KEYWORDS

Brown bear, Slovenia, coexistence, population density, conflict, target abundance, prevention

1 RJAVI MEDVED V EVROPI

Leta 2015 je bilo v Evropi število rjavih medvedov ocenjeno na 18.000, v 10 populacijah v 22 državah: skandinavska, karelijska, karpatska, dinarsko-pindska, baltska, alpska, vzhodno balkanska, centralno apeninska, kantabrijska in pirenejska populacija. Največja populacija je karpatska, sledita ji skandinavska in dinarsko-pindska populacija, kamor sodi tudi Slovenija. Vse druge populacije so precej manjše.



Slika 1: Razširjenost rjavega medveda v Evropi

2 RJAVI MEDVED V SLOVENIJI

Pogled v časnike 19. stoletja lepo kaže odnos do medveda. Imeli so ga za škodljivca, za odstrel je bila predvidena nagrada (strelščina, talija), takoj ko se je medved kje pojavil so se podali v lov nanj. Tako se je ob koncu 19. stoletja ohranil

predvsem na Kočevskem in Notranjskem, kamor so medvedi prihajali iz Hrvaške in Bosne.

Da bi ga ohranili, so na Snežniškem in Haasberškem veleposestvu zavarovali. Ob koncu 19. in v začetku 20. stoletja je živel na Kočevskem, Snežniku in Javorniku med 30 – 40 medvedov.

Ob razpadu Avstro-ogrske in nastanku Jugoslavije je po Rapalski pogodbi velik del Snežnika in Javornikov in s tem tudi habitat medveda pripadel Italiji. Medved je postajal tudi na Notranjskem in Kočevskem zelo redek. Ko je bil medved že skoraj zatrt, so za varstvo narave vneti lovci leta 1935 izposlovali odlok, ki je medveda uvrstil med redke vrste in ga zavaroval s celoletno prepovedjo lova v srezih Kočevje, Črnomelj, Novo mesto, Logatec in Ljubljana. Medved si je opomogel, tako da je živel pred začetkom druge svetovne vojne na slovenskem ozemlju okoli 60 ali celo 80 medvedov.

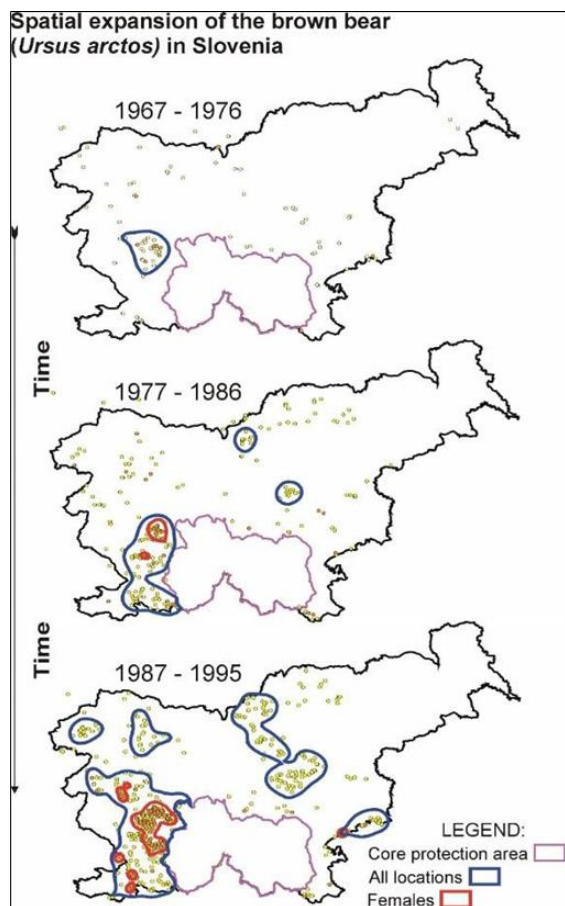
V Sloveniji sta se njegova številčnost in razširjenost po drugi svetovni vojni, kljub varovanju, najprej počasi, po strogi zaščiti leta 1993 pa hitro večali.

Takole je po Jerina in sod. (2020) naraščala populacija rjavih medvedov v Sloveniji. Po poleanju je bilo spomladi leta 1970 190 medvedov, leta 1993 že 300, leta 2008 (prvi genetski monitoring) 570, leta 2016 (drugi monitoring) 800 in leta 2020 že 990 osebkov (intervalna ocena 860–1120). Spolna in starostna sestava populacije sta po vseh dostopnih podatkih najmanj zadnjih 15 letih stabilni, v populaciji zmerno z 59 % prevladujejo samice, kar je za poligamno vrsto pričakovano in normalno. Relativna rodnost je okoli 24 %, relativna smrtnost zaradi naravnih, tj. ne-antropogenih dejavnikov (naravna smrtnost) je majhna, okoli 5 %; in so ji verjetno izpostavljeni predvsem mladiči v prvem letu življenja. Zaradi velike razlike med rodnostjo in naravno smrtnostjo ima populacija velik potencial rasti tj. 19 % na leto. Če od potencialne rasti odštejemo še različne antropogene vzroke smrtnosti medvedov (predvsem povozi), bi bila letna rast populacije, brez lova okoli 16 %. Lov je torej edini pomemben dejavnik, ki vpliva na medletno spreminjanje številčnosti medveda v Sloveniji. Relativna smrtnost zaradi lova je zadnjih 20 let povprečno znašala okoli 12 %, številčnost populacija se je zato letno povprečno povečevala za prek 4 %.

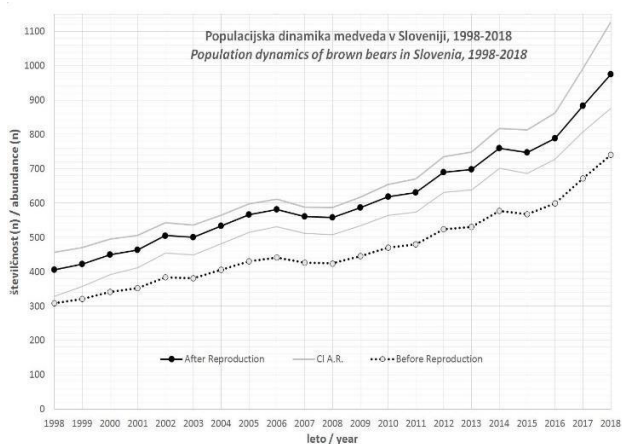
Število medvedov v Sloveniji znaša okoli 1.000, Dinarsko-Pindska populacija (od Slovenije prek Hrvaške, Bosne in Hercegovine, Črne Gore, Albanije, do Grčije) pa šteje prek 3.000 osebkov (Jerina in sod. 2020). Kar tretjina te populacije je v Sloveniji, ki je od tega področja tudi najbolj poseljena.

V Sloveniji je najvišja populacijska gostota rjavega medveda v Evropi, kjer je v povprečju 21 rjavih medvedov na 100 km² (Jerina in sod. 2020), na Hrvaškem 10 na 100 km², Slovaška 8 na 100 km², Apenini in Trentino v Italiji imajo 4 na 100 km², Švedska 0,15 na 100 km².

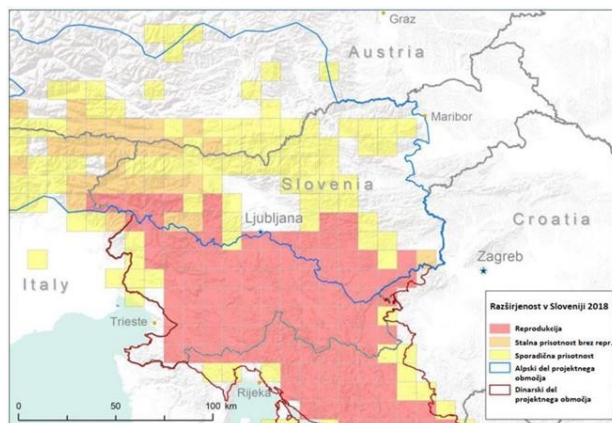
Z rjavim medvedom se praktično srečujemo že po pretežnem delu Slovenije, kar gotovo ni dopustno.



Slika 2: Širjenje populacijskega območja rjavega medveda v Sloveniji v obdobju po letu 1966. Z rdečimi poligoni so označena reproductivna jedra (prisotne samice z mladiči), z modrimi pa vsa opažanja rjavega medveda, z vijolično pa Jedro zaščitene območja (Kočevska in Notranjska do proge Ljubljana Postojna in naprej proti Reki). Povzeto po Jerina in sod. 2003.



Slika 3: Populacijska dinamika rjavega medveda v Sloveniji v obdobju 1998-2018. Vir: Jerina K. in sod. 2018. Reconstruction of brown bear population dynamics in Slovenia and Croatia for the period 1998-2018. Action C5. (Poročilo projekta LIFE DINALP BEAR). | Avtor: Klemen Jerina in Ester Polaina. Spletna stran: Velike zveri | GOV.SI



Slika 4: Razširjenost rjavega medveda v Sloveniji – podatki za leto 2018 (Vir: LIFE DINALP BEAR). Spletna stran Velike zveri | GOV.SI

3 NARAVNA PEHRANSKA NOSILNA ZMOGLJIVOST HABITATA MEDVEDA V SLOVENIJI

Naravna prehranska nosilna zmogljivost habitata medveda je v Sloveniji je tako velika, da količina hrane ni in ne bo omejevala dinamike številčnosti oz. ni pričakovati zmanjšanja rodnosti in povečanja naravne smrtnosti medveda (samoregulacija). (Jerina in sod. 2020). Iz tega sledi, da mora človek prevzeti vlogo regulatorja populacije rjavih medvedov, da doseže primerno gostoto, ki bo ob ohranitvi zdravih populacij medvedov, tudi v skladu z družbeno sprejemljivostjo v kulturni krajini Slovenije. Meje naravne (ekološke) nosilne zmogljivosti prostora sicer ne poznamo, a se zdi, da je še precej višja od sedanjih gostot/številčnosti.

4 TUDI DRUGI ALTERNATIVNI UKREPI NE ZMANJŠUJEJO KONFLIKTOV PRI SEDANJI VISOKI GOSTOTI MEDVEDJE POPULACIJE

Da bi zmanjšali možnost konfliktov so bili izvedeni številni ukrepi in aktivnosti: zaščita domačih živali, nedostopnost ostankov hrane v naseljih in osveščanje prebivalcev. Vendar podatki kažejo, da so veliki in še naraščajoči konflikti z medvedom v sedanjih razmerah primarno proženi z velikimi gostotami in znotraj- vrstnimi odnosi med medvedi, ki v iskanju kompromisa med nevarno bližino drugih medvedov in človeka vse pogosteje pristanejo v (s strani človeka) gostejše poseljenih območjih, začnejo zahajati v naselja in njihovo neposredno okolico, kar proži konflikte. To vednje torej ni primarno rezultat antropogene hrane v naseljih.

Zato tudi vsi izvedeni obsežni pretekli raznovrstni (odstranjevanje virov hrane, zaščita živali in čebel, kampanje za osveščanje) ukrepi zmanjševanja konfliktov z medvedom v Republiki Sloveniji. S niso mogli biti dovolj učinkoviti. Sorazmernih, zakonitih, izvedljivih in učinkovitih alternativnih metod odstrrelu/odvzemu ni, oz. so vse smiselne alternative že izčrpane.

5 DRUŽBENA NOSILNA ZMOGLJIVOST POPULACIJE MEDVEDA V DINARSKEM DELU SLOVENIJE JE PRESEŽNA

Raziskave stališč prebivalcev v območju medveda pa nas opozarjajo, da je družbena nosilna zmogljivost v dinarskem delu Slovenije že presežena ugotavlja Jerina s sodelavci (2020). Večina in vse več prebivalcev teh območij je izmerjeno prepričanih, da so konflikti (ki spremljajo škode) nesprejemljivi, nasprotujejo povečevanju gostot/številčnosti in smatrajo odstrel kot nujno sredstvo upravljanja populacije medveda. Za uspešno sobivanje ljudi in medveda je potrebno upoštevati tudi potrebe lokalnega prebivalstva in zmanjšati številčnost medvedov.

6 ZA USPEŠNO VARSTVO RJAVEGA MEDVEDA JE POTREBNO POLEG RAVNI POPULACIJA – HABITAT UPOŠTEVATI TUDI ČLOVEKA

Slovenija je kulturna krajina, ki sodi med tistih nekaj srednjeevropskih držav, ki jih še naseljujejo vsi avtohtoni veliki sesalci, med njimi tudi predstavniki velikih zveri: rjavi medved, volk in ris. Vsi trije so uvrščeni v ogrožene vrste sesalcev, predstavljajo dragocen element narodove naravne dediščine in biotske raznovrstnosti, hkrati pa se srečujemo s problemom njihovega vključevanja v kulturno krajino. Velike zveri sodijo v skupino problematičnih živalskih vrst, katerih značilnost je: 1. da človeku povzročajo škodo, 2. z njim tekmujejo v izkoriščanju istih naravnih dobrin in 3. so izjemoma ljudem tudi nevarne (Adamič, 1996). V to kategorijo pri nas gotovo sodijo predstavniki velikih zveri, po prvi in tretji točki rjavi medved, po prvi in drugi točki volk, najmanj problematičen je ris, ki pa ga ima del lovcev še vedno za konkurenta. Uspešnega varstva populacij prostoživečih živali v kulturni krajini danes ni več mogoče načrtovati samo na klasični dvosmerni ravni: živalska populacija-habitat, pač pa je potrebno upoštevati tudi tretjo raven – človeka (Adamič, 1996).

7 TISTO KAR ENEMU POMENI ESTETSKO ALI NARAVOVARSTVENO KAKOVOST, LAHKO DRUGEMU POVZROČA ŠKODO ALI GA OGROŽA

Pri rjavem medvedu, kot problematične živalske vrste moramo poleg njegovega naravovarstvenega pomena upoštevati tudi ogroženost lokalnega prebivalstva. Neupoštevanje odnosa tistih skupin lokalnih prebivalcev, ki so zaradi zakonskega varstva problematičnih živalskih vrst neposredno prizadete, lahko povsem izniči smisel varstvenih projektov. Tisto kar enemu pomeni estetsko in naravovarstveno kakovost, lahko namreč drugemu povzroča škodo ali ga celo ogroža. Pri ocenah nevarnosti medveda ne smemo upoštevati le neposredno škodo na živini, ovcah, konjih, poljskih pridelkih, sadnem drevju, uničenih čebeljakih, ki jo je mogoče z varovanjem zmanjšati ali preprečiti, temveč predvsem potencialno nevarnost za ljudi in stres prebivalstva, ki živi na področju večjih koncentracij

medvedov. Čeprav je glede na pogostost srečanj med človekom in medvedom dejanskih konfliktnih situacij malo, pa je treba upoštevati tudi dejstvo, da je prebivalstvo kjer se gibljejo medvedi, predvsem pa medvedke z mladiči, omejeno pri svojem gibanju, saj se zaradi strahu pred nesrečo ne upajo na sprehod, so pod neprestanim strahom, tako pri delu v naravi (polju, gozdu), kot pri rekreaciji. Posebno so pri tem prizadeti otroci, ki so močno omejeni pri različnih dejavnostih v naravi. omejeno je tudi gibanje otrok.

Kar 70% vseh napadov so v Sloveniji povzročile samice z mladiči. Ob naraščanju številčnosti in prostorskem širjenju rjavega medveda v Sloveniji je opazno, da se samice z mladiči pogosteje pojavljajo v bližini naselij ali celo v njih. Ponavljajoča

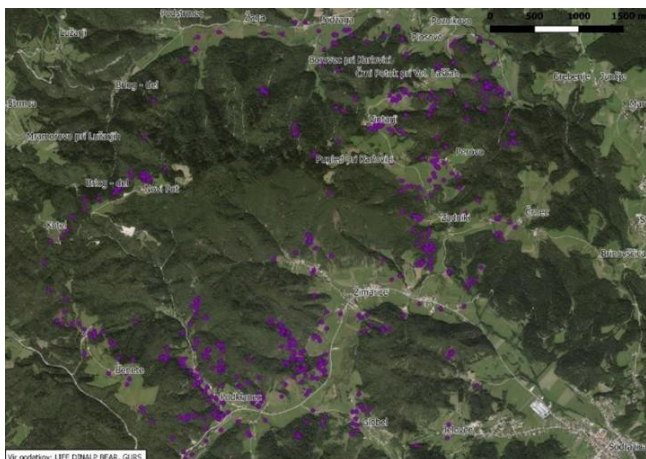
srečanja s človekom pa povzročajo pri samicah strah za mladiče, ki lahko preraste tudi v agresivnost. Nedvomno pa je treba pričakovati, da bo direktnih konfliktnih situacij med človekom in medvedom v prihodnje še več.

8 SLOVENIJA JE KULTURNA KRAJINA IN NE DIVJINA

Danes je pod gozdom dobrih 58 odstotkov površine, gozd na velikem delu Slovenije dejansko sega do naselij. Naselja, ki so jih v preteklosti obkrožale kmetijske površine, so danes bolj izjema kot pravilo. Kljub temu je Slovenija kulturna krajina, po njej je mozaično, nekje bolj na gosto, drugje redkeje razporejenih okoli 6.000 naselij. Tudi na področjih, kjer se nahajajo večji strnjeni kompleksi gozdov, so na njihovem obrobju številna naselja, velike zveri, če že ne živijo v bližini naselij, jih lahko brez težav dosežejo v okviru dnevne migracije in tako prihaja do stikov in tako lahko tudi do konfliktov s človekom.

To potrjuje tudi študija spremljave gibanja rjavih medvedov (Jerina in sod. 2012), ki ugotavlja, da so z vidika medveda tudi največje gozdne zaplate v Sloveniji relativno majhne (npr. največji slovenski gozdni kompleks na Snežniški planoti in Javorniki pokrivata približno 500 km², kar je celo manj od domačega razpona nekaterih medvedov). Zato ni presenetljivo, da so domači razponi skoraj vseh nadzorovanih medvedov vključevali tudi nekatera človeška naselja. Mesečni domači razponi (razen pozimi) so se gibali od 37 km² oktobra do 84 km² v maju (Jerina in sod., 2012).

To je eno ključnih dejstev za upravljanje z medvedom, saj kaže, da v Sloveniji nimamo na voljo regij, kjer bi medvedi lahko živeli ločeno od ljudi. Rjavi medved bo v Sloveniji preživel le, če bodo ljudje pripravljeni (in razumejo, kako) sobivati z njim.



Slika 5: Gibanje medveda blizu naselij: medvedka z dvema mladičema se je premikala od vasi do vasi in iskala hrano dobesedno med hišami - na vrtovih in v sadovnjakih. Prikazane so lokacije medvedke, spremljane z GPS-telemetrijo v okviru projekta LIFE DINALP BEAR Vir: Spletna stran Velike zveri GOV.SI

Za velik del območij, kjer so se gostote medveda v zadnjem desetletju povečale, so značilne nižje nadmorske višine, kmetijsko- gozdna raba tal, primerjalno gosta poselitev s strani človeka v obliki številnih gruč hiš, zaselkov, vasi in manjših mest, s tesnim prepletom gozda in kmetijsko-bivalne rabe prostora. Povprečna gostota zaselkov (baza GURS) teh območij znaša 0,3 zaselka/km², povprečna oddaljenost od naključnih lokacij v območju medveda do najbližjega naselja pa je manj kot 1,5 km, kar pomeni, da v bolj »urbaniziranih« delih teh območij medvedi živijo praktično med vasmi in zaselki, ponekod tudi v velikih gostotah (Jerina in sod. 2020).

9 KOLIKO MEDVEDOV NAJ BI IMELA SLOVENIJA?

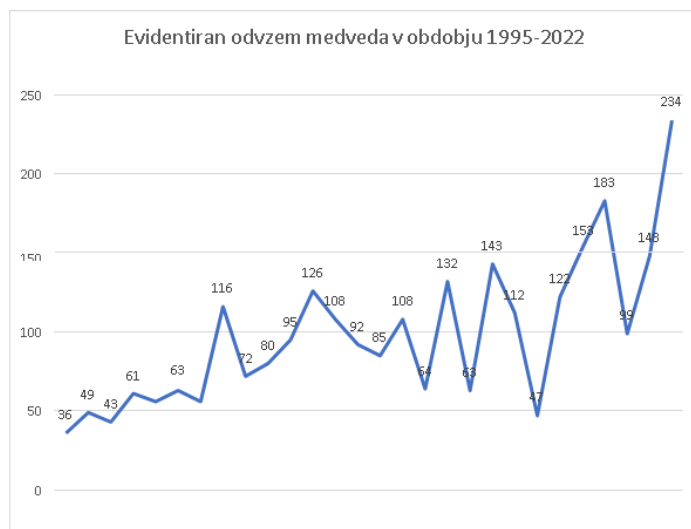
Ocene o tem kakšna naj bi bila primerna številčnost populacije medvedov v Sloveniji, se je stalno spreminjala.

Če privzamemo, da je od 400 do 500 medvedov tista številčnost, s katero so ljudje še pripravljene sobivati, povečanje pa bi privedlo do občutnega zmanjšanja te tolerance, je odstrel trenutno edini kratkoročni ukrep, s katerim bomo populacijo lahko umetno zadržali na tej ravni in tako posledično zagotovili obstoj vrste, ki je v prvi vrsti odvisen od tolerance ljudi (Krofl, Jerina 2012). Tedaj, leta 2012, je bilo v Sloveniji že okoli 700 rjavih medvedov.

Podatki o letni dinamiki različnih tipov konfliktov z medvedom kažejo, da so konflikti še dodatno narasli, ko je populacija presegla številčnost 630–700 osebkov. Kljub tem spoznanjem se je ciljna številčnost rjavih medvedov leta 2022 dvignila na 800 rjavih medvedov v Sloveniji. Tedaj je bilo v Sloveniji že več kot 1.000 medvedov.

10 STALNE OVIRE PRI STROKOVNO UTEMELJENEM NAČRTU ODVZEMA RJAVIH MEDVEDOV

Če bomo izvajanje vsake odločbo o odvzemu rjavega medveda tako ovirali in spotikali kot se sedaj dogaja bomo imeli leta 2050, ko se bomo razogljčili v Sloveniji namesto sedanjih 1.100 že 3.600 rjavih medvedov.



Slika 5: Evidentiran odvzem medveda (odstrel, odlov, nesreče) v obdobju 1995 – 2022. Vir: Poročilo Zavoda za gozdove Slovenije o gozdovih za leto 2022.

Res je, da poleg domače zakonodaje varujejo rjavega medveda še mednarodni dogovori, ki določajo varstvo medveda: Konvencija o varstvu prosto živečega evropskega rastlinstva in živalstva ter njunih naravnih življenjskih prostorov - Bernska konvencija; Alpska konvencija - Protokol o izvajanju Alpske konvencije iz leta 1991 o varstvu narave in urejanju krajine; Konvencija o mednarodni trgovini z ogroženimi prostoživečimi živalskimi in rastlinskimi vrstami – CITES,

Washingtonska konvencija; Konvencija o biološki raznovrstnosti, Rio de Janeiro, 1992; Predpisi Evropske unije, ki določajo varstvo medveda. Sklicevanje nanje in njih uporaba, lahko tudi zloraba, onemogoča realen in strokoven odnos do rjavega medveda v Sloveniji.

Zaradi pritožb, zadržanja ali zaustavitve izvajanja odstrela in s tem povezanih zapletov je bil odvzem medvedov v posameznih letih daleč pod načrtovanim in občutno pod prirastkom, kar je omogočilo naglo rast številčnosti daleč preko tolerančnih možnosti. Zavedati se je treba, da so še rezerve pri prehranskih možnosti za rast medvedje populacije, tako ne moremo računati na samoregulacijo medvedje populacije pri nas. Za ciljno številčnost populacije je potrebno upoštevati druge kriterije, to je toleranco lokalnega prebivalstva do medveda. da "odločitev pomeni kršitev slovenske in evropske zakonodaje na področju ohranjanja narave". Tožarjenje v Bruslju, če ne več za boljše

rešitev kot je predlagana, je najmanj neodgovorno dejanje, da ne rečem kaj hujšega. In Slovenija je država z največjo gostoto rjavih medvedov v EU, številne države rjavih medvedov sploh nimajo na svojem teritoriju, razen v živalskih vrtovih, in te naj bi presojale o naših rešitvah.

11 ZAKLJUČNE UGOTOVITVE

Dokler so populacijske gostote velikih zveri, v našem primeru rjavega medveda zelo nizke, je njihov vpliv na ljudi razmeroma majhen, odnos bolj pozitiven in je bila tudi stroga zaščita popolnoma sprejemljiva. To je v Sloveniji trajalo nekako do osamosvojitve, leta 1993 je štela medvedja populacija v Sloveniji okoli 300 osebkov.

Številčnost medvedov pa je kar rasla, leta 2008 jih je bilo že okoli 570. Pogosteje so se pričeli konflikti. Krofel in Jerina (2012) sta ugotovila v prispevku Pregled konfliktov med medvedi in ljudmi: vzroki in možne rešitve, da je od 400 do 500 medvedov tista številčnost, s katero so ljudje še pripravljeni sobivati, povečanje pa bi privedlo do občutnega zmanjšanja te tolerance, je odstrel trenutno edini kratkoročni ukrep, s katerim bomo populacijo lahko umetno zadržali na tej ravni in tako posledično zagotovili obstoj vrste, ki je v prvi vrsti odvisen od tolerance ljudi. Tedaj pa je štela populacija že okoli 700 medvedov.

Izhodiščna varianta ciljne številčnosti rjavega medveda v Sloveniji je bila ocenjena z grafom letnih konfliktov v naraščajočem gradientu številčnosti populacije rjavega medveda in je znašala pri različnih tipih konfliktov od 630 do 700 osebkov. Ko je populacija presegla to številčnost, so konflikti začeli še dodatno (tudi nelinearno) naraščati (Jerina in sod., 2020). Številčnost 700 osebkov (največjo letno, tj. po poleganju) je populacija medveda v Sloveniji presegla leta 2012; zatem je še naraščala (Jerina in sod., 2020).

Kljub tem spoznanjem se je ciljna številčnost rjavih medvedov v Sloveniji leta 2022 dvignila na 800 rjavih medvedov v Sloveniji. Tedaj pa je bilo v Sloveniji že več kot 1.000 medvedov.

Ob ugotovitvi, da sta spolna in starostna sestava populacije rjavega medveda v Sloveniji po vseh dostopnih podatkih najmanj zadnjih 15 letih stabilni (to je vsaj od leta 2005), v populaciji zmerno z 59 % prevladujejo samice. Relativna rodnost je okoli 24 %, relativna smrtnost zaradi naravnih, tj. ne-antropogenih dejavnikov (naravna smrtnost) je majhna, okoli 5 %; in so ji verjetno izpostavljeni predvsem mladiči v prvem letu življenja, bi bilo pričakovano, da je ciljna številčnost, ki ohranja obstoj populacije rjavega medveda in omogoča njegovo sobivanje s prebivalstvom med 500 (toliko jih je bilo okoli leta 2003) in največ 700 medvedov, kolikor jih je bilo leta 2012.

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Ogljikov dioksid – mit ali resnica?

Carbon dioxide – myth or truth?

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POVZETEK

Antropogeni ogljikov dioksid je glavna tarča svetovne in naše politike z drastičnimi škodljivimi ekonomskimi posledicami. Nujno je, da se pred izvajanjem ukrepov prepričamo v znanstvene podlage o krivdi človekovih izpustov ogljikovega dioksida. Novejša literatura kaže, da antropogeni CO₂ ne more biti kriv za segrevanje planeta. Zastrasovanje množic brez znanstvene podlage je nesprejemljivo. Prebivalci tega planeta imamo pravico do informiranega soglasja pred izvajanjem ukrepov. Javni dialog je odsoten, avtor je poskusil prekiniti enoumje in vključuje objavljen članek in komentar. V zaključku lahko ugotovim, da razogljčenje kot ekstrem nima znanstvene osnove.

ABSTRACT

Anthropogenic carbon dioxide is a major target for global and our policy, with drastic adverse economic consequences. It is imperative that, before implementing measures, we are convinced of the scientific bases on the guilt of human carbon dioxide emissions. Recent literature suggests that anthropogenic CO₂ cannot be to blame for the warming of the planet. Intimidating the masses without scientific basis is unacceptable. The inhabitants of this planet have the right to informed consent before taking measures. Public dialogue is absent, the author has tried to break the one opinion only and includes a published article and commentary. In conclusion, the author concludes that decarbonisation as extreme has no scientific basis.

KLJUČNE BESEDE

Ogljikov dioksid, razogljčenje, politika, javna diskusija

KEYWORDS

Carbon dioxide, decarbonisation, politics, public debate

1. UVOD

Pred branjem prispevka priporočam ogled filma The Great Global Warming Swindle (2007) o mitih in resnicah o človekovem CO₂ kot povzročitelju podnebnih sprememb (1). Bralec tako lahko primerja stanje na tem področju po šestnajstih letih. Odmeve najdemo z naslovom filma v Googlu, na Wiki tudi, kjer pa je seveda pisanje odprto vsakomur.

Varčevanje z energijo, materiali, njihovo recikliranje, zmanjševanje odpadkov, njihova predelava v še uporabne snovi, ponovna uporaba izrabljenih izdelkov, popolnejše čiščenje izpustov v zrak in v vode, novi zanesljivi viri elektrike in toplote, vse to so nujne smeri razvoja človeštva.

Moj prispevek pa predstavlja poskus javnega odpiranja vprašanja, na kakšnih znanstvenih osnovah je zasnovana politika vojne proti ogljikovemu dioksidu (CO₂) na vsakem koraku, osebno, v gospodarstvu, celo v šolstvu in v družbi nasploh.

Pri tem se opiram na objave znanstvenikov, ki objavljajo dejstva in jih navajam med viri. Komentarji na te virov so zaželeni, v dialogu z avtorji v virih. Prispevek je samo moj izbor virov, s katerim utemeljujem dvom v to, da bi bil človekov CO₂ kriv za planetne podnebne spremembe.

V smislu javnega odpiranja prostora za različna mnenja o vplivu CO₂ na podnebne spremembe, ki so v znanstvenem svetu močno prisotna, vključujem svoje objavljeno pismo v Delu (2) in edini strokovni delni komentar klimatologa Gregorja Vertačnika, univ.dipl.meteorologa iz Slovenskega meteorološkega društva, sicer zaposlenega na Agenciji RS za okolje, prav tako objavljen v Delu (3).

2. ZAKAJ ISKANJE ZNANSTVENE PODLAGE ZA PREGON CO₂ ?

Zato, ker prihaja do izjemno drastičnih, nerazumnih, škodljivih političnih in finančnih ukrepov za odpravo človekovih izpustov CO₂. Pri čemer ni znanstveno utemeljeno, zakaj je to potrebno, kaj bi s tem sploh dosegli, še posebej pa v majhni Sloveniji, ki nima merljivega vpliva na svetovna podnebja pa tudi na naše ne:

- "razogljčenje" do leta 2050 in zmanjševanje CO₂ do 2030
- "ogljčni odtis" posameznika, gospodarstva in družbe
- Vnos teh ciljev v zakonske predpise, na primer v Nacionalni energetski in podnebni načrt - NEPN (4).
- Davek na CO₂
- Plin, sicer uvoz, ima samo en C: CH₄
- Kurjenje odpadkov pa veliko C-jev: plastika ipd.
- Podražitev energentov – struktura cen?
- Vsiljevanje vetrnih in sončnih elektrarn, češ, da lahko zamenjajo 24/7 elektrarne (ekstrem Nemčija-propad Energiewende)

Opis teh in kopice drugih političnih pojavov/ukrepov bi terjal poseben članek, zato tu le omemba.

Javnost je zdaj potisnjena v verovanje, da je CO₂, ki izhaja iz naših dejavnosti, glavni krivec za "segrevanje" planeta in posledično sprememb raznih podnebnij po svetu, kljub temu, da ga je v ozračju izjemno malo 0,042 odstotka, glede na vodo

(vlago), ki jo je od 0,5 do 4 odstotke . Voda pa je tudi bistveno močnejši toplogredni plin. Človekovega CO2 pa je obenem le 5-6 odstotka naravnega CO2 (5) (6) (7: 1.4.2.).

To je današnja javna politična scena, vojna med mitom in resnico, ki se je zavlekla tudi v znanost. Zaupanje v podnebne znanosti je omajano. Nekateri znanstveniki so prirejali podatke v prid pretiranemu segrevanju planeta, čeprav dejstva tega niso potrjevala. Najbolj znani aferi sta Climategate in diagram "hokejska palica", odlično opisani v knjigi matematika mag. Miša Alkalaja (8). Medvladni forum za podnebne spremembe (IPCC) v okviru Organizacije združenih narodov pa tudi ni referenca za znanost, saj je že od ustanovitve političen organ (ime!). O selekciji znanstvenih del v IPCC, taki, da se nadaljuje zgodba o krivdi človekovega CO2 za segrevanje planeta pa zvemo iz (9).

Koonin (10) je v svoji knjigi Nerešeno (Unsettled) "osupel najprej zaradi pripravljenosti nekaterih podnebnih znanstvenikov - ki jih podpirajo mediji in politiki -, da napačno predstavijo, kaj pravi znanost, nato pa zaradi številnih drugih znanstvenikov, ki tiho sodelujejo pri teh napačnih predstavah.

Z dokazanim napačnim obveščanjem nestrokovnjakov o tem, kaj vemo in česa ne vemo o spreminjajočem se podnebnju, vladam, industriji in posameznikom odrekajo pravico do sprejemanja popolnoma informiranih odločitev o tem, kako se odzvati." (str.249/250). dr. Steven E. Koonin je bil med drugim 30 let profesor teoretične fizike na Caltech in je član ameriške National Academy of Sciences.

Znanstveni dvom mora biti omogočen in javen, saj je podlaga napredku znanosti.

Zaenkrat resna znanost ne daje osnove za pregon človekovih izpustov CO2. (11) Miskolczi dokaže: "Povečanje CO2 v ozračju ne more biti razlog za globalno segrevanje." Ferenc Miskolczi je prvi znanstvenik (več objav od leta 1989), ki je pokazal, kako vodna para in oblaki nadzorujejo zemeljsko sevalno ravnovesje in preprečujejo učinke sevanja nekondenzirajočih toplogrednih plinov.

3. PSIHLOGIJA MNOŽIC

Organizacija združenih narodov organizira vsakoletne klimatske konference COP - Konference pogodbenic (Conference of the Parties), to je držav, ki so podpisale Okvirno konvencijo Združenih narodov o spremembi podnebja (UNFCCC) - pogodbo, ki je začela veljati leta 1994. Udeležujejo se jih tisoči predstavnikov držav, vmes pa so še srečanja delovnih teles. Opazno je, da se vsako leto izrazje stopnjuje v smeri vedno hujših napovedi, kaj se dogaja in kaj bo s planetom in z nami.

Na COP27 pred slabim letom v Egiptu je na primer v svoji pridigi generalni sekretar OZN Guterres napovedal: "Z nogo na pedalu za plin smo na avtocesti v podnebni pekel". (12) Sredi letošnjega leta je opomnil "Obdobje globalnega segrevanja se je končalo, nastopilo je obdobje globalnega vrenja." (13) COP28 bo v začetku decembra letos v Združenih arabskih emiratih. Kaj je še hujšega, lahko ugibamo, na primer: "Obdobje globalnega vrenja se je končalo, nastopilo je obdobje globalnega

cvrenja", ali pa je to primerneje za COP29, vsekakor očitno nazaj ne morejo več, lahko jih ustavi le ohlajanje, o čemer obstajajo napovedi.

Hipoteza o slabitvi polarnega vrtinca naj bi vodila v ledeno dobo. Stratosferski polarni vrtinec je sezonska atmosferska struktura na visokih nadmorskih višinah, ki se oblikuje jeseni, pozimi utrdi in raztopi spomladi. V zadnjih letih naj bi prišlo do nenadnega širjenja polarnega zraka proti srednjim zemljepisnim širinam. (14). Več o polarnem vrtincu (15).

Zastraševanje javnosti je znana politična metoda in spada v znanstveno vedo Psihologija množic, kar je potrebno omeniti. (16) Mimogrede, tudi med kovidom smo bili tega deležni. V povzetku (17) prevedene knjige Psihologija množic (18) utemeljitelja vede Gustava Le Bona (1841-1931) je med ugotovitvami je tudi naslednja, ki ponazarja dogajanje ob podnebnih spremembah:

"Govornik, ki želi zavesti množico, se mora posluževati strašnih trditvev. Pretiravati, zatrjevati ter ponavljati mora svoje trditve in še pomisliti ne sme, da bi karkoli prikazal z razumnimi razlagami". Francoski mislec Le Bon je bil doktor medicine, socialni psiholog, sociolog, antropolog, izumitelj in amaterski fizik, pravijo pa mu tudi oče študija psihologije množic.

4. PODNEBNI UKREPI IN INFORMIRANO SOGLASJE

Informirano soglasje ima težo, če imamo o zadevi vsaj nekaj znanja. Zato je izjemno pomemben dvig splošne razgledanosti široke javnosti, da naravoslovne pojme, ki nastopajo v podnebnih spremembah razume, čeprav to terja po eni strani ponovitev osnovnošolskih in srednješolskih vsebin pouka (zemljepis, kemija, fizika, biologija, matematika, astronomija, geologija) po drugi strani pa dodatna znanja, da se sploh da sprejemati naravoslovna dejstva in pojme na področju obnašanja narave na planetu Zemlja. Seveda pa to velja tudi za politike, pravzaprav še bolj. Ločevanje vremena od podnebja, na primer, nam dela težave.

Priporočam predavanja klimatologinje prof. dr. Lučke Kajfež Bogataj (19). Definicije podnebja so različne, navajam iz predavanj. Tako, na primer zvemo, da je najkrajša definicija: "Klima je sinteza vremena." Ali pa definicija Društva meteorologov Slovenije: "Značilnosti vremena nad kakim območjem v daljšem časovnem obdobju (praviloma 30 let)." Ali pa najboljša (Fedorov): "Splet vremenskih pogojev tipičnih za regijo skupaj z opisom njihove pogostnosti in sezonske spremenljivosti." In najširša (McGuffie&Handerson-Sellers): "Vse statistike klimatskih stanj dobljene v dogovorjenem časovnem obdobju (sezona, dekada ali daljše obdobje) izračunane za celotno oblo ali za izbrano regijo."

Vsak, ki želi biti bolje informiran, predno pristane na ukrepe, primerjava s cepljenjem je na mestu – potrebno je informirano soglasje (Informed consent), pa naj pogleda v odlično nepolitično, razumljivo napisano znanstveno e-knjigo o podnebnju na 655 straneh (7), ki se stalno izpopolnjuje in je sproti recenzirana.

Toda javnost mora zahtevati predvsem od politike, ki izvaja ukrepe, da v zadevi podnebne spremembe zadosti pogoju informiranega soglasja (20): "Kot informirano soglasje se lahko šteje soglasje, podano na podlagi nedvoumne seznanjenosti in jasnega razumevanja dejstev, pomena in posledic dejanja."

Ob tem je potrebno omeniti, da je Svetovna zdravstvena organizacija – SZO (WHO) privzela podnebne spremembe v svoj repertoar aktivnosti (21). S tem pa tudi pogoj za informirano soglasje, ne zgolj v zdravstvu, ampak tudi v povezavi s podnebnimi spremembami. Informirano soglasje je tudi med človekovimi pravicami (22).

5. ČLANEK, DELO (2) mag. Tomaž Ogrin

Namen prispevka je vzbuditi kritično mišljenje o vlogi ogljikovega dioksida v celotnem dogajanju na Zemlji.

Vesela novica: naš planet postaja bolj zelen, odkar ogljikov dioksid (CO₂) raste. Če skočimo na Nasa Green Planet (23), najdemo satelitske posnetke in znanstvene študije o pozitivnem vplivu naraščanja CO₂ za naravo, tudi v sušnih predelih, in seveda za njene prebivalce. Naši osnovnošolci vedo, zakaj. Spoznali so skrivnost življenja rastlin: fotosintezo. Rastline vdihujejo ogljikov dioksid in vodne hlape, izdihujejo pa kisik, poenostavljeno povedano. Seveda jim pri tem pomaga še sonce. Obratno pa človeštvo in živali vdihujemo kisik in izdihujemo CO₂ in vodne hlape.

Večja ozelenitev planeta pomeni tudi hladnejšo površino in manj sevanja toplote v zrak, kar znižuje temperaturo. Največja korist večje koncentracije CO₂ je bujnejša rast rastlin za prehrano in za večjo pokritost kopnega z gozdovi.

V zraku je 0,042 odstotka CO₂ (420 ppmv), letno narašča za 0,0002 odstotka (2 ppmv). Od tega je prispevek človekovih izpustov zgolj 5 odstotkov (5) (6), to je 21 ppmv. Čez sedem let (2030) bi vsega CO₂ v zraku bilo 434 ppmv, do leta 2050 (obe politični, neznanstveni letnici za ukrepe proti CO₂) pa 54 ppmv več, to je 474 ppmv. Kar je Zemlji in nam le v korist.

Če bi se koncentracija ogljikovega dioksida teoretično v sto letih podvojila zaradi naravnih procesov, bi se navidezna temperatura planeta povečala le za 0,5 stopinje Celzija, je znanstveno utemeljil fizik Dieter Schildknecht z univerze v Bielefeldu (2020). Pravilnost izračunov so potrdile meritve s pomočjo satelitov. Tudi drugi znanstveniki so se približali temu rezultatu. Pri toplogrednem privzemanju toplote od tal pride do nasičenja. (24). Krivulja absorpcije je logaritimska, torej položna, po Beer-Lambertovem zakonu. Človekovi izpusti pa nimajo merljivega vpliva.

Zato je vsako strašenje o pregrevanju planeta zaradi človekovih izpustov ogljikovega dioksida znanstveno neosnovano in nam samo hudo draži življenje. Takoj je treba odpraviti davek na CO₂, kar mora slovenska vlada zahtevati od evropske komisije. Gre za legalizirano krajo denarja. Posvetimo se raje v večji meri onesnaževanju zraka, varčevanju z energijo ter obrambi proti vremenskim ekstremom in požarom (Kemis, Melamin, gozdovi ...).

Naš planet ima dolgo zgodovino preživetja. Spremembe se po obsegu, trajanju in moči sploh ne morejo primerjati z današnjimi,

ki so malenkostne. Koncentracija ogljikovega dioksida je bila tudi desetkrat večja, kot je zdaj (orjaške praprotnice, dinozavri pred več sto milijoni let). In naš planet je preživel!

Paleoklimatolog David Beerling v knjigi iz leta 2007 z naslovom Kako so rastline spreminjale zgodovino Zemlje (How plants changed Earth's history) opiše vlogo rastlin v različnih obdobjih. V času ledenih dob je padla koncentracija ogljikovega dioksida na vsega 300 ppmv (25). Ocenjujejo, da se fotosinteza ustavi pod 200 ppmv CO₂. To bi pomenilo tudi izumrtje človeka in živali. Tako zelo smo odvisni od rastlin. Optimum fotosinteze je pri 1200 ppmv, to je 0,12 odstotka CO₂ v zraku.

To vedo tudi pridelovalci zelenjave v rastlinjakih, ki dodajajo CO₂ do okrog 1000 ppmv in povečajo pridelek tudi do 50 odstotkov, čas cvetenja pa skrajšajo za teden dni.

Nesporno je, da so spremembe na Zemlji vedno bile, so in bodo. Povzročila jih narava in ne človek. To je utemeljil tudi fizik dr. Fred Singer, čigar predavanje na Institutu Jožef Stefan leta 2008 lahko poslušamo na povezavi videolectures.net (vtipkamo ime predavatelja). (26) Svoje ugotovitve podkrepi tudi z znanstvenimi deli, ki so v gradivih IPCC (Intergovernmental Panel on Climate Change) – medvladnega, torej političnega foruma za podnebne spremembe. Za IPCC je značilno, da njihova navodila politikom sveta ne izhajajo iz dejstev. Politika pa izključuje ali cenzurira znanstvenike, ki objavljajo dejstva (8)(9).

Ni enačbe med tistimi petimi odstotki naših izpustov CO₂ in kakršnimi koli spremembami različnih podnebij in različnih temperatur na planetu. Karkoli smo naredili za zmanjšanje izpustov, se nikjer ne pozna in se ne bo tudi v prihodnje. Ni namreč merljivo, ker je premajhno. No, ni povsem res, najbolj se pozna pri praznjenju naših žepov in uničevanju narave, zdravja in bivalnih razmer prebivalcev, na primer z vetrnicami.

Podnebna politika je zlagana in je prevara prebivalstva. Nekaj posrednih dokazov najdemo takoj: nikogar iz politike ni skrbelo večmesečno gorenje naftnih vrečev na Bližnjem vzhodu zaradi vojn, niti puščanje metana zaradi diverzije na dva plinovoda v Severnem morju, niti vojaški izpusti, zdaj že drugo leto vojne v Ukrajini, kakor da se vse to dogaja na nekem drugem planetu.

Že leta 2011 je matematik mag. Mišo Alkalaj v svoji knjigi Podnebna prevara (8) tak naslov utemeljil z mnogimi znanstvenimi viri. Doslej se še ni pojavil pisec, ki bi napisal protiknjigo. Nobeno ministrstvo ne ugovarja tej knjigi, očitno ne sledijo znanosti, ampak zgolj pohlevno, birokratsko prenašajo politične ukaze iz evropske komisije, v škodo Slovenije.

Na Zemlji delujejo ogromni, neobvladljivi sistemi, ki jih ne znamo niti napovedati, niti razložiti premikov za nazaj, niti nanje vplivati. Naš planet upravljajo sonce, oblaki, morja (70 odstotkov površine), glavni toplogredni plin voda v zraku (od 0,5 do 4 odstotke) in nekoliko še naravni CO₂ v ozkem pasu absorpcije toplote do nasičenja.

Namen prispevka je vzbuditi kritično mišljenje o vlogi ogljikovega dioksida v celotnem dogajanju na Zemlji. Zato povzemam dejstva, ki so plod znanstvenega dela. Brez uporabe znanstvenega dvoma, tudi v politiki, samo zavajamo ljudi.

Znanost napreduje, kritične presoje so nujne ves čas, znanost ni konstanta, dejstva odločajo, ne iluzije in ne modeli, ki nimajo potrditve v dejstvih.

Vojna proti ogljikovemu dioksidu je uničujoča za človeštvo in za Slovenijo.

6. ČLANEK, DELO (3) klimatolog Gregor Vertačnik

Prispevek mag. Tomaža Ogrina, ki je bil 8.julija objavljen v rubriki Prejeli smo v Sobotni prilogi, bralca sprva navda z upanjem na zares kritično mišljenje, a se kmalu sprevrže v ponavljanje zdavnaj ovrženih trditev, ki jih radi širijo zanikovalci antropogenih podnebnih sprememb. Analizirali bomo le nekaj trditev iz njegovega prispevka, ki so s stališča klimatologije napačne.

Trditev: " V zraku je 0,042 odstotka CO₂ (420 ppmv), letno narašča za 0,0002 odstotka (2 ppmv). Od tega je prispevek človekovih izpustov zgolj 5 odstotkov."

Ta izjava ponazarja pogosto zmoto med masnimi in bilančnimi tokovi. Med ozračjem in oceani se letno v eni in drugi smeri izmenja več kot 50 milijard ton ogljika, ogljična tokova zaradi fotosinteze in dihanja pa znašata celo več kot 110 milijard ton letno (vir: Šesto poročilo IPCC, 5.poglavje poročila I.delovne skupine) (27). Vendar so ti in drugi naravni masni tokovi skorajda uravnoreženi, zato so človekovi izpusti (zaradi kurjenja in rabe tal) velikosti okoli 11 milijard ton letno tisti, ki spreminjajo količino CO₂ v zraku. Na podoben način se človek počasi zredi, čeravno je povečanje vnosa hrane malenkostno glede na ravnovesno vrednost.

Da so človekovi izpusti CO₂ vzrok rasti vsebnosti (koncentracije) tega plina v ozračju, dokazuje tudi spreminjanje izotopske sestave ogljika in kisika v zračnih molekulah CO₂ – razmerje med izotopi je namreč v fosilnih gorivih nekoliko drugačno kot v ozračju in morju.

Trditev: "Če bi se koncentracija ogljikovega dioksida teoretično v sto letih podvojila zaradi naravnih procesov, bi se navidezna temperatura planeta povečala le za 0,5 stopinje Celzija, je znanstveno utemeljil fizik Dieter Schildknecht z univerze v Bielefeldu (2020). (...) Pri toplogrednem privzemanju toplote od tal pride do nasičenja."

Ogljikov dioksid v ozračju resda v nekaterih spektralnih pasovih ne prepušča skorajda nič sevanja z Zemljinih tal proti vesolju, a so drugi spektralni pasovi še daleč od nasičenja. Še bolj pomembno pa je, da se z večanjem vsebnosti CO₂ zvišuje plast ozračja, ki izseva največ dolgovalovnega sevanja v vesolje. Sicer velik sevalni tok s prizemne plasti ozračja višje ležeče plasti ozračja večinoma zadržijo, zelo visoko v ozračju pa je sevalni tok zaradi majhne gostote zraka in nizke temperature šibek in ni bistven za energijsko ravnovesje Zemlje. Vmes je nekaj kilometrov nad tlemi plast ozračja, s katero se – po domače povedano – Zemlja hladi. Ker je celotni tok dolgovalovnega sevanja z Zemlje v vesolje dokaj stalen, ima ta plast v povprečju dokaj stalno temperaturo (zaradi močne odvisnosti sevalnega toka od temperature). Temperatura zraka v tem delu ozračja z višino pada, zato njeno zviševanje vodi v zvišanje temperature pri tleh. Recimo, da je jedro te plasti na nadmorski višini 5

kilometrov in ga dvignemo na 6 kilometrov. S tem dvigom "prenesemo" tudi temperaturo s 5 na 6 kilometrov – celotna temperaturna krivulja pod 5 kilometri se prestavi za približno 6,5 stopinje Celzija navzgor. Dodatna količina CO₂ in drugih toplogrednih plinov v ozračju torej ne glede na morebitno nasičenje povzroči dvig temperature pri tleh.

Poleg neposrednega vpliva CO₂ na temperaturo je tu še močan učinek povišane temperature ozračja in tal na vsebnost vodne pare v zraku in svetlobna odbojnost Zemljinega površja – to dvoje še precej okrepi segrevanje ozračja in tal. Zato je najverjetnejša prava vrednost dviga temperature pri podvojitvi vsebnosti CO₂ v ozračju okoli 3 stopinje Celzija.

Trditev: " Naš planet upravljajo sonce, oblaki, morja (70 odstotkov površine), glavni toplogredni plin voda v zraku (od 0.5 do 4 odstotke) in nekoliko še naravni CO₂ v ozkem pasu absorpcije toplote do nasičenja."

Sonce je glavni vir vremenskega dogajanja na Zemlji, oblaki oziroma ozračje, morje, kopno in ostali deli podnebnega sistema so le igralci v igri energijskih tokov. Toplogredni učinek ogljikovega dioksida je na svetovni ravni skorajda primerljiv z učinkom vodne pare, hkrati pa ima to nesrečno lastnost, da imajo "presežki" ogljikovega dioksida v ozračju zelo dolgo življenjsko dobo. Nasprotno pa neposredni človekovi izpusti vodne pare v ozračje, na primer iz dimnikov termoelektrarn, povprečno v nekaj dneh do nekaj tednih izpadejo iz ozračja v obliki padavin. Velik del v ozračje izpuščenega ogljikovega dioksida pa kot presežek vztraja desetletja, manjši del celo stoletja in tisočletja. In ravno ta obstojnost presežkov ogljikovega dioksida je srž problema reševanja antropogenih podnebnih sprememb. Četudi z danes na jutri ugasnemo vse porabnike fosilnih goriv, nas bo povečana vsebnost ogljikovega dioksida v ozračju spremljala še zelo, zelo dolgo časa in preprečevala, da bi se Zemlja ohladila na temperaturno raven izpred desetletij in stoletij, na katero je človeštvo najbolj navajeno.

Gregor Vertačnik, Slovensko meteorološko društvo

7. KOMENTAR NA PISMO Vertačnika in ZAKLJUČEK

7.1. Absorpcijski spektri vode/vlage in CO₂.

Vodna para absorbira skoraj vse sevanje s površine planeta. Celoten CO₂, naravni in človekovi izpusti, absorbira le 2%, ker se 80% vodne pare in večina nizkih oblakov nahajajo v prvih 300 mbarih, tj. pod 3 km, četudi je voda neenakomerno porazdeljena. CO₂ je porazdeljen skoraj enakomerno po celotni višini in širini ozračja in tudi zato je njegova absorpcija šibkejša. Obenem ima voda v ozračju veliko širši absorpcijski spekter, ki prekrije tudi dober del absorpcijskega spektra CO₂ (7: str.124).

7.2. Nasičenje CO₂ s toplotnim sevanjem od tal.

Beer-Lambertov zakon o absorpciji še vedno velja. Uporablja se tudi v analizi kemiji (spektrofotometrija). Odnos med absorpcijo in koncentracijo je logaritičen, kar pomeni, da z naraščanjem koncentracije pride do vedno manjše absorpcije, do nasičenja, torej po neki koncentraciji je absorpcija minimalno

povečana (24). To pomeni, da dodajanje človekovih izpustov CO2 ne povečuje absorpcije in temperature.

Dieter Schildknecht je to potrdil z meritvami in tudi drugi znanstveniki so mu pritrdili, kot sem v članku napisal.

Zato priporočam Vertačniku, da vzpostavi dialog z Schildknechtom in razčisti. Jaz sem mu pisal, poslal oba sestavka v angleščini, mojega in Vertačnikovega in na mojega ni imel pripomb, potrdil pa je tudi svoje izračune in primerjave z meritvami.

Ne drži Vertačnikova trditev, da ima CO2 še druge spektralne pasove, kjer pa naj ne bi prišlo do nasičenja. CO2 ima glavni absorpcijski pas med 14 – 16 μm, ki pa je tudi delno prekrit z absorpcijskim pasom vodne pare. Namreč drugi pasovi CO2 niso pomembni za zajem sevanja od tal, ker so na robovih valovnih dolžin sevanja tal ali z vodo (vlago) pokriti.

Zato podvojitve koncentracije CO2, do katere sicer ne more priti s strani človeštva (7: 1.4.7.), na 800 ppm, ne pomeni praktično nobene nevarnosti, pač pa veliko korist za povečanje pridelkov in gozdov na planetu. **Absorpcijska krivulja je logaritemska, več CO2, manjši je učinek (7: str.110).**

Končen dokaz, da temperature planeta ne uravnava CO2, ponujajo meritve zemeljskega izstopnega dolgovalovnega (toplotnega) sevanja, ki ne sledi spremembam vsebnosti CO2 v ozračju (28: 2.del). Tu lahko sledimo tudi omenjeni logaritemski odvisnosti.

Kot zaključil avtor "se pravljičica o grozeči katastrofi zaradi izpustov CO2 ne ujema z dejstvi." **Nihanje temperature in vsebnosti CO2 na Zemlji je prikazano v (28: 1.del).**

van Wijngaarden in Happer (29) potrjujeta velik učinek nasičenja CO2 tudi na vrhu atmosfere.

Lindzen, Alfred P. Sloan profesor atmosferskih znanosti na MIT tudi napiše (30), da je segrevanje zaradi CO2 v logaritemski povezavi z njegovo koncentracijo, da je prišlo do nasičenja in pri podvojitvi njegove koncentracije segrevanje ne bo večje, kar potrjuje Schildknechtov rezultat.

Harde in Schnell (31) v laboratorijskem eksperimentu dokažeta močno nasičenje za CO2, metan CH4 in didušikov oksid N2O (smejalni plin) pri povečanju koncentracije. Meritve so dobro potrjene z izračuni prenosa sevanja. Zato je vpliv teh plinov na globalno segrevanje majhen. Avtorja poudarjata že v povzetku, da ni izrednih podnebnih razmer.

Zanimivo je, da je izvorno delo našega rojaka znanstvenika Jožefa Stefana, ki je odkril zakon sevanja, postalo ključnega pomena pri obravnavi podnebnih sprememb (28: 2.del)(32).

Prof.dr. William Happer (33) v svojem nedavnem predavanju v Avstraliji, Brisbane, navaja, da ob upoštevanju osnov fizike, podvojitve koncentracije CO2 iz 400 na 800 ppm pomeni segretje le za 0,71 stopinje Celzija.

Happer dokaže, da je skoraj vse sevanje, ki ga CO2 lahko zadrži, že absorbirano. Dodajanje CO2 skoraj nima vpliva na izstopajoče sevanje iz ozračja v vesolje. Sprašuje se, kako so

lahko podnebni znanstveniki alarmisti iz te nepomembne malenkosti naredili globalno podnebno paniko. Kako so lahko segrevanje do 0,7 stopinj Celzija spremenili v 3 stopinje, 4 stopinje, celo 12 stopinj, karkoli je že najnovejša številka, ki naj bi vzbujala paniko?

Happer nadalje pravi, da to dosežejo z dodajanjem nefizikalnih, hipotetičnih pozitivnih povratnih učinkov, ki tako povečajo skoraj neobstoječi vpliv dodajanja CO2. Vendar pa ni nobenega dokaza, da ti znatni povratni učinki dejansko obstajajo.

Vertačnikovi očitki o "zdavnaj ovrženih trditvah" nikakor ne držijo, o čemer pričajo novejši znanstveni raziskave in viri, ki jih navajam. Vsekakor je edina pot do razčiščenja nasprotnih stališč **neposreden stik z avtorji raziskav.**

Harde in Salby (34) dokažeta, da ne drži trditev IPCC, ki jo povzema Vertačnik, da se antropogeni CO2 nabira v ozračju in tam ostaja kot presežek desetletja in več. Nasprotno, kljub človekovim izpustom CO2, celotna količina CO2 ne preseže ravnotežnega nivoja, ker pride do večje absorpcije CO2. Obstoj ravnotežnega nivoja dokažeta z izračuni, ki se povsem ujemajo z žgasto krivuljo naraščanja CO2, kakršno izmerijo v observatoriju na Mauna Loa na Havajih (na 3.397 m n.v.) in, ki jo vsi navajajo za merilo vsebnosti CO2 v ozračju. **Zaključita, da antropogeni CO2 ne uravnava podnebja.**

IPCC poročila postajajo politično verska knjiga, enoumje, ki napoveduje podnebno krizo, požar, kot biblijski vesoljni potop, kazen za človeštvo, ker izpušča CO2. A znanstveni dvom še živi, skupine znanstvenikov objavljajo dejstva, čeprav večkrat s težavo zaradi cenzure, ker nasprotujejo napovedim IPCC. Primer je skupina Climate Intelligence (CLINTEL), ki je objavila Svetovno izjavo o podnebjju (World Climate Declaration). V njej poudarja, da ni pomembno število strokovnjakov-podpisnikov, ampak kakovost argumentov, znanstvenih dejstev. (35)

Objavili pa so tudi knjigo, recenzijo Šestega poročila IPCC, The Frozen Climate Views of the IPCC (36).

In kakšna je realnost razogljičevanja? Berimo: (28) (37)(38) Ampak, to je le del večjega projekta (39). CO2 in dušik.

Situacija postaja absurdna. Primer so aktivisti, ki kar tožijo države, češ, da se premalo borijo proti podnebnim spremembam (40). Dejansko tožijo Naravo.

Raziskave dokazujejo, da so sonce, atmosferska voda, morja (70% površine) in oblaki glavni regulatorji podnebnih sprememb in ne CO2. Razogljičenje nima znanstvene osnove!

In: Ne uničujmo narave, da bi reševali okolje!

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Kako poceni je električna energija iz obnovljivih virov

How cheap is electricity from renewable sources

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POVZETEK

Raba energije je temelj razvoja vsake civilizacije. Višja stopnja civilizacije vedno rabi več energije, kakor nižja, hkrati pa mora predstavljati manjši "strošek" za družbo. EU je sklenila, da bo svojo oskrbo z energijo "razogljičila", v nekaj desetletjih naj bi kot primarni energetske vir rabili samo še električno energijo iz "brezogljičnih" virov. Večinski delež naj bi predstavljali stohastični obnovljivi viri energije (OVE). To pa zahteva rekonstrukcijo oz. preobrazbo celotnega elektroenergetskega sistema (EES). Za ovrednotenje investicij v omenjene OVE se v svetu večinoma uporablja metode LCOE. Če je delež OVE v EES majhen, je uporaba metode do neke mere opravičljiva, kakor pa ta delež narašča pa nikakor ne. Stroški potrebnih prilagoditev ostalega EES, ki jih LCOE ne upošteva, namreč postanejo odločilni faktor in lahko za večkrat presežejo rezultat LCOE. Zato te "splošno sprejete" metode vrednotenja OVE na nacionalni ravni nikakor ne smemo uporabiti. Upoštevati je potrebno celotne stroške sistema energetske oskrbe, ki jih zajema t. i. metoda FCOE. Je pa to izjemno kompleksna naloga, saj ta zahteva dobro poznavanje obratovanja in načrtovanja EES.

ABSTRACT

The use of energy is the basis of the development of any civilization. A higher level of civilization always requires more energy than a lower level, but at the same time must represent lower "costs" for society. The EU has decided to "decarbonise" its energy supply and in a few decades only electricity from "carbon-free" sources will be used as a primary energy source. The majority should come from stochastic renewable energy sources (RES). This requires a reconstruction or transformation of the entire electricity system (EPS). LCOE method is most commonly used worldwide to evaluate investments in the mentioned RES. If the share of renewable energy in EPS is small, the use of the method is justified to some extent, but as the share increases, not at all. The costs of the necessary adjustments of the remaining EPS, which are not taken into account by LCOE, become the decisive factor and can exceed the LCOE results many times over. Therefore, this "generally accepted" method for assessing RES should under no circumstances be used at national level. The total costs of the energy supply system must be taken into account using the so-called FCOE method.

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However, this is an extremely complex task as it requires good knowledge of the operation and planning of an EPS.

KLJUČNE BESEDE

LCOE, FCOE, viri električne energije, obnovljivi viri, OVE, stroški

KEYWORDS

LCOE, FCOE, power sources, renewables, RES, costs

1 UVOD

Evropska unija in nekatere druge države so sprejele politične odločitve za spremembo paradigme oskrbe družbe z energijo. Cilji, ki so si jih zastavili so nek konglomerat različnih interesov v družbi. Glede na to, da so ljudem dostopne informacije o tem problemu, ki so v domeni medijev, iz tehnično-ekonomskega vidika v vsej EU izrazito enostranske, ni čudno, da se je večinsko volilno telo v večini EU nagnilo na stran, ki jo lahko označimo s ponarodelim izrazom "Energiewende", energijski prehod (preobrat). Povedna je izjava nekdanje nemške ministrske predsednice, ki je dejala, da bo to stalo vsakega Nemca sredstev v višini cene ene kepice sladoleda. Do sedaj je EU v novo paradigmo investirala stotine milijard evrov in strošek na povprečnega prebivalca EU se giblje v redu veličine nekaj tisoč EUR. Upoštevajoč tudi posredne stroške zaradi podražitve proizvodnje vseh dobrin zaradi vedno zapletenejših in zaostrenih okoljskih standardov je ocena 10 000 evrov na štiričlansko družino verjetno še optimistična. Precej velika kepica sladoleda, kratka.

Izkazalo se je, kar so tehniki in naravoslovno razgledani ljudje sicer že ves čas opozarjali, da so tehnične težave pri začrtani strategiji izjemno velike in predvsem drage. Politiki in PR službe so za to iznašle nov pomen obstoječe besede "izziv". Kar je tehnično ali ekonomsko praktično neuresničljivo tem ljudem predstavlja "izziv". Vedno očitneje postaja, da bo brez tako velikega posega v standard življenja, ki bi praktično pomenil zaton civilizacije, kakor jo v EU pojmuje danes, ciljev ne moremo uresničiti. Zato se rojevajo vedno nove ideje, kako to doseči, od katerih so nekatere izven vseh okvirjev realnosti. Če pojmuje "ceno" oz. "strošek" nekega potrebnega proizvoda, energenta, storitve kot merilo navora oz. aktivnosti, ki jo mora družba posvetiti, da pridobi ta proizvod, energent, storitev..., potem je seveda cena za oskrbo družbe z energijo ključni faktor pri odločitvi za oskrbo družbe z energijo.

V nadaljevanju želimo predstaviti nekatere splošne vidike stroškov pri oskrbi družbe z električno energijo

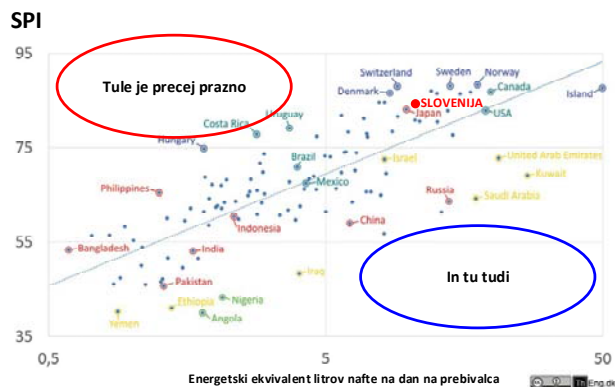
2 ALI RES RABIMO TOLIKO ENERGIJE

Zastavimo si najprej temeljno vprašanje, ki se samo po sebi porodi ob idejah za realizacijo omenjene "Energiewende". Skoraj vedno se najprej pojavi ideja, da lahko rabo energije v družbi bistveno zmanjšamo "ob skoraj" enaki kakovosti življenja prebivalcev. Če nam to uspe, bo potrebne energije manj, in čeprav bo dražja, bomo približno na istem. Pa še svet bomo rešili. V bistvu je razmišljanje povsem logično in smiselno, dokler si ga ne pogledamo pobliže.

Ni potrebno biti poseben ekspert, pa tudi zgodovina je to pokazala, da ugotovimo, da je odgovor na dilemo zelo kratek in zelo jasen. **DA, sodobna, kompetitivna in razvojno naravnana družba potrebuje veliko in vedno več ČIM CENEJŠE energije!!!** Logika, ki stoji za to trditvijo je v svoji osnovi zelo preprosta. Če želiš razvito družbo, kjer bo urejena skrb za dela nezmožne, vsem dostopno zdravstvo, šolstvo, sociala, umetnost, potem mora zelo majhen delež ljudi poskrbeti za življenje tistih, ki omogočajo prej navedene dejavnosti. Z drugimi besedami, če se ukvarja 70% neke družbe s tem, da zagotovi stopnji razvitosti družbe ustrezne osnovne pogoje za življenje članov te družbe, ostalih 30% preprosto ne more izvesti vseh ostalih dejavnosti v potrebnem obsegu. V razviti družbi mora zelo majhen delež ljudi (čim manjši, tem bolje) poskrbeti za energetske in materialne potrebe družbe. O tem nekoliko obširneje pišeta avtorja v [1]. To pa omogoča visoka stopnja avtomatizacije proizvodnje in transporta ter s tem povezana visoka raba energije. Utemeljevanje nujnosti energetskega prehoda s stališča zagotavljanja "zelenih" delovnih mest je odsev bodisi neznanja promotorjev teh idej, bodisi njihovega zavestnega zavajanja. V ZDA so izračunali ([1], str. 38), da je za isto količino energije iz sončnih elektrarn potrebno 79 krat več delavcev (ali iz nedavnega tvita twitter.com/drago_babic/: "Leta 2009 je bilo v Nemčiji pri JE, ki so proizvedle 135 TWh elektrike, zaposlenih 35.000 ljudi, danes je pri vetrnicah, ki so proizvedle letno 80 TWh, zaposlenih 160.000 ljudi."), kakor če to energijo dobimo iz premoga. Ko se bo pol ljudi v družbi ukvarjalo z montažo sončnih panelov, razkopavanjem ulic in polaganjem novih kablov, gradnjo vetrnic, uvajanjem elektronskih sistemov za pametna mesta, pametne vasi, pametne porabnike in ostale "pametne" zadeve, servisiranjem vsega tega (ker stokrat bolj komplicirana zadeva se po navadi tudi vsaj stokrat pogosteje kvvari) itd., itd., se lahko vprašamo naslednje: "Kdo bo pa zdravil, učil, pazil na nepokretne in onemogle, prideloval hrano (po možnosti EKO-BIO, brez gnojil in pesticidov in s pet krat manjšim donosom), razvijal nove tehnologije...?" To, kaj pomeni pomanjkanje zdravnikov, medicinskih sester, učiteljev, socialnih delavcev, inženirjev itd., Slovenija in Evropa že lepo občutita na lastni koži.

Tudi pri promotorjih energetske preobrazbe priljubljena čudežna skovanka "energetska optimizacija" pri vsem skupaj ne pomaga kaj dosti. Danes je pridobivanje energentov in surovin ter proizvodnja dobrin že v največji meri optimizirana, saj na globalnem trgu sicer podjetja nimajo nobene možnosti. Nenazadnje teoriji, da učinkovitejša raba energije zmanjša porabo energentov nasprotuje t. i. Jevonsov paradoks [2], ki ugotavlja (in zgodovina je to potrdila), da je učinek ravno obraten. T. Garrett [3] v skladu s tem pravi: "Če naredimo civilizacijo energetske učinkovitejšo, ji preprosto omogočimo hitrejšo rast in porabo več energije." Z drugimi besedami družba

postane bolj konkurenčna in se še hitreje razvija, za kar rabi še več energije. Kakor omenja taisti avtor lahko predstavimo človeško družbo kot neke vrste toplotni stroj [3], ki rabi energijo za njeno aktivnost, ki jo lahko merimo v BDP. V študiji, ki jo omenja so proučili družbe 2000 let v preteklost, njihov BDP in rabo energije (tudi človeške, živalske) in prišli do zaključka oz. izračuna, da je razmerje med proizvedenim BDP (oziroma SPI – Indeksom socialnega napredka, s katerim sta skoraj povsem korelirana) in rabo primarne energije skozi vso zgodovino skoraj konstanta. Sklepamo lahko torej: "Večji BDP (in s tem SPI), večja raba energije". To potrjuje tudi graf na Slika 1.



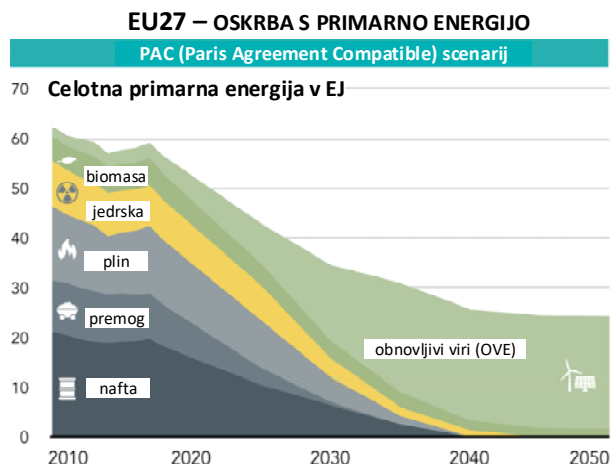
Slika 1: Indeks socialnega napredka SPI glede na rabo energije (povzeto po [4])

3 ZAKAJ RAVNO ELEKTRIČNA ENERGIJA

Prispevek obravnava (glej naslov) električno energijo. Zakaj samo njo? Odgovor dobimo, če si pobliže pogledamo politične cilje EU na področju oskrbe z energijo.

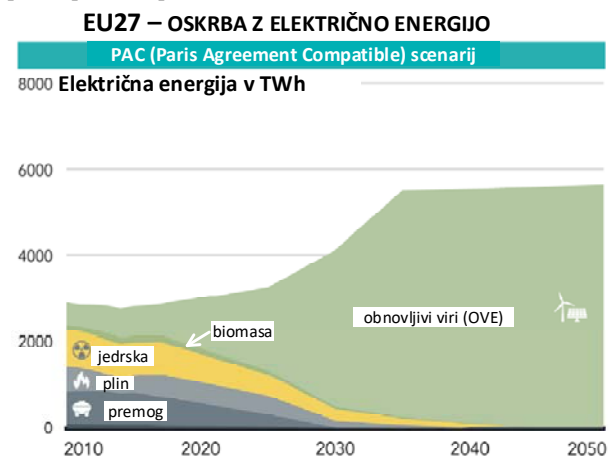
Decembra 2019 je Evropska komisija predstavila ambiciozen predlog, da bo EU27 do leta 2050 postala podnebno nevtralna. Predlog določa posebne cilje zmanjšanja emisij do leta 2030 in popolnega razogljčenja do 2050 [5]. Nadalje je Svet EU v sporočilu za javnost 27. junija 2022 objavil novico, da je dosegel dogovor o "višjih ciljih za obnovljive vire energije (OVE) in energijsko učinkovitost" [6], in sicer, da "EU do leta 2030 zmanjša neto emisije toplogrednih plinov za vsaj 55 % v primerjavi z ravnmi iz leta 1990 in hkrati doseže 40-odstotni delež energije iz obnovljivih virov v skupni mešanici virov energije do leta 2030. Hkrati naj bi se zmanjšala poraba energije na ravni EU, in sicer 36-odstotno poraba končne energije in 39-odstotkov poraba primarne energije."

Glede na zaveze [5] je ekspertna skupina v svojem poročilu za EU27 [7] predstavila pot, ki ji moramo slediti, da dosežemo tako imenovano "podnebno nevtralnost". Skladno s tem poročilom, ki je za dosego zastavljenih ciljev zahtevalo hitrejšo razogljčenje od do takrat predvidenega v EU27, je ta tudi sprejela predhodno omenjene "višje cilje" [6]. V bistvu gre za realizacijo ciljev v skladu s Pariškim sporazumom in s pomenljivim naslovom: 1.5°C pot za Evropo: doseganje najvišje možne podnebne ambicije (prevedel avtor iz: "1.5°C Pathways for Europe: Achieving the highest plausible climate ambition"). Razmere glede porabe energentov na tej poti so predstavljene na sliki 2.



Slika 2: Predlagana poraba energentov EU27 [7]

Očitno naj bi po tem scenariju celotna raba energije po letu 2050 izvirala elektrike, skratka vse na elektriko ali iz elektrike (recimo vodik, sintetična goriva). Pustimo ob strani vprašanje, kako to udejanjiti (problem električnih avtomobilov, električnih tovornjakov in ladij, polnilne infrastrukture, baterij itd.) in privzemimo, da bo praktično edini vir energije elektrika. Torej ostali energenti v primarni oskrbi sploh ne bodo več relevantni in zato pogled na scenarij proizvodnje električne energije pravzaprav vse pove – Slika 3.



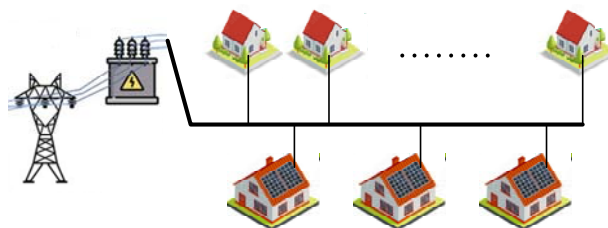
Slika 3: Od kod in koliko elektrike v EU27 [7]

4 KOLIKO PA BO TO STALO

Kot že omenjeno, pustimo denarne špekulacije s strani kogarkoli že ob strani in privzemimo, da strošek odraža pač potreben "napor" družbe, za realizacijo tega, kar strošek povzroča.

Za uspešno družbo mora biti "strošek" oskrbe z energijo čim manjši, predpogoj, da ga optimiziramo (najdemo načine, da je najmanjši možen) pa je seveda ovrednotenje investicij v oskrbo z energijo. Tu pa se zadeva lahko zelo zaplete in na videz relativno preprost problem postane skoraj nerešljiv.

Za ilustracijo si predstavljajmo, da imamo neko električno omrežje, ki napaja nek zaselek, kakor vidimo na sliki 4.



Slika 4: Shema električnega napajanja zaselka

Večina slovenskih nizkonapetostnih (NN) napajalnih sistemov (glavni vod, napajalni transformator) je bila zasnovana za povprečno električno moč gospodinjstva reda 1 ali 2 kW. Seveda lahko vsak "potegne" bistveno večjo moč, vendar to ne počno vsi naenkrat oz. se to zgodi zelo poredko in kratkotrajno in tak scenarij omrežje brez problemov prenese. Seveda se pri načrtovanju upošteva še neka rezerva, ki med drugim zajame predvideni razvoj in širitve zaselka. Tak koncept je očitno zelo uspešno deloval zadnjih približno 100 let.

Sedaj pa si predstavljajmo, da v skladu z doktrino "Energiewende" nekatera gospodinjstva želijo namestiti sončne elektrarne (SE), se ogrevati s pomočjo toplotnih črpalk (TČ) in polniti električna vozila (EV). Vsak od omenjenih porabnikov oz. proizvajalcev električne energije ima moč reda 10 kW. Pa še nekaj je nadvse pomembno. Čas visoke obremenitve omrežja ni bolj ali manj slučajno porazdeljen po porabnikih (nizek faktor istočasnosti), kakor je bil pred uvedbo novodobne tehnologije, pač pa, ko sije sonce, sije hkrati na vse SE, ko je zunaj zelo mrzlo, delajo hkrati vse TČ in prepričan sem, da bodo 31. avgusta zvečer, dan pred prvim šolskim dnevom ali 20. junija zvečer (dan pred počitnicami, beri dopustom) skoraj vsi električni avti priključeni na polnilce.

Zaradi omenjene rezerve obremenljivosti napajalnega sistema si dandanes del prebivalcev (recimo 10%, ponekod morda več, ponekod pa še manj) lahko privoščijo SE in/ali TČ in/ali domače napajanje EV. Tokovi IN NAPETOSTI ostanejo v spremenljivih mejah. Sedaj pa si predstavljajmo, da se recimo v naselju s 30 porabniki (hišami -gospodinjstvi), kjer trije že imajo SE, na obstoječe omrežje želi priključiti še četrti. To pa recimo tehnično ne gre več (in "elektro" mu ne da soglasja). Pogoj za njegovo priključitev je zamenjava obstoječega oz. dodatni napajalni vod (kabel - beri razkopavanje cest, pločnikov) in zamenjava napajalnega transformatorja. Cena prvih treh SE je torej vsebovala ceno same elektrarne in kvečjemu močnejši dovod med glavnim vodom in gospodinjstvom, cena četrtega pa omenjeno + zamenjavo glavnega voda + zamenjavo transformatorja. "Dodatni" stroški praviloma večkratno presegajo strošek SE. Tako ojačano omrežje bi morda ustrezalo za namestitev še nekaj SE, potem pa bi se našel spet kdo, ki bi moral investirati v nadaljnje ojačitve, pa morda ne le NN omrežja, pač pa morda celo naprav na srednji napetosti.

Tu se seveda porodi kar nekaj vprašanj za milijon dolarjev.

- Kdo naj kaj plača?
- Ali je prav, da prvi dobijo od "elektra" dovoljenje za instalacijo SE, ostali pa ne? Kje je tu enakopravnost? Obstoječe omrežje smo plačali vsi!
- Kako porazdeliti stroške, ko problem nastane zaradi velikega deleža SE na sredjenapetostnem ali celo visokonapetostnem sistemu, kjer "krivde" oz. vzroka

nastanka potreb po ojačitvi oz. rekonstrukciji sistema ni mogoče jasno pripisati določenemu elementu?

- Kdo bo plačal božjastno drag sistem shranjevanja električne energije na nacionalni ravni in za daljši čas, ki je tehnično nujen, če naj napajamo družbo s stohastičnimi viri?
- Kdo bo plačal škodo ob morebitnih "blackoutih" povzročenih od OVE? Ali vsi pod pretvezo "naravne nesreče?"
- Zakaj plačujemo subvencije v OVE preko dražje elektrike oz. omrežnine v Evropi vsi in na ta način vzpostavljamo "anti Robin Hood sistem", kjer revnejši subvencionirajo bogatejše?
- Kdo bo financiral pametna mesta, pametna omrežja, pametne skupnosti in kar je ostalega "pametnega", da bo moč integrirati kopico OVE v sistem?
- Zakaj bi se morali tisti, ki "s tem nimamo nič" v novodobnem elektroenergetskem sistemu prilagajati proizvodnji, se sprijazniti z večtarifnim sistemom, kot posledico integracije OVE, se sprijazniti z morebitno zmanjšano zanesljivostjo sistema ali zamenjavi žarnic in drugih čisto uporabnih naprav iz obdobja "220-tih" voltov, če sosed postavi na streho SE in nam napetost zaradi tega naraste na sicer dovoljenih 250 voltov ali čez in nam stare naprave "skuri"?

Odgovor na večino gornjih vprašanj je na žalost ob današnjem stanju duha v evropski družbi jasen in (zopet na žalost) je večina teh vprašanj retoričnih in kakor izgleda bo "nastradal povprečni Janez Novak". Zato, da se je sploh mogoče kompetentno pogovarjati (ali vsaj dajati tak videz) pa je v luči predhodnih dilem ključno naslednje osnovno vprašanje.

- "Kako ovrednotiti strošek OVE na družbo?"

V zvezi s slednjim vprašanjem se je v svetu najbolj uveljavil (verjetno zato, ker favorizira OVE) tako imenovani pristop LCOE (Levelized Cost Of Electricity) ali če skušamo posloveniti: »izravnanih stroškov električne energije«. Obstajajo tudi drugi pristopi (recimo VALCOE, LACE, LCOS), a se osredotočimo na LCOE. Ta princip upošteva pravzaprav samo investicijo v OVE in tekoče stroške obratovanja in kvečjemu investicijo v kratkotrajne shranjevalnike električne energije, ki naj bi zgladile samo največje konice oz. skoke v proizvodnji OVE in imajo kapaciteto le za nekaj ur proizvodnje OVE. Tak pristop uveljavlja tudi znana konzultantska firma Lazard v svojem poročilu (april 2023). Potemtakem ne preseneča, da v poročilu prikaže ceno električne energije iz OVE nižjo od cene "klasičnih" virov, recimo nuklearnih elektrarn (NE). Seveda pri Lazardu niso edini, pač pa se večina izračunov rentabilnosti OVE v svetu izvede po LCOE principu. Tovrstne ocene potem z veseljem povzamejo mainstream mediji in v družbi je kar naenkrat "splošno znano dejstvo", da so OVE najcenejša varianta oskrbe z energijo.

Če si LCOE princip ogledamo v luči primera iz začetka tega poglavja, bi veljal le za prve tri investitorje v recimo SE (dejali smo, da se četrti ne more več priklopiti), ki izkoristijo inherentno rezervo elektroenergetskega sistema (EES). Prvi trije plačajo torej zgolj lastno SE in dovod do centralnega napajalnega voda.

V bistvu lahko to dejstvo posplošimo na celoten EES, in sicer velja, da majhen delež stohastične proizvodnje OVE lahko brez

posebnih ukrepov oz. investicij prenese vsak EES. Ob tem se takoj pojavi vprašanje, kaj pomeni "majhen delež?" Na to pa na žalost ni mogoče dati enoznačnega odgovora. Zависи namreč od same strukture EES in lastnosti elektrarn v sistemu, z drugimi besedami od tega, kolikšen je delež elektrarn, ki se lahko brez škode prilagajajo hkrati porabnikom in stohastiki OVE, kakšne so zmožnosti prilagajanja porabe, kakšne so zmožnosti shranjevanja električne energije, kakšna je prenosna zmogljivost EES, kaka je sposobnost EES vzdrževati električne parametre v vseh točkah omrežja v varnih mejah, pa še kaj bi se našlo. Dodatno zaplete dejstvo, da nam tudi odgovor na vsa zastavljena vprašanja v nekem trenutku ne da odgovora za isti EES v drugačnem obratovalnem stanju. Če navedemo dva banalna primera, npr. situacija v istem EES je povsem drugačna v času velike porabe, kakor v času minimalne porabe, ali pa recimo, kaj pomaga velika količina prilagodljivih hidroelektrarn, če ni vode.

Vse skupaj postane seveda še bolj zapleteno, pa se spet naslonimo na obravnavani ilustrativen primer, ko hočemo priklopiti četrto SE (in kasneje peto, šesto dvajseto), za katero pa obstoječe omrežje nima več "dovolj rezerve". Naenkrat se odpre v točkah naveden kup vprašanj. Če ta vprašanja oz. dileme posplošimo na celoten EES in "električno" plat problema, se izkaže, da princip LCOE ne upošteva sprememb, ki jih je potrebno izvesti v EES, da lahko priklopimo večji delež stohastičnih OVE od navedenega "majhnega deleža", za katerega zadostuje inherentna rezerva EES.

Potrebne spremembe EES zaradi vključitve stohastičnih OVE so posledice osnovnega fizikalnega dejstva, da mora biti v EES vstopajoča energija v vsakem trenutku enaka iz EES izstopajoči energiji, hkrati pa mora biti frekvenca električne napetosti konstantna oz. se sme spreminjati v zelo ozkih mejah okrog nazivne (v Evropi 50 Hz). To, da mora biti EES in njegovi elementi zgrajeni tako, da omogočajo pretok zahtevane energije ob hkratnem zagotavljanju kakovostne napetosti porabnikom V VSAKEM TRENUTKU je samo po sebi umevno dejstvo. Z drugimi besedami tok ne sme preseči določene vrednosti, napetost se mora gibati znotraj nekaj % okrog tako imenovane nazivne vrednosti. (Če smo zelo natančni, slednjega ni moč vedno in v popolnosti zagotoviti, recimo med okvarami v EES, zato se odstopanje tolerira v posebnih primerih za kratke čase.). Če torej želimo vzpostaviti na stohastičnih OVE temelječ in hkrati samozadosten EES ter prehod ogrevanja in osebne mobilnosti na elektriko, bi bilo potrebno poleg same izgradnje OVE (kar predvideva metoda LCOE) ustrezno prilagoditi EES. To pa pomeni kup nadaljnjih investicij.

- Nadomestno proizvodnjo, ko OVE ne dajo nič ali ne dajo dovolj energije vsaj za en ali dva meseca. "Brezogljivična" alternativa za to so baterijski shranjevalniki električne energije ali morda proizvodnja vodika in/ali sintetičnih goriv. Prva možnost je izven domene realnega, saj trenutna svetovna proizvodnja vseh baterij ne pokrije niti potreb Slovenije za kaj takega, drugi dve alternativni pa sta nesprijemljivo dragi in povezani z enormnimi izgubami energije.
- Kompletno bi bilo potrebno prenoviti slovenski NN sistem in mu za nekajkrat povečati prenosno zmogljivost, kar pomeni zamenjavo ca. 46 000 km vodov in ca. 16 000 transformatorjev. Samo stroške tega nekateri ocenjujejo na reda 10 mrd evrov. Kdo bi dobil potrebna dovoljenja, mehanizacijo in delovno silo za izvedbo česa takega v

naslednjih nekaj letih bi moral imeti verjetno magične sposobnosti Marvelovih superjunakov.

- Prenoviti bi bilo potrebno tudi večino distribucijskih sistemov in velja v principu ugotovitev iz prejšnje točke.
- Ker imajo OVE relativno zelo majhne obratovalne ure (v kolikšnem času polne obremenitve bi proizvedli dejansko proizvedeno energijo – SE v Sloveniji recimo reda 11%), bi bilo potrebno dimenzionirati proizvodnjo OVE, prenos energije in shranjevalnike na nekajkratnik sedanje nazivne moči naprav. Torej tudi prenosni nivo EES ne bi mogel uiti krepki razširitvi. Tu pa postanejo zadeve še bolj zanimive. Če sklepamo po preteklih izkušnjah je namreč za postavitve 400 kV daljnovoda v naših logih in okolici potreben čas okrog 30 let (daljnovoda Maribor – Dunaj in Krško – Beričevo). HE Mokrice "umeščajo v prostor" okrog 10 let, pa po meni znanih podatkih prve lopate še niso zasadili.
- Če bi se odločili za shranjevanje električne energije v sintetični metan ali vodik bi bilo treba zgraditi ustrezno infrastrukturo, ki bi morala biti dimenzionirana na nekajkratnik sedanje moči EES Slovenije, saj bi v kratkem času visoke proizvodnje OVE morali shraniti energijo za daljši čas. Poleg tega bi morala biti proizvodnja električne energije še reda 2 x višja, kakor pri shranjevanju z akumulatorji, ker je izkoristek pri pretvarjanju iz elektrike v metan ali vodik, transportu in hranjenju zelo veliko izgub. Pretvorba nazaj v električno energijo pa izkoristek dodatno še drastično zniža.
- Vsemu temu lahko dodamo še škodljive vplive na družbo zaradi ogromne potrebe po bakru, grafitu, litiju, kobaltu redkih zemljah – beri rudarjenju gigantskih razsežnosti, ki jih tak sistem zahteva. Nakup surovin ali elementov EES drugje ne zmanjša vpliva na okolje, samo prestavi ga drugam, po navadi tja, kjer so okoljski standardi bistveno nižji, kot v EU, da o suženjskem delu ne govorimo.

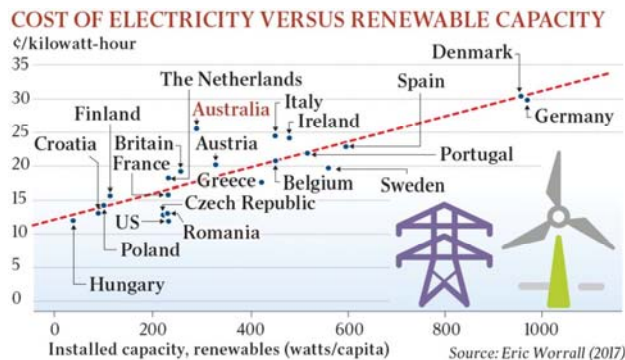
Namerno dolga interpretacija vplivov OVE na potrebo po rekonstrukciji celotnega EES je bila izbrana, da čim jasneje ilustrira, zakaj je metoda **LCOE povsem neprimerna** za ovrednotenje stroškov električne energije OVE. Če bi jo že lahko do neke mere uporabili pri majhnih deležih OVE v EES pa z rastjo deleža OVE in s tem potreb po prilagoditvi ostalega EES, postaja vedno manj primerna. O tem pišeta nekoliko obširneje avtorja v [8] in predlagata tako imenovano metodo FCOE (Full Cost Of Electricity), torej "polne" stroške električne energije iz virov, ki poleg stroškov:

- izgradnje,
- goriva in
- obratovanja

(metoda LCOE) upošteva tudi stroške:

- prenosa energije,
- prilagajanja EES stohastiki proizvodnje,
- hranilnikov energije,
- rezerve,
- vpliva na okolje,
- recikliranja OVE po koncu življenjske dobe,
- rabe prostora (cena zemljišča neposredno in posredno zaradi znižane vrednosti okoliških zemljišč),
- ostali vplivi in metrika (recimo ERoEI).

Omenjene dodatne stroške FCOE je zelo težko ovrednotiti, so pa očitno znatni in OVE postanejo z večanjem njihovega deleža krepko dražji od klasičnih virov elektrike (slika 5).



Slika 5: Več OVE, dražja elektrika (trend - rdeča črtkana črta – znaša 0,03 centa/kW dodatne moči OVE)

kljub temu, da je kup relevantnih igralcev na svetovni sceni (IEA, IEEJ, IMF, ACE, OECD) neposredno ali "med vrsticami" označilo LCOE kot povsem neprimerno metodo za vrednotenje investicij v stohastične OVE (Jože P. Damjan v svoji kolumni omenja 106 000 zadetkov na iskanje »what is wrong with LCOE«), pa se za upravičevanje investicij v stohastične OVE v veliki večini še vedno uporablja LCOE. In seveda investicija v omenjene vire je ekonomsko ugodna, gradi se jih na veliko, a glej čudo! Najdražjo elektriko imajo države z največ OVE. Očitno torej s "splošno znano resnico", da so OVE najcenejša alternativa, s katero vehementno opletajo nekateri mediji, nekaj ni v redu. Nenazadnje, zakaj za božjo voljo rabijo subvencije, ko sta vendar sonce in veter zastoj, cena OVE pa tako nizka?!

5 Sklep

Rabi energije se, če želimo ostati vsaj na približno enaki civilizacijski ravni, ne moremo izogniti. Fantazije o "odrastu", večji kakovosti življenja vseh in manjši rabi energije, optimizaciji proizvodnje, čudežnih "prebojih" in hkrati ohraniti obstoječe kakovosti življenja, dobrobiti množice "zelenih delovnih mest", da ne naštevam public dalje, so res samo fantazije. Eden od načinov, kako ljudem "prodati" bajko o rešitvi matere Zemlje s stohastičnimi OVE in jim hkrati iz denarnice za to izvleči kar je le mogoče je, da jim potem, ko si jih prestrašili, da se bo Zemlja skuhalo, če ne ukrepamo, prepričaš, da imaš rešitev, ki je poleg vsega še "najbolj poceni". Natanko to dosežemo, če uporabimo splošno uporabljeno metodo LCOE za vrednotenje investicij v stohastične OVE. Če imamo opravka z majhnim deležem OVE v EES je uporaba metode do neke mere opravičljiva, kakor pa ta delež narašča (in utopična ideja EU načrtovalcev evropske energetske politike je korakanje proti 100 %) pa nikakor ne. Stroški potrebnih prilagoditev ostalega EES namreč postanejo odločilni faktor in lahko za večkrat presežejo tiste, ki jih upošteva LCOE. Zato te "splošno sprejete" metode za ovrednotenje investicij v stohastične OVE na nacionalni ravni nikakor ne smemo uporabiti. Če nas zanima resnica, seveda. Upoštevati je potrebno celotne stroške, ki jih zajema t. i. metoda FCOE. Je pa to izjemno kompleksna naloga, saj zahteva

poznavanje množice parametrov, ki jih lahko le ocenimo. Ne glede na to pa da odgovor bistveno bliže realnosti, kakor LCOE.

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German Energiewende Between Ideology and Reality

Nemški Energiewende med ideologijo in stvarnostjo

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ABSTRACT

The article describes the goals and course of the German Energiewende from the early 1980s to today's situation. Despite huge investments and subsidies, they are reaching their goals with difficulty. High energy prices have negative consequences for industry and the political stability of the country. Energiewende is therefore at a turning point. To achieve the goals in 2030, the construction of regenerative resources should double or triple, which is not realistic due to financial problems, problems with bureaucracy, and the acquisition of raw materials.

KEYWORDS

German Energiewende, development, state, achievements, problems for the future.

POVZETEK

Članek opisuje cilje in potek nemške Energiewende od začetka osemdesetih let prejšnjega stoletja do današnjih razmer. Kljub velikim investicijam in subvencijam svoje cilje dosegajo s težavo. Visoke cene energije imajo negativne posledice za industrijo in politično stabilnost države. Energiewende je zato na prelomnici. Za dosego ciljev leta 2030 bi se morala gradnja obnovljivih virov podvojiti ali potrojiti, kar pa zaradi finančnih težav, težav z birokracijo in pridobivanjem surovin ni realno.

KLJUČNE BESEDE

Nemški Energiewende, razvoj, stanje, dosežki, problemi za prihodnost.

1 INTRODUCTION

The German Energiewende has its roots in the 1970s, when the protests against nuclear weapons began in Germany. This movement later evolved into the Green Party. In the early 1980s, demands were made for a change in energy policy and the closure of nuclear power plants, especially after the Chernobyl accident. These demands were then called the

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Energiewende.[1] In the late 1980s, CO₂ emissions became the main target of environmentalists because they are considered to be the main cause of climate change. In 1988, the IPCC Committee was established under the auspices of the UNO, which has since been a leading force in the "combat" against climate change. IPCC collects research and publications on climate change and, according to its own judgement, prepares reports on the consequences of climate change due to the increase in CO₂ in the atmosphere. The climate problem has become one of the most important issues in global politics. But the long-term success of measures against climate change would only be successful if the whole world acted in a coordinated manner and also kept its promises. This is, however, unlikely.

In 1992, the 1st Climate Conference was convened in Brazil, followed by such conferences almost every year. In 1997, Kyoto adopted the first, still optional promises to reduce CO₂ emissions by 2008, and then new commitments at the Paris Conference in 2015. Germany has been one of the main promoters of this ideology and wants to set an example for other countries in reducing CO₂.

They respond to the criticism that Germany by itself cannot save the world with less than 2% of total CO₂ emissions: If we show that the Energiewende is economically successful and increases people's satisfaction and well-being, others in the world will follow. Unfortunately, this has proved to be an illusion.

2 OBJECTIVES ENERGIEWENDE

In the beginning, the goal of Energiewende was to replace nuclear and coal power plants with regenerative sources, mainly wind farms, since there were no cheaper solar panels available at the time.

They committed themselves to reduce CO₂ emissions, compared to 1990 by 40% by 2020, by 65% by 2030 (here Germany tightened the EU requirement by 55%), by 80% by 2040 and to achieve climate-neutrality by 2045 (in the EU by 2050) [2]. In addition to the needed change in the structure of electricity production and the necessary network restructuring, this means also decisive long-range changes in industry, heating, agriculture and transport.

The first target for 2020 was not achieved by Germany for both subjective and objective reasons. In 2022, the crisis in the industry and the related reduction of emissions in this area enabled to achieve the target. The target for 2030 is, in the opinion of the profession, unattainable. And the goal for 2045 is so far away that all the guarantees whether they will achieve this are just speculation.

However, with a different, non-ideological, strategy, Energiewende could be more successful. This was shown by a study done by the ETG / VDE (Energie-Technische Gesellschaft) in the early time of planning for Energiewende. Independently of politics, she explored the best technical and economical way: to retain and build additional nuclear power plants if necessary and build wind turbines in wind-friendly regions. In addition, a smaller number of gas turbines to quickly compensate for changes in production from windmills. However, politics revised this solution and insisted to close all nuclear power stations.

3 STATE OF ENERGIEWENDE

Figure 1 [3] shows the sources of primary energy consumption for 2020. In recent years, there have been few changes. Although nuclear power plants have been shut down, additional old coal-fired power plants have had to be activated. The share of regenerative sources is only 16.5%. In just over 22 years, 84.5% of energy needs should be produced with wind turbines, solar panels, biomass and hydrogen, in the hope that this technology will be available for the needs of industry, traffic and power plants by then.

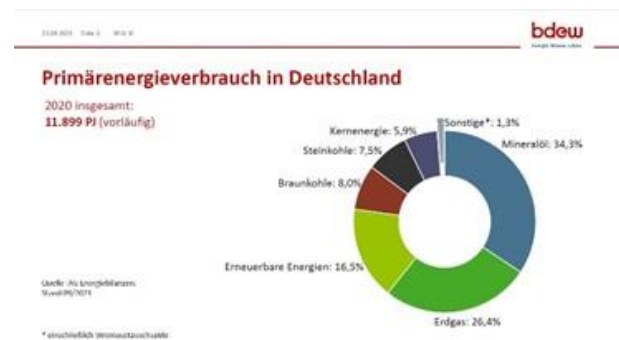


Figure 1: Primary energy consumption in Germany (year 2020)

In the past, the focus of Energiewende lay mainly on coal power generation, the last of which should be closed by 2038. This is to be made possible by the determined construction of wind turbines and the solar panels. Wind turbines are built mainly in the north of the country, where there are very good conditions for wind. In addition to on shore wind turbines, they also force offshore wind turbines, which are much more expensive. And since all this is not sufficient, they require the installation of wind turbines throughout Germany. Each German Land has to make 2% of its territory available for this purpose.

By the beginning of 2023, about 30,000 wind turbines had been installed. 2022 was a very favorable year for the wind. They produced 123 TWh of energy, which means about 25% of the total demand. However, the installed power of these wind turbines is (for comparison: the maximum load peak in this year was 40 GW) more than 66 GW.

The large-scale construction of solar panels began after 2010, when the Chinese achieved significantly lower costs with further development and rationalization of production. With guaranteed consumption of this energy and high price, the installation of large solar complexes has become a very profitable also for private investment. Currently, the rated power of installed panels is about 60 GW. In 2022, they produced 54 TWh of energy, which amounts to only 11% of annual consumption.

In 2022, regenerative sources, in addition to wind turbines, photovoltaic, water production and biogas plants, produced a total of 46% of annual consumption. The rest must be covered by coal, natural gas and 3 nuclear plants.

The main goal of Energiewende, of course, is to shut down all fossil fuel power plants. To close coal mines by 2038, the state will pay €40 billion. However, due to the closure of nuclear power plants, they had to additionally activate old, dirty coal power plants. With this, Germany again increased its CO2 emissions and thus further deviated from its goals.

The construction of wind turbines and solar panels and the guarantee for the consumption of all electricity produced required huge investments, which the State further subsidized. Large subsidies and taxes increased the therefore price of electricity intensive.

There are various estimates of the costs to date, with a real value of at least €500 billion, equivalent to €25,000 for a family of four.

Of course, all these costs have an impact on the price of electricity for private consumption. Figure 2 [4] shows this development. Different cost shares are also shown. The charge for regenerative sources amounts to more than 25% of the price. Higher network charges due to changes in the network and higher production costs also have an increasing impact on the price.

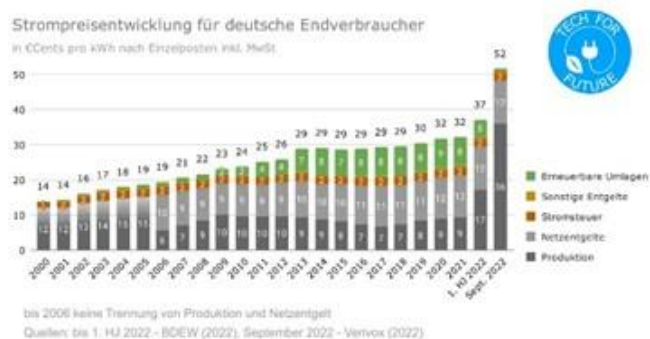


Figure 2: Electricity price development for German consumers

The electricity price for industry follows a similar pattern of about 55% of the above values. The electricity price is, however, 50% higher in Germany than the EU average.

According to the figure, the price jumped sharply in 2022 because of the gas crisis resulting from the Russian invasion of Ukraine. In 2023, the price cap, decides by government, lowered the price slightly again. However, the high energy price resulting from the Energiewende and the withdrawal of the nuclear plants threatens the stability of the German economy and thus also political stability.

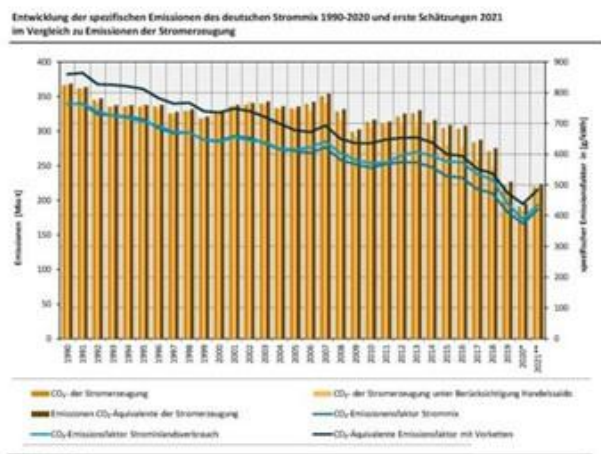


Figure 3: Emissions of the German electricity mix 1990-2021 (bars: emissions in Mio t; curves: specific emission factor in g/kWh)

Figure 3 [5] shows the values of CO₂ emissions in Mio t and the corresponding emission factors in g/kWh. The values are entered until 2021. However, the values in 2022 (not shown in the figure) increased again, mainly due to the closure of nuclear power plants and their replacement by coal-fired power plants. By 2022, the emission factor was reduced compared to 1990 from 746 g / kWh to 498 g / kWh, i.e., by only 35%. Less than expected.

The current situation of the Energiewende is shown in Figure 4 [6]. This is for the electric supply (which we discuss in this article as a priority), for heating and transport. The fields cover about 60% of total CO₂ emissions. The progress in electricity reached about half, but in the other two are only at the beginning. They want to make progress in heating with heat pumps and hydrogen, although hydrogen technology is not yet developed for mass use. In transport, they are betting on electric cars, although they are also far below the plans here. The actual share of electric cars in Germany is only 2%. Measures for both sectors also mean great additional electricity needs, which was not considered in the Energiewende.

A comparison with France shows that Germany has big problems with reducing CO₂ in this area because of its opposition to nuclear power. France achieves 5 times less emission factor of 92 g / kWh because of use of nuclear power plants. Germany, if the plan goes ahead, would not reach this value until 2040.

For further development, this means need for faster construction of wind turbines and photovoltaics. For wind turbines, they require that 4 to 5 units and three times more solar should go into operation per day. To replace coal-fired power plants, 50 gas-fired power plants would need to be built to cover the needs at times when there is no wind or sun and to enable operation of the total system. Connections with HVDC north-south transmission and large reconstruction of the distribution networks are necessary to connect solar panels and power heat pumps and electric cars.

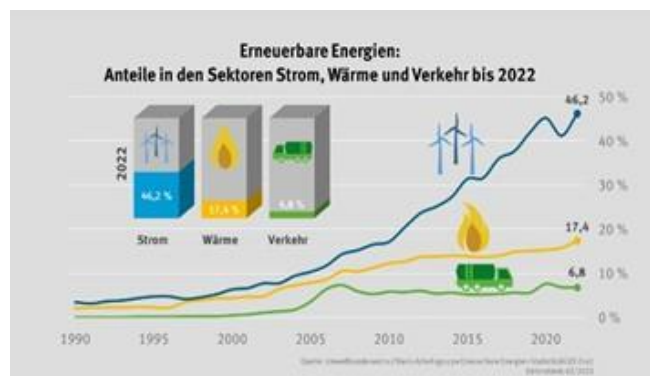


Figure 4: Renewable energies. Shares for electricity, heat and transport until 2022

They do not talk officially about the cost up to the year 2030. However, some estimations speak for more than 1000 billion € [7].

4 FUTURE OF ENERGIEWENDE

Politics promised people that the Energiewende would not lead to high energy costs, create new, high-quality jobs, and increase the prosperity of the country.

The reality is different. Investments and subsidies have led to extremely high electricity prices. This has been, of course, compounded additional by the financial crisis and problems caused by the loss of cheap Russian gas. The prices for households are 50% higher than the EU average. The prices for industry are 3 to 5 times higher than in the USA or China. The consequences of this are the loss of competitiveness of German industry, with the decline in production and the relocation of energy-intensive industries abroad.

To achieve the goals in 2030, we would need to accelerate the construction of regenerative sources by a factor of 2 to 3. From the current 1-2 to 4-5 windmills a day and several times more solar panels. To restore the electricity grid, 990 km of new transmission lines and cables would be needed, although in recent years they have managed to handle only 164 km per year. In addition, what is not even mentioned, the construction of about 50 new gas power stations if we wanted to close most coal-fired power plants. Cost estimates are over €1000 billion.

Due to bureaucracy, permits for the construction of new installations take 5 to 10 years. In addition, people opposition hinders the construction of windmills. For the first HVDC north-south connection, it has taken 10 years and they still cannot determine the final route. For example: for the short cable section, they need 19,000 pages of documentation.

Accounts also show that there cannot be enough materials (cement, iron, copper, cobalt) available at the existing capacity, and an even more serious problem is the lack of critical raw materials as rare earths, 90% of whose production is controlled by the the existing capacity, and an even more serious Chinese.

5 CONCLUSIONS

Energiewende, as they imagined at the beginning, is in a one-way street with the dead end resulting in serious degradation of living standard and political instability in the country.

However, the current political option (yet) is not ready for significant corrections. The solution, or at least the mitigation of the problems, would be what the current opposition promises: Accept that the climate is not the only priority. Compromise must be found between the economy and ecology as the successful economy first enables investment for ecology. This also means the reactivation of existing nuclear power station at least for some time and slowdown of the Energiewende. However, possible revision in the global climate policy could have also impact on the German Energiewende.

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Toplogredni učinek ozračja – ali sploh obstaja?

Atmospheric Greenhouse Effect – Does It Exist

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POVZETEK

Problem izračuna efektivne povprečne temperature planeta je v osnovi domneve o učinku tople grede ozračja (kar ni bilo nikoli fizikalno dokazano). S tem je povezan problemom ocene vpliva na podnebje s strani naravnih procesov in človeškega vpliva prek izpustov tim. 'toplogrednih' plinov. Pri IPCC izhajajo iz termičnega sevalnega ravnovesja tako, da iz povprečnega izstopnega sevanja ($\sim 240 \text{ W m}^{-2}$) neposredno izračunajo povprečno temperaturo (255K), ki pa je premajhna glede na dejansko izmerjeno (288K). Razliko (33K) pripišejo učinku tople grede ozračja, zaradi česar so ocenjeni vplivi 'toplogrednih' plinov preveliki in posledično klimatski računalniški programi napovedujejo segrevanje, za katerega že zdaj vidimo, da je preveliko glede na dejansko zabeleženo hitrost segrevanja planeta ($\sim 0,15 \text{ K}$ na desetletje). Drugačen izračun, podoben tistemu s katerim ameriška vesoljska agencija NASA izračunava temperaturo Lune in drugih teles brez ozračja, daje rezultat, ki odpravi potrebo po domnevi o toplogredne učinku ozračja in daje osnovo za bolj realne napovedi.

KLJUČNE BESEDE

Keywords in the language of the paper, keyword, keyword, keyword

ABSTRACT

The problem of calculating the effective average temperature of the planet is at the basis of the alleged greenhouse effect of the atmosphere (which was never physically proven). The problem of estimating the natural versus anthropogenic influence on climate is closely related to this calculation. In IPCC reports the idea of thermal radiation balance is used to obtain the average outgoing thermal radiation ($\sim 240 \text{ W m}^{-2}$) to directly calculate the average temperature (255K), which is too small compared to the known value (288K). The difference (33K) is attributed to the atmospheric greenhouse effect and because of that the estimated influence of the greenhouse gases is too large. Consequently the climate computer programs are giving warming projections which are large in comparison with the measured warming rate

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($\sim 0.15 \text{ K}$ per decade). A different calculation, similar to the one used by NASA to calculate the temperature of the Moon and other bodies with weak or no atmosphere, eliminates the need for the atmospheric greenhouse effect and gives the basis for more realistic projections of future climate.

KEYWORDS

If writing in Slovene, add English keywords below the Slovene ones, keyword, keyword, keyword

1 UVOD

Vprašanje v naslovu se seveda nanaša na primer odprtega ozračja, ne pa na zastekljeni rastlinjak. Prvo teoretično razlago učinka tople grede je podal Jean-Baptiste Joseph de Fourier. Slavniti matematik je kot topniški general v Napoleonovi vojski spoznal problem širjenja topovskih cevi pod vplivom toplote, kasneje pa je svoje raziskave razširil še na druge materiale, tudi zrak. Za tolo grede je zapisal: "Če segretemu zraku preprečimo, da se dviga in širi, ter s tem ohlaja, potem ...". Fourieru je torej bilo jasno, da v odprtem ozračju toplogrednega učinka ni, oziroma je lahko le kratkotrajen, dokler se ne vzpostavi vertikalni zračni pretok.

"Podnebne spremembe so resnične, povzročajo jih človek in so nevarne!", je bilo jedro sporočila predsednika ZDA Baraka Obame v govoru, ki ga je imel v Skupščini Združenih narodov leta 2009. Enaka sporočila poslušamo prek množičnih medijev že kakšnih 35 let s strani številnih podnebnih aktivistov, politikov, pa tudi znanstvenikov. Znanstveno podlago za take trditve najdemo v poročilih, ki jih vse od svoje ustanovitve leta 1988 vsakih nekaj let izdaja Medvladni odbor za podnebne spremembe, IPCC (Intergovernmental Panel for Climate Change) [1].

Pri tem se pojavljajo trditve, da je o problemu podnebnih sprememb znanost že vse dorekla ('science is settled'), da je čas za razprave že potekel in je sedaj čas za akcijo. Ostra medijska kampanja o tej temi pa je v zadnjem času šla tako daleč, da že mnogi odkrito pozivajo, da je dvomljivcem in 'zanikovalcem' (termin je namenoma izbran tako, da spominja na zanikovalce Holokavsta po drugi svetovni vojni) podnebnih sprememb onemogočiti dostop do medijev in jim tako preprečiti širjenje 'neresnic in zavajanj'.

Tovrstna politična cenzura je sicer pogosta v ideoloških in političnih razpravah, toda v znanstvenih razpravah cenzure in dogmatskega razmišljanja ne smemo tolerirati, ker to pomeni konec znanosti. Bistvo znanosti je ravno v tem, da se že dosežena spoznanja v luči novih dognanj ponovno preverijo in ovrednotijo, ter po potrebi ustrezno popravijo, ali pa občasno v celoti zavržejo in se nadomestijo z novo teoretično paradigmo. Pri tem je od ključnega pomena odprta razprava o vseh vidikih problema, od osnovnih predpostavk, metodologije izvajanja eksperimentov in analize ugotovljenih podatkov in zakonitosti, primerjanja s teoretično izpeljanimi rezultati, umeščanja v strukturo že obstoječega znanja, pa do njihovih znanstvenih in filozofskih interpretacij.

Eden od temeljev, na katerih stoji domneva o človeškem vplivu na podnebje je učinek tople grede, ki naj bi bil pogojen s sevalnim ravnovesjem planeta. Institucija v kateri sem zaposlen nosi ime najslavnejšega fizika slovenskega rodu, svetovno znanega ravno po dognani zakonitosti termodinamičnega sevalnega ravnovesja. Zato se mi zdi primerno, da o tem spregovorim nekaj besed.

Jožef Stefan in njegov učenec in asistent Ludwig Boltzmann sta eksperimentalno dognala, da je sevanje idealnega črnega telesa v termodinamičnem ravnovesju sorazmerno četrti potenci absolutne temperature. Konstanta sorazmernosti je v tem primeru Stefanova konstanta, označena z grško črko sigma. Zakonitost simbolično zapišemo takole:

$$j^* = \sigma T^4$$

Pri tem je:

- j^* gostota sevalne moči (na površinsko enoto) v enotah [Wm⁻²]
- σ Stefanova konstanta: $5,67 \times 10^{-8} \text{ Wm}^{-2}\text{K}^{-4}$
- T absolutna temperatura v Kelvinih [K]

Ob tem je treba upoštevati predpostavko, da se sevalna površina obnaša kot idealni Lambertov sevalnik, ki seva v pol-krogelni prostor z jakostjo odvisno od kosinusa sevalnega kota, merjenega glede na normalo na sevalno površino. Kasneje je bila Stefanova konstanta teoretično izpeljana s pomočjo drugih fizikalnih konstant in na teoretičnih osnovah Boltzmannove termodinamike:

$$\sigma = (2/15) \pi^5 k^4 c^{-2} h^{-3}$$

Tu je k Boltzmannova konstanta, h je Planckova konstanta in c hitrost svetlobe v vakuumu. Planckov zakon sevanja pa je le nekoliko drugače zapisan Stefan-Boltzmannov zakon, in sicer v odvisnosti od frekvenčnega spektra sevanja.

Telo, katerega sevanje ne ustreza Planckovi spektralni funkciji idealnega črnega telesa, je možno modelirati s pomočjo dodatnega faktorja emisivnosti ϵ , katerega vrednost je med 0 in 1, odvisno od fizikalnih lastnosti sevalne površine. Vendar je v splošnem emisivnost funkcija valovne dolžine, pa tudi temperature, kar pa običajno za nizke temperature zanemarjamo,

saj je v takih razmerah emisivnost večine materialov blizu vrednosti 1.

Eksperimentalno je mogoče ugotoviti, da spektralna funkcija sončnega sevanja ustreza Planckovemu spektru z maksimumom pri valovni dolžini 555 nm, kar ustreza temperaturi fotosfere okoli 5772 K (že Stefan je izračunal, da mora biti temperatura sončeve fotosfere okoli 5700 K). Efektivno temperaturo Sonca lahko uporabimo za določitev gostote sevalne moči, ki pa se na razdalji zemeljske orbite zmanjša za razmerje kvadratov radijev Sonca in zemeljske orbite, R_s^2/R_o^2 :

$$j^* = (R_s^2/R_o^2) \sigma T^4$$

Tako dobimo sevalno gostoto moči na razdalji zemeljske orbite, ki jo imenujemo solarna konstanta in jo običajno označujemo kot $S_o = 1366 \text{ Wm}^{-2}$ (čeprav ni ravno konstantna, malo se spreminja, saj je odvisna od sončeve aktivnosti, eliptičnosti zemeljske orbite, pa tudi položaj velikih zunanjih planetov vpliva na spremembo položaja Sonca glede na težišče sistema). To vrednost in njene majhne spremembe potrjujejo satelitska merjenja.

2 KAKO PRI IPCC DOLOČIJO UČINEK TOPLE GREDE?

Iz solarne konstante pri IPCC izpeljejo povprečno gostoto sevalne moči, ki segreva površje planeta tako, da upoštevajo še albedo $a = 0,3$ ker se okoli 30% sevanja odbije v vesolje. Vstopno sevanje doteka skozi površino navidezne velikosti zemeljskega diska πR_z^2 , med tem ko celotno površje Zemlje $A_z = 4\pi R_z^2$ seva kot približno črno telo proti vesolju. Če velja enačba za termično ravnovesje med vstopnim in izstopnim sevanjem lahko zapišemo:

$$(1-a) \pi R_z^2 S_o = 4\pi R_z^2 \sigma T_e^4$$

Površinski faktor πR_z^2 okrajšamo, nakar izrazimo efektivno temperaturo planeta takole:

$$T_e = [(1-a) S_o / 4\sigma]^{1/4}$$

Ko v to relacijo vstavimo ustrezne količine dobimo $T_e = 255 \text{ K}$ (ali -18°C). To naj bi bila temperatura brez ozračja, vendar z obstoječim albedom, ki vključuje oblake! Vendar vemo, da je dejanska povprečna temperatura planeta precej višja, $T_p = 288 \text{ K}$ (ali 15°C). Razliko pri IPCC pripišejo učinku tople grede ozračja, ki naj upočasnjuje odtekanje dela sevanja proti vesolju in s tem segreva ozračje:

$$T_{utg} = T_p - T_e = 33 \text{ K}$$

Dejansko sevalno ravnovesje planeta nastopa pri $T_e = 255 \text{ K}$ na višini približno 5 km, kjer je ozračje približno pol manj gosto in je pritisk približno polovica tistega pri površju. To lahko razložimo tudi s pomočjo kvantno-mehanskih verjetnosti, da posamezna molekula zajame ali spontano izseva foton pred

trkom s sosedno molekulo, vendar se s tem tu ne bomo ukvarjali. Pri IPCC potem sklepajo, da se zaradi povečanja vsebnosti toplogrednih plinov v ozračju (predvsem CO₂) spodnje plasti ozračja dodatno segrejejo za faktor, ki ga je možno izračunati, če poznamo Tutg in termično občutljivost na podvojitve vsebnosti CO₂, kar je mogoče izmeriti v laboratoriju. Pravzaprav merimo spremembo gostote sevalne moči, če gre sevanje skozi plin, seveda pa je sprememba sorazmerna spektralni absorpciji plina pri določeni koncentraciji. Izmerjena odvisnost absorpcije od koncentracije CO₂ se dobro prilega logaritmični funkciji [2]:

$$\Delta F = 5,35 \ln(C/C_0)$$

kjer je razmerje koncentracij $C/C_0 = 2$ (v primeru podvojitve). Sledi $\Delta F(2) = 3,7 \text{ Wm}^{-2}$. Potrebujemo še podatek za koliko se spremeni površinska temperatura T_p za omenjeno spremembo vsiljenega segrevanja. Za podrobno izpeljavo tu ni prostora, podana je v literaturi [3], nam pa naj zadošča naslednja relacija:

$$\Delta T_p = \Delta F \{T_p / [(1-a) S_o]\}$$

Potemtakem za $T_p = 288 \text{ K}$, $a = 0,3$ in $S_o = 1366 \text{ Wm}^{-2}$ dobimo $\Delta T_p = 0,301 \Delta F$, oziroma za razmerje koncentracij $\Delta T_p = 1,61 \ln(C/C_0)$. Ob $C/C_0 = 2$ torej dobimo $\Delta T_p = 1,11 \text{ K}$. Vsaka podvojitve koncentracije CO₂ bi nas torej ogrela za le 1,11 K – če vse ostalo ostane enako.

Vendar s tem takoj naletimo na težavo. Zgodovinsko se je koncentracija CO₂ od leta 1950 do danes povečala z 310 na 420 ppm (parts per million, volumskih delov na milijon), ali za 35%, torej smo še zelo daleč od podvojitve. V istem času pa se je povprečna globalna temperatura povišala za okoli 0,8 K. Iz tega pri IPCC sklepajo, da mora biti dejanska klimatska občutljivost za podvojitve koncentracije CO₂ približno trikrat večja, vsaj 2,4 K. Temu dodajo še manjši vpliv drugih toplogrednih plinov, ter odštejejo vpliv aerosolov in visoke oblačnosti, zato domnevajo, da mora biti klimatska občutljivost v območju med 2,5 in 3,5 K (v literaturi sicer najdemo vrednosti od 0,4 do 6 K; pri enem temeljnih klimatskih parametrov ni ravno visokega soglasja).

Kako pojasnjujejo to večjo občutljivost? Najpomembnejši toplogredni plin je v resnici vodna para, vendar jo IPCC obravnava kot nevtralnega, saj naj bi se s povečanjem vodne pare v zraku sorazmerno povečala tudi oblačnost, ki del sončnega sevanja odbije nazaj v vesolje in tako zmanjša segrevanje tal in posledično temperaturo ozračja. Toda za pojasnitev omenjene razlike v občutljivosti vendarle vpeljejo pozitivno povratno zanko prek vodne pare: več CO₂ ogreje ozračje, to potem lahko po Clausius-Clapeyronovi relaciji omogoča zraku da vsebuje več vodne pare, kar dodatno segreje ozračje, zato se ogreje tudi površje oceanov, ki izpusti več CO₂, in tako v krog, dokler ne nastane novo sevalno ravnovesje.

Tako dobljena 3× večja občutljivost ponuja možno razlago zakaj računalniški klimatski modeli (CMIP5, CMIP6) vsi po vrsti (razen dveh Ruskih modelov, INM RAS CM) napovedujejo hitrejšo rast temperature (v povprečju 3× hitreje), kot nam kažejo meritve ozračja z meteorološkimi baloni in sateliti.

Mnogi raziskovalci pa pravijo, da gledano v celoti vodna para ne more imeti ojačevalnega učinka [4], saj na temperaturo planeta močno vpliva oblačnost. Po nekaterih ugotovitvah bi vpliv toplogrednih plinov odtehtala že sprememba oblačnosti za okoli 2%. Poleg tega pa sevalno ravnovesje ni edini način prenosa toplotne energije v ozračju, približno 1/4 odpade na konvekcijo. Prav tako planet nikoli ni v popolnem termodinamičnem ravnovesju, saj se zaradi rotacije izmenjujeta dan in noč, razdalja od Sonca se spreminja, ker se spreminjajo orbitalni parametri, zračni in oceanski tokovi prenašajo toploto iz ekvatorialnega pasu proti poloma, pa tudi ogromna termična kapaciteta oceanov zamika prenos toplote za več stoletij. Zato je uporaba Stefan-Boltzmannovega zakona za izračun efektivne povprečne temperature brez dodatnih popravkov vprašljiva.

3 KAJ PRAVI ZADNJE POROČILO IPCC AR6?

Vpričo številnih do sedaj zgrešenih napovedi so v zadnjem poročilu IPCC (AR6) opustili izrecno napovedovanje prihodnje rasti temperature. Namesto tega ponujajo več različnih možnih 'scenarijev' in 'projekcij' v odvisnosti od prihodnjega omejevanja izpustov CO₂.

Scenariji, poimenovani 'Shared Socio-economic Pathways', nosijo ob okrajšavi SSP še dve karakteristični števili, prvo se nanaša na predvideno spremembo temperature do leta 2100, drugo pa predstavlja temu primerno dodatno sevalno siljenje. Tako denimo scenarij SSP5-8.5 (ki ustreza RCP8.5 v AR5) ponazarja porast temperature za 5 K in večje sevalno siljenje za 8.5 Wm^{-2} , kar naj bi bilo posledica povečanja letnih izpustov CO₂ s sedanjih 40 Gt na 130 Gt leta 2100. Kljub hudim kritikam je ta scenarij v preteklosti veljal za najbolj verjetnega, če bi pri omejevanju izpustov še naprej bili tako 'uspešni' kot doslej ('business as usual'). V AR6 je ta scenarij predstavljen kot manj verjeten skrajni primer, za najbolj verjetnega pa imajo SSP3-7.0, ki predvideva povečanje izpustov CO₂ na 80 Gt letno, ter posledično višje sevalno siljenje za 7 Wm^{-2} in povprečno globalno temperaturo za 3,7 K. Ostali scenariji predvidevajo znižanje izpustov, zato tudi ustrezno manjše temperature.

Poglejmo podrobneje SSP3-7.0. Po zelo zapletenih izračunih najprej določijo sevalno siljenje na podlagi predvidenega vpliva koncentracije CO₂ in ostalih toplogrednih plinov, čemur dodajo še vpliv mnogih drugih faktorjev, potem pa na osnovi tega izračunajo rast temperature, tej pa dodajo kot podlago do sedaj izmerjeno rast (od referenčnega obdobja 1850-1900 naprej). Po zgodovinskih podatkih naj bi do sedaj izmerjena rast temperature znašala 1,1 K (pri tem naj bi toplogredni plini prispevali 1,5 K, drugi faktorji, predvsem izpusti SO₂ in aerosolov, naj bi to znižali za okoli 0,4 K). Predvidena rast temperature zaradi podvojitve izpustov CO₂ do leta 2100 naj bi bila 2,6 K, skupno torej 3,7 K. To je izračunano na podlagi povečanega sevalnega siljenja 7 Wm^{-2} .

Tu imamo nov problem. Povečanje temperature za 3,7 K daje po Stefan-Boltzmannovem zakonu precej večje povečanje sevanja. Če izhajamo iz sedanje povprečne temperature planeta 15°C in to povečamo za 3,7°C bomo imeli:

$$j_1^* = 5,67 \times 10^{-8} (273+15)^4 = 390 \text{ Wm}^{-2}$$

$$j_2^* = 5,67 \times 10^{-8} (273+15+3,7)^4 = 410 \text{ Wm}^{-2}$$

$$j_2^* - j_1^* = 410 - 390 = 20 \text{ Wm}^{-2}$$

Kako naj bi tistih predvidenih 7 Wm^{-2} proizvedlo učinek 20 Wm^{-2} ni jasno. In spet imamo opravka s presežkom za faktor $3 \times$. Morda bo kdo pripomnil, da v zgornjih izrazih ni albeda, vendar pri izračunu sevanja izhajamo iz temperature, ki že bila izračunana ob upoštevanju albeda. Pri tleh pa prav tako mora veljati kontinuiteta enačba, torej tudi sevalno ravnovesje. Lahko sklepamo le, da tako modelirani sistem na nek način ustvarja energijo iz nič, kar fizikalno seveda ni možno.

Vidimo, da je v osnovi vseh modelov IPCC nekaj hudo narobe. Napak je lahko več [4]. Poleg problema sevalnega ravnovesja in načinov prenosa toplote, ter različno ocenjenih vrednosti občutljivosti planeta na koncentracijo toplogrednih plinov, se ena od napak verjetno skriva v načinu kako je izračunana efektivna sevalna temperatura planeta, zaradi česar imamo opravka z odločno prevelikim vplivom tople grede. Raziščimo to podrobneje.

4 DRUGAČEN IZRAČUN UČINKA TOPLE GREDE

Najprej moramo pojasniti zakaj je izračun učinka tople grede pomemben. Ta faktor nastopa v vseh enačbah s katerimi klimatski računalniški programi ekstrapolirajo razvoj temperature v prihodnje v odvisnosti od spremembe koncentracije CO_2 in vseh ostalih pomembnih parametrov. Navidezno preproste enačbe imajo obliko:

$$\Delta T_t(C) = f_{\text{CO}_2} \times T_{\text{utg}} \times \left\{ [F_0 + \sum \Delta F_i(t)] / F_0 \right\}$$

$\Delta T_t(C)$	spremenba temperature T v času t v odvisnost od koncentracije C
f_{CO_2}	klimatska občutljivost na podvojitev koncentracije CO_2
T_{utg}	efektivna temperaturna razlika zaradi učinka tople grede (33K)
F_0	osnovno sevalno siljenje
$\Delta F_i(t)$	časovna odvisnost siljenja številnih drugih faktorjev

Zapletenosti klimatskih računalniških modelov se skrivajo v vrednostih F_i , ki se spreminjajo s časom, mnoge v medsebojni soodvisnosti, njihove spremembe se seštevajo in dodajo osnovnemu siljenju, na katerega je vse skupaj normirano. Z večjo vrednostjo občutljivosti in večjo vrednostjo učinka tople grede že majhne spremembe drugih faktorjev močno vplivajo na spremembo temperature. Videli smo že, da laboratorijsko določena občutljivost ima lahko v naravi precej drugačne vrednosti, kot so ugotavljali različni avtorji.

Nadalje je treba opozoriti še na eno pomembno zadevo. V izračunu efektivne sevalne temperature je vstopno sevanje S_0 deljeno s 4. Tukaj faktor 2 prispeva izmenjava dneva in noči, preostali faktor 2 pa je posledica krogelne oblike planeta, kar pomeni, da je treba upoštevati kvadrat kosinusa vpadnega kota (Lambertov zakon). S tem je doseženo, da je celotno površje planeta obsevano z $1/4$ sončevega sevanja nepretrgoma dan in noč.

Vsakomur bi moralo biti jasno, da to povsem uniči dinamiko segrevanja in ohlajanja. A pri IPCC to upravičijo s tem, da je vrtenje planeta dovolj hitro, zato da so razlike majhne in četrti koren dodatno zmanjša spremembe. Tako naj bi po njihovem izračun povprečne temperature bil zadovoljivo natančen.

Mimogrede, 'dvomljivce' in 'zanikovalce' podnebnih sprememb v medijih pogosto ozmerjajo z 'ravnzemljaši'. Vpričo pravkar povedanega se je treba vprašati kdo je tu ravnzemljaš. Pri izračunu povprečne temperature obsevane polkrogle je seveda treba upoštevati da se ta segreva hitro s celotno gostoto moči sončevega sevanja S_0 , oziroma tistega dela, ki doseže površje. Ohlajanje celotnega površja s sevanjem pa poteka počasneje vseh 24 ur, in sicer z gostoto moči, ki je podana z razliko med povprečno temperaturo planeta (z dodano modulacijo med dnevom in nočjo) in temperaturo vesolja, ki znaša okoli 3 K. S tem ohranjamo dinamiko sistema neokrnjeno.

V ta namen razdelimo osvetljeno površje planeta na ozke koncentrične kroge, Sl.1, na površje katerih pada sončeva svetloba pod enakim kotom θ glede na normalo na njihovo površino [5, 6, 7]. Izhajamo torej iz nekoliko drugačne relacije za povprečno temperaturo, a da se izognemo zmešnjavi bomo namesto T_e pisali T_r . Tako bo odvisnost od kota vpadnega sevanja:

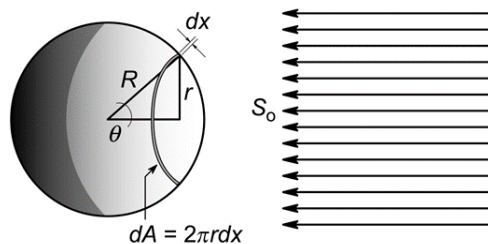
$$T_r(\theta) = [(1-a)S_0 \cos\theta / \sigma]^{1/4}$$

Ločimo konstante in spremenljivko:

$$T_r(\theta) = [(1-a)S_0 / \sigma]^{1/4} (\cos\theta)^{1/4}$$

Tako od θ odvisno temperaturo ima krožni izsek širine dx , z radijem $r = 2\pi R \sin\theta$. Njegova površina je $dA = 2\pi r dx = 2\pi R^2 \sin\theta d\theta$. Srednjo temperaturo T_{sr} dobimo, če izraz T_r da integriramo po kotu θ , ki se spreminja med 0 in $\pi/2$.

$$T_{sr} = (1/2\pi R^2) \int T_r dA = (1/2\pi R^2) \int [(1-a)S_0 / \sigma]^{1/4} (\cos\theta)^{1/4} 2\pi R^2 \sin\theta d\theta$$



Slika 1: Geometrija insolacije za izračun povprečne temperature

Po izpostavljanju konstant in krajšanju dobimo:

$$T_{sr} = [(1-a)S_0 / \sigma]^{1/4} \int (\cos\theta)^{1/4} \sin\theta d\theta$$

Rezultat integracije za vrednosti θ med 0 in $\pi/2$ je:

$$T_{sr} = [(1-a)S_o/\sigma]^{1/4} [-(4/5)\cos\theta^{5/4}]^{\pi/2_0}$$

Ker je $\cos(0)=1$ in $\cos(\pi/2)=0$, dobimo preprost izraz:

$$T_{sr} = (4/5)[(1-a)S_o/\sigma]^{1/4} = 288,3 \text{ K}$$

Ta presenetljiv rezultat je le za 0,3 K večji od 288 K, kolikor po IPCC znaša povprečna globalna temperatura planeta. To pomeni, da je učinek tople grede 100× manjši od izračunanega po IPCC metodi (33 K), zato ga lahko mirne vesti zanemarimo. In če učinka tople grede v resnici ni, je tudi vpliv toplogrednih plinov zanemarljiv. To potrjujejo tudi eksperimenti [8, 9]. Na temperaturo planeta torej neposredno vplivata le vpadno sončevo sevanje in albedo, ki seveda ni konstanta, ampak se spreminja odvisno od fizikalnih lastnosti površine, pa tudi časovno, denimo zaradi rasti rastlin, oblakov, vsebnosti aerosolov v zraku, zasneženosti površin, itd. Na povprečno temperaturo ozračja pa seveda vpliva še temperatura oceanov in globalna termo-halinska cirkulacija, saj ima voda okoli 3200× večjo volumsko termično kapaciteto kot zrak (in CO₂ je le 0,04% volumskega deleža zraka). Zaradi velike termične kapacitete vode pa prihaja do velikih časovnih zamikov v transportu toplote, celo za nekaj stoletij, kar pomeni, da pri analizi podnebja moramo upoštevati tudi daljšo zgodovino planeta. Vemo, da smo pred 150 leti izšli iz 400 let trajajoče male ledene dobe, zato sodobno zabeleženo segrevanje ne bi smelo biti nobeno presenečenje.

5 SKLEP: NI PANIKE!

Zaradi vsega povedanega lahko sklenemo, da panika zaradi kakšne (namišljene) točke preloma, po kateri naj bi podnebje podivjalo, ni upravičena. To pa ne pomeni, da lahko nehamo s prizadevanjem za čisti zrak, vodo in okolje. Vendar pa bo potrebno ukvarjati se z resničnim onesnaževanjem. Demoniziranje CO₂ nima prav nobenega smisla, saj je CO₂ hrana za rastline: pod koncentracijo 150 ppm rastline ne morejo več vsrkavati dovolj CO₂ za fotosintezo in odmrejo, kmalu zatem pa tudi vsi višji organizmi; temu smo se med zadnjo veliko ledeno dobo nevarno približali, koncentracija CO₂ je pred 12000 leti bila le 180 ppm.

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Po tej poti ne bomo ohranili trajnosti gozdov v Sloveniji

We Will Not Keep The Sustainability Of Forest In Slovenia By This Way

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POVZETEK

Slovenska gozdarska šola temelji na načelih trajnosti, sonaravnosti in večnamenskosti gozdov. V gozdovih naj bi se obnovilo po naravni poti več kot 95 % gozdov. Čeprav EU zaradi neprimerljivega stanja gozdov med posameznimi državami nima enotne gozdarske politike, imajo evropske strategije, direktive in trendi pomemben vpliv na gospodarjenje z gozdovi v Sloveniji. Na ravnanje z gozdovi vpliva tudi Natura 2000. Če upoštevamo lesno zalogo (okoli 300 m³/ha), 58 % gozdnatost 0,62 ha gozda na prebivalca pa ugotovimo, da ima največji pomen za državo in prebivalstvo gozd v Sloveniji, sledijo ji Nemčija, Avstrija, Češka, Romunija, Slovaška, Poljska in Estonija. Les naj bi bil slovenska strateška surovina, ki je hkrati naravno obnovljiva. Les je najbolj ekološka surovina, v lesu je vezanega veliko CO₂, izdelki iz lesa imajo dolgo življenjsko dobo, za njegovo predelavo je, če je les kakovit, potrebujemo malo vložene energije, pomembna pa je tudi njegova ponovna uporaba. Z gozdovi obnovljivim naravnim bogastvom je potrebno gospodariti po načelu trajnosti. Za zagotavljanje trajnosti gozdov je potrebna stalna obnova.

Prav pomanjkanje obnove v zadnjih desetletjih je pripeljalo do porušenega razmerja razvojnih faz gozda, tako da danes primanjkuje od 169.152 ha mladih gozdov (Kovač, Kušar 2023) do okoli 210.000 ha (Porocilo_o_gozdovih_2022_2.pdf (zgs.si)).

V obdobju 2011-2022 so bila gozdnogojitvena dela za naravno obnovo načrtovana na 27.745 ha, opravljena pa le na 11.001 ha, realizacija načrta je bila le 40% (v državnih gozdovih 73 %, v zasebnih gozdovih 24 %). Tudi obseg sadnje kot dopolnilo naravni obnovi je bil v obdobju 2011-2022 zelo skromen. Namesto že preskromno načrtovane sadnje okoli 500 ha letno, ki se je zaradi ujm in podlubnikov povečala na 536 ha letno, je bilo letno posajeno le 390 ha. Pa je samo zaradi podlubnikov v obdobju 2015-2022 nastalo kar 11.208 ha ogolelih površin.

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Pa je bilo kljub žledu in podlubnikom v obdobju 2011- 2022 posajeno le okoli 0,75 sadike letno na ha gozda (v zasebnih gozdovih okoli 0,6 sadike letno na ha gozda, v državnih gozdovih pa 1,4 sadike na ha gozda).

Intenzivnost sadnje je v zasebnih gozdovih, ki obsegajo 77 % vseh gozdov, 2,3 krat nižja kot v državnih gozdovih. Tako kot zaostajamo pri obnovi, daleč premalo tudi negujemo naše naravno bogastvo – gozdove. Kar 36 % mladovij je nenegovanih (v zasebnih gozdovih kar 42 %), še slabše so negovani drogovnjaki, kjer je nenegovanih 46 % (v zasebnih gozdovih kar 49 %). V 12-letnem obdobju je bil načrt nege realiziran le 42 % (v državnih gozdovih 75 %, v zasebnih gozdovih 26 %). Pri proklamiranem enotnem gospodarjenju z gozdovi je intenzivnost nege v zasebnih gozdovih 5,4 krat nižja kot v državnih gozdovih. Rezultat zanemarjanja nege se kaže v kakovosti gozdnega drevja, ki je iz desetletja v desetletje vse slabše.

Medtem ko so iglavci že v osnovi bolj kvalitetni saj je kar dobra tretjina (35 %) prav dobre in odlične kvalitete, je tako kvalitetnih le četrtnina listavcev (27 %). Bolj zaskrbljujoče je, da je pri listavcih kar 37 % zadovoljive in slabe kvalitete. In prav na listavcih bomo gradili svojo bodočnost, saj se bo delež listavcev v lesni zalogi povečeval tja do dveh tretjin.

Za večnamenski gozd, obnovljivo naravno bogastvo, država za biološka vlaganja v gozdove že vsaj dve desetletji prispeva veliko manj finančnih sredstev kot jih gozdovi potrebujejo, javna gozdarska služba ne kaže posebnih ambicij in naprežanja za primerno ravnanje z gozdovi, lastnike gozdov pa v preveliki meri zanima le trenutni ekonomski pomen gozda, ne pa njegova prihodnost. Rezultat tega pa je milo rečeno slabo stanje in še slabša perspektiva slovenskih gozdov. Zanamcem bomo pustili le osiromašene gozdove.

KLJUČNE BESEDE

Gozd, osiromašen gozd, obnovljivo naravno bogastvo, sonaravno gospodarjenje, trajnost, obnova gozda, nega gozda, ogroženost, Slovenija, EU

ABSTRACT

The Slovenian Forest School is based on the principles of sustainability, naturalness and multi-purpose forests. More than 95% of forests are expected to regenerate naturally. Although the EU does not have a single forest policy due to the incomparable state of forests between countries,

European strategies, directives and trends have a significant impact on forest management in Slovenia. Natura 2000 also has an impact on forest management. Taking into account the timber stock (around 300 m³/ha) and the forest cover of 58% (0.62 ha of forest per capita), Slovenia's forests are the most important for the country and its population, followed by Germany, Austria, the Czech Republic, Romania, Slovakia, Poland and Estonia. Wood is considered to be Slovenia's strategic raw material, which is also naturally renewable. Wood is the most ecological raw material, wood is high in CO₂, wood products have a long lifetime, processing wood requires little energy input if the wood is of good quality, and reuse is important. Forests, a renewable natural resource, must be managed sustainably. To ensure the sustainability of forests, continuous regeneration is needed.

It is the lack of regeneration in recent decades that has led to a disturbed relationship between forest development phases, so that today there is a shortage of 169,152 ha of young forests (Kovač, Kušar 2023) to about 210,000 ha (Porocilo_o_gozdovih_2022_2.pdf (zgs.si)).

In the period 2011-2022, forestation work for natural regeneration was planned on 27,745 ha, but only on 11,001 ha realized, with a realisation rate of only 40% (73% in state forests, 24% in private forests). The amount of planting to complement natural regeneration was also very modest in the period 2011-2022. Instead of the already too modestly planned planting of around 500 ha per year, which increased to 536 ha per year due to natural disasters and bark beetles, only 390 ha were planted annually. In the period 2015-2022 alone, 11,208 hectares of stripped areas were created.

However, despite the sleet and bark beetles, only about 0.75 seedlings per ha of forest were planted per year in the period 2011-2022 (about 0.6 seedlings per ha of forest per year in private forests, and 1.4 seedlings per ha of forest per year in state forests).

The planting intensity in private forests, which account for 77% of all forests, is 2.3 times lower than in state forests. Just as we are lagging behind in regeneration, we are also falling far short in nurturing our natural wealth - our forests. As many as 36% of young forests are unmanaged (42% in private forests), and even less well managed are forty years forests, where 46% are unmanaged (49% in private forests). Over the 12-year period, only 42% of the management plan has been implemented (75% in state forests, 26% in private forests). Under the proclaimed integrated forest management, the intensity of management in private forests is 5.4 times lower than in state forests. The result of neglecting care is reflected in the quality of forest trees, which is deteriorating from decade to decade.

While conifers are inherently better quality, with a good third (35%) of good and excellent quality, only a quarter of deciduous trees (27%) are of this quality. More worryingly, 37% of deciduous trees are of fair and poor quality. And it is on deciduous trees that we will build our future, as the share of deciduous trees in the timber stock will increase up to two thirds.

For a multi-purpose forest, a renewable natural resource, the state has for at least two decades been contributing far less financial resources to biological investment in forests than the forests need, the public forestry service shows no particular ambition or effort to manage forests properly, and forest owners are too interested only in the current economic importance of the forest, not in its future. The result is, to put it mildly, a poor state of Slovenian forests and an even poorer perspective. We will leave only impoverished forests for posterity.

KEYWORDS

Forest, depleted forest, renewable natural wealth, sustainable management, sustainability, forest restoration, forest care, endangered, Slovenia, EU

1 SLOVENSKA GOZDARSKA ŠOLA SLONI NA DVESTOLETNI TRADICIJI GOZDNOGOSPODARSKEGA NAČRTOVANJA IN SONARAVNEM GOSPODARJENJU Z GOZDOM

Gospodarjenje z gozdovi v Sloveniji temelji na načelih trajnosti, sonaravnosti in večnamenskosti gozdov ter načrtnem delu z njimi. Sonaravno gozdarstvo temelji na načrtnem gospodarjenju z gozdom, prilagojenemu gozdnim rastiščem, sestojnim razmeram in vlogam gozda. Pri tem v največji možni meri izkoriščamo naravne procese in jih s čim manjšimi vložki energije usmerjamo k ciljem gospodarjenja z gozdom - ekološkim, proizvodnim in socialnim.

Pomembna principa sta:

a) Naravna obnova gozdov omogoča oblikovanje rastišču prilagojene zmesi drevesnih vrst in zgradbe gozdnih sestojev. V Sloveniji z naravno obnovo obnovimo več kot 95 % gozdnih površin, ki so potrebne obnove. S tem ohranjamo v evolucijskem razvoju doseženo prilagojenost dreves danim rastiščnim razmeram.

b) Sproščena tehnika gojenja gozdov je temeljni gozdnogojitveni princip, ki za oblikovanje sestojnih zgradb sledi naravnim razvojnim procesom v gozdnih sestojih. Zanj je sicer značilna svobodna izbira gozdnogojitvenih ukrepov, najpogosteje pa se uporabljajo ukrepi skupinsko postopnega in prebiralnega gospodarjenja z gozdom. Nega gozdnih sestojev je osnovno orodje za usmerjanje razvoja gozdov. Temelji na pospeševanju ugodnih dejavnikov razvoja gozda in zaviranju neugodnih. Z nego gozda načrtno in racionalno usmerjamo razvoj gozda proti dolgoročnim gozdnogojitvenim ciljem (Gozd in gozdarstvo v samostojni Sloveniji - 25 let javne gozdarske službe. 2019).

Lepa načela, žal jim ne sledijo dejanja! Pa o tem več v drugem delu prispevka.

2 NOVA EVROPSKA STRATEGIJA ZA GOZDOVE IN STRATEGIJA ZA BIOTSKO RAZNOVRSTNOST DO LETA 2030

Slovenija je del Evropske unije in čeprav ta nima (zaradi neprimerljive stanja gozdov med posameznimi državami) enotne gozdarske politike, imajo evropske strategije, direktive in trendi pomemben vpliv na gospodarjenje z gozdovi pri nas.

Nova strategija EU za gozdove do leta 2030 temelji na Evropskem zelenem dogovoru in Strategiji EU za biotsko raznovrstnost do leta 2030. Osredotočena je na trajnostno zagotavljanje vseh funkcij gozdov (ekonomskih, ekoloških, socialnih), hkrati pa od gozdov in gozdarskega sektorja predvsem pričakuje pomemben prispevek k blaženju in prilagajanju na podnebne spremembe, ohranjanju in krepitvi biotske raznovrstnosti ter vzpostavitvi ogljično nevtralnega krožnega gospodarstva. Vsebuje načrte za ohranjanje in povečevanje vrstne in genetske pestrosti populacij gozdnih drevesnih vrst ter za povečevanje deleža zavarovanih gozdov ter zlasti gozdnih rezervatov, ko si bodo prizadevali za strogo pravno zaščito 10 % površin EU.

Strategija EU za biotsko raznovrstnost vsebuje zavezo, da se v EU do leta 2030 zasadijo vsaj tri milijarde dodatnih dreves (izven obstoječih gozdov) ob doslednem spoštovanju ekoloških načel, strategija predvideva tudi spodbude in nadomestila za lastnike gozda, zlasti v okviru shem plačil za ekosistemske storitve gozdov ter za uvajanje praks za vezavo (sekvestracijo) ogljika.

Slovenija ob skoraj 60 odstotni gozdnatosti in večnamenskem ravnanju z gozdovi ne more sprejemati obvez EU o 10 odstotni strogi zaščiti površin in o dodatnem pogozdovanju izven gozdnih površin.

3 GOZD IMA V SLOVENIJI ZELO POMEMBNO LESNO-PROIZVODNO VLOGO GOZDOVI SLOVENIJE

Površina slovenskih gozdov znaša 1.176.542 ha, kar pomeni 58,0 % gozdnatost. Največ je zasebnih gozdov (77%), državnih gozdov je 20 %, 3 % gozdov pa je v lasti lokalnih skupnosti (občin). Večina gozdov je večnamenskih (z njimi se gospodarji) 1.068.288 ha (90,8%), varovalnih gozdov in gozdov s posebnim namenom je 98.828 ha (8,4 %), gozdnih rezervatov pa je 9.426 ha (0,8 %), v okviru Nature 2000 je tudi 8.618 ha (0,7 %) ekocelic, območja gozdov v naravovarstveno pomembnih predelih, ki se za določeno obdobje (obdobje 20 let) načrtno prepuščajo naravnemu razvoju. Tako je prepuščeno naravnemu razvoju 1,5 % gozdov. Poleg tega pa je še načrtno puščanje stoječe biomase v gozdu s povprečnim premerom 54 cm. V letu 2022 je bilo na podlagi ukrepa prepuščanje naravnemu razvoju z zasebnimi lastniki gozdov sklenjeno 41 pogodb in tako za 20 letno obdobje izločeno iz gospodarjenja 83 ha gozdov. Lesna zaloga gozdov v Sloveniji je ocenjena na 357.031.760 m3

oziroma 303 m3 /ha. Letni prirastek je ocenjen na 8.736.972 m3 oziroma 7,43 m3 /ha.

4 NATURA 2000 V SLOVENIJI

Natura 2000 zajema 18 odstotkov kopenskega in 6 odstotkov vodnega ozemlja EU. Pokritost nacionalnih ozemelj z območji Natura 2000 sega od 9 % do skoraj 38 %. Prav Slovenija je na vrhu deleža Natura 2000. V Sloveniji je 355 območij Nature 2000, ki pokrivajo dobrih 37 % ozemlja države. Z Naturo 2000 v Sloveniji varujemo 205 živalskih in 27 rastlinskih vrst (vrste Nature 2000) ter 60 tipičnih naravnih okolij (habitatski tipi Nature 2000), kar predstavlja nekaj več kot 10 % vseh vrst in tipičnih naravnih okolij (habitatskih tipov) Nature 2000 v EU. V območjih Nature 2000 živi približno 6 % prebivalcev Slovenije, ali okrog 128.000 ljudi. 70 % Nature 2000 v Sloveniji pokriva gozd, nekaj več kot 20 % pa kmetijske površine.

Območja Natura 2000 se v gozdarstvu upravljajo preko gozdnogospodarskih načrtov, kateri načrtujejo izvajanje ukrepov prilagojene rabe naravnih dobrin.

5 NEKAJ PRIMERJAV Z GOZDOVI V EU

V EU zavzemajo gozdovi 158 milijonih hektarov, to je 5 % svetovnih gozdnih površin. Pokrivajo 38 % površin Unije, njihov pomen pa je po posameznih članicah različen. Nanje lahko gledamo z različnih vidikov. Po gozdnatosti prednjačijo Finska s 66 %, Švedska (64 %) in Slovenija (58%). Skromni z gozdovi pa so Malta, Nizozemska, Irska in Danska. Drugačen vrstni red dobimo, če upoštevamo ohranjenost gozdov, ki se kaže v lesni zalogi. Ob povprečni lesni zalogi EU 210 m3/ha, so najvišje lesne zaloge, okoli 300 m3/ha v gozdovih Slovenije, Nemčije, Avstrije in Češke. Skromne lesne zaloge pa imajo, zaradi slabe ohranjenosti gozdovi držav ob Sredozemskem morju, pa tudi Finska in Švedska saj segajo njuni gozdovi v tajgo. Zavedati pa se moramo, da le gozd, ki optimalno izkorišča rastišče lahko v največji meri opravlja poleg proizvodne tudi ekološke in socialne funkcije.

Medtem, ko je v EU 40 % gozdov v javni lasti, se ta delež med posameznimi državami zelo razlikuje. Več kot polovico gozdov je v javni lasti v nekdanjih socialističnih deželah (državah vzhodnega bloka) kjer se ob denacionalizaciji gozdov ni vračalo v naravi. Med države z nizkim deležem javnih gozdov (med 25-30 %) pa sodijo Slovenija, Danska, Švedska, Francija, Avstrija, Španija in Finska.

Vsak prebivalec EU ima 0,36 ha gozda, največ prebivalec Finske (4,23 ha), Švedske (3,18 ha), najmanj pa prebivalec Nizozemske (0,02 ha) in Belgije (0,06 ha). Slovenija je relativno bogata z gozdovi, na prebivalca pride 0,62 ha gozda. Če upoštevamo lesno zalogo, gozdnatost in površina gozdov na prebivalca pa ugotovimo, da ima največji pomen za državo in prebivalstvo gozd v Sloveniji, sledijo ji Nemčija, Avstrija, Češka, Romunija, Slovaška, Poljska in Estonija.

6 LES JE SLOVENSKA STRATEŠKA SUROVINA

Les naj bi bil slovenska strateška surovina, ki je hkrati naravno obnovljiva. Les je najbolj ekološka surovina, v lesu je vezanega veliko CO₂, izdelki iz lesa imajo dolgo življenjsko dobo, za njegovo predelavo je, če je les kvaliteten, potrebujemo malo vložene energije, pomembna pa je tudi njegova ponovna uporaba.

Predelava lesa je v primerjavi s predelavo drugih materialov tudi z energetskega vidika bolj smotrna, saj se za predelavo lesa porabi veliko manj energije kot za predelavo drugih materialov. Čim kvalitetnejši je les, manj energije in s tem izpustov je potrebno za njegovo predelavo in uporabo. Iz kvalitetnega lesa z malo dodane energije lahko izdelamo izdelke z dolgo življenjsko dobo. Zato je pomembno, da gojimo kvalitetne gozdove. Proizvodnja kakovostnega lesa, ki jo dosežemo z nego gozda, je tudi ekološko sprejemljiva. Torelli (1995) navaja podatke, da je za proizvodnjo žaganega lesa potrebno le 30 do 40 kWh/m³, za proizvodnjo intenzivno lepljenega lesa, ki ga lahko pridobimo z manj kakovostnega lesa, pa že 60 do 80 kWh/m³. Za iverne plošče, ki jih izdelujemo iz še manj vrednega lesa, porabimo že 120 do 160 kWh/m³, še več pa za vlaknene plošče (do 200 kWh/m³). Za tona papirja porabimo kar 500 do 1.000 kWh/m³. Ker je les tudi pomemben gradbeni element, se seznanimo še z dvema primerjavama: za proizvodnjo jelka je potrebnih 4.000 kWh/t, za aluminij pa kar 70.000 kWh/t.

Prav v lesu gozdnih drevesnih vrst je akumulirano veliko ogljika. Celotna količina ogljika, ki je bila izločena iz ozračja in je zdaj shranjena v gozdni lesni biomasi (živi nadzemni in podzemni ter odmrli biomasi) slovenskih gozdov, je ocenjena na nekaj manj kot 130 milijonov ton, ali 62 ton na prebivalca Slovenije. Okoli tri četrtine zalog ogljika je v nadzemni, petina v podzemni in okoli 5 % v odmrli lesni biomasi. V 1 m³ bukke je 273 kg ogljika, v 1 m³ smreke pa 188 kg ogljika (Stanje in spremembe slovenskih gozdov med letoma 2000 in 2018).

V Sloveniji ga imamo veliko, vendar žal ne zmoremo izkoristiti njegovih prednosti, med drugim ga izvažamo brez dodane vrednosti. V preteklosti so znali dostopnost, funkcionalnost in privlačnost lesa izkoristiti v mnogo večji meri kot danes, o tem nam priča bogata kulturna dediščina. Mizarji, tesarji, sodarji, kolarji, strugarji in drugi obrtniki so znali izkoristiti vse vrste lesa, ki so ga dobili iz bližnjih gozdov. Žal so les v vsakdanjem življenju postopno zamenjale kovine in številni umetni materiali, in mnoga znanja so šla v pozabo.

Pa se časi zopet spreminjajo, les zaradi svoje ekološke prednosti počasi a vztrajno pridobiva na veljavi. Les je material prihodnosti, potrebno je pridobiti znanja kako v kar največji možni meri njegove, za okolje pomembne in nenadomestljive prednosti, tudi izkoristiti. Zato je neekološko omejevati in zanemarjati lesno- proizvodno vlogo gozda.

7 LE Z DREVJEM BOGAT GOZD LAHKO OPRAVLJA VSE SVOJE SPLOŠNOKORISTNE VLOGE

In les, našo najbolj ekološko in okolju prijazno surovino proizvaja gozd. Predstava, da so gozdovi v sedanjih razmerah izgubili pomen kot proizvajalci lesa je napačna, nasprotno, z naraščanjem števila prebivalstva se v svetu povečuje tudi potreba po lesu. Tako je zmanjšanje proizvodne funkcije gozda le navidezno, posledica povečanja pomena njegovih neproizvodnih funkcij (ekološke in socialne). Lahko bi rekli, da se je zmanjšal relativni pomen proizvodne vloge gozda, ne pa absoluten.

Vse bolj se poudarjajo ekološke vloge gozda, manj socialna in kar nekako je zanemarjena (spregledana) lesno proizvodna vloga gozda. Pa saj je vendar gozdno drevje osnovni nosilec gozda, šele če to zavzema določeno površino lahko govorimo o gozdu. Prav v zavetju mogočnih gozdnih dreves, se lahko naselijo drugi elementi gozda, tako rastlinski kot živalski svet.

8 ZA ZAGOTAVLJANJE TRAJNOSTI GOZDOV JE POTREBNA STALNA OBNOVA

Slovenska gozdarska šola naj bi slovela po sonaravnem gospodarjenju z gozdovi. Sonaravno gospodarjenje seveda ne pomeni le žeti sadove preteklih generacij in prepuščati gozdove naravi. Sonaravno gospodarjenje pomeni gospodariti s temi gozdovi, kot je lepo zapisal dr. Živko Košir Gospodariti z gozdovi po meri narave. To pomeni tudi vlagati v obnovo, nego in varstvo, da bodo gozdovi trajno opravljali proizvodno, ekološko in socialno vlogo.

Pa še tole si velja zapomniti, gozd lahko trajno daje les in opravlja tudi pomembne ekološke in socialne vloge. Seveda pa je potrebno z gozdovi gospodariti po načelih trajnosti in vanje tudi vlagati. Za trajnost gozdov ne smemo gozdov le izkoriščati, v obnovo, nego in varstvo gozdov je potrebno tudi vlagati. Gre za dolgoročne naložbe, saj mine od semena do odraslega drevesa primerne za izkoriščanje kar okoli stoletje. Danes uživamo sadove gozdov, ki so jih naši predniki zasnovali pred stoletjem in ves ta čas tudi negovali.

Nacionalni gozdni program v temeljnih ciljih postavlja na prvo mesto Trajnostni razvoj gozda kot ekosistema v smislu njegove biotske raznovrstnosti ter vseh njegovih ekoloških, proizvodnih in socialnih funkcij.

Brez trajnega obstoja gozda, ki izkorišča dani rastiščni potencial, ni mogoče zagotavljati trajnosti ekoloških, proizvodnih in socialnih funkcij. Predpogoj za trajen obstoj gozda pa je njegova stalna obnova. Pri obhodnji 100-120 let (čas ko doseže zrelost za posek in ga pričnemo obnavljati) mora biti za zagotovitev trajnosti okoli 15 % površine v razvojni fazi mladovja (od mladja do faze letvenjaka (premer v prsni višini do 10 cm)), prav toliko površine mora biti sestojev v obnovi, okoli 40 % površine v razvojni fazi drogovnjaka (drevje ima v prsni višini od 10 do 30 cm) in

okoli tretjine površine v razvojni fazi debeljaka (drevje ima v prsni višini nad 30 cm) (Gozdnogospodarski in lovsko upravljavski načrti območij za obdobje 2011-2020. Povzetek za Slovenijo).

Da v slovenskih gozdovih močno primanjkuje mladovja, so na Zavodu za gozdove Slovenije spoznali že leta 2011 ob izdelavi Gozdnogospodarskih in lovsko upravljavskih načrtov območij za obdobje 2011-2020. Leta 2011 je primanjkovalo okoli 100.000 ha mladovij, zaradi dolgoletnega zaostajanja obnove za potrebami pa je primanjkovalo tudi okoli 40.000 ha drogovnjakov. Medtem ko je na eni strani primanjkovalo okoli 140.000 ha mladih gozdov, za okoli 20.000 ha je bilo premalo tudi sestojev v obnovi, je bilo na drugi strani za okoli 160.000 ha preveč starih sestojev. Usmeritev, da se več kot 95% gozdov obnovi po naravni poti, so bile daleč od realnosti, bile so le pobožne želje Zavoda za gozdove Slovenije. Kljub tem ugotovitvam leta 2011, pa žal niso storili nič, da bi se stanje izboljšalo.

V zadnjih 12 letih, so se kljub ujmam in podlubnikom razmere poslabšale, primanjkljaj mladih gozdov se je iz 160.000 ha povečal na 210.000 ha. Ker Zavod za gozdove Slovenije v svojih poročilih upošteva podatke iz gozdnogospodarskih načrtov gospodarskih enot, so podatki za pravkar izdelane načrte ažurni, najstarejši pa so stari 10 let, tako v povprečju zaostajajo za 5 let. Same podatke moramo tako jemati z določeno rezervo, trendi pa jasno kažejo, da je trajnost slovenskih gozdov vse bolj ogrožena.

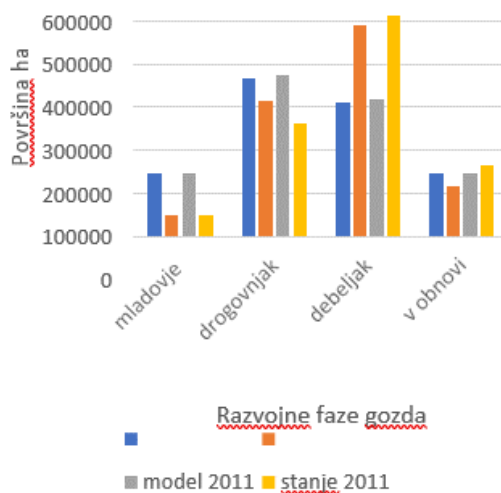
Da Sloveniji primanjkuje mladih gozdov, potrjujejo tudi podatki iz velikoprostorskega monitoringa gozdov in gozdnih ekosistemov Gozdarskega inštituta Slovenije, ki kažejo, da se je delež mladih sestojev (mladovje in drogovnjaki) zmanjšal iz 32 % v letu 2012 na 30 % v letu 2018, medtem ko se je v istem obdobju dvignil delež odraslih in starih sestojev (iz 68 % na 70 %). Navajajo, da v slovenskih gozdovih manjka 169.152 ha mladih sestojev (110.835 ha mladovij in 58.417 ha drogovnjakov), in da je hkrati toliko prevelik delež starejših sestojev (Kovač, Kušar, 2023).

Vzrok so pretirana in nerealna pričakovanja Zavoda za gozdove Slovenije, da se bo več kot 95 % gozdov obnovilo po naravni poti. Vzroki, da naravna obnova ne uspe in je potrebno pomagati s sadnjo so številni:

- Ni semenjakov, ali niso primerni, mladje ni primerno;
- Ni semenskega leta, čeprav smo opravili posek (npr. nestrokoven posek, posek ob nepravem času, ko ni semenskega leta), ali pa so ujme, podlubniki, razgalili sestoje;
- Zapleveljene površine, ki onemogočajo naravno obnovo;
- Neprimerni gozdnogojitveni ukrepi, ali pa potrebnih in primernih ukrepov ni bilo;
- Preštevilne populacije rastlinojede divjadi, ki marsikje otežujejo ali onemogočajo naravno

obnovo z rastiščnim razmeram primernimi drevesnimi vrstami.

Primerjava površin gozdov v ha po razvojnih fazah med modelom in dejanskim stanjem leta 2011 in 2022.
Leta 2011 je zajeto 967.475 ha (82 % vseh gozdov), leta 2022 pa 989.826 ha (84 % vseh gozdov). Vir: Poročilo Zavoda za gozdove Slovenije o gozdovih za l



V takih primerih je na produktivnejših rastiščih, pa tudi na ekološko ranljivih območjih potrebno naravni obnovi pomagati s sadnjo, včasih je rešitev tudi setev. Dopolnilne sadnje pa se je treba lotiti čim prej, da se površine ne zaplevelijo, ker bi se s tem le povečevali stroški in manjšala uspešnost obnove. S sadnjo v grmiščih in malo donosnih gozdovih skrajšamo večdesetletno (ali stoletno) naravno sukcesijsko pot do novega gozda.

9 IZVEDBA DEL ZA OBNOVO GOZDOV ZAOSTAJA ZA NAČRTI, NAČRTI ZAOSTAJAJO ZA POTREBAMI

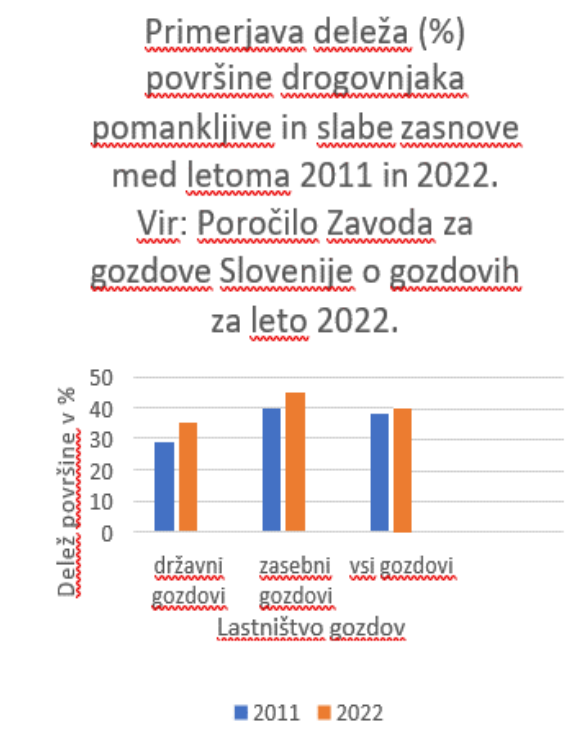
V obdobju 2011-2022 so bila gozdnogojitvena dela za naravno obnovo načrtovana na 27.745 ha, opravljena pa le na 11.001 ha, realizacija načrta je bila le 40 % (v državnih gozdovih 73 %, v zasebnih gozdovih 24 %). Če predpostavimo, da so bila gozdnogojitvena dela za obnovo (11.001 ha v 12 letih, ali 917 ha letno) potrebna v sestojih v obnovi, ki jih je leta 2022 kar 164.158 ha, vidimo, da je bilo deležno teh del letno le 0,006 % sestojev v obnovi (v zasebnih

gozdovih 0,003 %, v državnih gozdovih 0,016). Intenzivnost del za naravno obnovo je bila v državnih gozdovih okoli 5 krat višja kot v zasebnih. Zavoda za gozdove Slovenije tako skromen obseg del takole pojasni: Ukrepi naravne obnove, ki jih prikazujemo v poročilu, zajemajo le površine, na katerih je bilo potrebno aktivno poseči v ta proces z gojitvenimi ukrepi priprave sestoja za naravno nasemenitev, za katere izdajamo odločbe v upravnem postopku in jih v zasebnih gozdovih sofinanciramo iz sredstev državnega proračuna. Dodatno v veliko primerih cilje ukrepov naravne obnove dosegamo že z ustrezno zastavljenim posekom odraslega sestoja, ki zagotavlja nemoten razvoj naravnega mladja (Porocilo_o_gozdovih_2022_2.pdf (zgs.si)). To je precej slaba tolažba, premajhen obseg načrtovanih del za naravno obnovo in še bolj skromna izvedba se odraža v velikem primanjkljaju in skromni kvaliteti mladovij.

Tudi obseg sadnje kot dopolnilo naravni obnovi je bil v obdobju 2011-2022 zelo skromen. Namesto že preskromno načrtovane sadnje okoli 500 ha letno, ki se je zaradi ujma in podlubnikov povečala na 536 ha letno, je bilo letno posajeno le 390 ha. Pa je samo zaradi podlubnikov v obdobju 2015-2022 nastalo kar 11.208 ha ogolelih površin. Pa je bilo kljub žledu in podlubnikom v obdobju 2011-2022 posajeno le okoli 0,75 sadike letno na ha gozda (v zasebnih gozdovih okoli 0,6 sadike letno na ha gozda, v državnih gozdovih pa 1,4 sadike na ha gozda). Intenzivnost sadnje je v zasebnih gozdovih, ki obsegajo 77 % vseh gozdov, 2,3 krat nižja kot v državnih gozdovih.

Rezultati tega nedela so porazni, ne le da manjka okoli 100.000 ha mladovij, kar tretjina obstoječih mladovij ima pomanjkljivo ali slabo zasnovo. Tudi tu so trendi negativni, iz 22 % pomanjkljive in slabe zasnove leta 2011 je ta leta 2022 dosegla že 32 %, še slabše so razmere pri drogovnjakih, kjer je pomanjkljive in slabe zasnove že kar slaba polovica (43 %). Pomemben delež k temu doprinese tudi pomanjkanje nege v mladovju. Zaskrbljujoče je, da se razmere iz desetletja v desetletje slabšajo.

Nižja realizacija programa obnove gozdov, zlasti del za naravno obnovo (priprava sestoja, tal) v zasebnih gozdovih je posledica nizkega obsega proračunskih sredstev za vlaganja v gozdove iz proračuna RS (Poročilo ZGS).



10 NE LE OBNOVA, GOZDOVE JE POTREBNO TUDI NEGOVATI

Tako kot zaostajamo pri obnovi, daleč premalo tudi negujemo naše naravno bogastvo – gozdove. Kar 36 % mladovij je nenegovanih (v zasebnih gozdovih kar 42%), še slabše so negovani drogovnjaki, kjer je nenegovanih 46 % (v zasebnih gozdovih kar 49 %). V 12-letnem obdobju je bil načrt nege realiziran le 42 % (v državnih gozdovih 75 %, v zasebnih gozdovih 26 %). Pri proklamiranem enotnem gospodarjenju z gozdovi je intenzivnost nege v zasebnih gozdovih 5,4 krat nižja kot v državnih gozdovih. Kar okoli 300 let bi potrebovali, da bi s sedanjo intenzivnostjo nege obdelali vse zasebne gozdove, medtem bi v državnih gozdovih to opravili že v okoli 60 letih.

Rezultat zanemarjanja nege se kaže v kakovosti gozdnega drevja, ki je iz desetletja v desetletje vse slabše. Medtem ko so iglavci že v osnovi bolj kvalitetni saj je kar dobra tretjina (35 %) prav dobre in odlične kvalitete, je tako kvalitetnih le četrtnina listavcev (27 %). Bolj zaskrbljujoče je, da je pri listavcih kar 37 % zadovoljive in slabe kvalitete. In prav na listavcih bomo gradili svojo bodočnost, saj se bo delež listavcev v lesni zalogi povečeval tja do dveh tretjin. Medtem, ko manj kvalitetne iglavce še vedno uporabimo za izdelke z dolgoročno uporabnostjo, je pri listavcih drugače. Les listavcev zadovoljive in slabe kakovosti je uporaben predvsem za kurjavo in različne energetske potratne plošče, ne pa za izdelavo trajnejših izdelkov z visoko dodano vrednostjo. Zavod za gozdove Slovenije v letnih poročilih iz leta v leto poudarja, da se obseg potrebnih pri obnovi in negi v zasebnih gozdovih načrtuje na podlagi načrtov gozdnogospodarskih enot, njegova realizacija pa je odvisna od višine razpoložljivih proračunskih sredstev za financiranje in sofinanciranje vlaganj v gozdove, ki ne zadoščajo za izvedbo predvidenega programa vlaganj, in od pripravljenosti lastnikov gozdov za izvedbo teh del. Za večnamenski gozd, obnovljivo naravno bogastvo, država za biološka vlaganja v gozdove že vsaj dve desetletji prispeva veliko manj finančnih sredstev kot jih gozdovi potrebujejo, javna gozdarska služba ne kaže posebnih ambicij in naprežanja za primerno ravnanje z gozdovi, lastnike gozdov pa v preveliki meri zanima le trenutni ekonomski pomen gozda, ne pa njegova prihodnost. Rezultat tega pa je milo

rečeno slabo stanje in še slabša perspektiva slovenskih gozdov.

11 ZANAMCEM BOMO PUSTILI LE OSIROMAŠENE GOZDOVE

Ob tako opevanem pomenu gozda in lesa, pa z gozdovi, ki proizvajajo les, ravnamo zelo mačehovsko, kratkoročno, čim več in čim hitreje iztržiti iz njih. Že več desetletij pa pozabljamo na osnovni postulat gospodarjenja z gozdovi, to je trajnost. Nobeno priseganje na večnamenskost, biodiverzitetu, skladiščenje ogljika ne bo imelo učinka, če ne bomo z gozdovi ravnali trajnostno in vlagali vanje, da bodo tudi bodoče generacije lahko uporabljale to najbolj ekološko surovino – les. Namesto kvalitetnih večnamenskih gozdov, ki izkoriščajo bogat rastiščni potencial je po slovenskih gozdovih vse več grmišč in malodonosnih gozdov. Tega bi se morala zavedati najprej država, pa seveda javna gozdarska služba in seveda lastniki gozdov.

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Personal recollections on influencing the public opinion on GM food as some part of the struggle for rational decision-making in environmentalism

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ABSTRACT

Breeding methods have developed over the decades and in the 1980s led to the form of genetic engineering, useful for the transfer of selected genes from one species to a potentially unrelated species. This was followed by the successful introduction of various traits into plant species. At the same time, largely unnecessary over-regulation was adopted first in USA and later in the European Union. Such approach has served environmental activists well in their quest to cover up ever new forms of scaremongering of the population about described novelty. Most of the negative campaigns took place in Europe, resulting in a de facto ban on the cultivation of GMO varieties. This lecture, which I am briefly announcing here, will describe the author's personal view of what is happening of the last decades and the resulting situation in society. The article is being prepared at the same time as the first positive attempts by the European Commission to deregulate the more recent genome editing technology, which is now dealing with the same opponents.

KEYWORDS

Influencing public opinion; genetically modified food; GMO; winning the debate

1 PLANT BREEDING ACTIVITIES IN 1980ies

Plant breeding is a little-known activity to the general public in many countries, and is carried out by seed/nursery companies, assisted by universities and institutes developing increasingly sophisticated breeding methods and techniques. The aim of these activities is to create varieties that will increase the efficiency of agriculture and provide the population with sufficient quantities of food or, in the case of ornamental plants, exceptional aesthetic pleasures. Although the activity is primarily aimed at farmers, many farmers are aware of the new offerings from seed growers, but know little about the way they do this job. As a rule, the subject is researched and taught in agricultural faculties. By a series of coincidences that probably more or less follow each individual in his or her career path, I became a professor of plant breeding and plant biotechnology in the 1990s. Together with my colleagues, I developed several sub-branches of biotechnology, in particular plant tissue culture methods and, in particular, haploid induction. The latter I have found to be of great benefit to seed companies.

In 1994, 14 years after the approval of recombinant insulin, a tomato transgene was approved in the USA. It slowed down the ripening of the fruit, thus facilitating transport and edibility.

2 COUNTERING NEGATIVE PUBLIC OPINION ON GMO FOOD

It was to be expected that such major achievements, boosted by such success, would grow and rapidly outperform older methods. In fact, they initially did. Many large companies set up their own research laboratories in the 1990s, and the pressure to release new varieties was intense. However, as we know now, in the US, the largest companies pushed for a very high level of regulation, far beyond what was needed (Miller and Conko 2013). This, of course, foreclosed the market, because

the multi-million dollar amounts needed for deregulation, were not affordable for small companies, or, for example, academic spinoffs. The field was also narrowed down to four agricultural species (maize, soybeans, cotton and seed rape), and a few key traits (insect and virus resistance, herbicide resistance). Patrick Moore, known as the co-founder of Greenpeace, describes the reasons why environmental organisations have grabbed the subject and started to paint it in negative terms. His opinion is focused on the changed political situation such as fall of Berlin wall and adapting "green" politics by major parties..

It has become increasingly clear that, in the case of GMOs, the public debate is not reasoned but strongly biased by the agenda of the participants. If the proponents were dominated by the mainstream scientific establishment, the opponents were in a bit of a mess, with "environmental" organisations, consumer organisations, left (or right) political parties and the media claiming to be opponents, depending on the needs. The latter followed the protagonists of the debate, mostly without argumentation, in short, populistically.

In the meantime, several research laboratories including ours slowed down the GMO research procedures already in place, as it was clear that the EU market was closed to them. But we have stepped up our engagement in public debate. One of the turning points was an interview for Mladina (a left-wing newsletter) in which the journalist Staš Zgonik (2009) constructively put forward arguments in favour of GMOs.

In 2015, we took advantage of a joint meeting of the two scientific committees at the Ministry of Environment and Spatial Planning regulating GMOs and sent out an appeal to all leading media outlets <https://www.mladina.si/166584/znanost-proti-populisticnemu-zakonu/>. The trigger was proposal of another draft law that placed Slovenia at the tail of the developed countries that were advocating for a gradual phase-out. The proposed penalties for possible cultivation were (and still are) draconian. We monitored the media reactions to our appeal and found that, surprisingly, there was a preponderance of positive discussion on the subject, which was a great novelty. We have also published several popularly written books and disseminated them at home and abroad. Beside Slovenian version book titled Yes to GMOs was published also in English and Korean language.

In 2014, I was invited to speak at the TEDx Ljubljana event at Cankarjev dom. The response to the English-language lecture was overwhelming, with 233 thousand views on YouTube channel so far after nine years. It looks that younger generations prefer such medium.

In 2016, a group of senior managers from Bayer Crop Science visited Slovenia and, because they were familiar with my presentations, they wanted to interview me about it. At the Faculty we prepared two lectures and discussed the whole topic in a group of about 20 participants. My key argument was that, as a large company, they should strive to sway public opinion as the key to the success of the whole business. I suggested that they focus on consumer-oriented products. In 2018 Bayer acquired Monsanto for \$63 billion. So they did the opposite of my advice, and the consequences, driven by public opinion are still dramatic today.

Some of the media in Slovenia have refused to give up their negative coverage, with Delo and RTV Slovenia standing out. For example, see the interview in the Studio City programme (2015) with the Minister of Agriculture, mag. Dejan Židan, who had the full support of the interviewer (Marcel Stefančič).

Both this law and similar political gamesmanship have encouraged "exclusion zones", zones where individual countries could ban the cultivation of GMO varieties without scientifically sound reasons. We have joined a group of scientists (Erisson D. et al 2018) who have proposed the opposite, i.e. "inclusion" zones where individual countries could, if they so wished, grow non-GMO varieties that have not been accepted in other countries. The call was published in a top publication but, like several others, did not achieve a policy response.

However, in this very year (2023), a new cycle of debate is taking place, together with a legislative process to allow the cultivation of genome-edited varieties in the EU. If this is released, it will be a major step, to which a contribution from Slovenia was noticed.

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Mit-jedrska energija je ključna v boju s podnebnimi spremembami

Myth-Nuclear power is key in the fight against climate change

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POVZETEK

Jedrski zagovorniki želijo ustvariti prepričanje, da je jedrska energija ključna v boju s podnebnimi spremembami, saj naj bi bila edina dostopna nizko ogljična tehnologija, ki lahko odgovori na globalne podnebno-energetske izzive. Ob tem prikrivajo vse slabosti jedrske energije in poudarjajo zgolj eno, da pri jedrski cepitvi ne nastaja ogljikov dioksid.

Jedrski zagovorniki »spregledajo« dejstvo, da jedrska energija segreva planet s toploto, ki nastaja iz cepitve jeder. Poleg tega je jedrska energija krinka za vojaški jedrski program, ki je povzročil globalno segrevanje. Kako naj torej jedrska energija odpravi okoljske anomalije, ki jih je sama povzročila?

KLJUČNE BESEDE

Entropija, umetna cepitev jeder, toplotno onesnaženje, globalno segrevanje, sončno obsevanje, temperatura, stratosfera, jedrska doba

ABSTRACT

Nuclear proponents want to create a belief that nuclear energy is key to the fight against climate change, as it is believed to be the only available low-carbon technology that can respond to global climate-energy challenges. At the same time, they conceal all the weaknesses of nuclear energy and emphasize only one thing that nuclear fission does not generate carbon dioxide.

Nuclear proponents "overlook" the fact that nuclear energy warms the planet with heat generated from nuclear fission. In addition, nuclear energy is a cover for the military nuclear program that has caused global warming. How, then, can nuclear energy eliminate the environmental anomalies it has caused?

KEYWORDS

Entropy, artificial nuclear fission, thermal pollution, global warming, solar radiation, temperature, stratosphere, nuclear age

1 Miti o jedrski energiji

O jedrski energiji se ne sme govoriti, razen tako, da jo hvalimo. Zaradi takega jedrskega marketinga ima kar nekakšen mističen pridih, saj ji pripisujejo lastnosti, ki jih nima niti Chuck Norris. Naj bi bila nizkoogljična, trajnostna, obnovljiva, zelena, zanesljiva ... To je vsekakor mit, jedrska energija predstavlja preveliko tveganje za energijsko rabo.

1.1 Dodatni vir toplote na planetu

Umetno ustvarjen razpad jeder sprošča približno 14 milijard let staro energijo, ki je uskladiščena kot masa. Umetno povzročeni razpad jeder povečuje entropijo planeta. Vzpostavlja se novo toplotno ravnovesje na planetu, ki bo morda krepko spremenilo podobo planeta. Ravnovesje, ki je temeljilo na sončnem sevanju in geotermalni toploti, akumulaciji, odboju in toplogrednem učinku, je v polovici prejšnjega stoletja porušila energija, ki je nastajala iz umetne cepitve jeder.

1.2 Toplotno onesnaženje zaradi rabe jedrske energije

Jedrska energija povzroča znaten delež vsega toplotnega onesnaženja, ki vodi v globalno segrevanje. Na primer NEK greje Slovenijo približno 0,33 W/m². Ni veliko, ni pa zanemarljivo. Scenarij IPCC 2021 kaže segrevanje podnebja do 1,06 W/m².

Izkoristek jedrske energije je nizek. Sledeč faktorju primarne energije za električno energijo iz omrežja, je s standardom določen 10-% izkoristek jedrske elektrarne.

Od približno 200 držav na svetu jih je 32 jedrskih. Če se bo število jedrskih držav povečevalo in če se bo povečeval delež jedrske energije, bodo toplotne emisije zaradi jedrske energije še naraščale.

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<https://worldpopulationreview.com/country-rankings/largest-countries-in-the-world>
<https://pris.iaea.org/PRIS/WorldStatistics/OperationalReactorsByCountry.aspx>

no.	State	power [MW]	area [.000 km ²]	heat load* [W/m ²]
1	Slovenia	688	20	0,34
2	Armenia	416	30	0,14
3	Taiwan	2.859	36	0,79
4	Switzerland	2.973	41	0,72
5	Netherlands	482	42	0,12
6	Slovakia	2.308	49	0,47
7	Czech Republic	3.934	79	0,50
8	United Arab Emirates	4.011	84	0,48
9	Hungary	1.916	93	0,21
10	South Korea	24.489	100	2,44
11	Bulgaria	2.006	111	0,18
12	Belarus	1.110	208	0,05
13	Romania	1.300	238	0,05
14	United Kingdom	5.883	250	0,24
15	Belgium	3.928	305	0,13
16	Finland	4.394	338	0,13
17	Japan	9.486	378	0,25
18	Sweden	6.935	450	0,15
19	Spain	7.123	506	0,14
20	France	61.370	552	1,11
21	Ukraine	13.107	604	0,22
22	Pakistan	3.262	882	0,04
23	South Africa	1.854	1.200	0,02
24	Iran	915	1.600	0,01
25	Mexico	1.552	2.200	0,01
26	Argentina	1.641	2.780	0,01
27	India	6.290	3.287	0,02
28	Brazil	1.884	8.516	0,00
29	China	53.188	9.600	0,06
30	United States	95.835	9.832	0,10
31	Canada	13.624	9.880	0,01
32	Russia	27.727	17.098	0,02

Slika 1: Seznam jedrskih držav in ocena toplotnih emisij jedrske energije

1.3 Vpliv atomske dobe na globalno segrevanje

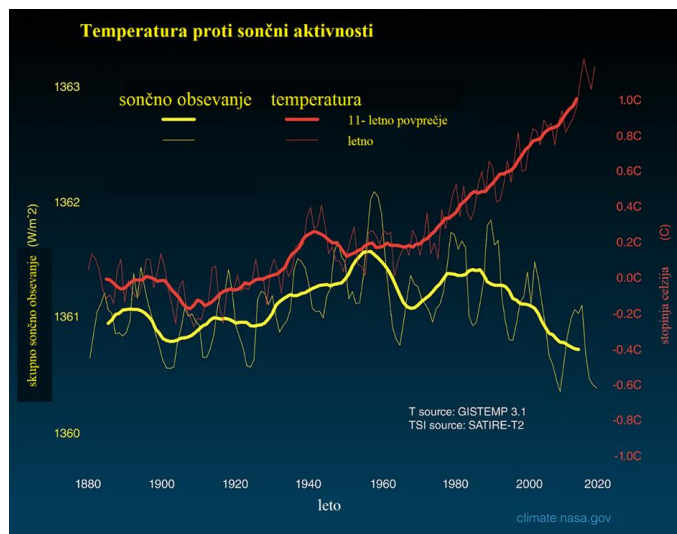
Globalno segrevanje se je začelo z atomsko dobo. Nasa je objavila članek Ali Sonce povzroča globalno segrevanje? (<https://climate.nasa.gov/faq/14/is-the-sun-causing-global-warming/>), v katerem ugotavlja, da je temperatura Zemlje sledila Sončevemu naravnemu 11-letnem ciklu, z majhnim odstopanjem navzgor in navzdol, brez neto povečanja temperature, do približno leta 1950. Od takrat dalje se je svetovna temperatura očitno dvignila. Zato je izredno malo verjetno, da bi Sonce v zadnjih pol stoletja povzročilo opažen trend globalnega segrevanja temperature. Povzročitelji so drugeje.

To poročilo je zanimivo zaradi analize temperature zemlje do preobrata v sredini 20. stoletja in po njem. V obdobju do preobrata je temperatura planeta sledila sončnim aktivnostim, ne gleda na druge vzroke, torej v tistem obdobju na temperaturo ni vplival delež CO2 v ozračju. Od preobrata naprej, ki se je zgodil hipoma, pa je temperatura planeta začela naraščati. Iz tega je lahko sklepati, da niti toplogredni plini niti sončne aktivnosti ne vplivajo na temperaturo planeta.

Je naključje, da se je preobrat zgodil ravno takrat, ko je človeštvo vstopilo v jedrsko dobo?

Kako na globalni ekosistem vpliva jedrska energija, posledice 2.053 jedrskih eksplozij, ki so v stratosfero vnesle na milijone ton prahu, črnega ogljika in bakterij, ki tvorijo oblake? Ali lahko

zanemarimo potencialni vpliv jedrske energije na podnebne spremembe?



Slika 2: Prikaz odvisnosti temperature od sončnega obsevanja

1.4 Zaključek

Mit je, da lahko jedrska energija ublaži podnebne spremembe, ki so se začele z atomsko dobo.

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Vključitev Slovenije v enotno evropsko varstvo zaradi ogroženosti pred izumrtjem medveda in volka

Slovenia's Inclusion in the European Single Protection Scheme for the Threat of Extinction of Bears and Wolves

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POVZETEK

Slovensko Ministrstvo za naravne vire in prostor (MNVP) je izdala ODLOČBO z dovoljenjem za odstrel 230 rjavih medvedov iz narave v letu dni. To je v nasprotju z EU varovanjem najbolj ogroženih naravnih vrst. Pomeni kršitev slovenske in evropske zakonodaje na področju ohranjanja narave. Vzporedno s tem etično in kulturno problematičnim ogrožanjem medveda in volka zaradi tveganja izumrtja, se dogaja istočasno več oblik pospešenega napada nanje: agresivno industrijsko uničevanje njihovega življenjskega prostora, spreminjanje njihovega življenjskega okolja z intenzivno industrijsko kmetijsko obdelavo in z netrajnostnim spreminjanjem gozda v zabaviščni prostor proste vožnje s motornimi vozili in kolesi povsod po naravi, z neznanstvenimi in posmehljivimi predlogi vodilnih strokovnjakov za drastično legalno zviševanje števila odstreljenih medvedov in volkov, državnem subvencioniranju kmetijske pridelave v življenjskem prostoru medveda in volka, pomanjkanju financiranja učinkovite varnostne službe za preprečevanje vznemirjanja, nelegalnega zastrupljanja in lova ter odstrela medvedov in volkov.

V šolske programe biologije in varstva okolja še niso vključene vsebine pomembnosti in koristnosti biološke raznovrstnosti, ni potrebnega financiranja programov varovanja biološke raznovrstnosti in izobraževanja o njenem pomenu za celoto družbo.

V številnih gostinskih lokalih se intenzivno širi ponudba medvedjega mesa, vključno z tačkami medvedjih mladičev, ki so odstreljeni skupaj z vodečimi medvedkami materami. Nekateri javni mediji spreminjajo to neetično in nekulturno ravnanje v medijsko zabavo, hkrati pa ni nujnih zakonskih ukrepov, ki bi zaščitili ogroženi vrsti medvedov in volkov pred profaniranjem njihovega preganjanja, ubijanja in

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kulinaričnega izkoriščanja. Na evropskem zakonodajnem nivoju je nujno prepovedati kulinarično izkoriščanje ubitih medvedov in njihovih mladičev. Hkratni odstrel vodečih medvedk in njihovih mladičev pa je nujno sankcionirati v evropski kazenski zakonodaji varstva ogroženih vrst.

Nekateri predstavniki kmetijskih proizvajalcev v Sloveniji intenzivno spodbujajo in javno zagovarjajo legalno in ilegalno pobijanje (zastrupljanje) ogroženih vrst medveda in volka. Medtem ko večina to zavrača. Tu gre za ekstremne oblike sovražnega govora, ki si zaslužijo nepopustljivo kazensko sankcioniranje, ki ga danes še ni in ki ga je potrebno uvesti na nivoju Evropske unije. Podobno nekateri člani lovskih organizacij zagovarjajo pobijanje ogroženih vrst, hkrati pa številni prejemajo subvencije za kmetijsko obdelavo v težjih pogojih kmetovanja. Medtem ko drugi lovci takšnemu neetičnemu in nesonaravnemu početju nasprotujejo.

KLJUČNE BESEDE

ogroženost medveda in volka, profaniranje pobijanja medvedov, rjavi medved Bruno, medijsko in kulinarična zabava z ogroženimi vrstami, Zveza ekoloških gibanj Slovenije – ZEG, Alpe Adria Green

ABSTRACT

The Slovenian Ministry of Natural Resources and Spatial Planning (MNVP) has issued a DECISION authorising the removal of 230 brown bears from the wild within one year. This is contrary to EU protection of nature's most endangered species. It is a violation of Slovenian and European nature conservation legislation. In parallel with this ethically and culturally problematic threat to bears and wolves due to the risk of extinction, several forms of accelerated attack on them are taking place at the same time: aggressive industrial destruction of their habitat, the alteration of their habitat through intensive industrial agriculture, and the unsustainable conversion of forests into entertainment areas for free-riding motor vehicles and bicycles everywhere in the countryside, unscientific and derisory proposals by leading »scientific« experts for drastic legal increases in the number of bears and wolves culled, state subsidisation of agricultural production in bear and

wolf habitat, lack of funding for an effective security service to prevent disturbance, illegal poisoning, hunting and culling of bears and wolves.

The importance and usefulness of biodiversity is not yet included in school curricula in biology and environmental protection, and there is a lack of funding for biodiversity protection programmes and education on the importance of biodiversity for society as a whole.

Bear meat, including the paws of bear cubs that are slaughtered together with their mother bears, is being intensively offered in many catering establishments in Slovenia. This unethical and uncultured behaviour is being turned into media entertainment by some mainstream media, while at the same time there are no urgent legal measures to protect the endangered species of bears and wolves from the profanation of their persecution, killing and culinary exploitation. It is essential to prohibit the culinary exploitation of killed bears and their cubs at European legislative level. The simultaneous killing of female brown bears and their cubs must be sanctioned in European criminal legislation on the protection of endangered species.

Some representatives of agricultural producers in Slovenia strongly promote and publicly advocate the legal and illegal killing (poisoning) of endangered species of bears and wolves. While the majority refuse to do so. These are extreme forms of hate speech that deserve the unrelenting criminal sanctions that do not yet exist today and that need to be introduced at European Union level. Similarly, some members of hunting organisations advocate the killing of endangered species, while at the same time many receive subsidies for agricultural cultivation in difficult farming conditions. While other hunters are opposed to such unethical and unconscionable practices.

KEYWORDS

Bear and Wolf endangerment, profanation of bear killing, Bruno the Brown Bear, media and culinary entertainment with endangered species, Association of Ecological Movements of Slovenia – ZEG, Alpe Adria Green

1 VKLJUČITEV SLOVENIJE V ENOTNO EVROPSKO VARSTVO ZARADI OGROŽENOSTI PRED IZUMRTJEM MEDVEDA IN VOLKA

Zveza ekoloških gibanj Slovenije-ZEG Odločitvi Ministrstva za naravne vire in prostor (MNVP) , ki je izdala ODLOČBO z dovoljenjem za odvzem 230 rjavih medvedov iz narave v nasprotujemo in jo obsojamo. (Zveza ekoloških gibanj Slovenije-ZEG ima status društva v javnem interesu. Odločba pomeni kršitev slovenske in evropske zakonodaje na področju ohranjanja narave in na področju biološke raznovrstnosti. »Izredni odstrel« medvedov, ki je v resnici rutinski, redni odstrel, ki ga odobril resorni minister, si zasluži vsakršno obsodbo(na srečo ga je predsednik Vlade RS v tem času-odstavil-tudi zaradi grobega posega v

zaščitene živali iz rdečega seznama) . Javni uslužbenec, katerega dolžnost je varovanje ogroženih vrst medvedov in volkov, ravna v nasprotju s svojo funkcijo in javno nalogo in namesto, da bi zaščiteno ogroženih vrst medvedov in volkov razumel kot svojo glavno nalogo, ravna, kot da bi ga ta funkcija ne obvezovala, da jih varuje in da celo svojo funkcijo izpostavi tveganju, da ga bodo zaradi oviranja lobističnih interesov prodajalcev medvedjega mesa, lastnikov restavracij s tem mesom, itd. razrešili z njegove funkcije. Njemu pa vse to ne pomeni veliko.

Zaščita živali, ki so na seznamu evropske Habitatne direktive (Direktiva Sveta 2/43/EGS), je izrecna naloga Ministrstva za naravne vire in prostor in na prvem mestu pristojnega ministra, zato je nesprejemljivo, da pri tem komur koli kakor koli popušča, še zlasti pa ni primerno, da nastopa kot propagandist pobijanja ogroženih vrst medvedov in volkov. To velja prav tako za znanstvenega predstojnika prof. Jerino, ki je pred časom celo v televizijskem intervjuju med smehom poudarjal, da je treba število medvedov v Sloveniji drastično zmanjšati. Univerza v Ljubljani, oz. njeno vodstvo, bi se v takšni situaciji morala zganiti in sprožiti postopek za razveljavitev njegovega znanstvenega naziva glede varstva biološke raznovrstnosti.

Gre pa tudi za vodjo odseka za varovanje biološke raznovrstnosti na ministrstvu za okolje in naravne vire, ki ne opravlja svoje varovalne funkcije glede ogroženosti medvedov in volkov in si zasluži, da ga nadomesti angažiran zagovornik varstva medvedov in volkov. Ob neodgovornem legalnem pobijanju mladičev skupaj z vodilnimi materami medvedkami, pa bi si ta človek zaslužil najmanj kazenski pregon. Pred tem pa tudi vključitev pobijanja ogroženih vrst medvedov in volkov v ustrezen kazenski zakonik.

Kot kaže, ima pristojni vladni organ v svojih telesih več lobistov za pobijanje kot varuhov, za varovanje evropsko ogroženih vrst medvedov in volkov. Pri tem so v postopke za ravnanje z ogroženimi vrstami, kjer obravnavajo predloge za odstrel velikih zveri, vključeni zagovorniki pobijalcev, tudi nekateri lovski lobiji in lobiji in rejcev domačih živali (pri tem celo taki, ki niso z območja medveda), so pa zainteresirani, da bi pregnali avtohtone medvede in volkovi in spremenili gozd v živalsko farmo. Tu se pojavljajo tudi nekatere nevladne organizacije, ki ponujajo usluge komur koli, ki jim je pripravljen plačati ali subvencionirati njihove ekspertize, v katerih so pripravljene zagovarjati kakršno koli »ekspertno« mnenje, ki je po volji njihovih financierjev. To seveda ni privatno financiranje, ampak je financiranje na račun države ali njenih izpostav.

V Sloveniji se je po zaslugi ekspertnih mnenj profesorjev za medvedje meso in vladnih funkcionarjev za varovanje biotične raznovrstnosti potreba po medvedjem mesu v Sloveniji v zadnjih letih znatno povečala (številne elitne restavracije, gostilne, mesarije in izvoz mesa in suho mesnih izdelkov). To je povezano z medijskim poročanjem nekaterih javnih medijev, ki si ustvarjajo klientelo z vzbujanjem strahu pred medvedi in volkovi, ne upoštevajo pa varovanja biotske raznovrstnosti in omejitve, ki so z njim povezane. Prodor na nekdanja ekskluzivna območja za varovanje biotske raznovrstnosti (tudi medvedov in volkov) in na območja, na katera se te vrste vračajo, ker so bile z njih pregnane, zbuja

neupravičeno domnevo, da se medvedi in volki na teh krajih sploh ne bi smeli pojaviti.

Lep primer take histerije je bil medved Bruno, ki je iz Slovenije odšel v Italijo (Dolomite) in naprej na Bavarsko. Očitno je prihodnost medvedov v Sloveniji bolje predvidel kot vsaka vlada, njeni uradniki in klečeplazni profesorji. Čeprav je bila njegova prehrana skoraj izključno trava in sočivje, je razrušil en čebelnjak in domnevno ubil tri ovce. Sam tedanji predsednik bavarske vlade Stoiber je takrat razglasil svojo odločitev, da ga je treba ubiti. S tem je Stoiber medijsko javno histerijo dvignil do vrelišča, kljub temu da Bruno ni nobenega človeka ogrožal ali celo poškodoval. Stoiber pa je medijsko priliko brezobzirno uporabil za svojo promocijo in pokazal svojo politično moč v konzervativnem bavarskem političnem okolju, kjer bi dežela nasprotno pozdravila prvega medveda, ki se je po 150 letih vrnil v deželo svojih prednikov. Ne pa da je iz Finske naročila morilce, ki so ga štirinajst dni neuspešno zasledovali, nazadnje pa ga je ustrelil domači lovec. Bavarska se s to nepremišljeno in nekulturno reakcijo ob srečanju s svojo biotsko raznovrstnostjo ni potrdila kot dežela z zgodovino, kulturo in ohranjanjem narave. Je pa primerna za dobro primerjavo s slovensko histerijo glede zaščite kurnikov in nezadostno utrjenih čebelnjakov, ki omogočajo lansiranje konservativne politične temperature in povečevanja subvencij za drobnico, da ni treba bolj skrbeti za trajnostna delovna mesta na gospodarsko onemoglem podeželju.

Od slovenskega ministra, ki je na predlog znanstvenika prof. Jerine razglasil izredni odstrel 230 medvedov, (in ni izključil možnosti pokola mladičev skupaj z njihovo materjo medvedko) da se bo najmanj pred tem o izrednim odstrelom posvetoval s člani Sveta ministra za naravne vire in prostor za sodelovanje z NVO. To pravkar ustanovljeno telo naj bi nudilo strokovno pomoč ministru pri pripravi boljših rešitev za vse (tudi živali iz rdečega seznama mednarodne zaščite). Opozarjamo, da naj MNVP (Ministrstvo za naravne vire in prostor) v ta telesa nemudoma vključi tudi neodvisne strokovnjake (ne le iz Zavoda za gozdove RS in Biotehniške fakultete) in nevladne organizacije, ki ne zagotavljajo korumpiranih strokovnih mnenj glede pobijanja medvedov in volkov, i jim je za zavarovane divje živali v resnici mar in da se pred kakšno koli odločitvijo v zvezi s tem MNVP na tej ravni temeljito posvetuje. Gotovo bolj od rutinskih prodajalcev mnenj bi bili v tem pogledu primerni člani Alpe Adria Green, ki so vložili na sodišča več tožb za zavrnitev ad hoc streljanja na medvede in njihove mladiče. S tem sicer niso uspeli preprečiti njihovega decimiranja, so pa za čas odločanja sodnikov zaustavili veselo streljanje ogrožene vrste in predvsem so izkazali svojo etično pokončnost in nekorumpiranost in s s tem kvalificirali kot vsestranski varuhi ogroženih vrst.

Medved, volk in ris so v Evropi strogo zavarovane vrste, kar pa očitno ne velja za Slovenijo. Še zdaleč pa niso izžrpani vsi ukrepi za zavarovanje domačih živali pred napadi medveda in volka. Uveljavitev izjeme za odstrel medveda, kot jo zahteva Habitatna direktiva, bi zahtevala veliko več ukrepov. Za varovanje živali na paši pa kot vsi vemo država na podlagi Programa razvoja podeželja RS daje na razpolago brezplačna

sredstva (električne ograje, pse čuvaje in celo ljudi pastirje). Omenjeni program za izvajanje paše na teh območjih upravičeno zahteva dodatno zaščito živali pred velikimi zvermi in spremembo obstoječih kmetijskih praks. Ali je kaj lepšega kot izpustiti domače živali na pašo v gozd, saj po možnosti same najdejo pot nazaj v svoj hlev. Še lepše pa je, če je odškodnina države za poškodovano ali izgubljeno domačo žival nekajkrat višja od njene tržne cene. Poleg tega je v Sloveniji v veljavi sistem odškodnin, ki jih povzročijo zveri, ki je popolnoma upravičen in v korist skrbnih rejcev domačih živali in ogroženih medvedov in volkov. Po uradnih podatkih je pri nas število škodnih primerov zaradi truda vestnih rejcev domačih živali in omenjenih programskih ukrepov v zadnjih letih močno upadlo, kar je pomembno znamenje, da je večina rejcev domačih živali skrbnih in so odgovorni za svoje živali in s tem hkrati varujejo ogrožene medvede in volkove pred pogromom njihovega pobijanja za vsako ceno. Čisto nekaj drugega pa sta dva tokova finančnega priliva na račun streljanja medvedov in volkov. Na eni strani finančni prilivi od tujih lovcev, ki prihajajo v Slovenijo na trofejni lov predvsem medvedov in manj volkov, ki plačujejo visoke zneske tudi po 10.000 evrov. Njim gre za odstrel, trofejo. Ne zanima pa jih veliko meso, saj so tudi postopki za izvoz v EU zelo komplicirani. Drugače pa je z domačimi lovci, ki jim po legalnem odstrelu enega od 230 medvedov tudi plačilo za medvedje meso za lovsko družino ali osebno pomeni dovolj atraktiven dohodek. Na tej osnovi se je v kratkem obdobju nekaj let skoraj neopazno razmahnila v Sloveniji najbolj neokusna in obsojanja vredna kulinarična ponudba medvedjega mesa, ki je svoj vrhunec hitro dosegla pri odstrelu mladičev za ponudbo medvedkovih šap na krožnikih brezobzirnih kulinaričnih »sladokuscev«. Poglejte na internet pod geslom »šapa« ali »medvedja šapa« ali »medvedovo meso« in šokirani boste nad več kot dvajsetimi lokali, od najbolj elitnih s svetovno slavo, do bolj zakotnih in nizkega profila, ki jih ni sram, da rahlo pod prtom ponujajo nekaj tako odvratnega.

Če prof. Jerina v posnetku med smehom opravičuje drastično povišanje števila odstreljenih medvedov, tudi ve, koga vse bo osrečil s tem svojim domnevno »strokovnim mnenjem«. Najprej je tu elitna družba, ki soupravlja državo in vlado in ki skrbi za večji dotok deviz in prihod na »lov« najbolj ekskluzivnih lovcev. Potem pa je tu še druga, skromnejša družba, ki pomaga oskrbovati z medvedjim mesom skromnejše kulinarične lokale, ki pa jih vse takoj najdete po dveh klikih na internetu, če kliknete »šapa«, ali »medvedja šapa«, lahko tudi »šapica« ali »medvedje meso«. Danes jih je več kot dvajset med ponudniki z nadvse nazornimi barvnimi posnetki jedi, za katerimi se vleče krvava sled pobitih medvedkov in medvedov. Saj je očitno vsaka zakonska regulacija prodaje strogo zaščitene medvedov in medvedkov deveta vas.

V zvezi s tem je potrebna razprava tudi v Lovski zvezi Slovenije, ki se rada predstavlja kot nevtralna, nad družbo in naravo vzdignjena instanca, hkrati pa si zakriva oči pred negativnimi posledicami trofejnega lova in z njimi povezanimi ekskluzivnimi zaslužki. Zato se je spontano pojavil predlog, da je treba trofejni lov pri ogroženih vrstah

izkoreniniti, to pa bomo dosegli tako, da se celotne kadavre z glavo in kožo vseh najdenih poginulih ali ustreljenih osebkov po uradnem forenzičnem pregledu po zakonu obvezno komisijsko sežgejo.

V sodnem sporu in iz njega izvirajočih razpravah, ki jih je sprožila Adria Alpe Green s svojo tožbo za zaustavitev postopkov glede predloga ministrstva za odstrel več kot 200 medvedov letno, je bilo pisno ugotovljeno, da v Sloveniji obstaja krivolov medveda in volka. Te dni je Upravno sodišče RS na veliko javno presenečenje politično popustilo in dovolilo odstrel še preostalih 182 medvedov do konca leta. Iz to ob sorazmerno večjem številu krivolov volka, in nekoliko sorazmerno manjšem številu krivolov medveda. V nobenem primeru pa se do danes še ni zgodila pravomočna obsodba krivolovca, ki je nezakonito ubil medveda ali volka. Slovenski državni organi, vlada, ministrstvo za naravne vire, policija, lovska zveza, preprosto nimajo volje in ne motivacije, da bi različne oblike krivolova volkov in medvedov, zastrupljanje, pasti, nezakonito streljanj itd. ustavile in preprečile njegovo stalno perpetuiranje.

VIRI

- [1] Stališča in menja ZEG do zaščite velikih zveri (www.zeg.si)

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INFORMACIJSKA DRUŽBA – IS 2023
Zvezek E

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16. Mednarodna konferenca o prenosu tehnologij
16th International Technology Transfer Conference

Urednici / Editors

Tinkara Mlinar, Špela Stres

<http://is.ijs.si>

11. in 13. oktober 2023 / 11 and 13 October 2023
Ljubljana, Slovenia

PREDGOVOR / FOREWORD

Dear guests, experts, panellists, participants,

It is a great honour to welcome you to the national event of the European Union campaign to boost knowledge valorisation, which takes place during this year's Science Month and the traditional 16th International Technology Transfer Conference.

We gathered today as a community of professionals, whose everyday work is closely intertwined with science and research, as well as innovation. One of the main missions of the Jožef Stefan Institute is the accumulation and dissemination of knowledge at the frontiers of natural sciences, life sciences and engineering. Equally important is our ambition to turn research results into sustainable products and solutions to improve the quality of life, including environmental benefits, as we contribute to the development of several key enabling technologies, such as quantum and nanotechnologies, biotechnologies, new materials, communication and computer technologies, and nuclear engineering, to mention some of them. Every day, we are faced with many new challenges, and as scientists, we are entrusted to deliver appropriate answers and solutions, either on a national or global level. It is important we do not betray this trust.

Throughout the years, especially since the organisation of the 1st International Technology Transfer Conference, we have been continuously learning from our friends in esteemed institutions across the world, which importantly contributed to the development of the technology transfer system within the Jožef Stefan Institute. Additionally, the new gained knowledge enabled us to become an active partner in building a national support innovation system in close collaboration with the competent ministries, agencies, support organizations, and partner public research organizations. We helped address numerous challenges, such as securing funding sources for innovation within spin-out companies during the proof of concept phases, proposing changes in national legislation related to research and innovation, spin-out development, and establishing and coordinating two consecutive consortia of technology transfer offices at leading Slovenian research institutions and universities. Looking ahead, the Central and Eastern European Technology Transfer (CEETT) initiative presents a promising investment program in collaboration with the EIF, and Slovenian and Croatian development banks. This initiative will offer spin-out teams the unique opportunity to secure investment pre-incorporation. Furthermore, we celebrate a significant legislative milestone with the incorporation of spin-outs into the new national Act on Scientific Research and Innovation. Since 2022, Slovenian public research organizations can take equity in their spin-outs, marking a pivotal recognition of spin-outs in national law. This breakthrough, while promising, necessitates practical implementation, offering both challenges and opportunities that we shall explore in our discussions.

At the commencement of the 16th International Conference on Technology Transfer, we eagerly anticipate reflecting on the journey taken. Many participants from the Conference and especially at the competition for the best innovation from public research institutions have embarked on the initial stages of commercialization and some of them successfully established spin-out companies based on technologies and inventions developed within their research institutions. The entrepreneurial researchers' pitch competition emerged as a pivotal platform, often marking the teams' initial exposure to the prospect of establishing their own ventures. The competition guided them through the vital stages of developing their first business model and crafting an impactful pitch. To date, nearly 100 entrepreneurial research

teams have engaged in the competitions, resulting in the awarding of 30 winners. We also take immense pleasure in the growth of the conference in the last three years, notably through the inclusion of peer-reviewed contributions from researchers specializing in the field of technology transfer. This expansion augments the knowledge base and elevates awareness surrounding the transfer of technologies and innovations.

Finally, let's reflect on the evolving organizational structure of the technology transfer organization and cooperation with industry at the Jožef Stefan Institute. The team of dedicated individuals over the past decade and a half has stabilized the Institute's support for researchers in the commercialisation and advancement of their innovations.

Thank you for being a part of this incredible journey, and here's to the promising future that lies ahead.

Organizing Committee of the 16th ITTC

ORGANIZACIJSKI ODBOR, PARTNERJI IN SPONZORJI / ORGANIZING COMMITTEE, PARTNERS AND FINANCIERS

The main organizer of the 16th ITTC Conference is Jožef Stefan Institute.



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Co-financing

The event is organized and co-financed in the frame of the Enterprise Europe Network (GA project number 101052776).



Collaboration

The 16th ITTC is organized in collaboration with the International multiconference Information Society (IS2023).



EUROPEAN UNION CAMPAIGN TO BOOST KNOWLEDGE VALORISATION

The 16th ITTC is taking place under the umbrella of the EU campaign to boost knowledge valorisation.

THE SCIENCE MONTH

The 16th ITTC is organised within the Science Month that is coordinated by the Ministry of Higher Education, Science and Innovation.



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ZRS Bistra Ptuj – Scientific Research Centre Bistra Ptuj



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Research Infrastructures and Cooperation with Industry

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ABSTRACT

The paper addresses the experience of European Strategic Framework on Research Infrastructure (ESFRI) Landmarks in their work with partners from industry. While the main mission of the RIs is to provide infrastructure support to scientific work, they are also cooperating intensively with the industry. Our survey among 42 ESFRI Landmarks showed that as many as 82% of them have a strong and well-established cooperation with partners. However, there are still several barriers to cooperation on both sides, with the management of intellectual property being an important one.

KEYWORDS

Research infrastructures, industry, cooperation, barriers, intellectual property.

1 INTRODUCTION

One of the most important achievements of the European Research Area (ERA) has been the establishment of research infrastructures (RIs) at the European level. With coordination efforts of European Strategic Forum on Research Infrastructures (ESFRI), the roadmaps of EU RIs have been developed[1], a set of Working Groups[2] formed to support the work of RIs as well as help provided by the ESFRI and EC to meet fully the objectives of RIs. The RIs are essential pillars supporting European basic research, yet their impact extends beyond the scientific community. They are facilities that provide resources and services for all research communities to conduct research and foster innovation, suggesting that they intensively cooperate with industry as well. The cooperation includes also transfer of knowledge/ technology developed jointly with using equipment or/ and data or/and testing facilities of the RIs.

In their cooperation with industry, RIs often encounter similar problems as we can observe in the relationship between public research organizations (PROs) and private sector [3]. To identify the level and type of cooperation between RIs and industry, we prepared a special survey, sent to ESFRI Landmarks. The survey

had the ambition to also identify main barriers to closer cooperation and suggest possible policy actions to stimulate this important cooperation. The findings of the survey were presented at the ESFRI Forum in Brno, 2022 [4] as well as by the ESFRI Drafting Group on RI – industry cooperation. Some of the observations and findings from the discussion at these fora have been integrated into the text as well. The end objective of our analysis was to contribute to the implementation of ERA Action 8 [5], and in this way to the creation of competitive innovation ecosystem at EU level.

2 THE SURVEY

The survey on RIs industry cooperation was prepared by the support team to ESFRI Chair in 2022[6]. The questionnaire was sent to 43 ESFRI Landmarks. 35 replies were received. Of these, 49% Landmarks responded that they regularly cooperate with industry, while 34% do so occasionally [7]. This confirmed our initial assumption that the cooperation between RIs and industry is well established. It mostly takes place at national level [8]. Most common form of cooperation is joint research projects, which are either financed at the EU level or by the national research funds. RIs offer industry access to their equipment, offer them various services, access to data, etc. They believe that cooperation with industry is beneficial to them and plan to expand it: 72% of the respondents actively stimulate the cooperation. The tools to promote cooperation are various. RIs involve industrial partners in decision-making bodies as members of strategic/ scientific boards. Several reported on the establishment of specialized offices, which serve as contact points for industry. Another way to promote cooperation is the preparation of special industry- focused days to present the potential forms of cooperation and services they can offer. It is interesting that RIs are engaged in so many different activities to promote cooperation although it is not very important in terms of revenue. At best, according to our survey, the RIs state that no more than 10% of their revenues are derived from industry. In part, the reasons for this may lie in unclear regulations as to commercial activities of publicly- financed infrastructures in some countries.

The importance of cooperation is reflected in the high percentage of responses on the future plans to intensify the cooperation: as many as 92% of the RI respondents wish to expand the cooperation and plan to actively engage in this. One of the motivation factors is the fact that RIs can complement

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traditionally insufficient financial resources received from the government(s) with the money from business sector. This may enable them to invest in appropriate new research equipment as well as maintain the existing infrastructure, either directly relevant for the research cooperation or expanding the options for basic research. In times of increasing costs of investment in sophisticated research equipment this is becoming increasingly important factor.

Among the factors which may hinder cooperation the lack of interest on the side of industrial partners in their area of work was most often cited by the RIs. However, several suggestions were provided as to the needed activities at the policy level as well as at the level of RIs to promote and ease the cooperation, with a clear objective to make transfer of knowledge from RIs to industry smoother.

3 ACTIVITIES TO PROMOTE COOPERATION

3.1 At RI's level

To promote cooperation with industry, RIs themselves have indicated that they should do more to increase the visibility of the services they are capable of offering. Various activities were proposed by the respondents. Let us share the most interesting proposals.

The appointment of an industry liaison officer was identified as an important action to bridge the communication gap between scientists working in RIs and the researchers from industry. As several other studies on cooperation between public research organisations (institutes or/and universities) have identified (among others, see [9] Bučar and Rojec, 2019; [10] Jensen et al., 2010; [11] Arvanitis and Bolli, 2009), the objectives of the researchers in the public research organisations (PROs) and the representatives of the industry are often highly different. While the criteria in many countries for successful research are based on the publication record and this has significant impact on the funding, the industrial research is focused on more immediate goal of finding optimal solutions to the business processes, be it in manufacturing or in services. The trend in PROs is towards open science and many of the funding agencies require the results of the research to be available widely and free of costs. On the other hand, industry needs to protect the findings as their intellectual property. Careful balancing on how to meet the requirements of the two different approaches and at the same time reach a working arrangement for both parties is needed. It seems that some RIs have been more successful in this than the others, thus sharing of the experiences may ease the cooperation for others.

Also, the already mentioned involvement of industrial representatives in different RI's decision-making bodies should be systematically encouraged. The latter would be important in shaping the RIs development strategy since input from industry would indicate which research fields are considered as most relevant for the RIs to focus on.

Additional dilemma faced by RIs is how to communicate with partners from industry. Differences in the objectives of participating in cooperation need to be openly discussed and at least initially, this may take some time. A clear understanding of each other's objectives, and respect for these, need to be a

starting point in establishing the cooperation. This is often achieved best by regular exchange of personnel or by close interaction of the key personnel from both partners working on a particular issue. Here, the issue of motivation on the side of individual researchers working in RIs, was identified as possible issue that needs special attention. The so called "liaison officer" in RI would need to be specifically stimulated to engage in cooperation with the industry, since this could mean that the traditional path of career progress through publications and citations would be slowed down. To cooperate with industry especially in the area of knowledge/ technology transfer, specialised staff is needed, which is often not available in RIs.

3.2 At the policy level

Issues related to financing of the cooperation were identified as a barrier to cooperation. On one hand, some RIs mentioned that it is sometimes expected that since they receive public financing, they should not be charging industrial partners for their services. On the other hand, the regulations in some cases make it too complicated to carry out commercialization of services to industry. The lack of suitable business models de-stimulates some of the RIs to pursue cooperation more actively, so it was suggested that a special platform, where sharing good practices and successful modes of cooperation are shared among RIs. This would help less experienced ones to learn from those with extensive practice of working with industry. Samples of agreements on sharing intellectual property benefits would be helpful as well.

The respondents to the survey proposed that such a platform should be established by EC so as to serve to RIs in all member states. It could be used to share good practices in all areas of cooperation: from legal and financial issues, overall appropriate business models, negotiations on intellectual property issues, personnel issues, etc.

Other policy measures suggested to support the cooperation include:

- a) Financing of joint research projects, where the cooperation between RIs and industry could be recognized as a positive characteristic of project application;
- b) Encouragement of exchange of personnel and/or hosting of researchers from industry by RIs (for example, to carry out Ph.D. research);
- c) Special grants to SMEs to co-finance some of the costs of using the services of RIs;
- d) The cooperation of RIs and industry should be actively promoted both at EC level as well as at the level of Member States, with specific resources available for such a promotion.

4 CONCLUDING OBSERVATIONS

The survey findings aligned closely with our initial assumptions concerning the collaborative engagement between RIs and industry. There is significant interest on the side of RIs to expand such cooperation. Recognized barriers, including the misalignment of objectives between RIs and industrial partners, have already been subject to policy interventions at various levels. There are several measures at national and EC level [12], which could be utilized to support such cooperation, yet it often seems that the awareness of their existence is still limited, especially among the SMEs.

Overall, the survey underscored transformative potential of RI-industry collaboration in fostering a competitive innovation ecosystem across the European union, bearing an important significance in the context of the ERA's overarching objectives. The imperative role of ESFRI in promoting the cooperation of RIs and industry and addressing barriers therein cannot be overstated. Within the policy discussions on European innovation ecosystems, the role and extent of cooperation of RIs with industry needs to be appropriately recognized. This is particularly significant if the enhancement of knowledge/technology transfer from public research to industry is to be implemented, thereby contributing to the competitiveness of the European industry.

In summary, RIs have the pivotal role as enablers of scientific progress and innovation in Europe. However, the evolving cooperation between RIs and industry shows the potential for mutual benefit, both in designing appropriate research questions as by further development of technology transfer from RIs to industry. This is calling for continuous efforts at both the operational and policy levels, where the role of ESFRI is of high importance in order to nurture a competitive innovation ecosystem across the European Union.

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Randomized Optimization: From Algorithmic Studies to Industrial Applications

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ABSTRACT

As opposed to deterministic optimization techniques, randomized optimization algorithms rely on random choices when searching for good solutions to a given problem. They represent a viable alternative for solving real-world problems whose properties are usually unknown and their complexity too high to be solved with deterministic techniques. In our research group, we are specialized in studying and designing randomized optimization algorithms and deploying them in practice. In this paper we report on our algorithmic studies that have led to successful industrial applications. We illustrate these with two case studies from engineering design and production process optimization.

KEYWORDS

optimization, black-box problems, randomized algorithms, numerical simulation, visualization, engineering design, production

1 INTRODUCTION

Many problems in science, engineering and business can be formulated as optimization problems, where the task is to find the best solution among the possible alternatives with respect to a given criterion. Mathematics and, in particular, operation research provide various optimization methods that are applicable given that the problems meet certain preconditions, such as linearity, continuity, existence of derivatives, etc. Unfortunately, real-world problems rarely comply with these requirements. Frequently, their structure and properties are unknown, they may involve several possibly conflicting objectives as well as constraints. This makes them intractable for traditional mathematical optimization methods. However, with the rise of computing power, a new class of optimizers, called randomized or stochastic optimization algorithms [17] has emerged. Their key characteristic is that, unlike in deterministic mathematical methods, certain algorithm steps depend on random choices. Randomized algorithms search for good solutions according to some heuristic and handle the problems in a black-box manner, i.e., without dealing with their structure and properties. Many of them are population-based, as is the case, for example, with evolutionary algorithms [5].

In the Computational Intelligence Group of the Department of Intelligent Systems at the Jožef Stefan Institute, we have decades of experience in studying, designing and deploying randomized optimization algorithms. In this paper we report on our algorithmic studies that have led to successful industrial applications. The paper is further organized as follows. Section 2 outlines the research topics dealt with and the proposed algorithms. The next

two sections present cases studies from their practical applications. Section 3 overviews our work in engineering design and focuses on the recent use case of designing an electric motor for the automotive industry. Section 4 lists the applications in production process optimization and presents a system developed to tune the parameters of a metallurgical production process. Section 5 summarizes our work and provides ideas for future development.

2 ALGORITHMIC STUDIES

Our interest in randomized optimization was inspired by the introduction of genetic algorithms as a method to perform search, optimization, and machine learning [13]. After the initial experiments on test problems and first attempts at solving real-world problems, we specialized in evolutionary multiobjective optimization [2]. Our early achievement in this area was the design of the Differential Evolution for Multiobjective Optimization (DEMO) algorithm [16], which combines the search mechanism of single-objective Differential Evolution [18] with the concepts of multiobjective optimization from the NSGA-II algorithm [3] and finds multiple trade-off solutions in a single algorithm run.

The algorithm was later extended to Asynchronous Master-Slave DEMO (AMS-DEMO) [4] suitable for solving computationally demanding problems, as it is parallelized and adjusted for both homogeneous and heterogeneous multiprocessor architectures. Another modification of the basic algorithm was DEMO based on Gaussian Process models (GP-DEMO) [15], which incorporates two practically relevant approaches: surrogate models for faster evaluation of solutions and newly defined relations for comparing solutions under uncertainty to minimize the effect of errors due to inaccurate surrogate model approximations.

Significant attention was also paid to the visualization of optimization results. This turned out to be useful in solving both artificial test problems and real-world problems as it helped better understand the problems themselves as well as the working of the algorithms. We introduced a method for visualizing fronts of non-dominated solutions called visualization with projections [19] and created a taxonomy of the existing visualization methods for multiobjective optimization [8].

3 ENGINEERING DESIGN OPTIMIZATION

We have approached several engineering design optimization problems using randomized algorithms. The addressed devices and the related optimization tasks were as follows:

- Electric motor for home appliances – determining the geometry of its rotor and stator such that the power losses are minimal [21];
- Energy supply system based on renewable sources – finding its configuration, i.e., the type and the number of its components (photovoltaic panels, batteries, etc.), such that both the proportion of unsupplied energy and the costs of the system construction and operation are minimal [6];

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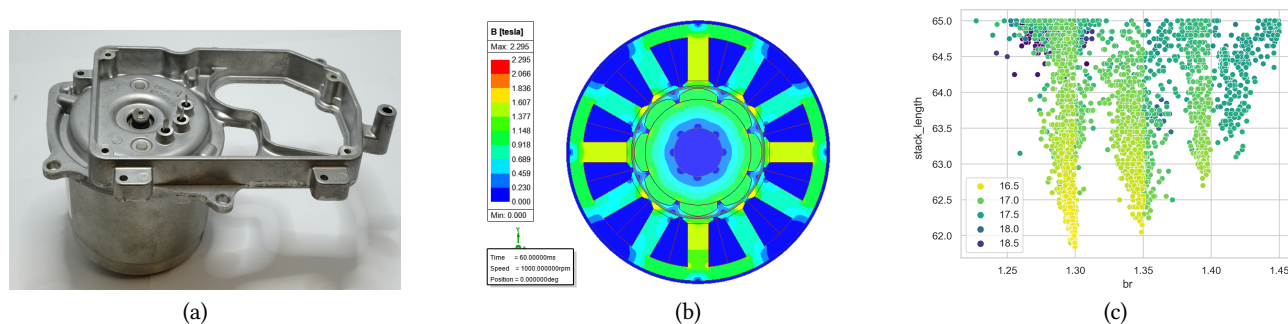


Figure 1: An electric motor for the automotive steering system: (a) a product example (source: MAHLE archive), (b) numerical simulation of the magnetic field (source: MAHLE archive), (c) visualization of candidate designs with respect to selected characteristics.

- Cyclone dust separator (a device for removing dust particles from gas streams, widely used in industry) – determining, through a number of design variables, its shape such that the device operates with maximum collection efficiency and minimum pressure drop [23].

A recent engineering design challenge we dealt with was the development of an electric motor for the automotive steering system [20] carried out for MAHLE Electric Drives Slovenija, an internationally recognized producer of components for the automotive industry. Specifically, a synchronous electric motor with surface-mounted magnets was considered. An example of the product is shown in Figure 1(a).

In the optimization problem formulation, both technical and economic aspects were involved. The task was to determine the geometry characteristics of the electric motor and the material properties of its components in such a way that the motor meets the technical requirements specified by the customer and its price is as low as possible. There are 13 design variables and seven constraints referring to the technical characteristics of the electric motor, given in the form of either minimum or maximum value to be respected. The optimization objective to be minimized is the total price of the electric motor, resulting predominantly from the costs of the magnets and the copper winding.

In design tasks of this kind, a numerical simulator capable of evaluating possible solutions (designs) is crucial for the automation of the design procedure. MAHLE uses the Ansys Maxwell simulator [1] based on the finite element method that, given the values of design variables, calculates the values of the regarded technical characteristics and the optimization objective (Figure 1(b) shows the result of the magnetic field simulation). This makes it possible to approach the problem in a black-box manner, where the designs are iteratively evaluated and improved. However, as numerical simulations are time-consuming, the key challenge is to set up the optimization process in such a way that it can find good solutions in acceptable time. To solve this design optimization problem, we implemented a prototype software environment incorporating measures to speed-up the optimization process, while additionally ensuring the robustness of solutions and supporting the design process with visualization.

The measures taken to speed-up the optimization process were the following:

- As an optimization algorithm, a specific version of the covariance matrix adaptation evolution strategy (CMA-ES) called lq-CMA-ES [14] was used, which partially replaces

costly simulation-based solution evaluations with fast-calculating surrogate models.

- Solution evaluation was carried out through a custom-designed five-step procedure performing a sequence of solution checks and eliminating a large proportion of infeasible solutions without running the costly simulations.
- The most complex step of the solution evaluation procedure, the detailed numerical simulation, was parallelized to take advantage of the available multicore processors.

Robustness of electric motor designs is related to the limitations of manufacturing where the matching of products with the optimized design can only be ensured within certain tolerances. For this reason, the designs are required to be robust in that small changes in design variables, within the tolerances, do not significantly affect the characteristics of the electric motors. In the design process, this was checked by simulating a variety of designs slightly differing from the original one.

Finally, in addition to producing numerical results in the form of the optimized values of design variables and the related electric motor characteristics, the procedure was also required to provide insight into the solution space. For this purpose, the methods for data analysis and visualization were applied. Figure 1(c) shows an example of visualization where, for a chosen pair of design variables, the value of a selected electric motor characteristic is indicated by color.

The project resulted in a design of the considered electric motor model substantially outperforming the prototype initially developed by the company using a simpler optimization procedure. As the key achievement, the price of the product was reduced by 10% compared to the price of the initial version. Given that large series are manufactured, this represents substantial savings for the company and considerably improves their competitiveness in the market.

4 PRODUCTION PROCESS OPTIMIZATION

Our practically oriented studies and applied projects in production process optimization refer to the following processes and the related optimization tasks:

- Deep drawing (a particular kind of sheet metal forming used, for example, in the automotive industry for the manufacturing of car body parts) – increasing the process stability by tuning the input parameter values [12];
- Clothing production – finding an optimal sequence of steps in the processing of work orders to minimize the production preparation costs [11];



Figure 2: Continuous casting of steel: (a) pouring of molten steel into the mold where the casting process starts, (b) casting device (source: Štore Steel archive), (c) cooling of billets.

- Continuous casting of steel (a key process in steel production) – determining the values of process parameters such that the conflicting criteria for process safety, productivity, and product quality are fulfilled [9, 7].

Among these, the largest amount of our work was devoted to the optimization of steel casting. In this process, molten steel extracted from the furnace passes through a sequence of rolls and water sprays in the casting machine where it is cooled and shaped into semi-finished products. Of crucial importance for the quality of cast steel is the control of metal flow and heat extraction during casting. They depend on numerous process parameters, such as the casting speed and coolant flows. Finding the optimal values of process parameters is not trivial as the number of possible parameter settings grows exponentially with the number of parameters, and trial-and-error parameter tuning is unattainable in practice. Fortunately, numerical simulators of the process exist that, integrated with efficient optimizers, allow for automated computer-aided parameter tuning.

We were dealing with various problem formulations for several steel producers. Here we present an optimization system developed for and installed at Štore Steel, a steel company best known for their production of spring steels for the automotive industry. A new casting device at the plant was considered and the quality of cast steel was of primary concern. Figure 2 shows the initial stage of the continuous casting process, the casting device, and the outcome, i.e., cast steel in the form of billets.

The optimization problem was formulated to include six input variables (process parameters) subject to boundary constraints and three output variables indicating the process suitability and, consequently, the expected steel quality. For output variables, boundary constraints and target values were specified in advance. The goal of optimization was to find the values of process parameters such that the resulting values of output variables respect the boundary constraints and their deviations from the respective target values are as small as possible.

Starting with this problem formulation, we designed and implemented a software system to automate the process parameter tuning [10]. The system consists of the following components:

- An optimization algorithm to search the space of parameter settings and identify the settings representing trade-offs between the objectives;
- An interface to the numerical simulator of the continuous casting process to evaluate the parameter settings encountered by the optimization algorithm;
- A visualization method to present the optimization results and support their analysis.

The optimization algorithm used is Differential Evolution for Multiobjective Optimization (DEMO) [16]. While exploring the process parameter space using population-based search, it invokes the simulator to assess the quality of candidate parameter settings. Progressively, it converges to a set of trade-off solutions.

As a simulator, a numerical model of the steel casting process based on a meshless method [22] is deployed, designed and calibrated for the considered casting machine during its introduction into production. Given the values of input variables, the simulator numerically evaluates the casting process and returns the values of output variables.

Visualization of solutions (process parameter settings) resulting from the optimization procedure is done in parallel coordinates. This is a method suitable for visualizing multidimensional spaces. Each dimension corresponds to a parallel axis and a solution is represented as a polyline through the related vertices on the axes. As illustrated in Figure 3, both input and output values of solutions are shown in a single plot. Moreover, the user can interactively analyze the solutions depending on the requirements for a particular product order. By indicating the intervals for selected variables (as shown in the figure for the first two output variables), one can see what input values are required and how they affect the remaining output values.

The practical importance of this optimization system is in that it automates the process parameter optimization and in this way replaces the time-consuming trial-and-error experiments carried out previously when only the numerical simulator was available. The automation is particularly beneficial as parameter tuning has to be performed individually for each steel grade. As a result, the company is more flexible in responding to customer requests and achieves a higher quality of their products.

5 CONCLUSION

Randomized optimization is the primary research topic of our research group. We have contributed to the field with new algorithms exhibiting competitive performance on multiobjective optimization problems, as well as with the methodological insights into visualization of solutions for this type of problems.

Potential industrial users often see the fact that randomized optimization algorithms generally return suboptimal solutions and produce different results over repeated runs as their critical disadvantage. However, for problems not amenable to mathematical treatment these algorithms may be the only viable approach. As frequently found in practice and confirmed by our case studies as well, substantial gains may result from their deployment.

Our further research efforts are directed towards shifting from black-box to gray-box problem handling, where the idea is to

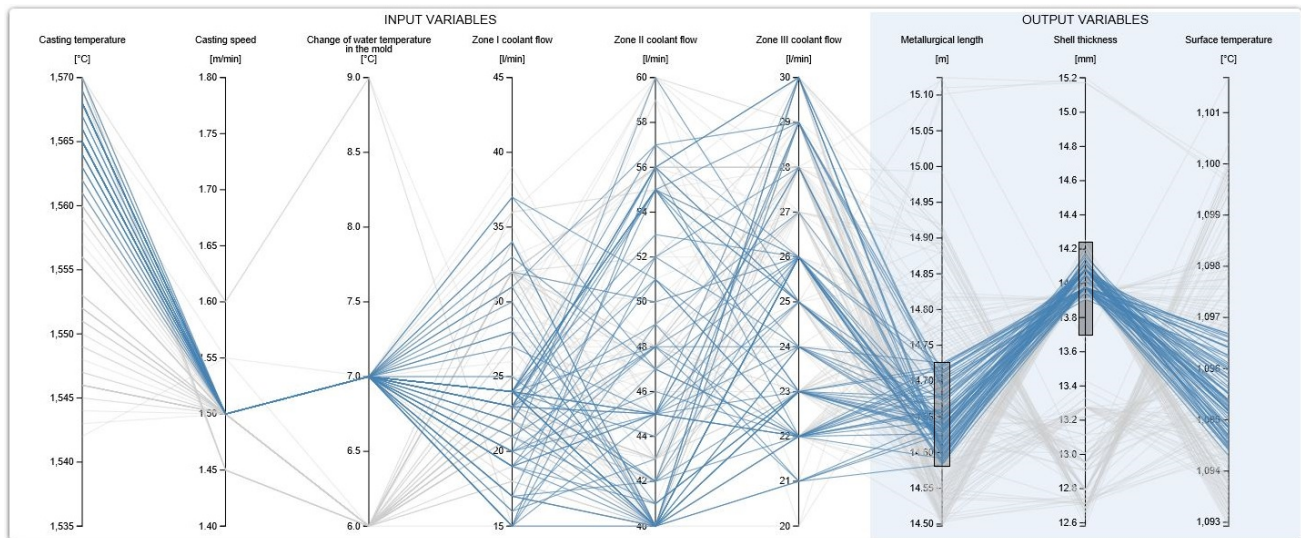


Figure 3: Visualization of optimized process parameter settings in parallel coordinates (blue color indicates solutions selected by the user).

characterize the problems with features extracted from the samples of their solutions and then use these features to better understand the problems [24]. As a future step, problem features will be matched with algorithm performance to help select the most efficient algorithm for a given problem. Moreover, in the applied work we plan to expand from solving specific problems to providing optimization environments capable of solving sets of related problems and offering more flexibility to the users.

ACKNOWLEDGEMENTS

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Creating Conditions for an Active Role of Public Administrations in Academia-Industry Cooperation: an Overview of Critical Points Through the ExSACT Project

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ABSTRACT

The ATTRACT European Scientific Research Infrastructures (ERIs) have formed an ERI Innovation Ecosystem (ERI-IE) as an essential tool in boosting academia-industry collaboration. The state administration encourages academia-industry (co)operation with financial incentives. However, it still encounters rules and legislation to protect competition in the free market imposed within state aid limitations. Due to limited recognition of state aid practices, the allocation of funding and intellectual property rights (IPR) needs management given state aid restrictions. Ambiguities result in state investments into academia-industry collaboration or research/technology infrastructure (RI/TI) usage needing improvement and simplification. This status quo, therefore, necessitates an examination of this field – to explore the effect of the state administration on financing research, RI/TI and IPR transfer procedures through state aid rules abiding (RI/TI and IPR) management. The following paper presents existing conditions and the most common challenges for creating conditions for an active role of public administrations to mitigate risks in academia-industry cooperation (in the EU). It concludes with state-of-the-art results obtained through the project ExSACT.

KEYWORDS

IPR, Protection, Public Administration, Role, Technology Transfer, Challenges, EU, ExSACT

1 INTRODUCTION

1.1 The Baseline and Status Quo

The ATTRACT European Scientific Research Infrastructures (ERIs) have formed an ERI Innovation Ecosystem (ERI-IE) as an essential tool in boosting academia-industry collaboration. ERI-IE operates in the global competitive environment wherein technological development is one of the few competitive levers capable of added value creation [1, 2].

The state administration encourages academia-industry (co)operation with financial incentives. Still, it encounters rules and legislation to protect competition in the free market imposed within state aid rules. The regulations, however, do allow the granting of aid within substantive exceptions (e.g., particular importance for development), special conditions (advance notification of state aid to the European Commission (EC) and its consent), or in a simplified form up to a certain amount (de

minimis rule). Due to limited recognition of the state aid rules, the allocation of funding and IPR needs management given state aid restrictions. Ambiguities result in state investments into academia-industry collaboration or limited and complicated research/technology infrastructure (RI/TI) usage. The provision of state aid and understanding or lack of knowledge thereof may thus support or slow down such investments and the smooth transition of technology through the technology readiness level (TRL) with the involvement of the ERI-IE [1, 2]. Improving the understanding the state aid rules in financing research, RI/TI's use, and IPR transfer procedures within ERIs collaborative projects with industry would improve incentives efficiency for research to the economy transition. To address the current status quo, the following research question(s) have been defined to guide research in the ExSACT project (Enable State Administration to be an Active Contributor in the Process of risk Absorption and Risk Reduction Through IPR and State Aid):

How to simplify and optimise public investments (into):

- a) research and technology infrastructures;
- b) background and foreground IPR;
- c) when academia-industry collaboration is in question, must state aid regulations be considered?

The research will, therefore, in the domain of crucial objective, explore the state administration's effect on financing research, RI/TI, and IPR transfer procedures through the state aid rules abiding (RI/TI and IPR) management. After successfully addressing the crucial objective, a seamlessly integrated ERI supporting research and economy from knowledge creation through defining IP to commercialisation with proper funding, given state aid limitations, would:

- a) enhance investments;
- b) lower risk; and
- c) enable involved stakeholders to bring more science to everyday use.

A better understanding of RI/TI use and IPR contractual issues concerning state aid rules will be easier to implement by the state administrations of the ERI-IEs.

2 METHODOLOGY

To achieve the crucial objective and for a better understanding of RI/TI use and IPR contractual issues concerning state aid rules and more straightforward implementation by the state administrations of the ERI-IEs, quantitative and qualitative research has been carried out, namely:

1. analysis of the critical points of RI/TI and IPR management;
2. preparation of a review of systems for valuing transferring IPR in collaborative projects in the ERI-IE;
3. preparation of a review of the regulation of the state aid system in RI/TI and IPR management;
4. preparation of a proposal for a sustainable system and changes to be implemented for more effective financial support of the innovation system, following and properly manifesting the EU state aid rules in the ERI-IE of ATTRACT.

A quantitative and qualitative analysis of critical points for the transfer of IPR and the development of guidelines for the management of IPR in joint research and development (R&D) projects has been carried out based on secondary data and primary data, obtained through semi-structured interviews. The research includes:

1. an international comparative review of systems for valuing the market value of IP rights in collaborative projects and a comprehensive process of detection registration of IP as an intangible asset and IP valuation;
2. a review of the regulation of the state aid system and a proposal for a sustainable system of the state aid system and the changes.

3 PRELIMINARY RESULTS

3.1 RI/TI and IPR Management Critical Points

Research infrastructures (RIs) are the scientific community's facilities, resources, and services to conduct top-level research. They can be single-sited, distributed, or virtual. RIs include major scientific equipment or sets of instruments, collections, archives or scientific data, computing systems and communication networks, and any other research and innovation infrastructure of a unique nature that is open to external users. RIs are organised and financed at the regional, national and European levels [1].

Technology infrastructures (TIs) are similar to RIs. Still, they are primarily intended for industrial users, including small and medium enterprises (SMEs), which seek support to develop and integrate innovative technologies to commercialise new products, processes, and services. TIs can have public, semi-public, or private status. Like RIs, TIs are organised and funded on different levels [3].

Although there are some differences between RIs and TIs, many infrastructures fit into both groups. The primary objective of an RI is to establish and operate on a non-economic basis. However, they can carry out limited economic activities if closely related to their principal task and not jeopardise their achievement.

The primary goal of a TI is to support SMEs and industry to develop the technologies with its help. In the case of TIs, economic activities are encouraged. However, these are sometimes partially financially supported by public means.

RIs and TIs should share information about their resources and services publicly. The price for using RIs and TIs can be set on a non-economic basis, using the cost approach, or on an

economic basis, using the market approach, the cost approach, or the income approach.

Public higher education and public research institutes may, as stated in Article 21 of the Slovenian Employment Inventions Act (ZPILDR), establish: (i) organisational infrastructures necessary for dealing with inventions; (ii) the rulebook, which regulates the process of taking over official inventions in a way that is adapted to the needs of scientific research work and the publication of scientific achievements; (iii) the shares determined by the regulations, which belong to the institution, the unit of the institution in which the inventor is employed, and the inventor(s), in the exploitation of the invention, whereby the share of the award to the inventors must not amount to less than 20% of the gross license fee that the institution receives from exploitation of the invention. Pursuant to Article 21 of the Act on Inventions from the Employment Relationship, upon fulfilment of the above conditions (i, ii, iii), the state is specifically obliged to provide funds for the organisational infrastructure necessary to deal with inventions according to the provisions of this Act and for their effective exploitation [4].

The EC recommends that public research organisations should have technology transfer strategic missions and policies. IP should be suitably managed by promoting its identification, exploitation and, where appropriate, protection in line with the strategy and mission of the public research organisation and to maximise socioeconomic benefits [5]. To this end, different strategies may be adopted – possibly differentiated in the respective scientific/technical areas – for instance, the ‘public domain’ approach or the ‘open innovation’ approach. Appropriate incentives should be provided to ensure that all relevant staff play an active role in implementing the IP policy.

The Slovenian ZPILDR does not envisage organisational infrastructure and financing for companies, only those intended to prepare, protect, and market IP [4].

Large companies often have their own departments with experts in IP management, while small companies mostly outsource legal, financial and accounting support related to IP. SMEs aware of IP protection often turn to patent attorneys for help preparing and protecting IP. Both companies and public research organisations (ROs) usually hire external patent attorneys to conduct IP protection procedures at the IP offices. Bigger companies that file many patent applications normally also have internal patent attorneys.

Research & technological infrastructures and suitably protected IP rights are key elements that support successful technology transfer from research organisations to industry. In this way, science returns benefits to the economy as the public budget generator. Cooperation of ROs with the economy in general is divided into the following activities [6]:

1. contractual cooperation with the economy, which includes consulting, contract research and collaborative research;
2. commercialisation of IP by establishing spin-off/spin-out companies;
3. licensing and sale of RO's IPR;
4. communication through public announcements and events;

5. teaching;
6. exchange and transfer of personnel.

EC has set rules on state aid regarding cooperation between academia and industry, more specifically in collaborative research, contract research/research service, licensing and consultancy – COMMUNICATION FROM THE COMMISSION, Framework for State aid for research and development and innovation (2022/C 414/01) [7]. In order to understand these rules and use them in practice, different guidelines and examples have been presented [8, 9]. We however believe that the awareness of these rules is insufficient. Public administrations could be more actively involved by providing educational materials, organizing info days and similar. Relevant stakeholders like technology transfer offices, financial offices, decision-makers in research organizations and companies should be involved.

3.2 Quantitative Analysis of IPR Transfer

As part of the ExSACT project within the ATTRACT phase 2 initiative, a survey was administered to 18 participating research & development & innovation (R&D&I) project partners. Responses from 29 individuals representing 16 different European projects were collected between April and June 2023. The majority of respondents were affiliated with startups (10), followed by universities (8), research institutes (5), small enterprises (5), micro-enterprises (3), large enterprises (3), and spin-off companies (2). Notably, seven individuals were employed at two separate institutions. More than 90% of the R&D&I projects our respondents are part of use their own IP. However, less than 25% of them successfully licensed it to other organisations. This implies that organisations are aware of the importance of IP. However, they need substantially more encouragement and assistance in licencing, for example, through better collaboration with their technology transfer offices. Almost 80% of respondents reported that individuals or offices for handling IP are well known in the involved organisations. More than half of the organisations highlight IP as part of their marketing strategies. However, only half of them consistently reward the inventors for the successful commercialisation of inventions. This, coupled with the fact that only 45% of individuals had a positive experience in managing IP rights in collaborative projects involving research organisations and companies, and even less (34%) of them had a positive experience in valuation and determination of the price value of said IP, might discourage employees from seeking appropriate IP registration and commercialisation.

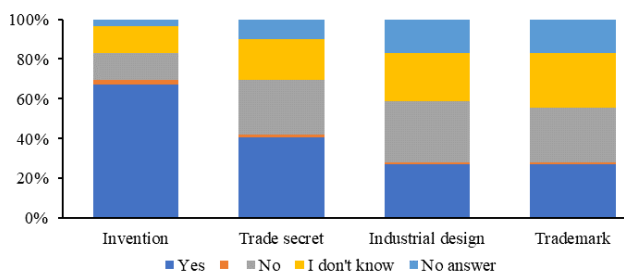


Figure 1: Transparency of procedures for the internal registration of IP.

Internal IP registration procedures in the involved organisations are most transparently regulated for inventions (69%) and trade secrets (41%), such as software and secret know-how, as seen in Figure 1. It is also apparent from the results that certain forms of IP, such as industrial design and trademark, are poorly represented and constitute a potential source of previously unprotected IP. In the involved organisations, the largest share (55%) of marketing is devoted to products and services, followed by marketing of IP (41%). Additionally, more than half of the involved organisations search for market connections through market and potential partner monitoring. Based on our survey results, organisations do not sufficiently encourage joint national or EU project applications (34%) or the joining of consortia (28%).

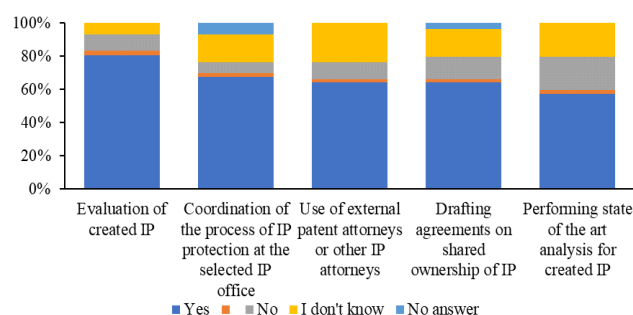


Figure 2: The most well-known offered IPR-related services.

The most common (83%) and well-known offered IP-related process in the involved organisations is the evaluation of created IP. The least common (21%) is the use of patent or IP attorneys, as seen in Figures 2 and 3. Given the frequent occurrence of IP in these projects and organisations, there appears to be great potential for multilevel IP analysis, thereby improving its quality.

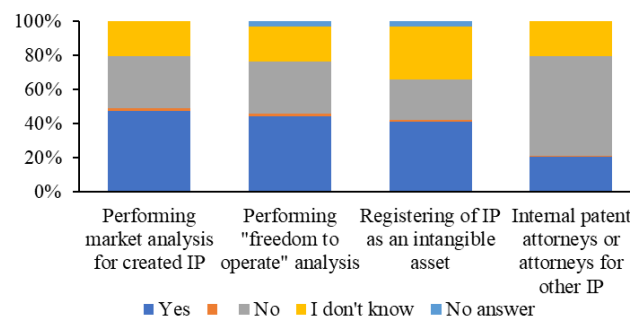


Figure 3: The least known offered IP-related services.

The level of uncertainty about whether a particular IP-related service is offered at included organisations was, except for evaluation of created IP, coordination of IP protection processes and drafting agreements on shared ownership of IP, such as inventions, more than 20%. Notably, 31% of survey participants were uncertain whether their technology transfer office handles IP registration as intangible assets. This could be resolved by better promoting IP-related processes by the designated technology transfer offices.

3.3 Qualitative Analysis of IP and State Aid Rules Within the ATTRACT Project

Five ATTRACT project partners from different R&D&I projects participated in semi-structured interviews, collectively providing insights into various topics related to IP and the application of state aid regulations. Interviewees were mostly researchers and group leaders from research organizations and companies. The prevailing IP form anticipated to emerge from these projects are patents, followed by secret know-how and trade secrets. While all interviewees exhibited familiarity with the EC's regulations about state aid for R&D, a notable point of consensus among them was their shared frustration regarding these rules. They noted how these regulations force them to set an excessively high market price for their products, making them less appealing to potential investors and hindering their progress.

Technology transfer offices are common within academic institutions, whereas start-ups, spin-offs, and SMEs rely on external IP attorneys.

Our interviewees noted a prevalent issue within university technology transfer offices, namely, their understaffing. As a result, the researchers often need to perform specific time-consuming tasks, such as conducting state-of-the-art analyses. Furthermore, a noteworthy observation made by one of our interviewees was the existing disparity between laboratory research and the process of bringing innovations to the market. The absence of direct communication channels between scientists and the industrial sector exacerbates this gap. Interviewees with ties to the academic world expressed frustration over the extended duration of the patent application process. In some cases, they deemed it more advantageous to prioritise publishing research papers to earn recognition for career advancement over safeguarding their IP, particularly when dealing with patents of limited or negligible exploitable potential. Furthermore, laboratories or SMEs occasionally preferred maintaining their developed IP as a trade secret rather than pursuing patent protection, ensuring their knowledge remained concealed.

4 CONCLUSION

Public funding for R&D is subject to critical scrutiny by the public and state-level decision-makers about the effectiveness and rationale for increasing funding for science. The impacts of science on social well-being are long-term and primarily indirect. If we recall – the EC recommends that public ROs should have technology transfer strategic missions and policies. IP should be suitably managed by promoting its identification, exploitation and, where appropriate, protection in line with the strategy and mission of the public ROs and to maximise socioeconomic benefits. To this end, different strategies may be adopted – possibly differentiated in the respective scientific/technical areas – for instance, the ‘public domain’ approach or the ‘open innovation’ approach. Appropriate incentives should be provided to ensure that all relevant staff play an active role in implementing the IP policy.

As seen from the preliminary results of the ExSACT project, they are already an essential source of feedback for public administrations on state aid for R&D. The current recognition of familiarity with the EC's regulations about state aid for R&D is particularly crucial. In our sample, most of the

interviewees are familiar with these rules, but their detailed familiarity can be questionable. As observed by interviewees, it is important that supportive units such as technology transfer and financial offices, which (should) understand state aid rules, support academia-industry cooperation. We recommend that all staff of these offices are properly trained and enough manpower is provided to these offices. The preliminary results dictate our future work, which will also focus on those points that we did not initially expect to be given such high priority by the interviewees. In future, a comprehensive overview of awareness in public research organisations and companies about the state aid rules will be a subject of research, including a larger actual sample of organizations and offices. An internationally comparative view on the regulation of the state aid system in infrastructure use and IPR transfer in cooperative R&D projects in the ERI-IE based on good practices of the general procedure for using the state aid system will be prepared to guide the users and the state administrations of the ERI-IE countries for maximum impact delivery with least friction among the stakeholders possible.

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Technology Transfer Office as a Support Structure for Innovation Management: The Experience of Latvia

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ABSTRACT

The study describes a support structure – technology transfer office for knowledge and technology management in Latvia between 2007 and 2023. The analysis is based on the operational programme of the Latvia for 2007–2013, 2014–2020, and 2021–2027.

KEYWORDS

Innovation management, Technology transfer office, TTO, Strategy.

1 INTRODUCTION

The analysis of the role of technology transfer offices in university-industry cooperation has received much attention in academic literature, especially as an interdisciplinary topic. It is important to point out that knowledge and technology transfer processes are influenced by personnel capacity and experience, university resources, legal framework, institutional arrangements, political and other issues [1].

In Latvia, technology transfer offices have existed for more than 15 years. The first six Technology Transfer Offices (TTOs) were already established in 2005, funded under the support programme established by the Ministry of Economics. Three years later, during the 2007–2013 programming period of the EU funds, the activities of the TTOs were supported by the Operational Programme “Entrepreneurship and Innovation”, under which eight TTO projects were approved and implemented in the period 2008–2013 in Latvian scientific institutions and universities [2]. The main performance indicators of the programme were related to the implementation of the classical forms of TTO tasks, such as the number of contracts for commissioned research, provision of research services and sale of industrial property or rights to use it, the number of applications for industrial property objects, the number of commercialisation offers, as well as revenues from contract research and/or licensing agreements [2].

At the end of the 2013 programming period, targeted public funding for TTO activities was reallocated to various activities to promote knowledge and technology transfer. During the programming period, a new support unit was created in the technology transfer system – Technology Scouts. The Scouts were active at the University of Latvia, Riga Technical University and in the following sectors: bioeconomy, smart materials and information and communication technology (the

following sectors were planned: bioeconomy, smart energy, biomedicine, smart materials, information and communication technologies). The aim of Technology Scouts is to foster cooperation between researchers and entrepreneurs by helping to find the right research organisation and researcher to solve a problem [3]. From the analysis of the programming documents, no information is available on whether the Scouts will be supported in the next programming period.

2 CASE STUDIES

In 2023, an analysis of the planning documents shows that in Latvia, technology transfer offices or more developed units of them are operating in science universities (in one case with transformation features). The objectives of the science university are also related to technology transfer – to develop research, study, innovation, technology transfer and business incubation processes that ensure dynamic development of the economy and the emergence of new, modern economic sectors [4].

The strategies of universities and research institutes indicate an important role for knowledge and technology transfer activities. Riga Technical University has indicated in its 2023–2027 Strategy that the development of the Science and Innovation Centre will be supported, including the scaling-up of the operational model by providing for a binding second-level strategic planning document – Innovation Development Strategy, the implementation of which is the responsibility of the Vice Rector of Innovations [5]. In turn, the 2021–2027 Strategy [6] of the University of Latvia sets out a number of tasks, such as: to establish a support system for know-how and technology transfer; to expand the involvement of entrepreneurs as research cooperation partners in all areas of science; to develop entrepreneurial skills and expand students' involvement in creating innovations; to develop an open science approach. It should be noted that the Institute of Solid-State Physics, University of Latvia, also pays significant attention to knowledge and technology transfer activities, which is also indicated in the 2017–2026 Strategy [7].

The 2022–2027 Strategy [8] of Rīga Stradiņš University states that the growth of internationally high-quality scientific results should be promoted by organising the development of research and innovation in research centres of excellence and innovation. As well as increasing the revenues of scientific activities from the private sector, from which the author concludes – both performance indicators of TTOs are included, as well as revenues

from the licensing or sale of contract research and industrial property.

On the other hand, the 2023–2027 Strategy of Latvia University of Life Sciences and Technologies describes technology transfer in this science university in great detail. Knowledge and technology transfer is one of the priority tasks for which a Knowledge and Technology Management Plan has also been developed, with tasks such as promoting the commercialisation of intellectual property through performance indicators, developing innovation and entrepreneurial skills of personnel [9].

The analysed science university strategies foresee knowledge and technology transfer activities which will be organised directly or indirectly by the relevant competent bodies – TTOs or similar innovation management structures. It is noticeable that in the 15 years of development of the TTO, there has been a significant accumulation of experience in the organisation of commissioned research with industry, in the marketing of science, in the development of a strategy for the commercialisation of scientific developments and in the organisation of the licensing process, including a strategy for the registration of intellectual property rights, in those scientific institutions that continued to fund TTO activities in the 2013–2017 programming period and beyond.

It is important to note that TTOs have established networks, e.g., the Baltic TTO Network was established in 2022 with the support of WIPO with the aim of promoting the exchange of knowledge and technology transfer experiences and practices between Latvia, Lithuania and Estonia, as, for example, the regulatory framework for knowledge valorisation is relatively similar.

However, during the development of the TTO, a stable funding stream is needed to enable the TTO to be self-financing after a certain period of time. As the implementation of RIS3 in Latvia also requires the development and accessibility of knowledge and technology transfer and the commercialisation of research results in all RIS3 specialisation areas and in the social sciences and humanities as an area with horizontal implications for RIS3 implementation, the Ministry of Education and Science ensures targeted investment in the development of the R&D system as well as RIS3 monitoring, while the Ministry of Economics should provide business sector analytics [10]. In parallel with the development of programmes for technology transfer, commercialisation of research results and development of new products and services, e.g., “Regulations for the implementation of measure 1.2.1.2 “Support for the improvement of the technology transfer system” of the specific support objective 1.2.1 “Increase private sector investment in R&D” of the Operational Programme “Growth and Employment”.

Within the framework of the Recovery and Resilience Facility activity 5.1.1.1.i. “Development and continuous operation of a fully-fledged innovation system governance model”, the project implements a new innovation governance model in RIS3 areas, fostering the development of innovation ecosystems in RIS3 areas, for example by fostering knowledge and technology transfer between ecosystem actors, i.e., through triple-helix, which led to the creation of 5 RIS3 Steering Groups in October 2022: Biomedicine, Medical Technologies, Pharmaceuticals; Information and Communication Technologies; Photonics, Smart Materials, Technologies and Engineering Systems; Knowledge Intensive Bioeconomy; Smart Energy and Mobility, aiming to create a dialogue between stakeholders in the RIS3 value chain ecosystems – companies, research organisations,

policymakers (sector ministries) and implementers, industry associations, various networks, investors, universities, etc.[11].

In view of the above, a direct publicly funded support mechanism for TTO and technology scouting activities in scientific institutions is not planned to be introduced in the planning period from 2024, thus leaving the maintenance of administrative activities for knowledge and technology transfer to the responsibility of scientific institutions.

3 CONCLUSIONS

In Latvia, there is a very pronounced institutional gap in the organisation of knowledge and technology transfer processes. Strong innovation management centres are emerging in some universities and research institutions, combining publicly funded support instruments with private institutional resources to develop organisational and legal issues of knowledge and technology transfer, build a strong panel of experts, and develop international relations with the industry. In scientific institutions and universities without the financial resources to provide focal points, the coordination of TTO activities is reallocated within existing human resources, thus not creating strong centres for TTO development.

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A Statutory Model for Organising the Process of Intellectual Property Protection and Commercialisation in Polish Public Universities *

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ABSTRACT/POVZETEK

For almost two decades, the Polish legislator has been encouraging the spread of the idea of entrepreneurship in the academic environment, delineating the scope of organisation of the process of protection and commercialisation of the R&D results created by university employees. As part of successive amendments to the Act - Law on Higher Education, it has proposed the introduction of internal regulations governing the management of intellectual property rights and the principles of commercialisation, the establishment of organisational units responsible for supporting the commercialisation process, and incentives such as additional remuneration for the implementation of the so-called third mission of the university. The aim of the conference paper is to show how the statutory model of intellectual property management at Polish public universities looks like. The final conclusions will take into account the results of research carried out in 2023-2024 under the project entitled: "Transfer of R & D results from universities of Podlaskie voivodeship to the economic and social environment", funded by the Ministry of Education and Science.

KEYWORDS / KLJUČNE BESEDE

commercialization, public universities, technology transfer units, internal regulations

OPENING REMARKS

It is important to note at the outset that this paper refers only to public universities, of which there are currently 133 in Poland [1]. The main legal act regulating their functioning is The Act of 20 July 2018 - The Law on Higher Education and Science [2]. It explicitly indicates that the mission of the higher education system and science is to provide the highest quality of education and scientific activity, to shape citizenship, and to participate in social development and the creation of an economy based on innovation (art. 2). Thus, it can be assumed that Polish universities are obliged to

*Article Title Footnote needs to be captured as Title Note

†Author Footnote to be captured as Author Note

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fulfil the so-called „third mission”, that is seen by many as crucial for making universities more responsive to societal needs. The idea behind it is that universities should not only serve their students but also engage with society, industries, and local communities to contribute to social development and economic growth. It often requires universities to work more closely with various external stakeholders and to develop new partnerships and collaborations outside the traditional academic sphere [3].

Through two decades of successive revisions of the Act - Law on Higher Education, the Polish legislature has advocated the adoption of internal regulations governing the management of intellectual property rights and the principles of commercialisation, the establishment of organizational units dedicated to oversee those processes, and the implementation of incentives, including supplementary compensation, to bolster the realization of universities' "third mission." Currently, the Act of 20 July 2018 - the Law on Higher Education and Science contains a separate section „Commercialisation of research results and know-how”.

REGULATIONS GOVERNING THE MANAGEMENT OF INTELLECTUAL PROPERTY RIGHTS AND THE PRINCIPLES OF COMMERCIALISATION

At the level of statutory provisions, legislator assumes that the senate of public university shall establish regulations governing the management of copyright, related rights and industrial property rights as well as the principles of commercialisation. It shall specify in particular:

- 1) the rights and obligations of university, employees, doctoral students and students with regard to the protection and use of IP rights,
- 2) the rules for the remuneration of authors,
- 3) the rules and procedures for commercialisation,
- 4) the rules for the use of a university's assets used for commercialisation and the provision of services in the field of scientific activity;
- 5) the rules for the distribution of funds obtained from commercialisation between an author who is an employee of a university and that institution
- 6) the rules and of mode of providing a university by employees, doctoral students and students with information on the research results and know-how related to them, information on the commercialisation funds obtained by the employee and the rules and mode of

provision by an employee of a part of the funds obtained from commercialisation to the institution;

- 7) the rules and mode of providing an employee by a university with information on the decisions concerning commercialisation or non-commercialisation and the part of the funds derived from commercialisation they are entitled to (*cf.* art. 152).

THE DECISION-MAKING PROCESS FOR THE COMMERCIALISATION OF R&D RESULTS

It is worth noting that the further described obligations related to the process of protection and commercialisation concern R&D results created by university employees. With regard to students and doctoral students, the university may define rules for dealing with the results of their creative work and support them in securing their resources. However, given the general principles of intellectual property law, in the absence of a separate agreement, it is the student/doctoral student who remains the subject of rights and retain the freedom to dispose of the R&D results.

Furthermore, the procedure discussed below relates only to:

- 1) scientific research being an invention, utility model, industrial design or integrated circuit topography, grown or discovered and developed plant variety,
- 2) development works,
- 3) artistic creation – created under the performance of duties resulting from the employment relationship by an employee of a university, and the know-how related to such results (art. 153).

It should be also clearly stated that the current statutory regulation does not define the process of commercialisation of R&D results (in this respect generally applicable acts of law are in force, including: Act of 15 September 2000 Commercial Companies Code [4], Act of 23 August 1964 Civil Code [5], the Act of 30 June 2000 – Industrial Property Law [6], the Act of 4 February 1994 on copyright and related rights [7]), however, obliges the university to decide whether it will undertake the commercialisation of R&D results or transfer the rights back to the employee.

The first step required of an employee is to provide a university with information on the research results and know-how relating to them. In the case of an employee's declaration of interest in the transfer of rights to those results and the related know-how, the higher education institution shall decide on their commercialisation within 3 months.

Where a university decides not to undertake commercialisation or after the expiry of the 3 months' time limit, the higher education institution shall, within 30 days, make an offer to the employee to conclude an unconditional and paid agreement for the transfer of the rights to the research results and the related know-how, together with the information, works, including the ownership of the media on which they are recorded, and technical experiments. The agreement shall be concluded in writing; otherwise, it shall be null and void. The remuneration payable to a university for the transfer of rights may not be higher than 5% of the average remuneration in the national

economy in the previous year, as published by the President of Statistics Poland. In 2022 the amount was 317.30 PLN [8].

If the employee does not accept the offer to conclude the agreement the rights to the research results and the related know-how, together with the information, works, including the ownership of the media on which they are recorded, and technical experiments, shall remain with the university.

It should be emphasised that the aforementioned rules of procedure and time limits shall not apply if the research was conducted:

- 1) under an agreement with the party financing or co-financing such research, providing for an obligation to transfer the rights to the research results to that party or to an entity other than a contracting party;
- 2) with the use of financial resources, the rules for the granting or use of which specify a different way of disposing of the research results and the related know-how.

It is also worth pointing out that upon receipt of information from an employee on the research results and the related know-how, a university and an employee may, in a manner other than provided above, determine the rights to such results or the manner of their commercialisation by way of an agreement (art. 157).

EMPLOYEE'S OBLIGATIONS

Beyond doubt, academics play a multifaceted role in technology transfer, contributing their expertise, research, innovation, collaboration, and industry partnerships to bring university-developed technologies from the lab to practical applications that benefit society and the economy. They collaborate with colleagues within their own institutions and across other universities, research institutions, industries, and government organisations. These networks facilitate the exchange of ideas, resources, and expertise, accelerating the technology transfer process. Effective communication and engagement with these stakeholders are crucial for securing funding, support, and resources for technology transfer initiatives.

Employee's input is critical in the commercialization of technologies. By actively engaging in activities such as licensing agreements, startup creation, and technology spin-offs, they ensure that the technologies are properly transferred to the private sector for further development and market penetration.

In view of the above, the legislator has formulated a catalogue of obligations to be observed in the process of protection and commercialisation of R&D results. An employee of a public university shall be obliged to:

- 1) preserve the confidentiality of the research results and related know-how,
- 2) provide the higher education institution with all its information, works, together with the ownership of the media on which they were recorded, and the technical experience needed for commercialisation,
- 3) refrain from any action aimed at the implementation of the results,
- 4) cooperate in the commercialisation process, including the proceedings aimed at obtaining exclusive rights - not longer

than for the period in which the rights of the higher education institution apply.

These obligations are formulated in very general terms and should be made more specific in the IP internal management regulations and/or in the employee's contract.

EMPLOYEE'S RIGHTS

As can be seen from the above, the process of protection and commercialisation is formalized and very involving and time-consuming. The statutory model does not balance these challenges by establishing an incentive system, in fact it only provides for additional remuneration for successful commercialisation.

Art. 155 states that, in the case of commercialisation, an employee shall be entitled to no less than 50% of the value of funds obtained by the university from direct commercialization/ by the special purpose vehicle as a result of a given indirect commercialisation, reduced by no more than 25% of the costs directly related to such commercialisation, which were incurred by the university or the special purpose vehicle.

It is worth noting that also in the reverse situation, in the case of commercialisation by an employee, a university shall be entitled to 25% of the value of funds obtained by the employee from commercialisation, reduced by no more than 25% of the costs directly related to such commercialisation which were incurred by the employee.

Costs directly related to commercialisation shall be understood as external costs, in particular the costs of legal protection, expert opinions, valuation of the subject of commercialisation and official fees. These costs shall not include the costs incurred before the decision to commercialise and the remuneration payable to a higher education institution for the transfer of rights.

The regulation acknowledges the role of researchers and innovators in generating valuable ideas, inventions, or discoveries that can be translated into products, services, or technologies. By offering employees a share of the value obtained from commercialization, the regulation provides a direct financial incentive for researchers and innovators to engage in activities that could lead to valuable outcomes with commercial potential. This can motivate researchers to explore practical applications for their work and actively participate in technology transfer and commercialization efforts.

KEY ACADEMIC UNITS INVOLVED IN THE TRANSFER OF R&D RESULTS

For obvious reasons, the process of protecting and commercialising knowledge cannot rest on the shoulders of academics, specialised units are established that are crucial in bridging the gap between academia and industry. If these offices are not effective, well-staffed, or properly funded, the commercialization process may falter.

Law on Higher Education and Science indicates which units may be set up by public universities to support entrepreneurship and the process of transferring R&D results into the economy. Art. 148 stipulates, that higher education institutions may operate academic business incubators (hereinafter referred to as a ABI) and technology transfer

centers (hereinafter referred to as a TTC). These units are differentiated by their structure and scope of action.

An ABI shall be established to support the business activities of the employees, doctoral students and students. It can operate in the form of a general university unit (under regulations approved by the senate) or a capital company.

A TTC shall be established for the purpose of direct commercialisation, consisting in the sale of research results or know-how related to these results, or to the provision of these results or know-how for use, in particular on the basis of a license, rental and lease agreement. It may be established as a general university unit and shall operate under regulations approved by the senate.

The law requires that the director of an ABI in the form of a general university unit or a TTC shall be employed by the rector after consultation with the senate from among candidates presented by their supervisory boards.

According to art. 149 a higher education institution may also, for the purpose of indirect commercialisation, consisting in taking up or acquiring shares in companies or taking up subscription warrants entitling it to subscribe for or take up shares in companies, in order to implement or prepare for the implementation of the research results or know-how related to those results, establish only single-member capital companies (hereinafter referred to as a „special purpose vehicle”). To finance the share capital of a special purpose vehicle, the higher education institution may make a contribution in kind (in whole or in part) in the form of research results and know-how related to those results. A special purpose vehicle shall be established by the rector with the consent of the senate. The university may, by way of an agreement, entrust a special purpose vehicle with:

- 1) the management of rights to the results or know-how in the scope of direct commercialisation;
- 2) the management of research infrastructure.

A special purpose vehicle may additionally conduct business activity separated in terms of organisation and finance from the activity referred above.

The university shall allocate the dividend paid to a special purpose vehicle to the performance of its basic statutory tasks.

Art. 150 underlines that only higher education institutions may be partners or shareholders of a special purpose vehicle. A special purpose vehicle may be established by several public higher education institutions. A public university may join a special purpose vehicle established by another public higher education institution.

All the institutions indicated above may operate, but are not an obligatory units within the structure of public universities. In fact, ABIs, TTCs and SPVs are the core of the IP protection and knowledge commercialisation model. They work in collaboration, seeking to share experience and develop best practices. To amplify these effects the Polish Association of Centers for Technology Transfer (PACTT.pl) was established in 2015. It is a voluntary association of representative units of Polish universities responsible for the protection, management and commercialization of university intellectual property. Among its objectives, it has adopted:

- the integration and development of the professionals dealing with the knowledge and technology transfer in academic ecosystem;
- exchange of knowledge, experience, standards and good practices;
- cooperation in the field of commercialization of research results
- joint representation of the members of PACTT.pl before public administration bodies, employers' associations and other entities operating toward innovation and cooperation between science and business. This representation applies, in particular, to such actions as: initiating pro-innovation activities of national character, preparing and giving opinions on legal changes and issuing opinions on strategic documents and actions taken by authorized bodies in the area of national innovation policy [9].

A year earlier the Polish Association of University Knowledge Transfer Companies (PSC) was appointed. The Association is a forum for cooperation of 34 university special purpose vehicles, established to commercialize scientific research results from universities and research institutes and carry out applied research commissioned by enterprises. Shows the real importance of SPVs that cooperate with investors, business angels, and innovative entities ready to implement science-based technologies, are vehicles supporting the creation of spin-off companies [10].

CONCLUSIONS

The commercialization process at Polish universities, like in many other countries, faces challenges despite having laws and bylaws in place. A one-size-fits-all approach does not guarantee success. Different fields and research areas require customized strategies and support. Currently, the legal and administrative processes is cumbersome, slow, and complicated, deterring both researchers and potential industry partners from engaging in collaborative ventures.

Cultural barriers exist both at the side of academia, as well as at the industry. The prevailing academic culture prioritizes traditional research and publishing over commercialization. It takes a shift in mindset to view research not just as an intellectual pursuit but also as a potential commercial product. Academics lack the necessary skills or understanding of market dynamics, business planning, and entrepreneurship required to transform research into a marketable product. Research is conducted in areas that don't align with current market needs or industry interests, leading to a gap between the creation of IP and its practical application. If universities do not provide proper incentives, recognition for commercialization efforts, researchers may see little personal benefit in pursuing these paths.

There is also insufficient funding to support the development, protection, and commercialization of R&D results. Polish science is underfunded. The share of higher education and science expenditure in GDP in 2023 was only 1.1 per cent. Not enough money for R&D activities and lack of dedicated resources for commercialization hinder the process of technology transfer. Without a robust ecosystem of venture

capital and private investment, it can be challenging to secure the funding needed to scale up a commercial venture.

Placing the burden on universities to build a model for commercialisation of research and development results can be assessed as a solution for adapting it to the specifics of each university and a manifestation of broadening the scope of self-determination of scientific institutions. However, it is not justifiable at this stage, as shown by research carried out in individual regions. Preliminary research carried out in 2023 under the project entitled: "Transfer of R & D results from universities of Podlaskie voivodeship to the economic and social environment", funded by the Ministry of Education and Science., confirmed that Polish universities still avoid innovative and risky ventures in favour of safe and standard activities. They have little experience in the commercialisation of research results and have not developed procedures to deal with their transfer. Universities fulfil the requirements set out in the Act - The Law on Higher Education and Science as obligations imposed by the legislator and not to achieve developmental goals.

We are therefore still left with the conclusion that addressing all the challenges requires a comprehensive approach involving fostering an entrepreneurial culture, promoting collaboration between academia and industry, simplifying regulatory processes, and improving access to funding and investment.

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A Comprehensive Analysis of Portuguese National and Regional Policy Instruments for Technology Transfer Offices*

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ABSTRACT / POVZETEK

In the rapidly evolving landscape of global technological advancement, the process of transferring technological insights from academic settings to industrial and commercial areas – known as Technology Transfer (TT) – is paramount. This research examines the national and regional mechanisms that Portugal employs in the TT domain, with a specific focus on instruments targeting academic Technology Transfer Offices (TTOs). Particularly, the research assesses the implemented policy instruments, emphasizing their respective significance and operational dynamics for the benefit of TTOs. This paper offers a comprehensive understanding of Portugal's ambition and strategy for translating academic knowledge into tangible industrial benefits. The findings illuminate not only Portugal's strategic trajectory in TT but also offer critical insights for policymakers, academia, and industry stakeholders, exploring and highlighting the instrumental role of TTOs in bridging the gap between innovation and commercialization.

KEYWORDS / KLJUČNE BESEDE

Technology Transfer; Science, Technology and Innovation Policy; Higher Education Institutions; Technology Transfer Offices

1 Introduction

*A Comprehensive Analysis of Portuguese National and Regional Policy Instruments for Technology Transfer Offices

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Historically, Higher Education Institutions (HEIs) have continually evolved in response to changing governmental visions and dominant socioeconomic influences[1]. A notable shift post-1990 was the intersection of education and research, highlighting the importance of knowledge dissemination and technological progress [1]–[3].

In today's landscape, HEIs are increasingly driven by applied research, positioning them at the forefront of technological innovations with marketable potential[4]. The modern role of HEIs integrates their primary educational and research missions into a holistic “third mission,” which envelops technology transfer, entrepreneurship, and industry partnerships [5]–[9]. At the heart of this value creation are technological breakthroughs, which are secured through Intellectual Property Rights (IPR), positioning Technology Transfer Offices (TTOs) as central figures[10], [11].

TTOs serve as pivotal conduits, connecting academia to industry. They meticulously review academic discoveries, guiding researchers toward identifying and presenting market-ready innovations. In defining their roles, responsibilities in patent decision-making, commercial potential assessment, and active marketing of inventions. Simultaneously, TTOs have a role in bridging information voids between industry and academia, particularly in valuing inventions [12], [13].

TTO efficacy hinges on available resources[13]–[15]. These resources, as highlighted vary across institutions and their effectiveness. Resources can be grouped into financial, infrastructural, human, and organizational capacities. Notably, seasoned TTOs often excel over their newer peers due to the extensive learning curve involved in mastering technology transfer[16].

To bolster this, HEIs have broadened their financial funds, focusing on translational research and the emergence of academic spin-offs [17]. Current discourse places emphasis on two mechanisms: Proof-of-Concept (PoC) programs [18], [19] and University Seed Funds (USFs) [14], [20].

Portugal's trajectory in R&D investment has historically been uneven, swayed by socio-political dynamics and economic downturns [21]. These fluctuations sometimes led to inconsistent support for TTOs, causing variances in their efficacy. While some Portuguese HEIs have blossomed into innovation hubs with proficient TTOs, others, especially those distant from urban centers, grapple with forming industry ties and securing steady funds. Contemporary barriers, such as challenges in promoting interdisciplinary research amidst bureaucratic limitations, funding, and capacity building further exacerbate these historical differences.

The crux of this paper is an examination of public funding's role in the evolution and sustenance of TTOs in Portugal, spotlighting government backing. Specifically, we delve into public financial structures that have engendered “gap funding” models [17], focusing on Portuguese HEIs deeply reliant on state support.

2 The Role of National and Regional Policy Instruments in Portugal's TTO Landscape

2.1 Direct Financial Support: A Catalytic Support for the Establishment of Portuguese TTOs

One of the pivotal strategies within the “third mission” of HEIs in Portugal has been the establishment of TTOs, which serve to sustain the interactions between HEIs, the industry, and the wider society.

In 2001, the Intellectual Property Support Offices (GAPI), spearheaded by the National Institute of Industrial Property (INPI), was introduced. They were co-funded by public schemes such as the Operational Programme for the Economy and the Incentive Program for the Modernisation of the Economy. These GAPIs aimed to guide researchers and academics regarding patentable knowledge.

By 2006, the Innovation Agency (ADI) launched the Technology and Knowledge Transfer Offices (OTICs), designed to streamline the transfer of knowledge and technology to businesses. Over time, the roles of GAPIs and OTICs began to intertwine, leading to their eventual integration into the unified TTOs (Table 1).

More recently, between 2016 and 2022, public funding (Regional Operational Programmes of Portugal 2020) was provided for the establishment of three additional TTOs in the Lisbon Region. These include a center at the NOVA University of Lisbon focusing on Social Innovation, aiming to be the first national infrastructure promoting a university-business-organization interface for innovative R&D projects addressing diverse social issues. At the University of Lisbon, the TTC@ULisboa acts as a facilitator for technology transfer and entrepreneurship, offering a strategically located space for young entrepreneurial students, researchers, and businesses. Lastly, the ISCTE - University Institute of Lisbon established a new TTO, leveraging its existing R&D structure, advanced training, and innovation, creating a hub for new ideas focusing on society and the challenges of digital transformation.

Table 1: Portuguese Higher Education Institutions with Technology Transfer Offices

Higher Education Institution	Type Funded Operation
Instituto Superior Técnico	GAPI
University of the Azores	GAPI
University of the Algarve	GAPI & OTIC
University of Coimbra	GAPI & OTIC
University of Évora	GAPI & OTIC
University of Beira Interior	GAPI & OTIC
University of Trás-os-Montes and Alto Douro	GAPI & OTIC
University of Porto	GAPI & OTIC
University of Minho	GAPI & OTIC
Polytechnic Institute of Setúbal	OTIC
Polytechnic Institute of Tomar	OTIC
Polytechnic Institute of Porto	OTIC
Polytechnic Institute of Leiria	OTIC
Polytechnic Institute of Beja	OTIC
Polytechnic Institute of Castelo Branco	OTIC
Polytechnic Institute of Portalegre	GAPI & OTIC
Polytechnic Institute of Viana do Castelo	OTIC
Technical University of Lisbon	OTIC
Portuguese Catholic University – School of Biotechnology	OTIC
New University of Lisbon	OTIC & Regional Operational Programs of Portugal 2020
Lusíada University of Vila Nova de Famalicão	OTIC
University of Aveiro	GAPI & OTIC
University of Lisbon	GAPI & OTIC & Regional Operational

University of Madeira	Programs of Portugal 2020 OTIC
ISCTE - University Institute of Lisbon	GAPI & Regional Operational Programs of Portugal 2020

Source: List of Approved QREN and Portugal 2020 Operations

2.2 Capacity Building: Shaping TTOs Ecosystem

2.2.1 University Technology Enterprise Network (UTEN)

In response to the fragmented interactions between Portuguese HEIs and industry, the Portuguese Foundation for Science and Technology (FCT) collaborated with the IC2 Institute of the University of Texas at Austin to establish the University Technology Enterprise Network (UTEN) in March 2007[22].

UTEN's primary objective was to develop a network proficient in transferring and commercializing science and technology. This network encompassed public Portuguese HEIs, an affiliated private institution, related TTOs, research centers, and occasionally, technological parks[23].

UTEN offered specialized training by internationally renowned experts, emphasizing the commercialization of Portuguese academic innovation[23]. From 2007-2010, UTEN facilitated international internships for technology transfer officers[22], [24]–[26].

2.2.2 TTO Network

Research indicates that academic TTOs evolve through experimentation, failure, and the mutual exchange of experiences [27], [28]. Yet, barriers persist in sharing best practices among TTOs. Initiated in 2018, the TTO Network represents National Innovation Agency's (ANI), previously ADI, commitment to fostering innovation, technology transfer, and knowledge commercialization within HEIs. In 2022, ANI commenced a two-year initiative to enhance TTO Network capacities.

In addressing the challenges Portuguese TTOs faced in capitalizing on their IP assets, an initiative was set in motion: the implementation of specialized training. The purpose behind this specialized training was twofold: it was structured to empower TTOs with the tools for effective collaboration, technology scouting

methodologies, precise market analysis, industry trend discernment, and the evaluation of technologies with high commercial potential. Moreover, the collaboration with international experts provided these TTOs with the strategic insight required to effectively manage their respective HEI's IP portfolios.

For each HEI was developed a comprehensive IP Portfolio, which integrates patents, trademarks, copyrights, and trade secrets, stands as a testament to an HEI's intellectual competence.

As part of this initiative, in the first semester of 2023 were introduced open innovation challenges. Rooted in the ethos of managing knowledge assets through open innovation [29], [30], these challenges encouraged companies to present real-world challenges they faced, incentivizing TTOs to respond with innovative technology solutions drawn from their IP portfolios.

2.3 Funding instruments for technology transfer: How TTOs support their activities?

The Portuguese government's support, although invaluable, primarily targets the creation and capacity-building of TTOs without explicitly supporting the daily operations of TT activities such PoCs and USFs. The primary onus, therefore, falls on TTOs themselves. These operations, characterized by collaborations with companies, demand for innovative solutions, and training initiatives, are not merely cost-intensive but also necessitate continuous financial inflow [14], [17], [18], [19], [20]. To address this, and in line with their “third mission”, Portuguese TTOs often resort to regional Operational Programmes, emphasizing the critical role such programs play in bridging the financial and operational gaps (Table 2).

Table 2: Overview of Funding Mechanisms for TT Activities Across Portuguese HEIs

Higher Education Institution	Funded Operation	Total Eligible Expenditure (in euros)	Operational Program	Type of Mechanism
Algarve University	TT 2.0	552 155,8	Algarve Regional Operational Program	PoC
Aveiro University	CAMPUS TEC	286733	Center Regional Operational Program	PoC and USFs

Católica University	3Boost	999960,89	Operational Programme for Competitiveness and Internationalization	PoC
Coimbra University	INOVC 2020	1627614,39	Center Regional Operational Program	PoC
Coimbra University	InovC+	3393755,86	Center Regional Operational Program	PoC
Polytechnic Institute of Leira	Knowledge Circle	477810,74	Operational Programme for Competitiveness and Internationalization	PoC
Trás os Montes and Alto Douro University	INOV@UT AD	754145,62	North Regional Operational Program	PoC and USFs
Trás os Montes and Alto Douro University	Lab2Business	506902,74	North Regional Operational Program	PoC
Trás os Montes and Alto Douro University	UI-Transfer	824056,95	Operational Programme for Competitiveness and Internationalization	PoC

Source: List of Approved Operations for Portugal 2020 as of June 30, 2023

3 Discussion and Conclusion

The introduction of the GAPI in 2001 marked a significant turning point in Portugal's commitment to fostering TT. With the formation of GAPIs and later the OTICs, the institutional structure for technology transfer was solidified. The involvement in UTEN activities expanded, and the focus shifted from just patenting to a more comprehensive TT ecosystem, encompassing patenting, licensing, start-ups, and industry collaborations.

Portugal's strategic approach to TTOs, seen through initiatives like TTO Network, is praiseworthy concerning the extensive learning curve involved in mastering tech transfer activities[16].

Out of the 26 HEIs that were funded to create the TTO, only 8 displayed consistent activity in TT funded by the Operational Programmes between 2016 and 2022. It's evident that more established and well-resourced institutions dominate TT activities, aligning with the observations from the literature. The appearance of Coimbra University twice could be attributed to multiple funding sources or different TTO initiatives undertaken at different periods. Such overlapping engagements aren't uncommon, especially in more established HEI.

The significant funding allocated by Operational Programmes for USFs and PoCs activities underscores their indispensable role. However, the persisting challenges, primarily the “funding gap” and the operational complexities, indicate the need for continuous adaptation and a synergistic approach involving policymakers, academia, and industry stakeholders to continue improving the funding programs.

This paper provides an insightful analysis of Portugal's approach to TT. When analyzing Portugal's historical and contemporary policy instruments, we uncover the commitment to building an ecosystem that fosters innovation, addresses funding challenges, and bridges the gap between academia and industry. The initiatives – from the establishment of TTOs, and capacity-building networks, to funding mechanisms – demonstrate a holistic strategy.

As Portugal continues its journey in the global TT landscape, the insights from this analysis can inform similar ecosystems globally, emphasizing the universality of the challenges and the importance of a coordinated approach to surmount them.

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Compulsory Licensing in Belarus

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ABSTRACT

The paper informs on the state of compulsory licensing in Belarus and recent changes restricting IP rights.

KEYWORDS

Intellectual property law, patent law, compulsory licenses.

1 INTRODUCTION

The term compulsory licensing refers to a situation where a court or government enforces a non-exclusive license to the protected intellectual property (IP) without the wishes and the consent of the IP owner. It can be dated back to Article 5A (2) of the Paris Convention for the Protection of Industrial Property (Paris, 1883), stating: "Each country of the Union shall have the right to take legislative measures providing for the grant of compulsory licenses to prevent the abuses which might result from the exercise of the exclusive rights conferred by the patent, for example, failure to work" [1].

The world practice has developed three main types of compulsory licenses: 1) for non-working or insufficient working of patented invention; 2) for dependent inventions; 3) in public interest, such as "national emergency" or "public health" [2-9].

The international legal basis for compulsory licensing is found in the WTO Agreement on Trade-Related Aspects of Intellectual Property Rights (1995) (TRIPS Agreement) and the Doha Declaration on the TRIPS Agreement and Public Health (2001). Due to the national character of intellectual property rights (IPRs) countries may implement their own systems of compulsory licenses (CL).

2 COMPULSORY LICENSING IN BELARUS

The compulsory licensing of industrial property in Belarus has been regulated by Articles 10 and 38 of the patent law (the Law "On patents for inventions, utility models, and industrial designs" dated December 16, 2002, No. 160-3) [2, 10].

Article 10 "Actions not recognized as infringement of the exclusive right of the patent owner" addresses the use of patented inventions under extraordinary circumstances (natural disasters, catastrophes, accidents, epidemics, epizootics, etc.) with notification of the patent owner of such use as soon as possible and payment of corresponding compensation.

For example, based on Article 10 during epidemic any person may, without authorization organize both the production and import of generic medicines. The weakness for the person is that the patent owner may at any time challenge the very legitimacy of such use, its scope and duration, as well as disagree with the amount of compensation offered to him.

In this case the granting of CL would be preferable, since the person in whose interests it is granted understands for what period of time, to what extent and under what conditions the patent-protected subject matter may be used.

Article 38 "Compulsory license" addresses the non-working or insufficient working (1) and dependent inventions (2) types of CL and describes the legal procedure for obtaining a CL by a third party, which is done by filing a claim with the Judicial Collegium for IP of the Supreme Court.

The patent law of Belarus does not use all options in terms of compulsory licensing, which are implemented in other countries. This concern primarily compulsory licensing in "public health" interest.

When opting for the issuance of a compulsory license in the "public health" interest, it is advisable that preference be given to the administrative procedure as it is much simpler and faster [6, 7].

3 AMENDMENTS TO THE PATENT LAW

Although Belarus is not a WTO member the above-mentioned gap has been closed by the law "On amendments to laws on the legal protection of intellectual property" dated January 9, 2023, No 243-3 that introduced amendments to patent law.

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Table 1: Compulsory licensing of industrial property in Belarus

#	Grounds for granting a CL, legislative act	Procedure	Conditions
Invention, Utility model			
1	Non-working or insufficient working by the patent owner within 3 years from the publication date, leading to insufficient supply of relevant goods, works or services on the market (patent law, Article 38 (1)).	Legal	* Refusal of the patent owner to conclude a license agreement on terms consistent with established practice. * The interested party has the ability to use the invention. * Absence of valid reasons for non-working proven by the patent owner.
2	A patented invention cannot be worked without exploiting an earlier patented invention (utility model) (patent law, Article 38 (2)).	Legal	* The invention is dependent on a patent for an invention (utility model). * The invention is an important technical achievement. * The invention has significant advantages over the original invention (utility model) patent. * Refusal of the patent owner to conclude a license agreement on terms consistent with established practice.
3	The need to ensure national security, state defence, safety and security of people's lives and health (patent law, Article 38 (3)).	Administrative	
Design			
4	Non-working or insufficient working by the patent owner within 3 years from the publication date, leading to insufficient supply of relevant goods, works or services on the market (patent law, Article 38 (1)).	Legal	As 1.
5	The need to ensure national security, state defence, safety and security of people's lives and health (patent law, Article 38 (3)).	Administrative	
Plant variety			
6	Non-working or insufficient working by the patent owner of a plant variety within 3 years from the registration date in the State Register of Protected Plant Varieties (law "On plant varieties", Article 31).	Legal	* Refusal of the patent owner to conclude a license agreement. * The interested party has the ability to use the plant variety. * Absence of valid reasons for non-working or insufficient working, proven by the patent owner.
Topography			
7	Non-working or insufficient working of the topography by the right owner within 3 years from the publication date in the official bulletin of information about the registration of the topography, leading to an insufficient supply of relevant products (goods) (Law "On protection of integrated circuit topographies", Article 22 (1)).	Legal	* Refusal of the patent owner to conclude a license agreement on terms consistent with established practice. * The interested party has the ability to use the protected topography. * Absence of valid reasons for non-working or insufficient working, proven by the rights owner.

The newly added Article 38 (3) of the patent law describes "public health" type of CL, which is granted by the decision of the Council of Ministers. The decision specifies:

1. Last name, first name, patronymic (if any) of the individual, or the legal entity to which CL is granted.
2. The period for which a compulsory simple (non-exclusive) license is granted.
3. Usage rights of a person who has been granted a CL.
4. A government agency that within 30 days from the date of the decision to grant a CL must notify the patent owner about the decision.
5. The procedure for notification of a government agency by an individual or legal entity that is granted a CL about the payment or impossibility of paying the compensation to the patent owner.

6. Amount and procedure for payment of compensation.

Table 1 summarizes procedures for granting CL for industrial property after the amendments.

4 RESTRICTIONS OF IP RIGHTS

The law "On restriction of exclusive rights to intellectual property objects" dated January 3, 2023, No. 241-3.

Articles (1) and (2) of the law allow the use of software, audio/visual works, music and broadcasts without the consent of the rights owner or the organization for collective management of property rights if they are from the foreign countries committing unfriendly actions against Belarusian legal entities or persons. The Council of Ministers appoints

state authorities for managing the lists of corresponding rights owners.

The user of above mentioned IP pays remuneration that is credited to the bank account of the national IP office (the National Center of Intellectual Property). Together with payment the information on IP use and calculation of remuneration shall be provided. The amount of remuneration assigns the Council of Ministers.

The remuneration will be kept on the bank account of national IP office for three years from the moment of deposit and during that period can be claimed by the rights owner. The national IP office can use up to 20% of the remuneration to cover its management expenses.

After three years, the unclaimed remuneration will be transferred within three months to the republican budget.

Articles (3) and (4) of the law allow import from any foreign country of goods from the List of goods (group of goods) vital for domestic market, if there is critical shortage (i.e. parallel import). The Council of Ministers appoints state authority for managing the list.

If imported goods include IP, it will be temporary excluded from the National customs register of IP objects. The notification letter will be sent at the address of the rights owner within two days of the decision to exclude the IP from the register.

The articles of the law are valid until the end of 2024.

5 CONCLUSIONS

Most countries provide for compulsory licensing to advance nation's technological development by encouraging the production and use of patented goods and increase access to advanced technologies [5–9].

The compulsory licensing in Belarus before 2023 was not applicable to medicines (new or expensive) since grounds for compulsory licensing did not include "protection of human life and health". Introduction of the Law No. 243-3 on January 9, 2023, updated the legislation for all options allowed by international laws. When granting compulsory licenses in "public health" interest an administrative procedure is applied.

Compulsory licenses in Belarus are not agreements and as such should not be registered with the National Center of Intellectual Property.

ACKNOWLEDGMENTS

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Assessing the Contribution of Hubs to Uganda's Innovation Ecosystem

A Case Study on the Role of Innovation Hubs in Kampala

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ABSTRACT / POVZETEK

This paper focuses on assessing the role of hubs in facilitating innovation for economic development.

It analyzes the ability of innovation hubs in Kampala to provide three critical elements for innovation - financial support, business development services and networking opportunities.

The paper also explores the development focus of these hubs, as well as the challenges they face in facilitating innovation.

Based on the results of this analysis, it is recommended that comprehensive instruments be developed to facilitate the integration of the different pathways for innovation, and the collaboration of actors in the National System of Innovation (NSI)

This paper emphasizes the need for innovators based outside of research and academic establishments to acquire good understanding of intellectual property assets in order to benefit from the knowledge economy. It is proposed that innovation hubs in the informal innovation pathway address not just the awareness gap that exists, but also the limited capacity in identifying, protecting and diffusing research products and intellectual property generated.

KEYWORDS / KLJUČNE BESEDE

Innovation, innovation pathway, development, Intellectual Property Management

1 INTRODUCTION

In a metanalysis utilizing data from 115 countries, Fagerberg and Srholec (2008) identified the development of an innovation system to be one of the top four out of twenty-five factors, critical for the economic development of any nation [1].

National Systems of Innovation, though comprising of a multitude of actors, often feature two distinct pathways: the formal innovation pathway which features state-supported activities conducted by actors in academia, research institutes and industry, and the informal pathway where players from civil society and grass root organizations take on self-financed innovation activities [2].

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Innovation enablers in the informal pathway (i.e private-owned incubators, accelerators and technology hubs) often offer a variety of business-related services including: office/ lab space, product development mentorship and business coaching in addition to networking opportunities, industry linkages, and in some case, seed funding.

What they seldom focus on, especially in the case of Uganda, are services directed at the exploration and management of intangible assets such as intellectual property (IP).

Intellectual Property is a critical component of any innovation ecosystem. IP assets can act as a safety net for innovators in developing economies like Uganda where approximately 75% of start-ups fail to reach the first anniversary of their business operations [3].

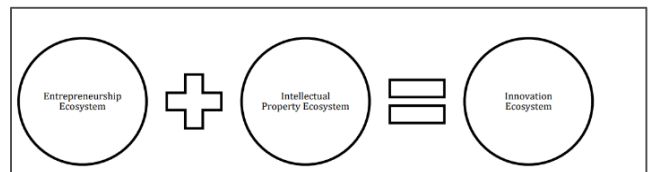


Figure 1: The link between entrepreneurship, intellectual property and innovation [4]

Systems required to facilitate innovation activities are complex and often call for collaboration among various stakeholders in bringing together inputs such as infrastructure, finances and expertise needed for innovation processes such as prototyping and IP registration [5].

While innovators in academic and research institutes may be privy to information on and the benefits of IP, the same cannot be said for actors in the informal innovation pathway.

In order to facilitate consolidated development of the National System of Innovation (NSI) in Uganda, this paper assessed the role of innovation hubs in greater Kampala and her neighbouring suburbs.

Specifically, the study sought to

- i assess the provision of three key elements for innovation, that is, financial support, business development services and networks;
- ii identify the development challenges addressed and the innovation focus in innovation hubs and;
- iii provide recommendations for further development of the NSI.

2 METHODOLOGY

2.1 Research Design

Purposive sampling and snow balling were utilized in identifying and approaching participants based in innovation hubs in Kampala.

These participants, ten (10) in total, categorized their establishments as incubators, technology transfer offices, accelerators and technology hubs based on the following descriptions:

- Incubator (IN) – an independent co-working innovation space that creates and develops start-up companies for at least 12 months.
- Technology Transfer Office (TTO) – a facility affiliated to a university or research institution that assists researchers in IP protection, licensing and commercialization.
- Accelerator (ACC) – an entity focused on accelerating or scaling up companies for a few months through structured programmes and funding.
- Science Park (SP) – an entity promoting innovation and competitiveness of associated businesses and knowledge-based institutions in a given community.
- Technology Hub (TH) – a facility focused on generating contacts or leads and/or providing motivation, exposure and self-belief for innovators.
- Co-working Space (CWS) – a facility providing only hot desking, office spaces, boardroom facilities or events to start-up companies.

Depending on the nature of operations and the innovation programmes hosted in their establishments, many participants identified their spaces to fall in more than one category.

Table 1: Innovation hubs by year, category and beneficiaries

Name of Innovation Hub	Year of Establishment	Category	Beneficiaries Supported (24 months)
StartHub Africa	2017	IN, ACC, TH, Others	>200
NARO Incubation Centre	1992	IN, TTO, ACC, TH	51-100
Women In Technology Uganda (WITU)	2012	IN, TTO, ACC, TH	>200
MoTIV	2020	CWS, IN, ACC	>200
Response Innovation Lab	2018	ACC	101-200
NFT Mawazo	2005	IN, ACC, TH	>200
Makerere Innovation and Incubation Center	2016	IN, ACC, TH	51-100
TechBuzz Hub	2016	CWS, IN, TH	>200
KQ Hub Africa	2018	Other	101-200
Design without Borders Africa	2014	Other	>200

2.2 Data collection and analysis

The data collection process constituted: a physical assessment of innovation establishments in Kampala; a desk review of information on the innovation hubs identified and; designing and administering a survey tool to assess innovation support.

Three elements were assessed: financial support, business development services and networking opportunities. Data analysis was then conducted in MS Excel and SPSS 26.

3 RESULTS AND DISCUSSION

3.1 Descriptives

The most commonly addressed development challenges, based on the SDGs were: Decent Work and Economic Growth (8); Industry, Innovation and Infrastructure (9) and No Poverty (1) and the least addressed were: Life below Water (14) and Life on Land (15).

The most supported themes in the innovation hubs were: Education and Skills Development while least supported themes were Transport and Infrastructure and Democracy and Governance. The average quantum of funding provided by hubs was USD \$10,000 - \$50,000

3.2 Provision of financial support

Financial support adversely influences an institution's decisions, ability to engage in innovative activities and the nature of outcomes of their innovation processes [6].

Results indicated that six of the ten innovation hubs were subject to financial constraints as the quantum of funding required by their beneficiaries was greater than the quantum of funding they provided.

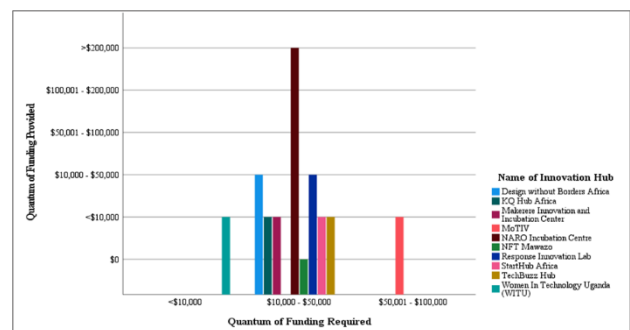


Figure 2: Quantum of funding provided against requirement

3.3 Provision of business development services

All ten of the participating innovation hubs provided at least two support services required for business development as presented in Figure 3.

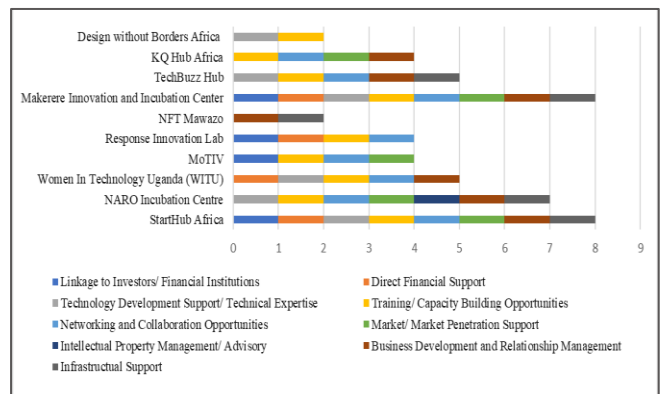


Figure 3: Business support services supported by innovation enablers

Services such as training and capacity building were the most common - provided by nine out of ten of the hubs, followed by networking opportunities, and business development and relationship management.

Intellectual Property Management (IPM)/ Advisory was the least supported service, only available at the NARO Incubation Centre.

While the protection of IP assets by registration can be viewed as a means to obtaining economic reward for innovation [7], many establishments supporting innovators, especially from the tech industry, are not keen on providing IPM support because of the rapid changes in the industry [8]. With a few modifications, a technology that is innovated today can quickly become irrelevant tomorrow. This could be a reason for no IPM services in some of the participating hubs.

Other possible arguments for the absence of this service could be the slow progress in developing markets for IP assets in Uganda, and the presence of a national IPM authority - the Uganda Registration Services Bureau (URSB) which would render in-house IPM services redundant in many of the hubs.

3.4 Opportunities for collaboration and networking

Findings from the component of affiliation to academic or research institutes, as well as networking and collaboration opportunities supported by the ten innovation hubs are presented in Figure 4.

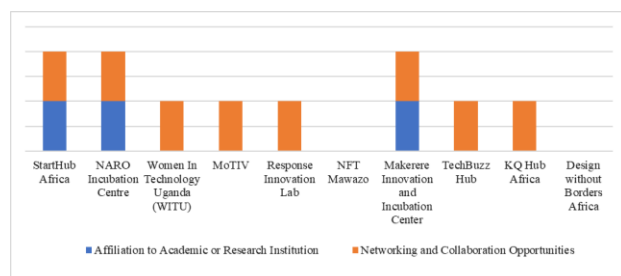


Figure 4: Networking and collaboration opportunities

There is evidence that innovation hubs derive more successful outcomes when they have links of any sort to larger entities including universities, private-sector actors, branches of government, development donors, and with other hubs [8].

Regardless of whether an innovation space is based at a tertiary institution, access to and integration between an innovation hub and a university or an academic/research institute can be mutually beneficial to both entities, as each learns progressively from the other [8].

To further explain the benefits of these affiliations, Bank *et al.* (2018) assert that academic institutions tend to form and maintain more sustainable networks and relationships with both

international and local communities [9]. This may be through the establishment of the International Relations Office or through the Technology Transfer or IPM function.

Either way, these support structures can be a source of opportunities including mobility and exchange programmes, scholarship opportunities and seed funding for innovators.

In turn, innovation hubs can be a source of knowledge and human capital in these relationships.

Peer-to-peer engagement amongst innovation hubs especially through clusters and networks can be beneficial in testing assumptions, combining different competences [10] and in diffusing knowledge [8]. Particularly, the interdependence created by innovation clusters, especially in Science and Technology Parks creates opportunities for exchange and collaboration and could even allow for sharing of infrastructure and services, improving production efficiency in the long run.

Links to parent companies and international collaborations are argued to provide access to better technology and infrastructure as well as more financial and knowledge resources [10].

It was clear that providing networking and collaboration opportunities was essential for many of the participating innovation hubs; What could be improved is the affiliation to research and academic institutions for the benefits afore mentioned.

3.5 Limitations to innovation

Innovation hubs experience diverse challenges in their work, depending on their interests and objectives, level/scale of operations and the prevailing socio-economic conditions.

However, many of the factors that inhibit innovation on the African continent, in some way, relate to the economic infrastructure, local institutions, domestic capabilities and the policy context that supports the NSI [11].

Some of the challenges highlighted by the participating hubs included:

- i) Limited technical skills in product development among young innovators.
- ii) Lack of early-stage investment for start-ups.
- iii) Weak IP enforcement.
- iv) A small and disinterested private sector with limited (human and financial) capacity to absorb the generated technologies.
- v) Little to no knowledge on business development and management for incubatees.
- vi) Inefficient follow up with innovators after programme exit.
- vii) Unsatisfactory sustainability plans presented by innovators.
- viii) High risk aversion towards novel ideas in the NSI.
- ix) Discrepancies in appropriate technology versus advanced technology.
- x) Lack of investment readiness programmes for innovators.
- xi) Low quality ideas/ innovations.

- xii) Limited research potential for some projects.
- xiii) Limited market potential for some innovations.
- xiv) Obstructive government regulations and taxes.
- xv) Rigidity in adaptation to changes in the ecosystem.
- xvi) A lack of understanding and appreciation for design innovations in the ecosystem.

In terms of the limited absorption capacity of innovations by industry, it can be argued that the nature of investment in innovations is often long term with uncertain returns, which can repel some investors.

Ayalew and Xianzhi (2019) also reason that the issue of reluctance to reveal innovative ideas could be to the detriment of many innovation firms as it reduces financiers willingness to grant loans or capital [6].

Evidence from the participating hubs suggests that protection through IP registration is not a top priority. Innovators are more likely to rely on ‘secrecy’ as a protection mechanism yet investors are looking to understand where they are placing their money.

As such, there is a need to bridge the gap between the expectations of investors with the liberties of innovators in Intellectual Property Management.

4 CONCLUSION AND RECOMMENDATIONS

Innovation hubs can be viewed as conduits through which inputs are often aggregated to create optimum conditions for the innovation process [8]. The nature of interaction of the inputs provided by these hubs ultimately determines the outcome of the product development chain. There is therefore a need to develop and sustain mechanisms and instruments to support these innovation enablers for innovation-led development.

The lack of financially-backed appreciation for innovation within larger societal operations is a common phenomenon in sub-Saharan Africa.

Better engagement with academic institutions, companies and local communities is required to influence more youth and individuals to participate in knowledge generation and more technical support along the innovation cycle, particularly in product development and intellectual property management is needed.

Companies and firms can be better encouraged to absorb local innovations developed in the NSI, through subsidies and tax exemptions.

Examples of successful networks and clusters of innovation hubs exist in developing nations such as South Africa [10]. The Government of South Africa has ensured that innovation hubs are far reaching in different townships, diffusing incubation services to stakeholders in all parts of the country.

While clustering is beneficial, adopting a similar decentralized approach, as in South Africa, could increase the reach and level of interest in innovation in the different regions in Uganda, especially outside of the capital - Kampala.

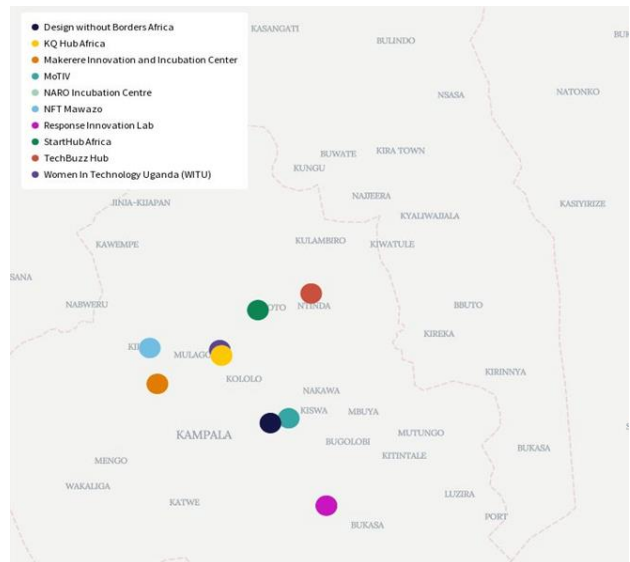


Figure 5: The participating innovation hubs by location

‘The functioning of an innovation system depends on its components – the organizations/actors and relations among the components which perform various innovation system activities [11]

System integration that allows national and regional systems of innovation to intersect with sectoral and technological innovation systems, especially through interactive learning among stakeholders in different pathways should be fostered to develop a NSI that is accommodative of and beneficial to Ugandans.

ACKNOWLEDGMENTS / ZAHVALA

This paper is evidence of the openness and willingness of the innovation hubs in Kampala to engage with other actors.

I am truly grateful to the teams at Design Without Borders Africa, KQ Hub Africa, Makerere Innovation and Incubation Centre, MoTIV, NARO Incubation Centre, NFT Mawazo, Response Innovation Hub, StartHub Africa, TechBuzz Hub and WITU, for sharing their stories of passion and perseverance in facilitating innovation.

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The Importance and Benefits of the Technology Transfer Ecosystem (TTE)

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ABSTRACT

Creating and maintaining the technology transfer ecosystem is a foundation on which many (future) technology transfers (TTs) are built. Having a good invention/technology is usually not enough, if you do not have either a buyer or a partner on the other side ready to assist you. It is important to establish and maintain (strong) relationships with the industry in order for them to give you the opportunity to present, when the opportunity presents itself, for example in the form of tender/call, innovation, research collaboration etc.

KEYWORDS

Technology transfer, ecosystem, marketing channel, innovate or die, EU, projects, venture capital.

1 INTRODUCTION

The problem, that not so few academic researches institutions face, is the lack of collaboration with the industry. Some even believe that the TT is failing endeavor [1]. There are certain projects that try to stimulate this cooperation/transfer.

One thing, that the Office for industrial liaison (SPOG) at the Jožef Stefan Institute (JSI) observed, that might be responsible for relatively low number of technology transfers, is the lack of “standby” relationships with the industry. This means that it might not be enough to seek for companies when certain tender/call/opportunity presents itself but the organization (or its TT office; TTO) must begin with this (much) sooner.

What SPOG at JSI identified, is that, predictably, the more companies that it visits, the greater the chance for a success story with the benefits for all parties. For example, even if a visited company might not be willing to spend the money on research directly, their topics of potential cooperation are still identified and written down. Also, their skills/areas are cataloged. Then (much) later certain funding opportunities might arise and the SPOG might see the opportunity to connect certain companies with the appropriate researcher or a research team. Some examples of collaborations grew (albeit slowly) from rather

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small projects like: KET4CP, DIH-World, DIH4AI but through this (small) collaborations, the teams (of researchers and companies) got to know each other and then later applied for or entered into greater projects together.

One of the building blocks of the TT ecosystem (TTE), that we are building at the Project and Innovation Support units (consisting of: Office for substantive project support, technology transfer and innovation (CTT) – U7, Office for industrial liaison (SPOG) – U8, Office for project informatics, organization of thematic events and conferences (SPIK) – U9) at the Jožef Stefan Institute, are certain thematic projects (Enterprise Europe Network, European Digital Innovation Hub – EDIH, KET4CP,...) in which we are involved with precisely this purpose: to help companies in other areas or rather, we are involved in those projects precisely for the reason of helping companies with the cascade financing to cooperate with the Jožef Stefan Institute or in the area of technology transfer. This means that we are actively building (or adding to) our TT ecosystem.

2 THE ECOSYSTEM

Once ecosystem is relatively large enough, further benefits arise. For example, if we successfully connect two companies, they form a partnership agreement (PA) and a stronger/bigger relationship develops as a result. Benefits of a PA, for the company, is an increase in sales abroad, for example, which strengthens the company and its ability to operate more developmentally and innovatively in the future, which then enables the company in the ecosystem to cooperate with a research institution. If this PA was a result of certain project (Enterprise Europe Network for example), then this same project allows the established partnership to be promoted (without any additional charge for the companies) as a success story, which then brings new recognition for all parties (the project itself, companies, project partner) and new opportunities could arise that could (later) involve also the project partner which made the PA of two companies possible. Further developments/opportunities/partnership can arise from either way.

At the Project and Innovation Support units (at the JSI) we are constantly monitoring for new calls/tenders/projects with the objective/question in mind if they can benefit the companies and the researchers. Ideally, they would help with funding, but sometimes they can help even better, by giving them the opportunity or recognition to expand, through connecting certain partners together. It is important to see the whole picture, all of

the benefits of the ecosystem, the full deck or the full checkerboard in order to be motivated to do certain things that might not give/provide/promise direct/immediate benefit(s) in the first step(s); to the Jožef Stefan Institute in our case. For example, one might ask what's in it for the Institute, to connect certain companies together in the partnership agreement, that might not include the Institute itself. The answer is in the future (probability) of involving the researchers from the JSI in some project, even much later. There are existing cases that speak about this and that can show how further opportunities were developed because of this ecosystem. Opportunities that one might/could not even envision so much in advance. One example of further benefits for the JSI is, since companies are aware of the (EU) funds, they are also monitoring certain project/funding opportunities and since the focus of the (EU) projects is (more and more) on international/abroad cooperation among the companies and involvement of the academia/institutes in a consortium for example, if certain companies would like to either apply for certain project, they would need to involve some (public) research organization for example and if this is the very same organization that helped them (in some ways) before, then there is a greater chance they will contact/include it. The idea/key is to see the potential down the road, to invest time and effort in certain steps that might not yet give direct/immediate benefit. Of course, not every path will lead to new opportunities/partnership but it is important to see it like from a venture capitalists' point of view; if few success stories outweigh the many unsuccessful trials/paths, it was all worth it, in an economic and satisfactory way.

The major problem is the different focus that the parties might have. Researchers in Academia have focus on research and writing/publishing of scientific articles that brings them credits/points that are used for promotion etc. But the industry has a different focus, they (usually) see things from the perspective of ROI (Return of Investment) etc. in a certain period (within 3 years for example). In not so rare cases, both parties could benefit but they need a guidance, case studies, a different overview, for them to see the synergies without any real downsides. For example, the industry could invest (or gain funds for) in something that might be for rather direct application down the line, while the researcher could focus more on a fundamental/part of certain subject. In this way, both parties gain. Scientists/researchers could still be "true to their cause" by researching in fundamental science but the company can then narrow it down to the application. As a result of this collaboration, a new IP (Intellectual Property) might arise and a patent application could get filed, hoping to get to the granted patent (up to 20 times or more research points for the researchers). Based on this IP, in parallel to patent application, the researchers can also write (scientific) article on the very same subject, what is in fact promoted (but a patent application must of course be filed before the publication of the scientific article). So in the end, the researchers could get scientific/publishing credits (for article(s) and patent (application(s)), industry could get the (cutting edge) innovation (and maybe granted patent) that could lead them to more profits and, if all goes very well, the new (foreground) IP could get licensed to the third parties (plural). But it all begins with the proper "selling" to all parties of why they should start to collaborate in the first place and to convince them that they are not on different sides but on the same plane.

3 MULTIPLE ANGLE APPROACH

Transferring technology, into the industry in particular, is a difficult endeavor. Companies receive a lot of emails/offers daily and it is difficult to get past the basic filter/screening and gain their attention, especially for the technologies on a lower technology readiness level (TRL).

It helps to try to establish the relationship with the company first, to know a few people, to recognize the key people, decisions makers, to show them the value of such relationship and then, (much) later, introduce them to new technologies that have a potential but need funding in order to raise its' TRL. And one way of doing exactly that is by presenting/giving the company benefits of some project that is specifically designed to help them in some way. One such project is the Enterprise Europe Network that is founded by the European Commission and its' purpose is to connect the companies together, across the border. It promotes/stimulates collaboration between companies internationally. The connection can happen through connecting them on the business side; via so-called BR – Business Request or BO – Business Offer (one company is ordering/offering services to the other) or connecting them through the particular technology (via so-called TR – Technology Request, TO – Technology offer). Once the companies see the benefit of this, through the established partnership agreements (PA), then their interest increases, relationship deepens and the connector (Jožef Stefan Institute in particular case, that is a Hub in the Enterprise Europe Network) has the option to promote its's services and technology to the companies it helped. Therefore, all the companies, its services, projects, people, become part of the bigger picture, so-called ecosystem. And every (good) system is more than the sum of its parts or greater than the sum of its parts. That might be truer in the case of the ecosystem.

It is of most importance to see the difference between the (isolated) product/service and the ecosystem. One practical example of this is the mobile phone analogy. There are certain phone brands that are of higher price and when comparing just their physical product alone, by specifications, with the competitive products, they might seem high in price. But the important thing here to consider is the additional/surrounding services that are built/integrated with the device: stores, music service, cloud storage, synchronization, backup, location service, ... With this different overview, the mobile product is not just a (overpriced, comparing just by physical) device but it is the (part of a) mobile ecosystem. Similarly, if one views technology-transfer office (TTO) just as a "forwarding service", that forwards certain email/inquiry and establish contact, it might be harder for them to justify its size/function but if one sees the full spectrum of benefits of the TTO, then they will almost not want to do the contact/service themselves.

Sometimes researchers think that it would be better to contact certain company directly and not via TTO, especially if that is allowed in the organization. But this might show problems down the road, especially if there is a higher money involved. Particular field when something might get wrong is the legal field, when drafting/signing the contract of potential collaboration. If the relationship between organizations is

established without the contract, that has its own problems since many things are undefined (for example use of logo/brand/name, background IP etc.). Also, it is important to have companies on stand-by, for certain tenders/opportunities which are hardly maintained by individuals and this is where the TT ecosystem comes in play.

As we see, it is important to have a established (organic) ecosystem of technology transfer with all the essentials, such us: legal assistance (drafting the contracts, managing the signing procedures), intellectual property (IP) rights guidance/management, informing companies of certain funding/financing and networking opportunities, organizing brokerage events, publishing and promoting profiles (offers, requests) online for the companies that are in need of product/service/research/technology or are looking to sell product/service/technology, mediating/stimulating negotiations (which is very critical in the beginning stages), mediating or “translating” between academia/researchers and companies/industry since there is a usually a very different language/focus between the two, etc.

4 RESULTS AND DISCUSSION

It appears that one of the more effective ways, for the industry and academia to meet, is building and maintaining the TT ecosystem with promoting of value added for all parties. The researchers might get (scientific) credits while the industry (companies) can increase their profits, either directly (by optimizing certain parameters in certain areas: production, logistics, material use etc.) or by gaining some technological advantage (through innovation) in the market.

The innovation is still one of the leading forces of progress or marketing advantage. “Innovate or die” is the motto by which many high-tech companies are driven by. The “host” for this collaboration is a so-called TT ecosystem in which the relationship between academia (and basic science institutes) are formed, maintained and stimulated. It is important to have as much industry and researchers identified/catalogued and connected as possible. Not unusually, the collaboration starts even years after the first contact, when the right opportunity arises or something/management change. It is important to design the organization around the idea of the importance of the TT ecosystem. [2]. At the Jožef Stefan Institute there is a mentioned group of support units, known as Project and Innovation Support, that help to promote the TT idea itself and that also do (bi)weekly visits to Slovenian companies, that are pre-identified/screened as having (the research department/potential) with which the group try to identify topics of possible cooperation and then try to match it with the researches at the Jožef Stefan Institute or, if there is no match at the JSI, with the potential partners abroad. Potential topics/opportunities get forwarded, with the help of Enterprise Europe Network project, to other organization (abroad) due to the lack of resources at the Jožef Stefan Institute. At the first glance, this would seem as an opportunity wasted but due to this TT ecosystem idea, not so few times, the opportunity (later) comes from a different path. For example, the company that we

connected with the company/Institute abroad, later came back with the request for a direct research cooperation or with the invitation to certain tender/call. The company, although had no direct relationship with the Jožef Stefan Institute itself, later realized the value added of the Institute and reached it for another opportunities. The important thing is to keep ecosystem alive, to circle ideas and opportunities and sooner or later, due to pure statistics - if nothing else, the seed of (another) opportunity begin to sprout in the soil of the originator.

5 BEST PRACTICES

One of the recent good examples or best practices, is the successful collaboration (that is ongoing and is evolving) between the researchers from JSI and Slovenian company with registered research group under the Slovenian Research Agency: ARIS. On the other side were the researchers from JSI. The whole collaboration started when the TTO/TTE sent particular funding opportunity to sourced companies that they believe would be suitable. Once the company expressed interest and the technology needed by the SME was defined, the TTO/TTE located the appropriate researchers at the JSI. After the meeting, they agreed to apply for particular project together. After they won the project and completed it, they later applied for a different project of similar size. By this time, they got to know each other quite well and they started to think/brainstorm, during one particular teleconference (TTO was guiding it), that maybe they should not just be looking/applying for certain projects, now that they found they are a good research consortium, but to propose it/them. The idea then gained track, they filed a proposal for a fundamental project and won it. The company got the funds, the researchers got the funds but also, due to fundamental project, researches will have the benefit to work on the fundamental research, which is their main purpose at the institute, to publish, to get research credits etc. The company got the material/base that they can upgrade to more applicable/marketable version of the subject. All parties win. All this all due to the organic progress of relationship between the Institute and the company. With such established relationship, specially with the ongoing support from the TTE, the possibilities/options increased greatly and also there is a potential for the foreground Intellectual Property (IP), further commercialization of joined (secret)know-how or IP etc.

6 CONCLUSIONS

Benefits of the Technology transfer ecosystem are hard to envision at first but the more one work with(in) it, the greater the benefits presented. Many ask what is the purpose for a (basic) research institute to connect the companies and opportunities (specially abroad) but at the end there are many. By visiting companies, identifying their challenges, connecting them with other companies/institutions (abroad), that could solve their challenges, every once in a while, those companies (either domestic or abroad) remembers the originator (the Jožef Stefan Institute in this example) and enters into a research partnership or apply together for great(er) projects in (fundamental) research with the potential for further direct applications. Therefore,

everyone gains. EU also seem to support Improved technology transfer ecosystem and networks across Europe [3].

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The Interconnection of Property Technology and Intellectual Property: Literature Review

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ABSTRACT / POVZETEK

This paper presents a systematic literature review on the link between property technology and intellectual property. Property technology or PropTech is technology and innovation which improves various aspects of the real estate industry, etc. the optimization of the way people buy, sell and manage property. It may for example refer to property management platforms, smart home technology, and data analytics for market insights, virtual property tools etc. Innovative technologies and solutions developed in the PropTech sector often require legal protection through various intellectual property mechanisms, however, our analysis shows, that there is not a single study analysing the interconnection between intellectual property and PropTech innovation.

KEYWORDS / KLJUČNE BESEDE

Property technology, PropTech, patents, intellectual property, IoT, Blockchain, GreenTech, FinTech, Startups, literature review

1 INTRODUCTION

The aim of this study is to explore the interconnection between property technology and intellectual property. So first we must explain and define both terms.

1.1. Property technology (PropTech)

Property Technology or PropTech refers to the use of technology to streamline and improve the processes involved in the real estate industry. PropTech means any technological solution in the real estate sector, be it 3D visualization, a platform to connect buyers and sellers of real estate, crowdfunding, FinTech, GreenTech the sharing economy, smart cities, smart homes, smart contracts or BIM (building information modeling). FinTech refers to the

*Article Title Footnote needs to be captured as Title Note

†Author Footnote to be captured as Author Note

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integration of technology into offerings by financial services companies to improve their use and delivery to consumers. ConTech is the construction technology that is used for all the work that is done within the construction industry. GreenTech was developed in response to climate change and the COVID-19 pandemic.

We can see, there are different areas in technology, especially areas (niches) in PropTech.

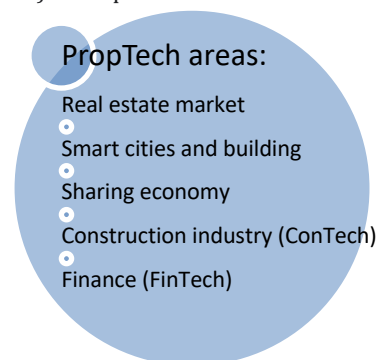


Figure 1: PropTech is currently developing in several areas (PropTech in the narrowest sense)

We have three generations of PropTech (Baum, 2017), while the fourth generation is already mentioned (Ascendix Tech, 2023). The current generation, PropTech 3.0 includes different IT solutions: AI, IoT, Cloud Computing, Blockchain. A blockchain is a distributed database or ledger shared among a computer network's nodes. They are best known for their crucial role in cryptocurrency systems for maintaining a secure and decentralized record of transactions, but they are not limited to cryptocurrency uses.

The real estate industry faces the challenges of reducing carbon emissions (Tan, 2023). Siniak et al (2020) say that the concept of "PropTech 3.0: Real Estate of the Future" was developed in 2017 at the University of Oxford. Consequently, PropTech has become part of the digital transformations of the property industry, in terms of driving the property market and promoting radically new approaches to property acquisition and management. The Croatian Chamber of Architects (2023) has developed Building Information Modeling, a process of creating projects in the field of construction through the creation of a virtual three-dimensional information model of the building, with a strong emphasis on the cooperation of all participants in the design

process and participants in construction. This can be called as innovation in PropTech (ConTech).

PropTech is a new trend set to grow over time. The purpose of PropTech is to transform the built world and make it more digital, more climate conscious and more efficient by applying innovative solutions. It encompasses a wide range of technologies such as software, hardware and data analytics that are used to improve various aspects of the real estate sector, including property management, construction, investment, and sales. PropTech has experienced a huge expansion in the last ten years.

1.1. Intellectual property (IP)

IP refers to any intellectual creation, such as literary works, artistic works, inventions, designs, symbols, names, images, computer code, etc. IP law exists in order to protect the creators and inventors and covers areas of copyrights, trade secrets, trademarks, industrial designs and patents. There are also other forms of IP, such as geographical indicators, but we will focus only to forms which may be relevant to property technology.

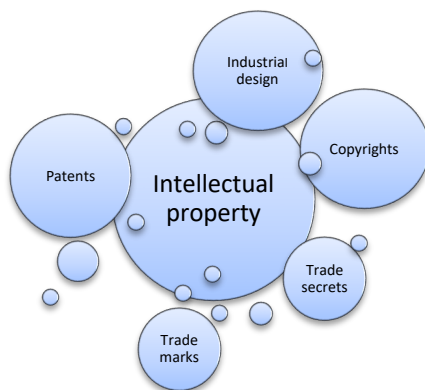


Figure 2: PropTech and intellectual property can be complementary in several ways

1.2.1 Patents: PropTech often involves the development of novel hardware or software solutions that address specific challenges in the real estate industry. These solutions may include unique devices, algorithms, or methods for property management, data analytics, energy efficiency, and more. Companies in the PropTech space may seek patents to protect their inventions from being copied or used without permission. Patents provide exclusive rights to the inventor for a specific period, allowing them to control the use and commercialization of their technology.

1.2.2 Copyrights: PropTech companies develop software applications, platforms, websites, and other digital assets to offer services such as property searches, virtual tours, and data analysis. Copyright protection may apply to the source code, user interfaces, graphics, and other creative elements of these digital products. Copyrights prevent unauthorized copying or distribution of these works.

1.2.3 Trade Secrets: PropTech firms often create proprietary algorithms, databases, business processes, and other confidential information that give them a competitive

edge. Trade secret protection is crucial to safeguard these valuable assets from being misappropriated by competitors.

1.2.4 Trademarks: PropTech companies develop brands and logos to distinguish their products and services in the market.

1.2.5 Industrial designs: It can be assumed that PropTech companies involved in architecture and home interior design often register industrial design as a form of intellectual property.

In the last three years, as companies rapidly develop new innovative, technological solutions, the question arises whether such IP is worth protecting and in what way? How is PropTech and IP connected? While (material) property in a business sense presents a tangible asset, IP is an intangible asset, the successful exploitation of which can be a valuable foundation and contribution to business. The purpose of this paper is to provide a systematic literature review of existing research on this topic.

2 METHODOLOGY

Using Google Scholar on 06/24/2023, we found 149 results that referenced PropTech and intellectual property (I also try to search for specific form of IL) in the same article.

The searches were determined in this way:

- “intellectual property” AND “property technology” OR PropTech
- patent OR patents AND “property technology” OR PropTech
- copyright OR copyrights AND “property technology” OR “PropTech”
- “industrial design” OR “industrial designs” AND “property technology” OR PropTech
- “trade secret” OR “trade secrets” AND “property technology” OR PropTech
- trademark OR trademarks AND “property technology” OR PropTech

Where the quotation marks specify that a specific phrase should be selected and not each word individually.

Then I carefully selected 30 scientific articles that mentioned Real Estate Technology and IP or IP forms more than 3 times in article. Then I analyzed all of 30 scientific articles (see attachment: Systematic data analysis). I excluded all articles that unrelatedly mention IP and technology (Real Estate, PropTech, building technology etc.) I determined the most important papers and examined them in further detail based on the number of times a paper mentions IP (or patents, copyrights, etc.). At the end I have selected only 9 articles that have a link on IP with the possibility of application in some of the real estate technologies. These articles are listed in the last column as articles of high importance.

3 RESULTS

Here is a summary of these 9 relevant articles:

3.1 IP as Patents, Trademarks, Industrial designs, Trade Secrets and Copyright in Technology

3.1.1. Non-fungible token (NFT). NFTs provide proof of ownership and the corresponding asset can only have one owner at any given time (Zhang, 2023). Today, they are widely used by artists, musicians and brands to secure their copyrights and IP. Based on the presented data, it can be concluded that blockchain-supported technologies are highly represented in published articles and journals, but lack innovation, which is reflected in the number of published patents. Mixed reality technologies show strong maturity through published articles but have limited research and development as indicated by the small number of patents. On the other hand, artificial intelligence (AI) technologies show a balance between the number of published patents and articles Edge computing and smart contracts have proven themselves great research interest and development due to the number of published patents. Namely, there are many published one articles on non-fungible tokens, but a relatively small number of patents, which may be a consequence overlapping with other technologies or due to the novelty of the technology itself. It is possible notice that there is a significantly higher number of published articles on AI technologies in relation to the number of published patents.

A non-fungible token (NFT) is a unique digital identifier that is recorded on a blockchain and is used to certify ownership and authenticity. There is insufficient research on the use of NFTs in matters such as IP. Application for a patent and trademark is not only a time-consuming process, but also extremely expensive (Mojtaba and others, 2022).

3.1.2 Trade secrets and patents. One of the explanations is that FinTech (Imerman & Fabozzi, 2020) are used proprietary to generate profit, but when IP patented, it has been published in the public domain and is therefore no longer a "trade secret". Another source of risk in FinTech stems from legal issues. Legal issues in FinTech is particularly tricky because there is significant IP components associated with these technologies, but financial services companies are not known to obtain patents for their technologies.

3.1.3 Copyright. IP (Van Erp, 2019) law deal with problems, such as copyright and database law in European Union. There are several problems to solve at a more theoretical level on the way how to express such rights as copyright. Technical developments go incredibly fast and IT developers seem to overrun the law with their rallying cry that "computer code is law".

4 DISCUSSION

From the systematic literature review we can conclude that even scientific papers on PropTech are very new (very rare before 2018). Despite enormous potential, PropTech

remains largely unexplored by the academic community (Friedman, 2020). Moreover, most of the literature on the real estate development process explains more about the construction process technology and financial technology, while other proprietary technologies are rarely mentioned (Maududy and Gamal, 2019) and as we have shown above, no one has investigated the impact of IP on innovation or the success of PropTech companies.

As can be seen, most articles are related to decentralized technology (Blockchain), which is also related to the concept of Web 3.0. The articles define specific research niches, but we can conclude that there are many challenges, and that significant research will be needed in this area. However, there is, so far, not a single study detailing the impact of IP on PropTech innovation. As can be seen in the attachment, even the most significant papers only superficially consider the role of IP, although they confirm that IP has a significant role. PropTech has enormous innovation potential with the arrival of the 5th industrial revolution and 4.0 PropTech revolutions (robotization, smart intelligence, smart contracts with realization in the present time...) and understanding how innovative protected technological solutions can increase the revenue of PropTech companies is very important for both management researchers and managers. NFT has significant potential in the domain of IP of PropTech solutions and this is the area of software protection. The Office of Technology Assessment of the US Congress has reported that copyright law provides unsatisfactory protection for computer software.

The book of Rushing & Brown (2019) analyses the importance of the social rate of return on investments in new technology and deals with a discussion of some policy issues regarding IP rights. The less developed countries tend to feel that IP rights give inventors and innovators an undesirable monopoly on advanced technology that can be used to extract unjustifiably high prices, as well as unwarranted restrictions on the application of the technology. The main point is that if one considers the long-run benefits for economic growth resulting from IP protection, as well as the long-run costs in terms of economic stagnation when no protection exists, the case for strengthening IP protection in developed and developing countries is very strong. Creating new types of output in such areas as biotechnology, computer software, and information transmission, not considered in IP protection mechanisms, means that maintaining a degree of protection requires flexibility in the mechanism itself. The impact of IP protection on the firm's decision to allocate resources to research and development (R&D) is clearly at the core of any discussion regarding an optimal IP policy. From the firm's perspective, the degree of protection afforded IP has an impact on its profits and therefore on the amount of money that it invests in R&D.

PropTech is also a collective term used to define startups that offer technologically innovative products and new business models for the real estate market. PropTech startups are important drivers of change in accelerating the digitization of buildings. While many researchers analyze the economic and environmental savings from the application of digital

technology, far less attention has been paid to the challenges for PropTech startups to increase profits and become sustainable businesses (Tan & Miller, 2023). Lawrence (2023) says that European Proptech startups are thriving because they are changing the way real estate is bought, sold and rented.

Those 9 articles talk about the application of innovations in technology, but specifically not in PropTech. Therefore, the interconnection between PropTech and IP presents an important research niche.

Financing is growing, and companies are expanding their markets and developing new, innovative products. There are many types of IP recognized by law, and each type provides some form of protection to a person who has made the creation. The basic idea behind various types of IP is to provide an incentive to the owners to disclose the idea to the public, so that others can further develop the technology, and therefore, it leads to an overall growth of science and technology. As logical as this may be, it has been criticized by many people who follow an opposing school of thought propose that IP rights serve as a tool to provide monopoly to large corporations, and it's difficult for smaller players to invest in R&D as much as bigger companies, eventually, strict implementations of IP laws kill the innovation and thus it defeats the sole purpose. There are two solutions for small start-up companies in the fields of Proptech, Contech or Fintech:

- to book a presentation space on some PropTech fairs and secure a presence in the central innovation area. If this business idea has the power to disrupt the real estate industry, some investor will invest in R&D and IP protection and a new innovation will be born.
- to improve the actual situation defined by a lack of research, I recommend that academic institutions encourage more research on PropTech and its connection with innovation and IP. This can also be accomplished by offering relevant courses, supporting doctoral-level research on the topic, and engaging industry-academy consortium research projects.
- academic institutions can further encourage Proptech startups to cooperate with them to improve their products and services and underpin the growth of the industry as a whole.
- academic institutions can support founding of spin-out and spin-off PropTech enterprises.

The practical application of innovations on PropTech cannot yet be fully explored, until there will be more research papers in the field of IP and PropTech.

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A ATTACHED DOCUMENT

A.1 Research method of articles considering, together, PropTech and intellectual property

An Information-Centric Perspective on Data

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ABSTRACT

While the focus of information theory, science, and technology is information, most of the current legal and regulatory frameworks focus on data and portability, disregarding the information aspect, and therefore fail to successfully achieve their goals. The paper presents an information-centric perspective on data. Furthermore, it argues that data ownership could enable additional regulatory aspects while being key to develop a data market and a data value chain. Moreover, some ideas are drafted on how the value of information could be attributed across different stages of the data value chain.

KEYWORDS

Data, Theory of value, Data value chain,

1 ECONOMIC ASPECTS OF DATA

1.1 Who or what generates data?

Data is defined by Bygrave [4] as "*signs, patterns, characters or symbols which potentially represent some thing (a process or object) from the 'real world' and, through this representation, may communicate information about that thing*". Nevertheless, Gellert [8] notes that the definition of data and the distinction between information and data remain a matter of discussion. Two kinds of data generation processes exist. First, we find sensors that observe certain phenomena (either physical or virtual) and quantify them. Second, we find processes that generate synthetic data based on previous knowledge about something they aim to emulate (e.g., heuristics or machine learning models for synthetic data generation).

1.2 What makes data valuable?

Data is not sought by the data itself, but for the information it contains. While information has been defined in many ways, it is generally understood as the knowledge communication [5]. That knowledge is sought at a particular time with a particular goal in mind, and the value of the information is related to that goal [1].

The increasing adoption and use of machine learning fosters an increasing demand for data suitable for satisfying the particular goals the machine learning models are trained for. In the machine learning realm, multiple paradigms exist and they

conceive learning goals in different ways. Among these paradigms, we find unsupervised learning, supervised learning, and reinforcement learning [2]. Unsupervised learning aims to learn from unlabeled data for clustering, density estimation, or dimensionality reduction. Supervised learning aims to learn the association between input vectors and dependent variables (classification or regression settings). Finally, reinforcement learning aims to find suitable actions in a particular situation that maximize a reward and help achieve a certain goal. In reinforcement learning the algorithm interacts with the environment by trial and error, exploring actions and context to learn something new, and exploiting gained knowledge to attain the final goal. In every case, the relevant knowledge toward the specific goal is different. Furthermore, it can be conveyed using different modalities (tabular data, graph data, sequence data, or image data).

While commodities usually are subject to divisibility, appropriability, scarcity, and display decreasing returns to use, it has been observed that information is not easily divisible, and its value often increases with its use [9]. While data is abundant and can be replicated arbitrarily, the scarcity could arise from the finite amount of means to replicate, process and store the data.

From the abovementioned observations, multiple considerations arise, which we briefly introduce in the following sections.

1.3 How informative is the data?

Many approaches and metrics have been developed to measure the amount of information present in the data. Among common measures we find the Shannon entropy, mutual information, and directed information. The Shannon entropy measures the degree to which the data is unexpected: the higher the unexpectedness of the data, the higher the information value it holds. Conditional entropy measures the degree of unexpectedness of a variable given the value of another known variable. Mutual information assumes two random variables are given and measures how much information about one variable can be drawn by observing the second one. Finally, given a pair of sequences, the directed information measure the extent to which one sequence is relevant for causal inference on the other one.

In machine learning, there is an interest in understanding what is invariant and what is noise across datasets and contexts. The capacity to discriminate between information and noise is a key aspect of learning [16]. While in this context valuable data would be the one that provides information that displays little correlation to already known independent variables, such information could still be useful to a person for the sake of context (e.g., while economic growth is usually correlated with employment rates, and using both may be meaningless for a

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machine learning algorithm in certain cases, they may still be valuable to a person).

1.4 Do we have substitutes?

A key aspect that defines the economic behavior of consumers with respect to a given product in the market, is whether a good substitute product exists for it. The demand for substitute products shows a negative correlation: the demand for one product reduces or replaces the need for the other. Substitutes of a particular data variable would be any kind of data that displays a high enough degree of mutual information.

1.5 Data enrichment

When considering learning goals for a specific machine learning algorithm, we may find that a single data variable will unlikely be able to describe complex relations observed in the real world. Therefore, data enrichment is required to join multiple data variables describing the different aspects of the real world, and therefore providing new information to the machine learning model or the person consuming it.

1.6 Data elasticity

The demand for a certain product is considered elastic when the demanded quantity of a product changes more than proportionally when its price increases or decreases. While product elasticity is usually considered in the realm of physical products, intangible assets could also display elastic behavior. E.g., people would be more or less likely to disclose some sensitive information based on the perceived benefit. The perceived benefit could be considered the price of that piece of data, paid either in kind (e.g., access to a product feature), money (either selling or renting the data), or both. A particular example could be access to data describing typing patterns. Such data could be used for continuous authentication of a person using a particular hardware (e.g., ensuring only the owner uses a particular device) [7, 15], or for early disease diagnosis [10]. In each case, the person could grant access to the data in exchange for (a) a digital good (e.g., a typing profile), (b) some service (e.g., authentication, (continuous) identity verification, or disease diagnostics, or (c) money obtained from data leased or sold at an aggregate level (e.g., for analytic purposes, such as its use within the scope of the research of a given disease, public health policy planning, or market research). While in (b) the person would benefit from the service and eventually pay an additional fee for it, in (c) the person could perceive a fraction of the money paid to access some of the data he owns. We devote part of Section 2.3 to weight the benefits and drawbacks of granting access to data permanently, and the benefits and drawbacks of selling or leasing data.

1.7 Data amortization

Amortization refers to the accounting method used to expense the cost of intangible assets over their expected lifetime for tax or accounting purposes. Amortization is analogous to the depreciation of physical assets. The costs are expensed to reflect the asset's loss of value over time (e.g., in physical assets this could be due to the wearing out with their use over time). Without delving into the details of data amortization, it can be observed that not all data was created equal: while certain data wears out with time (e.g., fraud patterns change over time, and, therefore,

past patterns do not provide insights into current fraud strategies), some other may be lightly affected by time (e.g., prices in inflationary context), or may not be affected by time at all (e.g., landscape images). When the underlying semantics change (e.g., new types of fraud emerge and old ones disappear) there is little that can be done to avoid data depreciation. Nevertheless, when the semantics remain the same but changes in the data distribution are observed, we speak about data drift. Data drift can be mitigated to a certain extent with strategies that learn how to align past and current data distributions (e.g., through Monge mapping). While not always feasible, such alignment could extend the lifecycle for certain data if required. Anyway, the existence of different data lifecycles requires different depreciation strategies to be considered in each case.

2 DATA: ITS VALUE AND PRICING

2.1 Theories of value

A key question in economic theory regards the value of goods and their price. In his work "*An Inquiry into the Nature and Causes of the Wealth of Nations*" [13], Adam Smith presented the water-diamond paradox: water, which is required for life, is far less expensive than diamonds, which have very limited use. The subjective theory of value solved the paradox by claiming that the value of the asset is determined by the consumer, based on the marginal utility. The theory explains that while water, in total, is more valuable than the diamonds, water is plentiful, and diamonds are scarce. Therefore, an additional unit of diamonds exceeds the value of an additional unit of water. Nevertheless, does the paradox hold in the realm of data? The paradox supposes four key properties are observed in most assets: appropriability, divisibility, scarcity, and the display of decreasing returns to use. Appropriability relates to the ownership of data. While data is not divisible *per se*, divisibility could be derived from ownership: access to data could be granted by extending ownership, through a lease, or as a donation. While data is abundant and can be replicated arbitrarily, the scarcity could arise from the finite amount of means to replicate, process and store the data, and from the fact that ownership should be respected. Finally, the decreasing returns in the realm of data could be associated to the degree of information that each new piece of data provides. This is likely to diminish over time. Nevertheless, a fifth factor must be considered: the malleability of the asset under consideration, defined as how a certain asset can be used. The higher the malleability, the greater the market potential and its potential demand. While physical assets have a limited range of uses, each piece of data can be used for a virtually infinite amount of applications, and therefore directly impacting its value. Nevertheless, the subjective value assigned to data in each case may not directly correlate to its pricing. Data can be used in applications that have different value regimes, centered on different value forms (e.g., economic or aesthetic), each of them subject to different internal dynamics [3].

Bolin [3] considers that the following aspects are relevant to data valuation: (a) data is transient (the value of data diminishes over time), (b) it requires human involvement to be generated and processed, (c) data will never be exhausted as long as there is human activity, (d) and it is a non-rivalrous good. We agree with the author that data requires human involvement to be generated and processed. Furthermore, we consider both

properties as the foundation of data ownership. Nevertheless, we consider that while (a) is true for certain cases, many phenomena described by data remains invariant through time (e.g., images describing a landscape). Moreover, technological degradation could impact the ability to produce data. Finally, we agree that data is a non-rivalrous good (the use of data by a company does not infringe upon others' use of it). Jones [11] considers this has at least two consequences: (a) it cannot be priced if not legally restricted (ownership attributed to it), and (b) there may be potentially large gains by using it broadly. Furthermore, it considers that giving data property rights could generate nearly optimal allocations. While we agree that data should be given property rights, we consider that two dimensions of data value must be considered: the ownership of data and the information contained in the data. While the data ownership enables selling or renting a particular piece of data, the information contained in a piece of data may be shared by a wide range of data. We elaborate further on this concept in Section 2.3, linking this property to data pricing.

2.2 Owning data

Ownership is considered a key aspect of pricing. While some authors argue that data exhibits traits of a public good (public goods are non-excludable (it is costly or impossible to exclude someone from using the asset) and non-rivalrous) data is not non-excludable *per se*. Therefore, while some data could be legally turned into non-excludable (e.g., due to public interest or the owners' will), by default, it should be considered private property under the scheme of data markets. We ground this claim in the fact that all data is collected as a result of human intervention and certain investments, and therefore fulfilling the criteria that ownership is gained by doing some work. Nevertheless, data has the particular characteristic that its value relates to the information it holds, which (i) by the definition of information relates to a certain goal, and (ii) can be found in other pieces of data that may be owned by other people. Therefore, while data is owned by the person or entity producing it, the ownership over the information cannot be enforced and could be shared based on data ownership attribution.

2.3 Pricing data

Usually, consumers are willing to pay a higher price for products they consider to be of higher value. Therefore, how should data be priced? Spiekermann et al. [14] explored a user-centered value theory for personal data. Based on experimental research, the authors concluded that (a) most people are not aware that their data may have a market potential, (b) awareness that there is a market for data influences the perceived value of data, (c) the value of data correlates with engagement and psychological ownership (e.g., in a certain application or platform), and (d) lack of control over how data is used likely leads people to abandon the data market.

Data ownership and administration. To solve issues related to peoples' ignorance about data market potential, ensure their psychological ownership and grant them control on how the data is used, we propose regulation should mandate that browsers and devices must have a data management dashboard linked to a digital profile. Such a dashboard could display what data is being collected and provide a typified description on how this data can

be used, the privacy implications, and the estimated price a piece of data has on the market. The dashboard should also display which websites /applications/legal entities are accessing the data or have accessed it in the past, the time span for which they stored the data, the purpose for which they use it, and their price offerings. Finally, it should provide data administration tools to operate with the data supporting e.g., the deletion of certain data to anyone who acquired it in the past, disable its further use, or grant it to some particular entity or anyone interested in it.

Such a dashboard could be a product created and marketed by any company interested in providing such oversight. The companies would not store the data: the dashboard would just issue API calls to any third parties and keep track of what data was given or not to particular websites/applications/legal entities. Furthermore, such implementation would provide a default and full GDPR-compliant interface e.g., ensuring the right to data deletion, which under existing implementations is hard to realize. We consider key to data privacy that such dashboards are associated with distributed identities [6]. Furthermore, such a distributed identity could be associated with multiple virtual wallets to preserve data owners anonymity and enable the trading of data.

Data intermediaries. To increase data marketing power and in the interest of privacy, persons could provide some of their data to data intermediaries who would market the data or aggregated data to interested parties under particular terms of use. This would help such parties to acquire a critical mass of data of interest while also increase price negotiation power on behalf of the data producers. The Data Governance Act has already established a legal framework and certain governance standards for data intermediation services [12].

Pricing data. When pricing data, we consider that for each piece of data two things must be considered: (i) the (ownership of the) data itself, and (ii) the information contained by the data. While the data is owned by someone, the information cannot be owned exclusively and is shared across many pieces of data. Therefore, data pricing should consider (i) the compensation paid to the owner for the right to exploit the piece of data with a particular goal, which accounts for the information value of the data in that particular case, and (ii) the compensation paid to anyone who has a piece of data that shares some amount of the information extracted from the piece of data mentioned above. The second compensation is rooted in the fact that given the data is a non-rivalrous good, a single piece of data could be arbitrarily selected and exploited without limit, inducing a certain loss to the rest of the owners of pieces of data that contains similar information. The compensation should alleviate that loss. This second component could be fixed, the amount established by a regulatory entity and paid to a third party, in a similar manner as public performance royalties are managed, collected and distributed by performance rights organizations in the music industry. The royalties would be distributed based on the fraction of information shared by a particular piece of data for which the royalty was paid, and the data owned by a particular person or legal entity. We consider that such an information-sharing-based compensation schema would help to solve attribution issues that arise from generative artificial intelligence models, where no direct attribution to a digital work exists. Furthermore, it would solve issues that arise from competing interests between open-

sourced datasets and private datasets that could contain similar information, compensating for the loss caused to owners of private datasets due to the adoption of opensource (free) ones. This is particularly relevant given the non-rivalrous nature of data.

Renting data. While data could be sold, we consider data renting to provide a more appropriate framework. By renting data, the data producers retain the rights to the data and therefore can decide at any moment to stop sharing it, relocate it, or delete it, among other choices. Data rental could provide a solution to the data portability issue: since the company would not own the data, the data generator retains the right to move the data somewhere else. Therefore, it could be considered that companies take the cost of hosting data as part of the exchange price for data. Nevertheless, they could be mandated to offer a portability service (export some or all of the data producer data on request, for a given fee), to honor the ability to relocate the data. Furthermore, such a service should guarantee that exported data can be understood (e.g., by providing a minimal amount of metadata, with a good-enough semantic description). Specialized companies could provide hosting services for exported data if a person just wants to move the data from some company to avoid losing it when denying further use of it. Furthermore, competing companies could assume the costs of porting data between platforms as a means to lure new consumers to start using their product.

When considering the data rental model, data pricing could have two components: a fixed price paid for the ability to use the data, and a variable price based on the effective value the data provides to the product. The variable component could be measured based on how many requests impact analytic outcomes leveraging certain piece of data, or if a certain piece of information is key to a machine learning model or particular request (e.g., feature significance or other explainable artificial intelligence outcomes, and how these correlate with a particular piece of data). Furthermore, in some cases, to guarantee transparency, the insights used to assess the degree up to which a piece of data is relevant for an outcome should be the ones provided to create explanations as required by regulatory normatives for the use of AI in a product (e.g., the AI Act). The price paid in the market for the (rented) data should be related with the value it provides to a particular feature or product. Furthermore, a fraction of the fixed and variable price should be assigned to the performance rights organizations established to compensate the loss suffered by other data owners whose data contains similar information as the one that was shared.

2.4 Data value chain

We envision the data value chain should have at least three parts: (a) the value of the product (e.g., some application or synthetically generated image - their value is determined by the market price based on specific value regimes), (b) the value of the information extraction process (e.g., artificial intelligence model or analytics - it considers how much of the product value can be attributed to this component (e.g., by number of requests, shared screen time, etc.)), (c) the value of data (determined through some attribution technique, e.g., which variables were most relevant to a forecast, what data contains that information, and in what degree). The data value chain also contemplates at least five distinct actors: (i) consumers (use the application), (ii)

data owners renting or selling their data, (iii) data owners compensated (given data shared by third parties contains certain degree of the information contained by their data), (iv) some regulatory entity ensuring such compensations take place, and (v) a person or company that owns and develops the product.

3 CONCLUSIONS

In this paper we have briefly described some considerations regarding the value of data. We consider data ownership is key to realizing data markets, where data rental would provide means to not only pay data owners for their data, but also provide a technical solution that enables the realization of privacy rights. Furthermore, we propose the compensation of data owners based on the information contained within their data and the data shared by third parties. Finally, we propose a data value chain

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Fostering Research & Innovation in AI through Regulatory Sandboxes

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ABSTRACT

This paper advocates for the establishment of AI regulatory sandboxes in the European Union to enable responsible testing of AI systems in real-life conditions. By aligning the sandbox modalities with the risk tiers of the AI Act, a smooth transition from research to testing of AI systems is ensured. The framework emphasizes the oversight and compliance obligations needed for the desired outcomes to be realised. This will foster AI Research & Innovation in the European Union, delivering benefits for society and ethical legally conforming AI technologies.

KEYWORDS

AI systems, knowledge transfers, EU regulation

1 INTRODUCTION

The European Union (EU) is currently deploying or getting ready to deploy several regulatory instruments to deliver a Union “fit for the digital age” [1]. The not-yet adopted Artificial Intelligence (AI) Act, is one of them. It imposes obligations on providers, makers, and facilitators of AI systems, as well as on users of AI systems or their outputs. The specifics of what constitutes an AI system, the obliged parties, and the conditions these must abide by are still being discussed. The European Commission (EC) released its Proposed AI Act in 2021 [2]. The Council [3] and the European Parliament (EP) [4], have both released their amended versions of the text. These bodies are now engaged in interinstitutional negotiations, which will deliver the Final AI Act, expected by the end of 2023.

The operational functioning of the AI Act will be set at a later stage through implementing acts. However, the content of these documents indicates that regulatory sandboxes will be the chosen environments for the development of safe AI Research & Innovation (R&I). This paper argues that AI regulatory sandboxes should be structured following the tiered approach towards risk that characterises the AI Act, as the space where certain AI systems can be tested before being placed in the market. This framework for AI regulatory sandboxes will favour the growth of AI technologies in the EU and bring about benefits to society.

2 KEY ASPECTS OF THE AI ACT

To understand the content of this paper, some concepts contained in the AI Act need to be introduced and clarified.

2.1 A Tiered Approach Towards Risk

The Proposed AI Act regulates AI systems based on a tiered approach towards risk. It differentiates between (i) unacceptable risk AI systems, to be outlawed; (ii) high risk AI systems; and (iii) low or minimal risk AI systems. Moreover, the Proposed AI Act sets two categories of high risk AI systems: those characterized by their use as safety components of specific products, and those with implications for fundamental rights. Thus, both the purpose of the AI system and the technologies it utilizes will be key factors in determining the risk category of the AI system. The Final AI Act is expected to follow this structure. However, the specific traits defining what makes the AI systems fall within each category of risk have still not been set. The Final AI Act will likely follow the Proposed AI Act in providing flexibility for the expansion or modification in the future of the traits of AI systems that define them as high risk.

Moreover, the Council and the EP agree with the Proposed AI Act that high risk AI systems will need to be assessed before being put on the market and throughout their lifecycle, while limited-risk AI systems will only need to comply with transparency requirements, enabling users to make informed decisions as to engaging with them. To ease the transition of AI systems from the inception stage to the market stage, the regulation puts forth the creation of AI regulatory sandboxes (sandboxes).

2.2 AI Regulatory Sandboxes

The Proposed AI Act envisions controlled environments for the testing and refinement of AI models, named AI regulatory sandboxes. These are intended to allow obliged parties to ensure that the AI systems comply with the AI Act obligations and to provide feedback on potential risks before such risks can be realized in society. This includes instances of substantial modifications of the AI system which motivates the need for a new conformity assessment. Sandboxes are also intended to enhance legal certainty for AI system innovators.

The concept of regulatory sandboxes is not new. They have been analysed in the literature as experimental regulatory instruments “offer[ing] the flexibility, adaptability, room for compromise, and innovation-friendliness required by novel technological developments” [5]. Regulatory sandboxes have already been implemented across jurisdictions, especially in the

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financial sector. They serve companies to test the potential compliance of new business models [6]; and regulators to understand the evolution of new technologies [7] and develop “evidence-based lawmaking” [8].

The Council and EP agree on the creation of AI regulatory sandboxes. Both bodies consider that the specific conditions for the establishment of these environments need to be developed through later delegated implementing acts. Thus, the actual functioning and structure of AI regulatory sandboxes will depend on the implementing acts to be developed and adopted after the Final Text of the AI Act becomes law. The current vision regarding regulatory sandboxes described in the Proposed AI Act and the amendments adopted by the Council and EP contemplates the following stages:

2.2.1 Establishing AI regulatory sandboxes. Specific competent authorities at the Member State(s) and (or) the EU will oversee the accreditation and auditing of these spaces, following given rules and principles. The competent authorities have discretionary powers to adapt their tasks to specific AI sandbox projects.

2.2.2 Conditions of operation of the AI regulatory sandbox. The operation of the AI regulatory sandbox, including the procedure to apply for its utilization, the eligibility criteria, the rights and obligations of participants, duration, and other aspects of operating the AI regulatory sandbox will be set in implementing acts. These sandboxes will be under the direct supervision, guidance, and support of the national competent authority. These are key aspects for the proper functioning and the effectiveness of regulatory sandboxes, as explained by Ranchordas [5].

2.2.3 Modalities of AI regulatory sandboxes. Possibly, different modalities of AI regulatory sandboxes should exist. All sandboxes are intended to deliver controlled environments, permitting the assessment of AI systems before facing full-scale regulatory requirements in real life. The specific requirements and scenarios of different sandboxes are likely to depend on the individual function, technology, or purpose of the given AI systems they are envisioned to assess.

2.2.4 Testing and assessment of AI systems. The sandbox is designed to identify the risks of the AI system, with the purpose of both classifying the AI system accordingly and assuring that the AI system complies with the corresponding rules and obligations. The methods utilized in the AI regulatory sandbox must be geared towards the identification of risks and their mitigation to ensure legal compliance with the AI systems. The AI regulatory sandboxes should focus on dangers to fundamental rights, democracy, the rule of law, health, and the environment. These are, especially, distinguishing traits of high risk AI systems. This way, AI sandboxes can enable truly responsible innovation.

2.2.5 Cooperation among AI Regulatory Sandboxes. The competent authorities should cooperate and coordinate their activities. When possible, cross-border cooperation should be facilitated. This is essential to prevent differences across Member States, and to assure the maintenance of the free movement of products and services in the Union's internal market.

2.2.6 Exclusion of administrative fines by using AI regulatory sandboxes. The sandbox participants that have respected the rules and procedures set within the AI regulatory sandbox

framework can enjoy a presumption of legal conformity and will not be subjected to administrative fines for eventual infringements of AI systems legislation, even if they remain liable for the damages they may cause.

In terms of the appropriateness of mainlining the responsibility for potential liability damages during the duration of the sandboxes, the question remains open in the academic sphere. One side agrees with maintaining liability, as the EC and Council defend, arguing that this is necessary for consumer protection and the keeping of trust. However, others consider this approach too onerous, warning that it may disincentivise innovation, and harm smaller players in the market who could be burdened by extensive legal obligations even before fully operating in the market. [9]

2.3 Research Activities & the AI Act

The Proposed AI Act did not include a provision excluding AI research activities from its scope of application. However, both the Council and the EP have brought forth this exemption in their adopted amendments. This suggests that the Final AI Act will set a different framework for such activities.

The Council desires to amend Article 2 of the AI Act to explicitly exclude its application to AI systems “specifically developed and put into service for the sole purpose of scientific research and development”, as well as “any research and development activity” [3]. Meanwhile, the EP would amend Article 2 to exclude AI systems research, testing and development activities “prior to this system being placed on the market or put into service” [4]. Neither of these suggested exclusions, however, sufficiently pre-empt potential risks.

This paper argues that for this exemption to operate, the research activity must be performed ensuring the absence of harm to people. Otherwise, research activities that require interaction with people (e.g., to gather behavioural insights, people-facing testing, etc.) could be wrongfully placed outside the scope of the regulation. This could lead to the same societal harms that the AI Act is explicitly tasked to avoid. Thus, this latter type of research activities should also be conducted within the scheme of AI regulatory sandboxes, and their appropriate controlled environment.

3 AI REGULATORY SANDBOXES THAT FOSTER SAFE AI RESEARCH AND INNOVATION

This section argues for the incorporation of three key traits into the framework of AI regulatory sandboxes, either within the AI itself or its delegated implementing acts, for the sandboxes to serve as effective environments for the development of transparent and responsible AI innovation and safe AI systems: (1) making AI regulatory sandboxes the environment for the controlled testing of AI systems in real-life scenarios, (2) creating different modalities of sandboxes following the tiered risk approach of the AI Act and (3) outlining some common requirements for all types of regulatory sandboxes. They also recognize the varying complexities and potential impacts of different AI technologies, ensuring that regulatory oversight is proportionate and targeted to foster the transfer of AI knowledge to society.

3.1 The Shaping of the AI Act Regulatory Sandboxes as the Environment for Real-Life Testing

The Council and EP agree that the ‘placing in the market’ of the AI system should be the moment when the AI Act is triggered, and the AI system needs to fully comply with the legal obligations within the AI Act. This circumstance is understood as the moment in time in which “[a product] is first supplied for distribution, consumption or use on the market in the course of a commercial activity, whether in return for payment or free of charge” [10]. However, research activities that interact with people in the real world should be covered by AI safeguards, and regulatory sandboxes could provide the entities with means for a progressive transition towards the full applicability of the AI Act.

Currently, the Council and the EP diverge on whether entities should be given the possibility to test AI systems in real-life settings. The Council considers that this should be enabled, under specific conditions and safeguards, within AI regulatory sandboxes. The EP, however, would not exempt the testing of the AI system in real-world conditions from the full application of the AI Act. This paper argues that enabling real-life testing in regulatory sandboxes is the safest and most significant manner in which the AI Act can foster AI R&I while preserving the trust and safety of the people. Real-life testing is necessary. This is in line with the ordinary operation of entities in the market. For example, companies incrementally test whether the changes they implement are successful and behave as expected. If so, they propagate the changes to the rest of their goods or services, while if issues are identified, they revert to the previous version and resolve them.

Carrying out this process for the real-life testing of AI systems within AI regulatory sandboxes, where approval of the AI system is needed before it can be fully released to the market, enables the avoidance of misconduct or abuse. It also ensures that risks are properly identified and mitigated and that by the end of the sandbox period, the outcomes are fully compliant with existing regulations.

3.2 Regulatory Sandboxes Based on the AI’s Tiered Approach Towards Risk

This paper argues that AI regulatory sandboxes should be structured following the tiered approach towards risk that characterises the AI Act. Two modalities of regulatory sandboxes can be created according to the potential risk the tested AI systems can generate. These modalities would be foundational, but not exhaustive; others can be created based on criteria such as the sector where the AI system would be deployed.

3.2.1 Regulatory sandboxes for limited-risk AI systems. This sandbox would serve to test new limited-risk AI systems, or those which are already in the market, but are being applied to an additional or different purpose. Access to such a sandbox should be voluntary, and legal requirements less strict.

3.2.2 Regulatory sandboxes for (potentially) high risk AI systems. This sandbox would test new high risk applications, or existing high risk AI systems for a new purpose. This sandbox should also be utilised if the entity is unsure about the risk classification of the AI system. The main purposes of this

modality are to enable entities to (1) test their AI system, to assess whether it is high risk, and (2) if the AI system is high risk, to determine what mitigating factors can be implemented, and if the implemented mitigated factors are sufficient. The utilisation of this type of sandbox could be voluntary or compulsory. The choice depends on the ability of certification bodies to establish sufficient high risk AI systems regulatory sandboxes, and the associated benefits the entities utilising them could enjoy. Making the utilisation of this sandbox compulsory is the most effective way of assuring that high risk AI systems conform to the law before being placed in the market. If the utilisation of this sandbox is made voluntary, its use could provide the entity with a fast-tracking process in the third-party conformity assessment procedure all high risk AI systems must undergo.

Moreover, certain entities utilising this type of sandbox could be given access to a ‘nursery status’, a concept developed in other jurisdictions. This status acts as a transitional phase where companies, especially startups, can continue to receive targeted support even after exiting the sandbox environment. This responds to the fact that startups often rely heavily on the guidance provided during the sandbox period, unlike established companies that are more experienced in the field of regulatory compliance. The nursery status recognizes that, mitigating the risks of no longer being exempt from regulatory consequences, and facing real-world responsibilities (including potential fines), by offering increased support. This continued assistance helps organizations meet regulatory requirements and build the necessary experience in a more controlled setting, serving as a period of growth. [11]

3.3 Common requirements for all Regulatory Sandboxes

Regulatory sandboxes must adhere to certain common requirements to ensure that AI systems and other innovative technologies go through real-life testing within controlled and legally compliant environments. These minimum terms and conditions must be explicitly defined, as part of the procedure to establish the regulatory sandbox. The requirements for limited-minimal risk AI sandboxes can be adjusted, reflecting the lower danger posed by such AI systems. This section argues that all AI regulatory sandboxes must meet the following criteria:

3.3.1 The identification of the AI system features that are being tested. This encompasses understanding not only what functionalities are being tested but also why and how they are being assessed. The supervisory authority will not have direct access to the code itself and must safeguard sensitive and/or proprietary information, allowing innovation to flourish without undue risk of exposure.

3.3.2 The proportion, composition, and selection of users subjected to testing. Users should be made aware that they are engaging with an AI system that is being tested, and must provide their consent. For instance, if a financial institution is offering a new credit product based on an experimental algorithm, customers must be informed that this offering is not part of the financial institution’s regular operation.

3.3.3 The time frame for testing, with provisions to interrupt it. The complexity of the technology and the nature of the testing environment should justify the start and end dates of the

regulatory sandbox. Crucially, provisions must be made to allow for an immediate interruption of the testing if insurmountable risks arise, with an identification of the measures set to identify such a situation.

3.3.4. Documentation and timestamping. Entities benefiting from regulatory sandboxes must develop rigorous documentation. This may include timestamps indicating when specific documents, descriptions, or test plans were submitted. As a counterpart, entities could utilise this document to undergo or strengthen their claims over intellectual property rights.

4 BENEFITS OF REGULATORY SANDBOXES

Regulatory sandboxes can be constituted as the best environment to achieve legally conforming AI systems being released to the market. They entail benefits for the various stakeholders:

4.1 AI System Innovator

The AI regulatory sandbox enables the testing of new technologies that do not yet exist in the market and may therefore still not be subjected to a given classification, or which need to be modified to mitigate risks. In cases where the use of the AI regulatory sandbox has not served to prevent the materialisation of risk, the company utilizing the AI system may still be considered liable for the harms incurred, but the companies will not be fined for unexpected harms of the AI system.

The UK experience with regulatory sandboxes reveals other associated benefits. Among them, sandboxes have been found to improve access to capital, as firms operating within these controlled environments often find it easier to secure investment. These firms are also more likely to remain in operation and even secure a patent. Sandboxes also significantly reduce the time and cost of getting products to market, a factor that is particularly beneficial for first-time innovators. [12]

4.2 AI System Regulators

The regulatory sandboxes permit the establishment of feedback loops in the regulation. Regulators themselves can observe if the sandboxes are meeting their desired goals, or whether some AI systems need to transit from one category of risk to another. In cases of AI systems causing harm despite being considered legally compliant by AI regulatory sandboxes, the regulators can update the functioning of the AI regulatory sandboxes, to avoid this from happening again.

4.3 Benefits for Society at Large

The purpose of the AI Act is to foster safe innovation. Regulatory sandboxes would enable this, but also an increased degree of positive spillover effects for society. The sandbox, by improving the collaboration between the regulator and the innovator, has the potential to enhance consumer protection by fostering a more transparent and cooperative relationship that focuses on safety and compliance. Another significant benefit is the increased throughput of tested and introduced products and services to the market. Regulatory uncertainty frequently inhibits the most innovative products from reaching consumers, as they are often abandoned at early stages due to associated risks. Through the sandbox framework, these products can be guided and supported,

thereby minimizing early-stage abandonment and enhancing the flow of innovative solutions into the marketplace.

5 CONCLUSION

This paper contends that AI regulatory sandboxes must be established as the natural environment for the controlled testing of AI systems within the EU. By aligning sandboxes with the tiered risk approach of the AI Act, two main modalities of AI Regulatory Sandboxes can be created, tailored to the potential limited-minimal risk, or high-level risk of the AI system. This structure not only facilitates a seamless transition from research to testing but also ensures strict, transparent oversight of AI technologies. By integrating provisions for user consent, intellectual property protection, defined time frames, and safeguards against risks, these measures will propel the growth of AI technologies in the Union, while allowing the systematic and informed integration of AI technologies into broader societal contexts and applications.

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New Initiatives for Knowledge Transfer between Industry and Academia: The INDUSAC Project

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ABSTRACT / POVZETEK

At the Jožef Stefan Institute most current practices of knowledge transfer involve licensing and contract and/or collaborative research between researchers and industry, whereas student-industry relations are less explored, often do not regard geographical or gender balance, and rarely involve upskilling in entrepreneurship. In the Horizon Europe INDUSAC project, the main objective is to develop and validate a simple and user-friendly industry-academia collaboration mechanism for short-term (4-8 weeks), challenge-driven co-creation. Knowledge transfer is importantly extended from researchers to also involve students, who are in turn financially supported. Gender balance is ensured by the conditions set out in the project's calls for applications. Emphasis is put on upskilling, achieved through looking for solutions to real-life challenges faced by industry. The workflow involves registering on the INDUSAC online platform, issuing a Challenge by companies, assembly of student/researcher co-creation teams, and submitting Motivation Letters to apply to solve a Challenge. Once Motivation Letters are evaluated and approved, selected co-creation teams proceed with solving the Challenge with assistance from the company. Once completed, companies and co-creation teams submit reports and feedback on the process in terms of experience with the project, and upskilling and familiarity in regards to selected entrepreneurial areas. The workflow will be carried out three times during the project, so as to allow for dynamic Challenge solving and feedback-based improvements on the process itself. By solving companies' Challenges, students are expected to acquire international collaborative experiences as well as transversal and entrepreneurial skills, access to companies from the EU and associated countries, and references for future networking. Through supporting at least 300 transnational co-creation teams and creating a dynamic community of industry-academia stakeholders, the INDUSAC mechanism will establish the co-creation system as a catalyst for integration of academia in business practices and technical solutions in the future.

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¹ Widening countries: Bulgaria, Croatia, Cyprus, Czechia, Estonia, Greece, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovakia, Slovenia

KEYWORDS / KLJUČNE BESEDE

INDUSAC project, international cooperation, student-industry cooperation, upskilling

1 INTRODUCTION

Knowledge transfer may involve different types of collaboration; in most often listed examples, it takes place between knowledge-rich entities (such as universities and research institutes) and industry. The Jožef Stefan Institute (JSI) is the largest Slovenian public research organisation and hosts working units that carry out activities connecting research and industry. While current practices at JSI involve licensing and contract and/or collaborative research between researchers and industry, student-industry relations are less explored, or they are explored indirectly, involving students in cooperation with departments that may cooperate with industry, and mostly without particular regard to geographical or gender balance. Furthermore, researcher-industry collaboration takes place mostly as licensing or contract / collaborative research but rarely as upskilling in the fields of entrepreneurial skills such as marketing, product development, or business modelling. Lastly, knowledge transfer is not inherently financially supported; therefore, funding schemes and mechanisms that encourage collaboration by, for example, cascade funding (such as the calls for third parties within running Horizon Europe projects) are constantly sought in order to boost small-scale short-term R&D projects.

Enter the INDUSAC project. The on-going Horizon Europe Quick Challenge-driven, Human-centred Co-Creation mechanism for INDUSty-Academia Collaborations (acronym INDUSAC) project (www.indusac.eu) started in September 2022 (EU project number 101070297) with the main objective to develop and validate a simple and user-friendly industry-academia collaboration mechanism for quick, challenge-driven co-creation. The process allows to develop solutions that address the needs and interests of companies, students, and researchers in the EU, with special attention to widening¹ and associated² countries. In the project, knowledge transfer is extended from researchers to also involve students, who are in turn financially rewarded for successfully completing the project, and gender balance is ensured by the conditions set out in the project's calls

² Associated countries: Albania, Armenia, Bosnia and Herzegovina, Faroe Islands, Georgia, Iceland, Israel, Kosovo, Moldova, Montenegro, North Macedonia, Norway, Serbia, Tunisia, Turkey, Ukraine, Morocco, UK

for applications. Emphasis is put on upskilling, achieved through looking for solutions to real-life challenges faced by industry.

2 METHODOLOGY AND OUTPUTS

The INDUSAC platform. To enable the workflow of the project described below, an online platform has been set up as a user-friendly and intuitive tool for posting industrial challenges, assembling co-creation teams, applying for calls to solve the challenges, and submitting reports.

General workflow of the project. The workflow (Figure 1) starts with a company registering on the INDUSAC platform and issuing a Challenge (eg. a particular problem that needs to be solved). Students and researchers likewise register on the platform, select a Challenge to solve, assemble an international team, and submit a Motivation Letter to the company. If selected, the student/researcher teams proceed to solve the Challenge, and submit appropriate reports for evaluation, as well as responses to upskilling questionnaires.

Registering on the INDUSAC platform. Before co-creation projects can take place, companies, students, and researchers need to register on the platform. Registration allows a company to create a profile and publish a Challenge, and students/researchers to submit Motivation Letters.

Issuing of industrial Challenges. In October 2023, companies will be invited to issue a Challenge by selecting one of nine different predefined Challenge type templates, covering mainly entrepreneurial skills, and ranging from developing a product, market analysis and strategy, and developing service/product ideas, to developing a business plan and a business model. There is no limitation regarding the area of industry – Challenges may, for example, be from the area of sustainable biotechnology seeking product development, automotive industry seeking business plans, or textile industry seeking assistance with marketing. The Challenge, apart from describing the problem (excluding confidential information), will also list the companies' expectations in terms of solutions, and in terms of the co-creation team's skills. Eligible companies shall comprise companies established in the EU or associated countries, but there are no restrictions on the sector, type, or size of a company to issue a Challenge, or the number of Challenges issued per company. The company defines the maximum number of teams that may be accepted to solve the issued Challenge.

Submitting Motivation Letters. As part of an ongoing campaign, students and researchers from public universities and public research institutions are made aware of the INDUSAC project by promotion by the INDUSAC Consortium and by the academic institutions themselves, as well as by non-academic institutions such as clusters and chambers of commerce, through social media and physical leaflets. In November 2023, students and researchers will be able to apply to a Call, which entails putting together an international and gender balanced student/researcher (ie. co-creation) team and filling out a joint Motivation Letter. The Motivation Letter includes a description of the applicant's motivation and skills.

Eligibility of co-creation teams and team members. Students and researchers in each co-creation team must come from EU member states or associated countries, as indicated by their citizenship or residency. Students must attend public

universities during the entire duration of the activity whereas researchers must be employed at a public research organisation during the entire duration of the activity. An individual student or researcher will be able to participate in more than one co-creation team but in no more than three different applications of a Motivation Letter. The co-creation team must have at least three and up to six members. Team members must be from at least three different EU member states or associated countries and at least 60% members of the co-creation team must be from widening countries. The co-creation team has to be gender balanced, including at least two out of the [Male], [Female], and [Would rather not say] gender options. A co-creation team must include at least one student, ie. no co-creation team may comprise exclusively researchers.

Evaluation of Motivation Letters. As noted above, a company may select more than one co-creation team to solve a Challenge. Motivation Letters are evaluated by a company representative, on a number of criteria - team's motivation and enthusiasm, excellence, market impact, team quality, resource allocation, and transversal criteria.

Signing the FSTP Declaration. If a Motivation Letter has been approved, the co-creation team signs the Declaration on Financial Support to Third Parties. FSTP, in the amount of up to 1,000 EUR gross per student and up to 3,000 EUR gross per co-creation team, is given solely to student members of the co-creation teams, after the finalisation of the project.

The co-creation process. INDUSAC will provide the co-creation teams with a list of deliverables, methods and tools for solving the Challenge. Throughout the process, the company will have an introductory meeting, and subsequent milestone meetings as needed, with the co-creation team. The co-creation process will also be monitored by the INDUSAC consortium so as to enable smooth progress. Should the co-creation process give rise to any form of intellectual property (IP; for example, a patent application), division of ownership of IP rights, the type of IP and its management will be arranged with appropriate agreements.

Reporting by co-creation teams. After completion of the co-creation project (ie. solving the Challenge), co-creation teams submit implementation reports including a summary / description of results (ie. solutions to Challenges), deliverables as defined in the Challenges, filled-in upskilling and familiarity questionnaires (one before the project and one after the project), and testimonials about the experience. Solutions to Challenges are evaluated by the Evaluation Board and companies, and include scores on deliverable quality, business performance indicators, technical performance indicators, and deadline compliance. The co-creation process ends when the Evaluation Board and the company evaluate and approve the implementation report and students receive funding.

Reporting by companies. In addition to co-creation teams, the company also provides feedback in form of a quality assessment of the solution to the Challenge, including deliverable quality, business performance, technical performance, and deadline compliance. The company also fills out the questionnaire indicating their experience during the project.

Time dynamics of the project. Industrial Challenges will be posted continuously. Motivation Letters will also be able to be

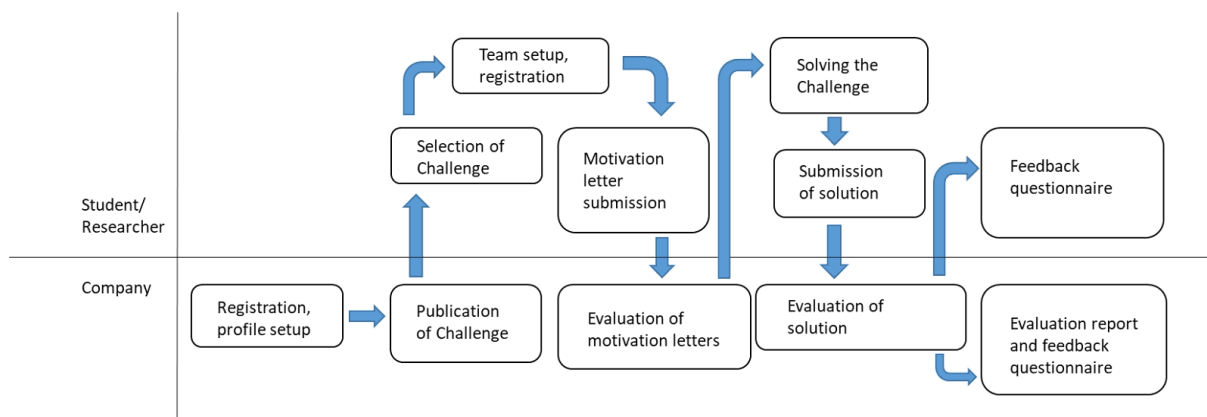


Figure 1: Simplified general workflow of the INDUSAC project.

submitted continuously, but they will be evaluated following three cut-off dates (in January 2024, May 2024, and October 2024). Four weeks after the call opening, applicants receive a decision on their applications. If approved, one week later, solving of the Challenge may begin. Individual co-creation projects will be given 4-8 weeks to complete. Three months after the first cut-off date, co-creation teams will be asked to submit final reports for revision; two weeks later, the Evaluation Board confirms the list of students from the co-creation teams to be funded; a month later, provided that administrative procedures from the students' side have been finalized, all students from the list receive funding.

3 DISCUSSION

The INDUSAC approach brings several advantages to the existing landscape of knowledge transfer practices. First of all, the calls for solving Challenges within the project are prepared with particular attention to geographical and gender balance in order to maximise inclusiveness. Including gender balance and an international dimension in a project have been shown to result in increased returns-on-assets and financial performances of companies, acquisition of new skills and knowledge, and increase in regional competitiveness (eg. [1-3]). Making sure the co-creation team members must be from at least three different countries not only increases geographical balance but also importantly provides the team members with experience in working in international teams. Thus it enables exchange in knowledge and experience between individuals from different backgrounds that come together to collaboratively create and innovate. This collaboration is further strengthened by the process that includes several checkpoints and feedback meetings between the co-creation team and the company. This encourages participants to provide constructive criticism, suggestions, and insights at various stages. Iterations and refinement of ideas based on the feedback received ensure continuous improvement and successful outcomes. The condition that at least 60% members of the co-creation team must be from widening countries further emphasises the support given to areas that do not reach 70% of the average research excellence index³. This is

assisted by publishing a wide range of different types of Challenges, which enables diversity in content and field of work, and the possibility for individuals to participate in more than one co-creation team expands their opportunities as well.

The co-creation team also has to be gender balanced and the expected outcome is at least 50 % female representation in the co-creation projects overall, which will aid in changing the current trend of representation of women in entrepreneurship trailing behind that of men [4,5]. Finally, the project is strongly oriented towards students, as every co-creation team must include at least one student. The student status, as attested for by the registration process, is of particular importance as the INDUSAC mechanism puts emphasis on supporting the younger generations in acquiring experience in working with industry. This is further supported by the fact that only student members of co-creation teams receive financial support, which is a welcome mechanism for facilitating student-industry collaboration usually hindered by the lack of financial support [6,7]. The combination of geographical balance and the requirement for student participation also represents a unique opportunity for students to get a head start in creating international networks on their career paths.

Importantly, the major output of the project, which is the INDUSAC platform, enables most of the activities to take place conveniently and user-friendly at one place.

Rather than putting emphasis on particular technological achievements and inventions, the INDUSAC project makes upskilling the central knowledge transfer theme. Co-creation teams are given upskilling and familiarity questionnaires before the start of the co-creation project and after its end. It is the co-creation project's ambition to increase the students' and researchers' skills / experiences in working in an international team, working with companies, solving concrete tasks, assisting a group to agree on a mutually acceptable solution, working within a group to identify common goals, and listening to suggestions. Communication and negotiation skills, results oriented thinking, creativity, critical and analytical thinking, time management and effective planning, and leadership are among the skills mostly encouraged in the INDUSAC project. These types of skills have been shown to be important both in employer selection as well as for increased productivity in industry 4.0 and

³ Widening countries, as defined by the European Commission, are countries where the Composite Index of Research Excellence is less than 70% of the average value

of this indicator for all EU countries (modified after <https://quantera.eu/spreading-excellence/>).

digital transformation of manufacturing [8]. In particular, the project aims to improve familiarity of students and researchers with methods such as SWOT analysis, utility analysis, trend analysis, cost-benefit analyses, product portfolio analysis / BCG Matrix, creating marketing strategies, value proposition analysis, developing a business plan, preparation of business model canvas, and target group analysis. The concept, i.e. the short-term nature of the co-creation projects and three separate opportunities (cut-off dates), encourage looking for quick and dynamic solutions with possibilities of advanced problem solving by extending the primary Challenge through the next cut-off date.

Specific control steps (evaluations), as defined in the INDUSAC project's methodology, ensure that the co-creation process is not only inclusive but also of high quality: the review process ensures a high-quality cooperation arrangement, and specific requirements for the reports (i.e. pre-set structure and content of the work) ensure high-quality performed tasks. Furthermore, by setting up three consecutive calls, the process is continuously refined through feedback-based improvements of the methodology itself.

In the first year of the INDUSAC project, 34 Letters of Support from universities from Cyprus, Greece, Hungary, Latvia, Lithuania, Czechia, Slovakia, Austria, Germany, Spain, Slovenia, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia have already been collected, indicating vast interest across Europe in participating in the project, and several students, approached at various conferences and fairs, have expressed interest in being informed about the call once it opens. Through the experience of supporting at least 300 transnational co-creation teams and creating a dynamic community of industry-academia stakeholders throughout the project lifetime, the INDUSAC mechanism will establish the co-creation system as a catalyst for integration of academia in business practices and technical solutions. At least 70% of students and researchers participating are expected to report at least one core professional transversal and entrepreneurial skill having been significantly developed by participating in the INDUSAC project. An improved set of skills in students and researchers by at least 30% compared to before the beginning of

the project is expected, allowing them to rapidly expand their skill set in a short period of time and to find themselves more prepared for the business environment. Provided the project is successful, it represents an encouraging inspiration for similar industry-academia knowledge transfer practices, and the lessons learned will provide a basis for policy recommendations for similar EU and national initiatives in the future.

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PREDGOVOR

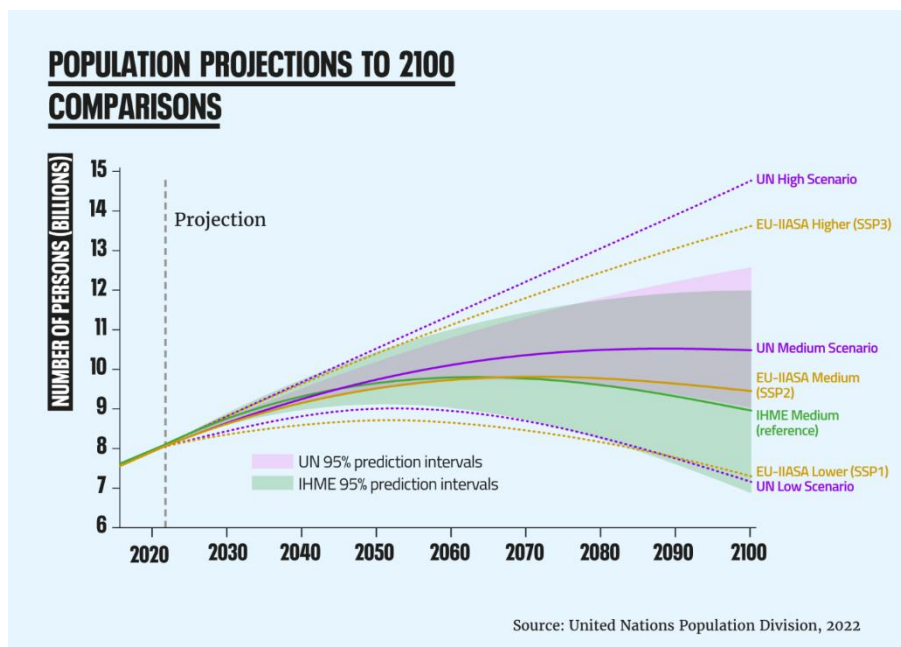
Dinamika svetovne populacije ostaja eden največjih izzivov, saj smo presegli 8 milijard ljudi, problemi pa se povečujejo. V Sloveniji in drugih delih Evrope se demografski, ekonomski in socialni pritiski kažejo predvsem skozi migracije in depopulacijo.

Depopulacija ni le demografski pojav, ampak tudi politični izziv. Slovenija, podobno kot mnoge evropske države, se sooča s posledicami nizke rodnosti in staranja prebivalstva, ki vplivata na delovno silo, socialno varnost in celotno faktorsko produktivnost in produktivnost dela. To se pogloblja z obsežnimi migracijami, ki pritiskajo na politične in socialne strukture v Evropi in ZDA.

Pritisk migracij izpostavlja potrebo po uravnoteženih in trajnostnih politikah, ki naslavlajo tako potrebe migracij kot tudi ohranjanje socialne in kulturne kohezije. Slovenija se, obkrožena z dinamičnimi migracijskimi tokovi, sooča s kompleksnostjo integracije priseljencev in ohranjanja nacionalne identitete.

V tem kontekstu postane razumevanje in upravljanje demografskih trendov še bolj pereče. Potreba po inovativnih rešitvah in prilagodljivih politikah, ki se odzivajo na spreminjajoče se demografsko okolje, ni bila nikoli večja. Z izmenjavo znanja, raziskav in strategij lahko oblikujemo učinkovite odzive na te izzive in spodbudimo trajnostni demografski razvoj.

V zborniku tega leta želimo prispevati k obsežni in poglobljeni razpravi o teh vprašanjih, s poudarkom na Sloveniji, Evropi in širšem globalnem kontekstu. Naš cilj je združiti strokovnjake, politike in družbo, da skupaj raziskujejo in razvijajo strategije za soočanje s kompleksnimi demografskimi izzivi današnjega časa.



Slika kaže rast svetovne populacije

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Prehod od naravne k načrtovani rodnosti v Sloveniji: spremembe v tridesetih letih od leta 1991 do 2021

The Transition from Natural to Planned Procreation in Slovenia: The Development in Three Decades from 1991 to 2021

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POVZETEK

Prehod od naravne k načrtovani zakonski rodnosti je v Sloveniji potekal v skladu z modelom A.J. Coale-a in T.J. Trussell-a do 1990ih let. Raven načrtovanja teh rojstev pa je pri nas zaostajala ne le za Švedsko ampak tudi za Italijo. V obdobju 1991 – 2021 pa je prišlo do velikih sprememb starostno specifične rodnosti nasploh in zakonske rodnosti še posebej. Prišlo je do obsežnega prelaganja rojstev v višjo starost. Ta je bila lahko tudi deset ali več let višja. Zato smo morali na osnovi analize zakonske rodnosti v Sloveniji s pomočjo modela ameriških demografov zavrniti hipotezo, da se je načrtovanje zakonskih rojstev pri nas v obdobju 1991 – 2021 povečalo. Rezultat pa je bolj posledica odsotnosti predpostavk modela kot trdnosti ugotovitve o načrtovanju zakonskih rojstev v Sloveniji.

KLJUČNE BESEDE

Naravna rodnost, načrtovana zakonska rodnost, A.J. Coale, T.J. Trussell, model rodnosti, demografske spremembe, načrtovanje zakonskih rojstev

ABSTRACT

In Slovenia, the transition from natural to planned fertility had been developing in accordance with the A.J. Coale and T.J. Trussell model till the 1990s. However, the level of planning of marital fertility had been lower in the country than in Sweden and Italy. In the period from the year 1991 to the year 2021 the age-specific overall and marital fertility changed tremendously in the country. Huge postponement of the childbearing into higher age stood place in Slovenia. Therefore, our empirical work has led to the rejection of the hypothesis that marital fertility planning has increased in the three decades studied. However, the result is more the consequence of the absence of

the basic assumptions of the model than the real changes of marital fertility planning in Slovenia in the studied period.

KEYWORDS

Natural fertility, planned marital fertility, A.J. Coale, T.J. Trussell, fertility model, demographic changes, planning of marital births

1 UVOD

Naravno rodnost prebivalstva lahko najbolj enostavno opredelimo kot rodnost prebivalstva, ki ne uporablja nobenih učinkovitih sredstev kontrole rojstev (Henry, 1976). V nasprotju z njo pa prebivalstvo, za katerega je značilna načrtovana rodnost, učinkovito uporablja različna sredstva za zavestno omejevanje rojstev. Naravna rodnost je prevladovala v tradicionalnem, načrtovana rodnost pa prevladuje v modernem režimu obnavljanja prebivalstva (Malačič, 2006, str.101). V obdobju demografskega prehoda, ki loči ta dva režima obnavljanja, se je hitro širila načrtovana rodnost. Kljub temu pa na ta proces ne smemo gledati kot na linearni, nemoten in izključno enosmerni proces. Zanj je značilnih veliko posebnosti. Zelo se razlikuje že med zakonsko in izven zakonsko rodnostjo. Prav tako pa lahko na osnovi zgodovinskih virov in arheoloških najdb ugotovimo, da so ljudje kot posamezniki, družine in družbene skupnosti v različnih krajih in različnih časih poskušali posegati v proces rodnosti. Pri tem so bili nekateri posegi tudi vsaj deloma učinkoviti in ravno to dela obnavljanje prebivalstva humano. Še posebej so se ljudje in družbe trudili kontrolirati izven zakonsko rodnost. Zato je primerno, da se pri raziskovanju prehoda od nenačrtovane k načrtovani rodnosti osredotočimo na zakonsko rodnost.

V tem besedilu bomo obravnavali samo delček zelo kompleksnega procesa uveljavljanja načrtovanja rodnosti na primeru slovenske zakonske rodnosti v obdobju od leta 1991 do leta 2021. Čeprav se na osnovi agregatnih podatkov o rodnosti zdi, da se je načrtovanje rodnosti v Sloveniji in v razvityh državah že razširilo na celotno družbo, takšnega sklepa ne smemo poenostavljeno in brez temeljitih raziskav sprejeti. Zato smo si pri našem raziskovanju postavili naslednjo hipotezo: »v

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demografskem razvoju prebivalstev razvitih držav in med njimi tudi Slovenije postaja rodnost vse bolj načrtovana. To še posebej velja za zakonsko rodnost. Zato je osnovna hipoteza tega besedila, da se je načrtovanje zakonskih rojstev v Sloveniji v obdobju 1991 – 2021 povečalo.

Postavljeno hipotezo bomo v nadaljevanju analizirali in testirali s pomočjo demografskega modela, ki sta ga razvila pred okrog pol stoletja ameriška demografa A.J. Coale in T.J. Trussell (Coale A.J. and Trussell T.J., 1974). Zato bomo v naslednji točki prikazali osnovne značilnosti njunega modela. V tretji oziroma osrednji točki tega besedila bomo analizirali slovensko zakonsko rodnost v obdobju 1991 – 2021 s pomočjo parametrov modela ameriških demografov. Na koncu bomo podali sklepe raziskovanja in navedli uporabljeno literaturo in vire.

2 MODEL RODNOSTI AMERIŠKIH DEMOGRAFOV A.J COALE-a IN T.J-TRUSSELL-a

Coale in Trussell sta zgradila model na osnovi razlik med naravno in načrtovano rodnostjo ter ob upoštevanju, da se z demografskim razvojem vse bolj uveljavlja načrtovana rodnost. Velika večina prehoda med tema dvema oblikama rodnosti se je v razvitih državah dogodila v času demografskega prehoda. Za današnje svetovne demografske razmere pa lahko rečemo, da v manj razvitih delih sveta ta prehod še zmeraj zelo intenzivno poteka.

Osnovna ideja modela je, da je v procesu prehoda od naravne k načrtovani rodnosti mogoče napovedati način, na katerega se spreminja zakonska rodnost. Ta rodnost se bolj znižuje v višjih starostnih razredih. Njena oblika je odvisna od stopnje prehoda od naravne rodnosti, ki je določena zunaj modela, k vse bolj načrtovani rodnosti. To omogoča zgraditi model, ki bo prikazoval izredno široko paleto zelo različnih oblik in vrednosti zakonske rodnosti prebivalstev razvitih držav in držav v poznih fazah demografskega prehoda.

Avtorja sta izdelala naslednji model:

$$f_a = M * n_a * e^{m * v_a}$$

V modelu pomeni * množenje, a označuje starost, f_a je starostno specifična zakonska rodnost v razredu a ali a + n let, na je zunaj modela določena naravna rodnost in v_a eksterno določeno oddaljevanje zakonske rodnosti od naravne rodnosti. Za petletne starostne razrede od 20 – 24 do 45 – 49 so vrednosti na zaporedoma 0,460, 0,431, 0,396, 0,321, 0,167 in 0,024, za v_a pa 0,000, -0,316, -0,814, -1,048, -1,424 in -1,667 (navedeno po Malačič, 2006, str. 103). Starostno specifične vrednosti naravne rodnosti so izračunane kot povprečja za prebivalstva, za katera je zbral podatke L. Henry (Henry, 1961), starostno specifične vrednosti oddaljevanja zakonske od naravne vrednosti rodnosti pa sta izračunala Coale in Trussell ravno tako v obliki povprečij za 43 tipov zakonske rodnosti iz Demografskega letopisa OZN leta 1965.

Model ima parametra M in m. M kaže raven modela in je v osnovi multiplikator, ki določa raven krivulje modela na grafu. Drugi parameter m pa kaže raven kontrole rojstev. Njegova vrednost se giblje med 0,0 in 2,5. Vrednost 0 označuje naravno rodnost, vrednosti med 1,5 in 2,5 pa kažejo že zelo visoko stopnjo kontrole rojstev. Ob upoštevanju vsega navedenega lahko za vsako kombinacijo M in m izračunamo konkretno vrednost f_a . Naravna in zakonska rodnost sta enaki, ko je vrednost M enaka 1 in vrednost m enaka 0. Model je v praksi veliko širše uporaben, kot ga bomo uporabili v tem besedilu. Uporabljamo ga lahko za ocenjevanje starostno specifičnih stopenj rodnosti iz nepopolnih podatkov, letnih vrednosti iz petletnih podatkov, za izravnavanje ali popravljanje podatkov o rodnosti ipd.

3 ANALIZA SLOVENSKE ZAKONSKE RODNOSTI V OBDOBJU 1991 – 2021

V obravnavanih treh desetletjih so se dogodile tektonske spremembe na področju sklepanja zakonskih zvez v Sloveniji. Osnovne značilnosti teh sprememb so veliko zmanjšanje števila sklenjenih zakonskih zvez, njihova velika nestabilnost, vse krajše povprečno trajanje in veliko povečanje števila izven zakonskih skupnosti. Pri tem so pravno gledano izven zakonske skupnosti skoraj v celoti izenačene z zakonskimi zvezami. S temi spremembami se tukaj ne bomo podrobneje ukvarjali. Povejmo le, da je glavni rezultat teh sprememb na področju rodnosti velik padec deleža živorojenih otrok v zakonski zvezi med vsemi živorojenimi v Sloveniji. Samo za ponazoritev navedimo, da je bil še leta 1991 delež rojstev v zakonski zvezi v Sloveniji še 73,6 %, v letih 2011 in 2021 pa je padel na 43,2 in 42,3 % zaporedoma (neobjavljeni podatki Zavoda za statistiko RS za leto 1991 in SISTAT).

Zakonsko rodnost v Sloveniji bomo analizirali s pomočjo modela ameriških demografov za leta 1991, 2011 in 2021. Rezultate analize za leto 1991 bomo povzeli po knjigi Demografija avtorja tega besedila. Izračune za leta 2011 in 2021 pa bomo prikazali v posebnih tabelah. Za izračun parametrov M in m potrebujemo starostno specifične stopnje zakonske rodnosti po petletnih starostnih razredih. Kot smo deloma že omenili, smo za leto 1991 uporabili neobjavljene podatke takratnega Zavoda za statistiko. Če jih tukaj navedemo za petletne starostne razrede od 15 – 19, ..., 45 – 49 let, so bile takratne vrednosti zaporedoma 0,456, 0,251, 0,117, 0,041, 0,013, 0,003 in 0,0002 (Malačič, 2006, str. 104).

Navedimo še obrazca za izračun parametrov M in m:

$$M = (f_{20-24} / n_{20-24})$$

Parameter m pa računamo po starostnih razredih in po obrazcu:

$$m_a = \log (f_a / (M * n_a)) / v_a$$

Za leto 1991 je bila vrednost parametra M 0,546, vrednost parametra m pa 1,016. Leta 1981 je bila vrednost m 0,831. Samo za primerjavo navedimo, da je bil m na Švedskem leta 1930 0,6,

leta 1960 pa 1,5 (Malačič, 2006, str. 103). V sosednji Italiji je znašal m leta 1971 kar 1,235. Pri tem so vrednosti m izračunane kot povprečja iz vrednosti v starostnih razredih.

Povprečne vrednosti parametra m za Slovenijo do leta 1991 kažejo običajen in pričakovan razvoj za državo na slovenski ravni razvitosti. Vendar je bila raven kontrole zakonske rodnosti v Sloveniji v drugi polovici dvajsetega stoletja ne le precej nižja kot v Švedski, ampak tudi znatno nižja kot v Italiji. Takšne razmere so bile posledica specifičnosti sklepanja zakonskih zvez v Sloveniji in vse večjega naraščanja števila izven zakonskih skupnosti, ki se je v Sloveniji začelo v zadnjih desetletjih prejšnjega stoletja.

Poglejmo sedaj, kaj se je dogajalo v Sloveniji s starostno specifičnimi vrednostmi parametra m in na njihovi osnovi izračunanim povprečjem za obravnavano leto v letih 2011 in 2021. Vsi potrebni podatki in računski postopki za izračun starostno specifičnih vrednosti m so prikazani v tabelah 1 in 2.

Tabela 1: Izračun parametra m za Slovenijo za leto 2011.
Vir: Coale and Trussell, 1974, str. 185-158 in SISTAT, dostop 15. 9. 2023

Starost (a)	n_a	v_a	f_a	M^*n_a	f_a / M^*n_a	$\log(f_a / M^*n_a)$	m
1	2	3	4	5	6	7	8=7/3
15 - 19	0,411	-	0,349	-	-	-	-
20 - 24	0,460	-	0,257	0,257	1,000	-	-
25 - 29	0,431	-0,316	0,216	0,241	0,896	-0,048	0,152
30 - 34	0,395	-0,814	0,129	0,221	0,584	-0,234	0,287
35 - 39	0,322	-1,048	0,041	0,180	0,228	-0,642	0,613
40 - 44	0,167	-1,424	0,00049	0,093	0,00053	-1,279	0,898
45 - 49	0,024	-1,667	0,00013	0,013	0,0001	-1,989	1,193

Tabela 2: Izračun parametra m za Slovenijo za leto 2021.
Vir: Coale and Trussell, 1974, str. 185-158 in SISTAT, dostop 15. 9. 2023.

Starost (a)	n_a	v_a	f_a	M^*n_a	f_a / M^*n_a	$\log(f_a / M^*n_a)$	m
1	2	3	4	5	6	7	8=7/3
15 - 19	0,411	-	0,264	-	-	-	-
20 - 24	0,460	-	0,234	0,234	1,000	-	-
25 - 29	0,431	-0,316	0,224	0,219	1,023	0,001	-0,003
30 - 34	0,395	-0,814	0,141	0,201	0,701	-0,154	0,189
35 - 39	0,322	-1,048	0,049	0,164	0,299	-0,524	0,500
40 - 44	0,167	-1,424	0,001	0,085	0,012	-1,921	1,349
45 - 49	0,024	-1,667	0,00046	0,012	0,038	-1,416	0,849

Parameter M je znašal v letu 2011 0,559 in v letu 2021 0,509. Zadnja vrednost kaže, da se je raven grafa znižala. Veliko bolj nepričakovani pa sta povprečni vrednosti m za obravnavani leti. Ti dve sta bili 0,629 in 0,557 v zaporednih letih in kažeta dve možni razlagi. Ena bi bila veliko znižanje načrtovanja zakonske rodnosti v Sloveniji v zadnjem času. Druga veliko bolj verjetna razlaga pa je, da je prišlo do velikih sprememb v starostno specifični splošni in zakonski rodnosti v Sloveniji in da oddaljevanje v našem primeru zakonske rodnosti od naravne rodnosti v starejših starostnih razredih preprosto ne ustreza več trendom, ki so bili značilni v zadnjih desetletjih prejšnjega stoletja. Mladi so v preučevanem obdobju preprosto predstavili

rojevanje otrok v pet do deset ali celo nekaj več let višje starosti, kar velja tako za zakonska kot izven zakonska rojstva. Na ta način pa osnovna predpostavka modela ameriških demografov ne drži več v taki obliki, kot je veljalo v drugi polovici prejšnjega stoletja. Starostno specifične vrednosti parametra m v letih 2011 in 2021 v Sloveniji še zmeraj kažejo naraščajoče vrednosti, vendar so tudi te zelo verjetno prenizke, da bi dobro pokazale, v kolikšni meri je slovenska zakonska rodnost načrtovana.

4 SKLEP

Osnovni sklep, ki sledi iz naše analize načrtovanja zakonske rodnosti v Sloveniji, je, da moramo našo hipotezo zavrniti. Model ameriških demografov v Sloveniji v letih 2011 in 2021 ne kaže povečanja načrtovanja zakonskih rojstev. To pa je najverjetneje posledica prestavljanja rojevanja otrok v starejše starostne razrede, zaradi česar se poruši predpostavljeno oddaljevanje dejanske rodnosti od naravne rodnosti v starejših starostnih razredih.

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Depopulation politics

Depopulacijska politika

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POVZETEK

Izraz »politika depopulacije« se nanaša na politike in strategije, ki naslavljajo izzive in posledice upadanja prebivalstva. V drugi polovici 20. stoletja so dejavniki, kot so povečana urbanizacija, spremembe kulturnih vrednot in izboljšan dostop do izobraževanja in kontracepcije, privedli do upadanja rodnosti v različnih regijah. To demografsko prehodno obdobje prinaša pomembne socioekonomske izzive, vključno z ekonomsko stagnacijo, obremenitvijo zdravstvenih sistemov in zmanjšano inovativnostjo. Z okoljskega vidika bi lahko upadajoče prebivalstvo zmanjšalo obremenitev z viri in emisije ogljikovega dioksida, vendar prinaša tudi izzive, kot so urbano, nacionalno in globalno veliko poslabšanje. Države iščejo rešitve z različnimi pristweisimopi, od spodbujanja rojstev do priseljevanja. Vendar te strategije uvajajo etične kompleksnosti, še posebej, ko države vplivajo na osebne reproduktivne izbire ali se spopadajo z niansami priseljevalske politike. V zaključku, razumevanje depopulacije zahteva celovit pristop ob upoštevanju njenih večplastnih vplivov na družbo, gospodarstvo in okolje.

ABSTRACT

Depopulation politics refers to policies and strategies addressing the challenges and implications of population decline. Throughout the latter half of the 20th century, factors such as increased urbanization, shifts in cultural values, and enhanced access to education and contraception have led to declining birth rates in various regions. This demographic transition poses significant socioeconomic challenges, including potential economic stagnation, strains on healthcare systems, and reduced innovation. From an environmental perspective, while a declining population might reduce resource strain and carbon emissions, it also introduces challenges like urban, national and global decay. Politically, nations are formulating responses with approaches ranging from incentivizing childbirth to considering immigration as a potential solution. However, these strategies introduce ethical complexities, especially when states influence personal reproductive choices or grapple with the nuances of immigration policies. In conclusion, understanding depopulation

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requires a comprehensive and nuanced approach, considering its multifaceted impacts on society, economy, and environment.

KLJUČNE BESEDE

Upadanje populacij, depopulacija, svetovno in nacionalno

KEYWORDS

Population decline, depopulation, worldwide and national

1. INTRODUCTION

Depopulation politics refers to the set of policies and ideologies aimed at either promoting or countering population decline. Historically, concerns about overpopulation, as explored in Paul Ehrlich's "The Population Bomb" (1971) dominated the narrative. Yet, various regions now face the challenge of declining birth rates, leading to severe socioeconomic and environmental repercussions. This paper delves into the science behind depopulation, its causes, its implications, and the strategies that nations are employing to address or capitalize on it. Several factors converged in the latter half of the 20th century to precipitate declining birth rates in various parts of the world. These include increased urbanization, higher educational attainment for women, improved access to contraception, and a shift in cultural values. The role of urbanization in this shift is elucidated in Edward L. Glaeser's "Triumph of the City" (2012). Later childbirth and reduced fertility rates further contribute to the trend. Medical and sociological studies, like those found in "The End of World Population Growth" by Wolfgang Lutz (2004), suggest that increased exposure to environmental pollutants and shifting societal norms about family structure also play a role.

The implications of depopulation are manifold. Economically, a declining workforce can lead to reduced productivity and potential stagnation. The socioeconomic impact of this decline is explored in depth in "The Empty Cradle" by Phillip Longman (2004). As a larger proportion of the population ages, the strain on healthcare and social security systems intensifies. Furthermore, with fewer young people, innovation may slow down, potentially resulting in a lack of dynamism within economies and globally.

Environmental scientists have highlighted some potential benefits of depopulation, such as reduced strain on resources, decreased carbon emissions, and the possibility for nature to reclaim previously urbanized areas. In "The World Without Us" by Alan Weisman (2008), the potential environmental impacts of

significant population reduction are explored. Yet, these benefits are offset by challenges like urban decay, infrastructural redundancy, and the loss of cultural heritage as towns and even cities face abandonment.

From a political standpoint, depopulation has become a central issue in many national agendas. Doug Saunders in "Maximum Canada" (2017) discusses the complexities and potential benefits of population growth through immigration. Countries like Japan are experiencing profound demographic shifts, leading to policies designed to incentivize childbirth, support families, and integrate older individuals into the workforce. Immigration, as a counter to native population decline, has its challenges, especially around integration and cultural preservation.

Depopulation politics also intersects with ethical concerns. "The Ethics of Population Control" by Joyce Tischler (2012) dives into the debate on the state's role in influencing personal reproductive choices. The role of the state in encouraging or discouraging childbirth raises profound questions about autonomy and individual rights. Furthermore, the decision to promote immigration as a solution touches upon broader debates about national identity, xenophobia, and global responsibility.

In conclusion, depopulation politics represents a complex interplay of biology, environment, economics, and sociocultural factors. As explored in "Empty Planet: The Shock of Global Population Decline" by Darrell Bricker and John Ibbitson (2019), the world's understanding of population dynamics must evolve beyond simplistic binaries of growth versus decline. A more nuanced appreciation of demographic shifts, their causes, and their implications is essential for crafting effective, ethical, and sustainable policies.

2. OVER- AND UNDER-POPULATION VIEWPOINTS

The demographic trends were already by Malthus (1798) defined as exponential, of the equation type A^x . A is the fertility rate (children per woman) divided by 2.1 since this is the sustainable population threshold, while X is counted as a generation turn-around, which is around 30 years. Since the growth of resources, eg. food is not exponential, but polynomial, the demographic growth will sooner or later cause major problems in terms of famine, hunger or war. The population will – according to Malthus – always grow till some limitation factor is reached, e.g. starvation or disease or war. Indeed, that is the case with some animals or plants when introduced into a new environment, e.g. rabbits in Australia.

The problem with the exponential equation and the limitations is that humans do not necessarily behave as animals (McRae, 2023). For example, the plant production was so far actually exponential due to the advancements of human knowledge. Second, humans do not need to enter the poverty stage since they can control the population by several means such as contraception, woman education and emancipation, and reorientation regarding the optimal number of children. If the number of children would be set to 2.1, the sustainability would be reached.

However, the number of children per woman was in the middle of the previous century around 5, is still 5 in several African countries, and the expected longevity rose to about twice compared to one century ago. Both factors produced exponential growth of world population by 1 to 2% per year in the last century. There were only 2 billion people one century ago and now we are 8 billion strong.

The growth in Figure 1 corresponds to the exponential growth Malthus predicted and would as such certainly meet the limits of growth (Malthus, 1789; Meadows 1972). In recent years, there

have been a couple of similar doomsday predictions. An example is from a distinguished Australian professor Frank Fenner, estimating that the human population will become extinct in 100 years due to overpopulation and environmental (global warming) issues (<https://phys.org/news/2010-06-humans-extinct-years-eminent-scientist.html>).

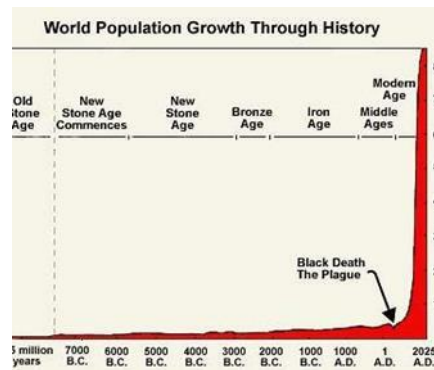


Figure 1: Population growth resembles exponential growth in recent centuries.

The danger of over-populating is also presented in several other publications, maybe most prominently in Paul Ehrlich's "The Population Bomb", released in 1968. It provided a dire alert about the global challenges posed by rapid population growth. Ehrlich postulated that unchecked population expansion would outpace food production, leading to catastrophic famines in the 1970s and 1980s. Drawing on Malthusian principles, he argued that the planet's carrying capacity could be overwhelmed, resulting in resource scarcities, ecological degradation, and socio-economic upheavals. Furthermore, he discussed potential solutions, like promoting birth control. Although several of Ehrlich's predictions did not occur within his projected timelines, his work was instrumental in drawing attention to population, sustainability, and environmental concerns, catalysing debates and research in these fields.

A most recent warning of the forthcoming overpopulation is coming from Rees (2023) in his article "The Human Ecology of Overshoot: Why a Major 'Population Correction' Is Inevitable" »The population increase from one to eight billion, and >100- fold expansion of real GDP in just two centuries on a finite planet, has thus propelled modern techno-industrial society into a state of advanced overshoot. We are consuming and polluting the biophysical basis of our own existence... The global economy will inevitably contract and humanity will suffer a major population 'correction' in this century«. Rees doubles down the reasoning about population danger and rejects idea that reduced population growth will bring any relief to the global problems. Currently, with 8 billion people, the planet is already overpopulated and our advanced civilisation will collapse as all civilisations did previously in human history (Diamond, 2005). The developed countries might better survive the pressure, but the population decline, i.e. purge, will result in 100 million to 3 billion people globally.

There are also warnings of the opposite phenomena – decaying and extinction of population through lack of sufficient number of births and the consequences following, e.g. in "Empty Planet: The Shock of Global Population Decline" by Darrell Bricker and John Ibbitson (2019). And there is an opinion of one of the most popular visionaries in the world – Elon Musk. He is involved in five major companies (Tesla, SpaceX, Twitter, Boring Co. and

Neuralink) and best known due to his promises to revolutionize our civilization as we know it today. Musk's key vision is the necessity to as soon as possible go to Mars or our civilization may get destroyed. For this vision to come true, most advanced countries need enough energy, courage, youth – i.e. childbirths. When asked who he think caused most harm recently in this area, Musk¹ pointed out just one person - the famous biologist Paul Ehrlich, author of the controversial book "The Population Bomb" (1971), in which he warned that overpopulation and consumerism are driving the world to the edge. Prof. Ehrlich commented that his study at that time revealed a potential danger and now it is indeed not most appropriate. However, in his viewpoint, historically the book was correct to point out the potential danger.

3. DEPOPULATION POLITICS - METHODS

In terms of population control, China officially set guidelines that brought the Chinese birthrate to around 1.6. However, after the population growth was stopped, and China wanted to approach the 2.1 fertility, the numbers stayed much lower – for the time being. We will see what happens in China, but no country going below 2.1 ever returned to 2.1 – at least till now.

Western countries did not prescribe formal measures like China to curb population growth, but instead relied on non-governmental initiatives to deal with the population agenda by Malone (2023) Population Control and Official USG Policy Some of them are related to the Bill and Melinda Gates Foundation, World Health Organisation, United Nations and other non-governmental (and governmental) organisations. The results are quite successful and currently much of the world is beyond fertility rate (Figure 2) with a notable exception of Africa. An interesting analysis was presented in National Security Study Memorandum titled the 'Kissinger Report'², and the National Security Directive Memorandum 314 'Implications of Worldwide Population Growth for US Security and Overseas Interests'³.

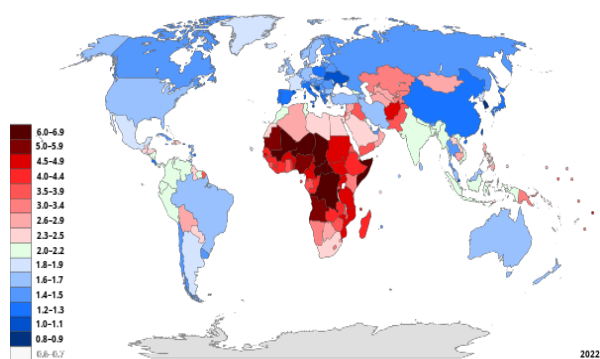


Figure 2: Fertility rate in countries.

In those studies, an opinion was presented that the population explosion in developing countries was not only a threat to US interests in the economics and in the development of those countries but also, more fundamentally, presented a danger to the global civilisation.

This major objective – to not exceed 8 billion – combined with the fact that we hit the 8 billion mark might help explain the

intense urgency. Indeed, there are some indications of the forthcoming problems. One is the current record number of people at risk of starvation. Before the covid era, the number of people at risk of starvation was 135 million. By the end of 2021, that had increased by another 135 million people, and in 2022, it then increased another 67 million.

The Kissinger Report similarly to other depopulation politics includes:

- Fertility and contraceptive research.
- Biomedical research would be doubled.
- Field testing of existing technology.
- Development of new technology.
- Oral contraceptives.
- Intra-uterine devices should be developed.
- Sterilisation of men and women has received wide-spread acceptance in several areas.
- Leuteolytic and anti-progesterone approaches to fertility control including use of prostaglandins.
- Injectable contraceptives for women ... administered by pare-professionals.
- Male contraceptive, in particular an injection which will be effective for specified periods of time.
- Injection which will assure a woman of regular periods.

The Report recommends population control only in least developed countries. The Report also mentioned mandatory programmes of population control: "A growing number of experts are of the belief that the outlook is much harsher and far less tractable than commonly perceived... the conclusion of this view is that mandatory programmes may be needed and that we should be considering these possibilities now."

The Report proposes the commercial approach in which US government uses "big-medical research to improve the existing means of fertility control and to develop new ones." It favours "large-scale programmes that will induce fertility decline in a cost-effective manner," and enthusiastically describes controversial examples, such as what it calls "the remarkably successful experiments in India in which financial incentives, along with other motivational devices, were used to get large numbers of men to accept vasectomies."

The Kissinger Report stated it is "desirable in terms of US interests" to work with the UNFPA which already had projects in more than 70 countries.

UNFPA ran programs described by critics as forced abortions and coercive sterilisations. The UNFPA gave money from the US to support the People's Republic of China's birth control campaign, widely accused of major human rights violations, mainly on women and girls. Likewise, UNFPA provided funding for the forced sterilisation program promoted by the Indian government, exposed in 2014 when dozens of women died in "sterilisation camps" to which they were lured in exchange for social benefits.

Here are the top 10 methods to reduce human population down to a "manageable" amount:

- Targeted sterilisation
- Wars

¹ <https://www.thestreet.com/technology/elon-musk-reveals-the-person-he-despises#:~:text=He%20just%20did%20so%20in,the%20world%20to%20the%20edge>

² <https://rwmalonemd.substack.com/p/population-control-and-official-usg>

³ <https://static1.squarespace.com/static/61910a2d98732d54b73ef8fc/t/64bfe4b98dabae7cf6d3dc64/1690297530817/nsdm314.pdf>

- No cures for diseases
- Sexually transmitted diseases
- Environmental manipulation
- Abortions
- Genetically modified organisms
- Same sex relationships
- The food supplies
- Transhumanism

It should be noticed that the above list might be based on one of the conspiracy theories (The Great Reset, AI Revolution & ‘Global Boiling’: Unveiling the Secret Depopulation Plan – Are YOU the Carbon Footprint they want to Eliminate?), as claimed by reliable sources (<https://www.reuters.com/article/factcheck-schwab-population-idUSL2N2OB1JW>).

However, the Kissinger report and several other depopulation policies are real projects. One example that can not be refuted is the China depopulation policy. The way depopulation is achieved, besides the already mentioned ones methods, catapulted through human-rights and new-culture movemets is summarised here:

- **Promotion of Same-Sex Marriages:** The statistics shows that promoting same-sex marriages reduces birth rates since such couples can't biologically reproduce without assistance. Even with the help, the fertility in such families is about 50% of the average marriage.
- **Introduction of Multiple Gender Identities:** Recognizing various gender identities beyond the male/female binary is seen by some as a way to blur traditional reproductive roles.
- **Sex Change and Gender Reassignment:** Undergoing gender reassignment can impact an individual's reproductive ability, in particular in case of surgical changes.
- **Voluntary Sterilization:** Some individuals choose sterilization for personal or health reasons. In a broader context, offering voluntary sterilization can be a part of family planning and reproductive health services.
- **Decline in Sperm Count:** Studies have indicated that there's been a significant drop in sperm count in some regions and worldwide over the past few decades. Theories about this decline range from environmental factors to lifestyle changes. While some suggest it might naturally reduce population growth, the primary concern is understanding its implications for health and fertility.
- **Lack of Research into Declining Fertility:** Some theorists argue that insufficient effort has gone into researching and counteracting declining fertility rates, suggesting a covert acceptance or even promotion of reduced population growth. However, in reality there are some researchers and organizations actively investigating these trends and their causes. Why this is not proclaimed a major problem, it can not be depicted from the Web or scientific literature.
- **Promotion of Child-Free Lifestyles:** The cultural acceptance and promotion of choosing not to have children can be seen as a measure that supports depopulation.

4. DISCUSSION AND CONCLUSIONS

The ongoing debate about the implications of human population growth is not new. Centuries after Thomas Malthus postulated that populations would inevitably surpass their resources due to the intrinsic animalistic drive to reproduce, the world grapples with similar concerns. Malthus may have tapped into the inherent tendency in humans to breed expansively, but can contemporary societies channel this drive in more sustainable directions? Many modern scholars and visionaries have echoed Malthusian sentiments, warning of the potential collapse of civilization and significant population reductions if unchecked growth continues. China's One-Child Policy and similar strategies in other countries testify to the efficacy of deliberate depopulation policies. As depicted in Figure 3, projections of global fertility rates suggest a trajectory towards sustainable levels within this century.

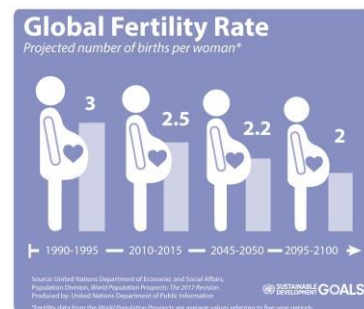


Figure 3: Projected global fertility rate.

However, an examination reveals disparities in population growth rates across nations. The Kissinger report highlighted the need to focus depopulation efforts on countries exhibiting unsustainable growth rates.

Counterintuitively, implementing depopulation policies in already low fertility nations can be detrimental. Elon Musk, a prominent visionary, has voiced concerns regarding this, emphasizing that promoting certain aspects of 'woke culture' might unintentionally align with harmful depopulation objectives, despite their seemingly relation to human rights advocacy. Musk's perspective offers an ambitious alternative: prioritize rapid colonization of Mars. His argument underscores the idea of moving forward rather than devoting energy to not most relevant issues, risking missing the window of opportunity.

Several academic studies bolster the claim for Martian colonization, suggesting that humanity's future might well be interplanetary.

It's intriguing to visualize the population distribution on Earth: if the entire global population resided in a landmass equivalent to Slovenia, it would allocate a few square meters per individual. This hypothetical scenario illuminates the potential for sustainable habitation with appropriate urban planning and ecological measures.

In recent years, the depopulation is being continued in several ways, e.g. by value-infrindgment through mass media and the Web by inducing that there are tens of sexes, through persuasive sterilisation etc. Unlike the Kissinger report perpetuating that depopulation measures should primarily be introduced into countries with high fertility rates, these depopulation values are being transmitted through Western countries already with fertility rates around 1.5 probably causing extinctions of smaller nations in several hundred years.

It can be assumed that the fear of causing a global collapse of our civilisation through global warming and overpopulation is the baseground for such extreme measures.

In conclusion, the discourse surrounding population dynamics is complex, requiring a balance between Malthusian concerns and innovative, forward-thinking solutions. Whether the answer lies in Earth-centric strategies or interstellar ventures remains a central question in this ongoing debate (Gams, Malačič, 2018).

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Izzivi materinstva v dobi instagrama

Motherhood Challenges In Instagram Era

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POVZETEK

Sodobni trendi na področju spletnega komuniciranja vse bolj spreminjajo načine povezovanja in pridobivanja informacij. Mladi starši običajno spadajo v starostno skupino najbolj aktivnih uporabnikov družbenih omrežij, zato je v zadnjih desetletjih tudi starševstvo pod močnim vplivom novih načinov informiranja uporabnikov, za katere je značilno, da so meje med posredovanjem kakovostnih informacij in oglaševanjem zelo zabrisane. Prepoznati je potrebno, da so učinki novih načinov spletnega komuniciranja tako pozitivni, kot negativni. Če je sledenje družbenim omrežjem na eni strani v pomoč in podpora staršem, da se kljub preobremenjenosti in pomanjkanju časa lahko povezujejo z ljudmi, ki imajo podobne interese in so izpostavljeni podobnim izzivom, so idealistični prikazi materinstva na instagrame profilih pri mnogih materah vir zavisti ter odzivne anksioznosti in posledično slabo vplivajo na njihovo samozavest ter starševske kompetence. Moč družbenih omrežij ter vpliv različnih virov in načinov nagovarjanja uporabnikov (predvsem mladih mater) morata biti v sodobni družbi resneje upoštevana pri informiranju in opolnomočenju mladih staršev s strani državnih in drugih institucij. Na ta način lahko znanstvena spoznanja neposredno in posredno pripomorejo k varovanju duševnega zdravja v skupnosti, izboljšanju starševskih kompetenc mladih staršev, povečanju dobrot družin in ob upoštevanju ostalih pomembnih dejavnikov posredno prispevajo k zmanjševanju upada rodnosti v družbi.

KLJUČNE BESEDE

Materinstvo, starševstvo, družabna omrežja, instagrame, duševno zdravje, rodnost

ABSTRACT

Modern trends in online communication are changing ways of connecting and information gathering in our society. Young parents usually fall in the category of most active social network users, so in the last decades, the parenting is also under strong impact of new ways of connecting and informing online users. The separating line between quality information and advertising

*Article Title Footnote needs to be captured as Title Note

[†]Author Footnote to be captured as Author Note

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is very blurred on social media profiles, and the effects of this way of communicating can be positive or negative. On one side, following social network profiles can be helpful and supportive to young parents, because they can easily connect to people with the same interests and issues, on the other side, the idealistic portrayals of motherhood on instagrame profiles can be a source of envy and state anxiety in some mothers, and can have negative impact on their self confidence and parental competence. The power of social networks and the impact of different sources and ways of addressing users (especially young mothers) should be considered very seriously in modern society as a means of informing and empowering young parents by governmental and other institutions. In this way the scientific findings can directly and indirectly contribute to better mental health in society, improvement of parenting skills in young parents, increase in the welfare of the family and, considering also other important factors, indirectly contribute to slowing of the birth rate decrease in society.

KEYWORDS

Motherhood, parenting, social networks, instagrame, mental health, birth rate

1 UVOD

Družabna omrežja in spletni portali v zadnjih letih zelo izpodrivajo prej dolgo uveljavljene oblike podajanja informacij in nudenja podpore znotraj različnih podskupin. Starševstvo ni nobena izjema, prej nasprotno. Če so bili še pred nekaj desetletji glavni viri posredovanja znanja in informacij ustno izročilo, literatura, predavanja in mediji, lahko danes opazimo, da pomembno vlogo pri nagovarjanju mladih staršev prevzemajo družabna omrežja, predvsem instagrame in facebook. Do določene mere je to zagotovo prednost, saj gre za hiter in dostopen nabor številnih informacij ter možnost za povezovanje ljudi v nekakšno digitalno skupnost s podobnimi interesi. V zadnjem času pa se vse več govori tudi negativnih učinkih družbenih omrežij. O teh lahko neposredno izvemo od klientov, vključenih v psihoterapijo, izvedenih tudi že kar nekaj znanstvenih raziskav.

2 TRENDI NA PODROČJU DIGITALNEGA VEDENJA

V zadnjem desetletju se je svet na področju digitalnega vedenja precej spremenil, velikim spremembam pa smo po poročanju

mednarodne kreativne agencije We are social priča tudi v zadnjem letu. V svojem tradicionalnem letnem poročilu »Digital 2023« (We are social, 2023) opažajo pomembne spremembe, tudi v primerjavi z leti pandemije. Najbolj zanimiv je podatek o upadu časa, ki ga posameznik porabi za uporabo interneta (januarja 2023 so posamezniki na spletu porabili v povprečju 6 ur in 37 minut, kar je 20 minut manj kot leto prej). Pri tem pa poudarjajo, da ne gre za to, da postaja internet v življenjih ljudi vse manj pomemben, temveč to kaže na dejstvo, da postajajo ljudje pri svoji uporabi digitalnih tehnologij vedno bolj ciljno usmerjeni in učinkoviti. Kljub temu, da je poraba skupnega časa na internetu za spoznanje manjša kot leto prej, pa ljudje porabljajo več časa kot kadarkoli na družbenih omrežjih, število uporabnikov le-teh pa še narašča (v januarju 2023 je bila povprečna uporaba 2 uri in 31 minut na dan, kar je 3 minute več kot leto prej). Vse več ljudi se na socialne platforme obrača pri iskanju informacij in odkrivanju novih stvari, v središču svetovnih digitalnih vedenj pa ostajajo mobilni telefoni. V januarju 2023 je bilo na zemlji 8,01 milijarde prebivalcev, število uporabnikov mobilnih telefonov 5,44 milijarde (68%), število uporabnikov interneta 5,16 milijarde (64,4%), število aktivnih uporabnikov družbenih omrežij pa 4,76 milijarde (59,4%). Leta 2013 je bilo aktivnih uporabnikov družbenih omrežij precej manj, 1,72 milijarde.

3 MATERINSTVO IN VPLIV DRUŽBENIH OMREŽIJ

Po raziskavi »Digital 2023« (We are social, 2023) kot glavni razlog za uporabo družbenih omrežij največ (47,1%) uporabnikov navaja vzdrževanje stika s prijatelji in družino, visoko na vrhu pa je tudi iskanje vsebin (30,3%). 23,4% uporabnikov kot glavni razlog za uporabo družbenih omrežij navaja delitev in diskutiranje svojih mnenj, med pomembnimi razlogi pa sta tudi iskanje skupnosti in interesnih skupin s podobnimi mnenji (21,4% uporabnikov) ter sledenje znanim osebam ali spletnim vplivnežem (20,8% uporabnikov). Večina uporabnikov instagrama (62,2%) je starih med 18 in 34 let, kar pomeni, da so uporabniki instagrama približno v isti starostni skupini kot večina mladih staršev.

Raziskava iz leta 2017 (Djafarova in Trofimenko), je pokazala, da so med ruskimi materami matere predšolskih otrok najbolj pogost uporabnik družbenih omrežij. Sklepajo, da je to posledica časovne razpoložljivosti, saj je večina teh mater na porodniškem dopustu, drugi razlog pa je verjetno v tem, da imajo malo znanja na področjih, ki jih prinese starševstvo, kar vodi k manjši samozavesti. Tako na družbenih omrežjih pretežno iščejo informacije ter podporo s strani skupnosti žensk s podobnimi izzivi. Iz izkušenj pri terapevtskem delu vemo, da veliko mladih staršev uporablja družbena omrežja za iskanje informacij o razvoju otroka in drugih starševskih dilemah, kljub temu pa so starši precej slabo raziskana populacija na področju uporabe družbenih omrežij. Matere so najbolj aktivne na socialnih omrežjih v prvem letu otrokovega življenja, prav tako pa bolj pogosto kot očetje uporabljajo družbena omrežja, vključno z instagramom (Djafarova in Trofimenko, 2017). Obstoječe študije na to temo (Egmose in dr., 2022; Kirkpatrick in Lee, 2022) navajajo, da starši sledijo trem vrstam oziroma virom instagram profilov. Prvi so takoimenovani »instaparents« (»instastarši«)

oziroma »instamum« (»instamama«) profili. Gre večinoma za s strani instagrama verificirane spletne vplivnice, ki delijo svoje osebne izkušnje z materinstvom na svojem profilu z namenom, da bi pritegnile sponzorje in služile s promocijo blagovnih znamk. Drugi vir so profesionalni profili, ki jih kreirajo večinoma pediatri, kineziologi, nutricionisti in podobni strokovnjaki, ki z uporabniki delijo svoje strokovno znanje in nasvete. Tretji vir pa so tako imenovane »običajne« mame, na primer prijateljice, znanke, sorodnice ter druge »ne-slavne mame«, ki delijo svoje starševske izkušnje in doživljanja na družbenih omrežjih, ampak od tega nimajo neposrednih ali posrednih finančnih koristi. Spletne vplivnice, ki preko družbenih omrežij delijo svoje starševstvo, lahko glede na način vplivanja delimo v dve skupini: eno, ki pretežno deli pozitivne in všečne plati starševstva in drugo, ki na svojem instagram profilu pretežno predstavlja težave in izzive starševstva.

Čeprav obstajajo številne raziskave o povezavah med pretirano uporabo instagrama ter anksioznostjo in depresijo pri mladostnikih in mladih odraslih (Ramzan in dr., 2019; Moreno in Kolb, 2012;...), pa bi bilo potrebno področju materinstva ter povezavi med uporabo Instagrama in anksioznostjo matere, morebiti celo odločanjem o številu otrok pri materi, nameniti večjo pozornost. Pri terapevtskem delu z mladimi mamami namreč vse pogosteje slišimo pripovedovanja o anksioznosti, občutih nesposobnosti in krivde ter negativni samopodobi, ki jih pušča spremljanje instagram profilov tako mam spletnih vplivnic kot tudi »običajnih« instagram mam. Seveda pa vpliv ni vedno negativen, ter je običajno nekoliko odvisen od vira, ki mu mati sledi, predvsem pa od njenih psiholoških karakteristik.

Raziskava Egmosejeve in drugih (2022) je pokazala, da mlade matere na družbenih omrežjih v glavnem iščejo informacije v zvezi z dojenjem, razvojem in motoričnimi funkcijami otroka, spanjem, prehrano socialnimi interakcijami in razvojem, časom za zasloni in podobnim, obenem pa iščejo tudi podporo in povezovanje s skupnostjo, s katero si delijo podobne življenjske izzive (Egmose in dr., 2022). Idealizirani prikazi materinstva na družbenih omrežjih nemalokrat predstavljajo povečan pritisk na matere in negativno vplivajo na njihovo duševno zdravje. Matere se namreč primerjajo s prikazi materinstva na družbenih omrežjih in primerjanje s temi idealiziranimi portreti ima pri nekaterih škodljive učinke. Predvsem mlade matere (v prvem letu življenja prvorojenega otroka) se bolj primerjajo in doživijo več podobnosti s prikazi, ki niso idealizirani ali s prikazi mam vplivnic. Ne glede na vir (običajna mama ali vplivnica) pa idealizirane objave povzročijo pomembno višje ravni zavisti in odzivne tesnobe, kar je močno povezano z materinim duševnim zdravjem (Kirkpatrick in Lee, 2022). Nagnjenost k primerjanju z ostalimi je pomemben dejavnik, ki vpliva na odnos med vključenostjo v instagram profil vplivnice ter anksioznostjo pri materah. Matere, ki bolj aktivno sledijo instagramskim vplivnicam so v večji meri mame z višjo anksioznostjo in višjo orientiranostjo k socialnem primerjanju (Moujaes in Verrier, 2021). Steers in drugi (2014) ugotavljajo, da je tudi frekvenca socialnih primerjav tako navzgor kot navzdol povezana s povečanimi depresivnimi simptomi pri ameriških študentih.

Festingerjeva teorija socialne primerjave (Festinger, 1954) temelji na predpostavki, da imamo ljudje samoocenjevalni

nagon, torej da smo notranje gnani k samoocenjevanju in primerjanju z drugimi. S primerjavo mnenj in sposobnosti drugih s svojimi lastnimi, ljudje ocenimo doseganje ciljev našega idealnega jaza, hkrati pa se lahko bolj približamo doseganju teh ciljev. Ljudje smo gnani k zmanjšanju neskladja, ki ga zaznavamo med sabo in tarčno primerjavo (osebo, ki ji želimo biti podobni), kar je pretežno posledica človeške motivacije biti boljši. V skladu s to teorijo lahko primerjave ločimo v dve vrsti: vertikalno in horizontalno. Za vertikalno primerjavo gre, ko se primerjamo z nekom, ki ga doživljamo, kot da mu gre boljše od nas (navzgor), ali pa z nekom, za katerega menimo, da mu gre slabše od nas (navzdol). Horizontalna primerjava se osredotoča na to, ali smo si s subjektom primerjave podobni, imamo podobna mnenja in sposobnosti. Nekatere raziskave (Dibb in Foster, 2021; Hwnag, 2019; Steers in dr., 2014) so pokazale, da so primerjave navzgor v družbenih omrežjih, povezane s povečanim negativnim afektom ter poslabšanjem dobrobiti uporabnika.

Matere se k družbenim omrežjem obračajo zato, ker se s strani profesionalnih, pa tudi drugih profilov počutijo pretežno podprte, dobijo nove informacije ter povezanost s skupnostjo ljudi, ki imajo podobne življenjske izzive, na drugi strani pa prinaša ta aktivna vključenost tudi težave. Tudi ob spremljanju profesionalnih profilov lahko matere doživljajo znižan občutek starševske kompetence in slabo vest, ko ne morejo ves čas slediti dobri praksi, zato bi komuniciranje o dovolj dobrem starševstvu mogoče lahko pomagalo zmanjšati takšna negativna občutja. Čas pred pred zasloni se je izkazal kot ena od najpogostejše omenjenih tem, ki v materah zbujajo slabo vest ob sledenju profesionalnim profilom, kar kaže na to, da morajo biti strokovnjaki pri osveščanju staršev o tej tematiki previdni (Egmoose in dr., 2022).

V raziskavi iz leta 2022 (Egmoose in dr.) so bile matere z višjo orientiranostjo k socialnemu primerjanju (meri jo raven strinjanja s trditvijo »Primerjam se z drugimi starši, ki jim sledim na instagramu.«) deležne večjih negativnih učinkov ob sledenju katerikoli vrsti različnih profilov na instagramu. Največkrat so omenjale zmanjšan občutek starševske kompetence, rezultati pa so nakazovali, da na matere negativno učinkujejo primerjave navzgor z idealizirano sliko, ki je bila predstavljena v objavah s strani nekaterih staršev na instagramu. Matere z visoko orientiranostjo k socialnemu primerjanju se primerjajo navzgor tudi v relaciji z objavami na profesionalnih profilih, saj se posredno primerjajo s »perfektnim« staršem, ki lahko ves čas sledi vsakemu posameznemu nasvetu (Egmoose in dr., 2022).

Vir prikaza materinstva na instagramu vpliva na stanje v socialnem primerjanju, doživeto podobnost, zavist in odzivno anksioznost. Med idealizirane prikaze štejemo tiste, ki predstavljajo idealistične, všečne orise materinstva s tem, da se osredotočajo samo na pozitivne aspekte starševstva (»zrežirane« fotografije veselih, urejenih mater in otrok, s teksti o dosežkih otrok, o tem, da imajo »perfektnega« otroka in podobno). Neidealizirani prikazi so definirani kot tisti, ki predstavljajo bolj avtentičen, neidealističen oris materinstva, na primer kakršnakoli omemba izzivov, težav v starševstvu, objave z »nezrežiranimi« fotografijami realnosti, s tekstom o sitnih otrocih, o težavah pri iskanju ravnovesja med starševstvom in drugimi obveznostmi in podobno (Kirkpatrick in Lee, 2022).

Matere mlajših otrok se na družbenih omrežjih bolj primerjajo z neidealiziranimi prikazi v primerjavi z idealiziranimi, ter s profili »običajnih« mater (v primerjavi z vplivnicami). S temi objavami doživljajo večjo podobnost, idealizirani prikazi (ne glede na vir) pa povečujejo njihovo zavist ter odzivno anksioznost. Pomembno več je primerjanja z neidealiziranimi prikazi, saj se z realističnimi prikazi matere lažje poistovetijo, idealizirane objave pa pri materah bolj povečajo odzivno anksioznost. Medtem ko je idealizacija materinskih objav povečala pri udeleženkah zavist in odzivno tesnobo pa vir materinskih prikazov ni imel pomembnega učinka. Idealizacija objav se je torej izkazala kot bolj škodljiva kot to, kdo jih objavi (vplivnice ali vsakdanje matere). To kaže na to, da lahko kdorkoli na socialnih omrežjih, ki objavi idealizirano vsebino, potencialno škodljivo vpliva na uporabnike vsebine. Pri preverjanju prepoznavanja manipulacije s strani uporabnic družbenih omrežij, se je v tej raziskavi pokazalo, da so bile idealizirane objave v študiji ocenjene bolj na sredini skale, namesto na skrajnem koncu. Pričakovati je, da če idealizacija materinstva (iz kateregakoli vira) postane bolj poudarjena (vsebinska bolj idealizirana), bo negativni vpliv na uporabnice verjetno še bolj očit. (Kirkpatrick in Lee, 2022)

4 ŠIRŠE POSLEDICE VPLIVA DRUŽBENIH OMREŽIJ NA STARŠE

Socialno primerjanje mater na družbenih omrežjih je povezano z višjimi preobremenitvami s starševskimi vlogami, nižjo ravnijo starševske kompetence, več partnerskega konflikta in višjo ravnijo depresije pri materah (Coyne in dr., 2017). Pri terapevtskem delu z materami malih otrok, ki pogosteje poročajo o primerjanju z drugimi mamami na instagramu, velikokrat slišimo (od njih ali njihovih partnerjev), da pod takšnim pritiskom ne bi zmogli imeti še enega otroka, tako da marsikdaj ostajajo pri enem, največ dveh. Tudi če se odločijo za več otrok, poročajo o izjemnih čustvenih in fizičnih obremenitvah.

Potek spreminjanja ravnih rodnosti v Sloveniji je podoben trendom v večini evropskih in drugih razvitih držav. Značilni so nizka smrtnost in rodnost ter sorazmerno nizek ali celo negativen naravni prirastek prebivalstva. Leto 2022 se je, po poročanju Statističnega urada Slovenije (Statistični urad Republike Slovenije, 2022), uvrstilo na 5. mesto med leti z najmanj rojstvi v 101 letni zgodovini. Rodilo se je 17.627 otrok, kar je 7% oziroma 1.357 manj kot leto prej. Povprečna starost matere ob rojstvu prvega otroka je bila 29,6 leta, ob rojstvu vseh otrok pa 31,1 leta. Celotna stopnja rodnosti za leto 2022 je znašala 1,55, sorazmerno največ otrok so rodile matere v starosti 26 do 32 let. Skoraj polovica (47%) rojenih otrok je bila prvorojencev, 38% pa drugorojencev. Naravni prirast je v Sloveniji negativen od leta 2017, kar pomeni, da vsako leto umre več prebivalcev, kot se jih rodi. Na letni ravni je leta 2022 znašal - 2,3 na 1000 prebivalcev, oziroma -4.865 prebivalcev. Na svetovni ravni je bila v letu 1963 skupna rodnost 4,6 otroka na žensko, leta 2022 pa le še 2,3 otroka na žensko, kar kaže na to, da je trend upadanja rodnosti globalen. Demografi že desetletja intenzivno iščejo odgovore, ki zadevajo vprašanje dviga stopnje rodnosti, vendar izpostavljajo, da ni preprostih in univerzalno učinkovitih rešitev. Podatki Raziskave o vplivih veljavnih ukrepov družinske politike na odločanje za otroke, ki jo je v letu 2010 izvedel Inštitut Republike Slovenije

za socialno varstvo, so pokazali, da se ljudje za otroke odločajo predvsem zato, ker si jih želijo imeti, medtem ko so ukrepi družinske politike obrobne pomena, čeprav so na dolgi rok tudi pomembni. Po navedbah Resolucije o družinski politiki 2018-2028 (Pravno informacijski sistem, 2018, v nadaljevanju Resolucija) je gibanje števila živorojenih otrok v Sloveniji povezano s pomembnima dejavnikoma, ki sta v preteklosti vplivala na število živorojenih otrok in bosta vplivala tudi v prihodnje, to sta: gibanje povprečne starosti ženske ob rojstvu otroka in starostna struktura žensk v rodni dobi, torej v starosti od 15 do 49 let. Povprečna starost ženske ob rojstvu otroka se v zadnjih treh desetletjih hitro zvišuje. Pri odločanju za otroka je pomembno tudi urejeno stanovanjsko vprašanje.

Resolucija prepoznava, da je duševno zdravje z vidika realizacije vseh zmožnosti in potencialov posameznika izjemno pomembno. Prav tako pa je pomembno tudi z vidika zagotavljanja kakovosti življenja družin in širše družbe. Družinski član s težavami v duševnem zdravju namreč bistveno vpliva na kakovost življenja celotne družine. Ker zdravstvene statistike beležijo porast duševnih bolezni, so še toliko bolj pomembni kakovostni programi krepitve duševnega zdravja, preprečevanja, zgodnjega odkrivanja in zdravljenja duševnih motenj, psihoterapije, rehabilitacije in socialne integracije oseb s težavami v duševnem zdravju. Pomemben ukrep za izboljšanje duševnega zdravja na področju družine je razvoj in implementacija programov, ki ga izvajajo zdravstveni strokovnjaki na domu in je namenjen intenzivni podpori zgodnjemu starševstvu za ranljive nosečnice in družine z dojenčkom oziroma malčkom, pomembne pa so tudi prenovljene vsebine šole za starše.

5 SKLEP

V skladu z Resolucijo o družinski politiki RS (Pravno informacijski sistem, 2018) je družina temeljna družbena institucija in predstavlja ključno komponento družinske politike. Pomembna naloga države je, da ustvarja pogoje za doseganje visoke ravni kakovosti življenja družin in posameznikov, zagotavlja socialno vključenost, varstvo in zaščito, in tako ustvarja možnost zdravega razvoja vseh družinskih članov. Za učinkovitejše doseganje teh ciljev je država razvila model programov v podporo družini, ki se osredotočajo na različne oblike pomoči družinam in na določen način predstavljajo dopolnitev drugih programov in storitev, kot so recimo socialno varstveni programi in storitve. Programi v podporo družini so v vsebinskem smislu namenjeni pripravi na starševstvo, spodbujanju pozitivnega starševstva in krepitvi starševskih kompetenc, izboljšanju komunikacije in odnosov v družini, ustvarjalnemu in aktivnemu preživljanju prostega časa otrok in družin, lažjemu usklajevanju poklicnega in družinskega življenja, psihosocialni pomoči otrokom in staršem ter drugim vsebinam za izboljšanje kakovosti družinskega življenja. Ti programi morajo, da bi služili svojemu namenu, prepoznati pomen družbenih omrežij ter načina podajanja informacij preko njih za duševno zdravje mladih staršev. V programih priprave na starševstvo ter poporodne skrbi je potrebno resneje vzeti tudi vse večje pritiske po »perfektnem starševstvu« torej vse večjo intenzivnost starševske vključenosti, kot jo mladim staršem nerealno posredujejo med drugimi tudi družbena omrežja, ki s tem povečujejo breme mladih staršev v že tako napornem

obdobju. Pri tem je pomembno upoštevati znanstvena dognanja o učinkih različnih virov in načinov nagovarjanja mladih staršev, ter jih obrniti v prid opolnomočenju in krepitvi starševskih kompetenc in samozavesti.

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Na poti k bolj celovitemu merjenju ekonomskega prispevka moških in žensk

Toward a more comprehensive measurement of men's and women's economic contributions

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POVZETEK

V ekonomski analizi je starostni razpon ekonomske neodvisnosti običajno opredeljen z uporabo fiksnih starostnih mej (tj. v starosti 20-64 let). To obdobje je privzeto neodvisno od države, leta analize, spola itd. Poleg tega se običajno predpostavlja enak obseg ekonomske neodvisnosti, ne glede na starost posameznikov. Metodološki okvir računov nacionalnih transferjev (angl. *National Transfer Accounts* – NTA) nam s pomočjo koncepta presežka življenjskega cikla (tj. pozitivna razlika med dohodkom iz dela in potrošnjo) omogoča natančno merjenje obdobja in obsega ekonomske neodvisnosti. Ob tem, z namenom odprave spolne pristranskosti običajnih NTA, v analizo dodamo še vrednosti neplačanega gospodinjanskega dela in na ta način običajne NTA združimo z računi nacionalnih transferjev časa (angl. *National Time Transfer Accounts* – NTTA). Na ta način poleg natančnega merjenja ekonomske neodvisnosti celostno merimo tudi prispevek moških in žensk k financiranju ekonomske odvisnosti mladih in starih. Rezultati analize 14 držav EU kažejo, da vključitev neplačanega gospodinjanskega dela močno vpliva na zmanjševanje razlik v prispevku obeh spolov. Pri tem pa v nekaterih državah moški tudi po vključitvi neplačanega gospodinjanskega dela prispevajo znatno več kot ženske (npr. v Veliki Britaniji in Nemčiji), medtem ko ženske v Litvi in Sloveniji ob vključitvi denarno ovrednotenega neplačanega gospodinjanskega dela prispevajo več kot moški.

KLJUČNE BESEDE

Računi nacionalnih transferjev, neplačano delo, dohodek iz dela, potrošnja, razlike med spoloma.

ABSTRACT

In economic analysis, the age period of economic independence is usually defined using fixed age limits (i.e., between the ages of 20-64). By default, this period is independent of country, year of analysis, gender, etc. Moreover, the same level of economic independence is usually assumed regardless of the age of the individuals. The methodological framework of National Transfer Accounts (NTA) allows to accurately measure the period and the level of economic independence using the concept of lifecycle surplus (i.e., the positive difference between labour income and consumption). To remove the gender bias of the conventional NTA, we also add the values of unpaid household work to the analysis and thus combining the conventional NTA with the National Time Transfer Accounts (NTTA). In this way, we not only accurately measure economic independence, but also comprehensively capture the contribution of men and women to financing the economic dependence of the young and the old. The results of the analysis of 14 EU countries show that the inclusion of unpaid household work has a strong impact on reducing the differences in the contribution of both sexes. However, in some countries, men contribute much more than women even after including unpaid household work (e.g., in the United Kingdom and Germany), while women in Lithuania and Slovenia contribute more than men when the monetary value of unpaid household work is included.

KEYWORDS

National Transfer Accounts, unpaid work, labour income, consumption, gender differences.

1 UVOD

V življenju gredo posamezniki skozi dve obdobji ekonomske odvisnosti, ko so mladi in ko so stari. Takrat posameznikova potrošnja presega dohodek iz dela. Presežek potrošnje nad dohodkom iz dela krije delovno aktivna populacija, ki zasluži več kot potroši, in se tako sooča z obdobjem ekonomske neodvisnosti [6]. V naslednjih desetletjih se bo prebivalstvo EU hitro staralo. Višji delež starejših glede na delovno aktivne pa ogroža vzdržnost javnofinančnega sistema in povzroča pritisk na javne in zasebne institucije, da se spremembam ustrezno prilagodijo.

Med ukrepe, ki bi lahko že kratkoročno omilili vpliv staranja na vzdržnost javnofinančnega sistema, se uvrščata predvsem daljše ostajanje v zaposlitvi in zvišanje velikosti ekonomske neodvisnosti prebivalstva (tj. zvišanje razlike med njihovim dohodkom iz dela in potrošnjo) [3], [7], [8]. Slednje bi pripomoglo k zvišanju privarčevanega dohodka iz dela in/ali omogočilo višje javne in zasebne transferje, s katerimi delovno aktivni prebivalci financirajo ekonomsko odvisnost mladih in starih. Podatki računov nacionalnih transferjev (angl. *National Transfer Accounts* – NTA) kažejo, da je razlika med agregatnim dohodkom iz dela in agregatno potrošnjo višja v tistih državah, v katerih je ekonomska neodvisnost in s tem prispevek žensk glede na moške relativno višji – torej predvsem v tistih državah, kjer je udeležba žensk na trgu dela višja [3], [8]. Tako lahko kot možen ukrep za povečevanje vzdržnosti javnofinančnega sistema vidimo spodbujanje udeležbe žensk na trgu dela [8].

Moški na trgu dela v povprečju zaslužijo več kot ženske, prav tako plačanemu delu namenijo več časa, vendar po drugi strani ženske v primerjavi z moškimi namenijo več časa neplačanemu gospodinjskemu delu in tako v primerjavi z moškimi ustvarijo več storitev v obliki neplačanega gospodinjskega dela [3]. Osnovni namen članka je tako celostno analizirati ekonomski prispevek moških in žensk, in sicer kot razliko med njihovo proizvodnjo in potrošnjo, vključno z denarno vrednostjo neplačanega gospodinjskega dela.

2 METODOLOGIJA IN PODATKI

V članku uporabljamo enega od temeljnjih konceptov metodologije NTA, to je koncept presežka življenjskega cikla. Presežek življenjskega cikla predstavlja pozitivno razliko med dohodkom iz dela ter (javno in zasebno) potrošnjo, ki je značilna za čas aktivne delovne dobe. Starostni profili (to so starostnospecifična povprečja) dohodka iz dela in potrošnje za države EU so pridobljeni iz podatkovne

baze projekta AGENTA [4] in so ocenjeni na podlagi anketnih in administrativnih podatkov. Za ocenjevanje starostnih profilov dohodka iz dela so uporabljeni mikropodatki EU-SILC, za ocenjevanje starostnih profilov zasebne potrošnje pa Anketa o porabi gospodinjev (angl. *Household Budget Survey* – HBS). Rezultati NTA so izračunani za leto 2010 in se ujemajo z agregatnimi vrednostmi iz sistema nacionalnih računov (angl. *System of National Accounts* – SNA). NTA po spolu so ocenjeni podobno kot običajni NTA, pri tem pa so starostni profili po spolu prilagojeni tako, da se zagotovi skladnost z makroekonomskimi agregati in tudi s starostnimi profili običajnih NTA. Metodologija Evropskih NTA je podrobno predstavljena v Istenič in drugi [4].

Tržni pristop k ocenjevanju ekonomske neodvisnosti daje zavajajočo sliko o proizvodnji in ostalih prispevkih obeh spolov v gospodinjstvu. V članku tako odpravimo spolno pristranskost običajnih NTA in jih združimo z računi nacionalnih transferjev časa (angl. *National Time Transfer Accounts* – NTTA), ki so izračunani na podlagi ankete o porabi časa in prav tako pridobljeni iz podatkovne baze projekta AGENTA [9]. Pridobljene vrednosti o porabi časa za posamezne aktivnosti neplačanega gospodinjskega dela, z namenom primerljivosti z rezultati NTA iz leta 2010, monetarno ovrednotimo z uporabo povprečnih plač elementarnih poklicev v posamezni državi v letu 2010 [2]. V članku so predstavljeni rezultati za 14 držav EU z razpoložljivimi podatki NTA in NTTA.

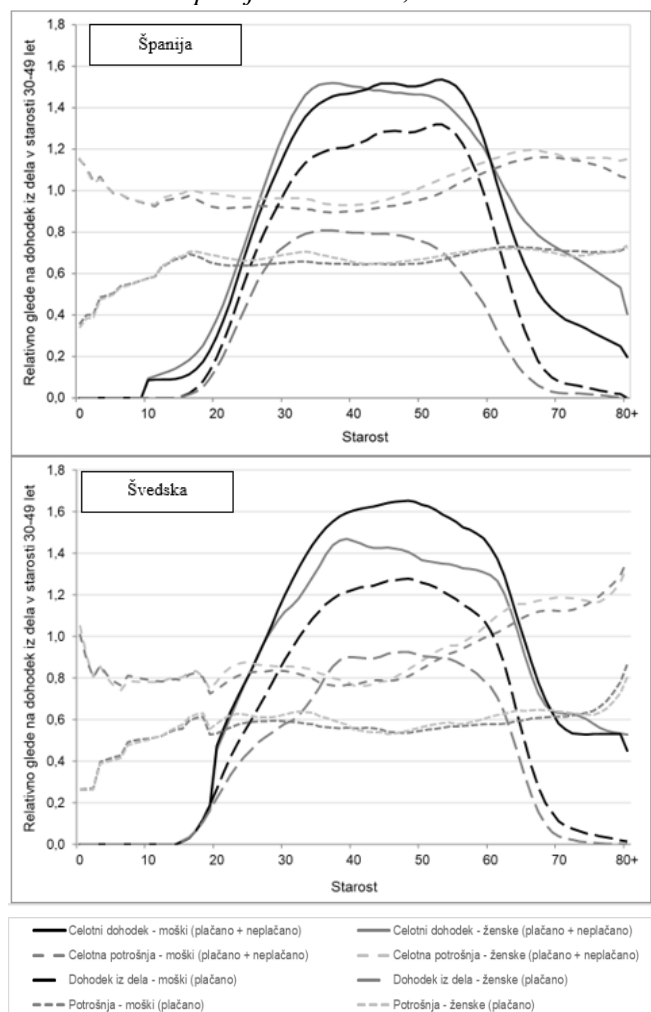
3 REZULTATI

Slika 1 prikazuje dohodek iz dela in potrošnjo po starosti in spolu za dve izbrani državi, to sta Španija in Švedska. Na sliki ločeno prikazujemo tržne vrednosti dohodka iz dela in potrošnje ter dohodek in potrošnjo kot vsoto tržnih vrednosti in denarno ovrednotene vrednosti neplačanega dela. Iz slike je razvidno, da je v obeh državah dohodek iz dela žensk nižji od dohodka moških, kar je predvsem posledica nižje stopnje zaposlenosti žensk ter razlike v plačah med polno zaposlenimi moškimi in ženskami. Razlika v dohodku iz dela med obema spoloma je nižja na Švedskem, kjer se enakost med spoloma tradicionalno spodbuja v večji meri. Razlika med spoloma v potrošnji je v obeh državah manj razvidna kot razlika v dohodku, tako je razlika med spoloma v presežku življenjskega cikla pretežno rezultat razlik v dohodku med spoloma.

Po vključitvi denarno ovrednotenih vrednosti neplačanega gospodinjskega dela se razlike med spoloma v dohodku oziroma proizvodnji zmanjšajo v

obeh državah, a je velikost sprememb med državama različna. Medtem ko na Švedskem razlike v dohodku ostajajo očitne tudi po vključitvi neplačanega dela, se razlike med spoloma v Španiji praktično izničijo.

Slika 1: Dohodek in potrošnja moških in žensk, Španija in Švedska; 2010



Viri: [2], [4], [5], [9].

V Tabeli 1 predstavljamo celoten presežek življenjskega cikla za moške in ženske v vseh 14 preučevanih državah EU, ki je izračunan kot produkt evropskega standardnega prebivalstva [1] in povprečnega presežka življenjskega cikla posameznika. Za lažjo primerjavo med državami je celoten presežek izračunan kot odstotek celotnega dohodka iz dela v posamezni državi. Rezultati so najprej prikazani brez denarno ovrednotene vrednosti neplačanega dela, nato pa še z upoštevanjem le te.

Presežek življenjskega cikla moških se giblje med 8,3 % dohodka iz dela v Litvi in 30,3 % dohodka iz dela

v Nemčiji. Presežek življenjskega cikla žensk je v vseh državah nižji od presežka moških in se giblje med 0,6 % dohodka iz dela v Italiji in 14,3 % v Sloveniji. Ob tem se presežek žensk glede na presežek moških med državami bistveno razlikuje in znaša med 2,5 % v Italiji ter 62,0 % v Sloveniji. Ob vključitvi neplačanega dela se razlika v presežku življenjskega cikla med spoloma zmanjša v vseh državah, a ostaja visoka npr. v Veliki Britaniji (37 %) in Nemčiji (40,1 %). Na drugi strani se razlika znatno zniža v Italiji (celotni presežek življenjskega cikla žensk glede na celotni presežek življenjskega cikla moških naraste na 86,1 %) in Španiji (89,7 %). V Litvi in Sloveni pa je celotni presežek življenjskega cikla žensk celo višji od celotnega presežka življenjskega cikla moških.

Tabela 2: Presežek življenjskega cikla moških in žensk, države EU, 2010

Država	Presežek življenjskega cikla kot % dohodka iz dela			Celotni presežek življenjskega cikla kot % dohodka iz dela		
	M	Ž	Prispevek Ž/M*100	M	Ž	Prispevek Ž/M*100
Belgija	28,1	7,7	27,4	29,1	19,0	65,2
Bolgarija	15,1	1,7	11,6	14,1	9,8	69,4
Estonija	23,5	5,4	22,8	23,6	13,3	56,3
Finska	20,3	7,9	39,0	21,9	18,8	85,6
Francija	26,3	6,4	24,2	26,7	17,5	65,5
Italija	24,6	0,6	2,5	20,6	17,7	86,1
Litva	8,3	4,1	49,1	8,0	10,3	128,8
Latvija	16,3	3,9	24,0	14,9	10,1	68,0
Nemčija	30,3	2,2	7,3	31,4	12,6	40,1
Poljska	23,8	3,0	12,5	24,7	14,9	60,5
Slovenija	23,1	14,3	62,0	23,3	24,4	104,7
Španija	23,8	3,6	14,9	20,8	18,7	89,7
Švedska	25,5	10,3	40,5	29,2	20,2	69,2
VB	27,4	0,8	2,9	28,3	10,5	37,0

*Opombe: M = Moški, Ž = Ženske, Prispevek Ž/M*100 = Prispevek žensk glede na moške (v %), VB = Velika Britanija.

Viri: [1], [2], [4], [5], [9].

4 ZAKLJUČEK

V članku s pomočjo koncepta presežka življenjskega cikla natančno merimo dolžino in velikost ekonomske neodvisnosti moških in žensk in s tem njihov prispevek k financiranju ekonomske odvisnosti mladih in starih. Celostno merjenje ekonomske neodvisnosti, vključujoč plačano in neplačano delo, je še posebej pomembno v času spreminjajoče se starostne strukture prebivalstva in s tem vprašljive dolgoročne vzdržnosti javnofinančnega sistema.

Kot eden od možnih ukrepov za zagotavljanje vzdržnosti javnofinančnega sistema se navaja tudi zviševanje udeležbe žensk na trgu dela. Glede na rezultate članka lahko zaključimo, da je zvišanje udeležbe žensk na trgu dela lahko učinkovit ukrep za zagotavljanje vzdržnosti javnofinančnega sistema v državah, kjer je prispevek žensk glede na moške nizek tudi po vključitvi denarno ovrednotenega neplačanega dela. To velja na primer za Nemčijo, Veliko Britanijo, Estonijo in Poljsko. Na drugi strani pa je tak ukrep lahko problematičen v državah, kjer je celoten prispevek žensk glede na moške visok, kar velja predvsem za Litvo in Slovenijo ter tudi za Finsko, Italijo in Španijo. V teh državah je breme žensk veliko in bi več dela na trgu verjetno pomenilo manj časa, namenjenega neplačanemu gospodinjškemu delu. Ker je vzorce delitve dela med moškimi in ženskami na kratek rok težko spreminjati, lahko tak ukrep močno zniža blaginjo prebivalstva teh držav. Ob tem je potrebno še dodati, da je neplačano delo, ki ga še vedno v večji meri opravljajo ženske, nižje ovrednoteno kot je povprečje za plačano delo na trgu. To pomeni, da je prispevek žensk glede na moške, ki je merjen le v času, še višji v vseh državah.

ZAHVALA

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Koncept spolnih vlog pri mladih odraslih

The Concept of Gender Roles in Young Adults

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POVZETEK

Ustrezno oblikovanje družbenih vlog, med katere spadajo tudi spolne vloge, ima lahko velik pomen za posameznikovo življenje, njegove odnose ter občutja gotovosti, orientacije v okolju in predvidevanja, posledično s tem pa tudi na zmanjševanje tesnobe. Razumevanje pojava družbenih in spolnih vlog je še posebej pomembno v luči pojava vedno večje prisotnosti tesnobe na družbeni ravni, ter vedno večje množičnosti spolnih identitet in spolnih vlog, katerim smo priča. Ob vedno večjem poudarjanju svobode izbire posameznikove spolne identitete in z njo povezanih spolnih vlog nas je v raziskavi zanimalo, kako pojem spolne vloge dojemajo mladi odrasli. Na temelju analize intervjujev, ki smo jih analizirali po metodologiji osnovane teorije, smo med drugim ugotovili, da mladi odrasli veliko bolj kot statične vidike spolnih vlog poudarjajo procesne vidike (npr. iskanje, raziskovanje, oblikovanje, preoblikovanje spolnih vlog). Hkrati pa je v njihovem dojetju spolnih vlog zelo močno prisotna tudi težnja po iskanju avtentičnih načinov doživljanja in prakticiranja spolnih vlog.

KLJUČNE BESEDE

Spolne vloge, razvoj spolnih vlog, avtentičnost, mladi odrasli, osnovana teorija.

ABSTRACT

Appropriate social role modelling, including gender roles, can have a profound impact on an individual's life, relationships, feelings of security, orientation, and anticipation, and consequently on anxiety reduction. Understanding the phenomenon of social and gender roles is particularly important in the light of the increasing presence of anxiety at a societal level, and the growing multiplicity of gender identities and gender roles that we are witnessing. With the increasing emphasis on the freedom to choose one's gender identity and associated gender roles, our research was interested in young adults' perceptions of the concept of gender roles. Based on the analysis of the interviews, which were analysed according to grounded theory methodology, we found, among other things, that young adults

place much more emphasis on the process aspects (e.g. searching for, exploring, shaping, transforming gender roles) than on the static aspects of gender roles. At the same time, their perception of gender roles is also strongly influenced by a tendency to seek authentic ways of experiencing and practising gender roles.

KEYWORDS

Gender roles, gender role development, authenticity, young adults, grounded theory

1 KONCEPT SPOLNE VLOGE IN SPOLNA IDENTITETA V SPREMINJAJOČEM SE DRUŽBENEM OKOLJU

Eden od najpomembnejših mehanizmov, preko katerega se določajo pričakovani načini vedenja znotraj socialnih okolij, so različne družbene vloge, v katerih nastopamo. Med njimi so spolne vloge, ki so bile do nedavnega opredeljene kot pričakovanja družbe in kulture, kako naj se posameznik vede glede na to, ali je moškega ali ženskega biološkega spola **Napaka! Vira sklicevanja ni bilo mogoče najti.** Spolne vloge so podvržene stereotipizaciji, znotraj katere prihaja do enačenja družbenih norm z "naravnimi" značilnostmi moških ali žensk, kot da so te odvisne od fizioloških značilnosti [2]. Vendar je potrebno jasno razlikovati fiziološke značilnosti posameznikov in njihov biološki spol, ter doživljajske značilnosti posameznikov in njihov družbeni položaj, ki se tekom posameznikovega življenja spreminja, kar se posledično povezuje tudi s spremembami pojmovanja posameznikove lastne spolne vloge skozi različna razvojna obdobja.

Spolne vloge torej niso nekaj statičnega, temveč gre za dinamičen koncept, ki se tekom posameznikovega življenja spreminja. Razvoj spolnih vlog poskuša pojasniti več teorij, ki jih je Millerjeva [3] razvrstila v tri skupine. Biološke teorije sledijo pojmovanju, da so psihološke in vedenjske spolne razlike posledica bioloških razlik med moškimi in ženskami, pri čemer se naslanjajo na evolucijske procese, gensko strukturo ter spolne hormone. Socializacijske teorije trdijo, da nastanejo spolne vloge kot produkt različnega obravnavanja deklic in dečkov ter spolnih stereotipov, ki so jim otroci izpostavljeni v svojem okolju. Kognitivne teorije pa izpostavljajo posameznika kot aktivnega ustvarjalca znanja, ki svoje znanje o sebi oblikuje na način, da bi svoje vedenje uskladil s svojim razumevanjem spola.

Koncept spolnih vlog se povezuje s posameznikovo spolno identiteto, ki je pogosto opisana kot posameznikovo notranje

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občutje, da je moški ali ženska, oziroma v sodobnem času ena od identitet, ki jo posameznik doživlja v povezavi z doživljanjem svojega spola [4]. Psihološka identiteta se v splošnem nanaša na značilnosti, na katere je posameznik navezan oziroma si jih na nek način lasti, pri čemer se tekom življenja lahko znajde v negotovosti, katere so njegove najbolj značilne lastnosti [5]. Ker se tako posameznikova spolna vloga kot tudi spolna identiteta oblikujeta znotraj socialnega okolja, v katerega je posameznik vpet, se spremembe v socialnem okolju odražajo tudi v napetostih, ki jih posameznik doživlja, ko poskuša definirati sebe in svoj družbeni položaj.

Raziskava, ki jo je izvedla organizacija GALLUP na ameriški populaciji, je pokazala, da se odstotek oseb, ki se ne identificira s prevladujočo heteroseksualno usmerjenostjo, iz leta v leta povečuje, pri čemer se največje spremembe odražajo v generaciji najmlajših odraslih oseb, ki so bile vključene v raziskavo. Medtem, ko se pri odraslih, rojenih pred letom 1946, s heteroseksualno usmerjenostjo identificira 92,2% oseb, se v generaciji, ki je rojena v letih med 1997 in 2003, s to tradicionalno spolno usmerjenostjo identificira le še 75,7% [6].

Enoznačnih vzročnih raziskav, ki bi pojasnjevale nastajajoče trende na področju spolnih identitet in z njimi povezanih spolnih vlog, nimamo. So pa zanimive primerjave nekaterih drugih sprememb, ki jih je mogoče opaziti na ravni družbe v sodobnem času. Ena takih je opazen porast občutij tesnobe v zadnjem obdobju, kar potrjuje več raziskav. Metaanalitična študija, ki jo je izvedel Racine s sodelavci [7], je pokazala globalno prevalenco klinično pomembne tesnobe v 19% primerov. Posebej problematične so ugotovitve, da je še posebej mlajša populacija podvržena tem težavam.

Raziskava v ZDA [8] je pokazala, da je polovica (50%) mladih med 18. in 24. letom poročala o simptomih tesnobe in depresije, ki so jih doživljali v zadnjem letu. Do podobnih rezultatov so prišli v raziskavi KFF/CNN [9], kjer je prav tako polovica mladih odraslih poročala, da so se v zadnjem letu »vedno« ali »pogosto« počutili tesnobno. Med odraslo populacijo se je podobno počutila tretjina oseb. V skladu z ugotovitvami omenjenih raziskav imajo dekleta višjo stopnjo težav na področju mentalnega zdravja, izstopajo pa tudi LGBT osebe.

Če upoštevamo ugotovitev, da je stopnja tesnobe in depresije v obdobju od 2005 do 2017 povečala za 63% [10], je porast tesnobnih stanj očitno povezan z bolj globalnimi spremembami, ki se odvijajo v daljšem časovnem obdobju. Tukaj se samo po sebi poraja vprašanje, ali bi bil lahko porast spremenjenih spolnih identitet in z njimi povezanih spolnih vlog povezan s povečanimi stopnjami tesnobe. Hkrati se poraja vprašanje, kaj je tisto, kar po eni strani spodbuja ali omogoča večjo izbirnost na področjih, kjer v preteklosti te izbirnosti ni bilo, oziroma kaj ustvarja neka bolj globalna negotova stanja na ravni družbe, ki vodijo v tako močno povečano stopnjo pojavnosti tesnobnih stanj.

Tesnoba, predvsem socialna, je močno povezana s posameznikovim strahom, da se ne bo znal ustrezno vesti [11], ali s strahom, da ga socialno okolje ne bo sprejelo v tem, kar doživlja kot avtentično svoje [12]. Eno in drugo je morda povezano z manj jasno definiranimi družbenimi pričakovanji ter z njimi povezanimi družbenimi vlogami, ali pa s posameznikovo nezmožnostjo izbrati med tem, kar čuti kot avtentično svoje ter številnimi vlogami, ki so mu ponujene s strani družbe.

2 RAZISKAVA

Ob vprašanih, kako izoblikovane so naše spolne vloge, ali kako ljudje oblikujemo svoje znanje o sebi in svojih spolnih vlogah, se pojavlja tudi vprašanje, kako ljudje sploh pojmujejo svojo spolno vlogo. Katere vidike spolnih vlog imamo v mislih, ko reflektiramo svoj razvoj na tem področju in kako te vidike povezujemo v bolj kompleksen koncept svoje spolne vloge? Da bi odgovorili na to vprašanje, smo izvedli kvalitativno raziskavo po metodi utemeljene teorije.

2.1 Udeleženci

V pilotsko raziskavo smo vključili 6 mladih odraslih oseb, starih med 30 in 40 let, od tega so bili trije udeleženci moškega biološkega spola ter tri udeležence ženskega biološkega spola. Glede na smernice izbrane raziskovalne metodologije so bili v raziskavo vključeni udeleženci, ki so se glede opredeljenosti do svoje spolne vloge med seboj čim bolj razlikovali. Tako so bili v raziskavo vključeni udeleženci, ki svoje spolne vloge še niso imeli opredeljene, kot tudi udeleženci, ki so jo imeli izbrano. Med tistimi, ki so jo imeli izbrano, so bili vključeni tako tisti, ki so bili z njo pretežno zadovoljni, kot tudi tisti, ki z njo niso bili povsem zadovoljni.

2.2 Postopek

Podatki so bili zbrani v intervjujih, ki so se tematsko nanašali na posameznikov dosednji spolni razvoj, ki je vključeval tudi vprašanja o razvoju posameznikove spolne vloge. Zvočni posnetki intervjujev so bili nato natančno prepisani, pri čemer so bili odstranjeni oziroma ustrezno zamaskirani vsi podatki, na temelju katerih bi bilo mogoče prepoznati identiteto udeležencev. Postopek kodiranja intervjujev je sledil načelom utemeljene teorije, kot jih je zapisala Charmazova [13]. V analizo so bili vključeni deli besedila, ki so se vsebinsko nanašali na spolne vloge, kodirale pa so se posamezne enote analize (praviloma besedne zveze, zbrane okoli ene glagolske oblike).

V prvi fazi kodiranja so bile posameznim notam analize pripisane kode, ki so vsebinsko povzemale kodirano besedilo. V nadaljevanju smo podobne kode združili v kategorije 1. stopnje, te pa potem na temelju prepoznanih odnosov med njimi naprej v kategorije 2. stopnje in na koncu še v kategorije 3. stopnje.

2.3 Rezultati

2.3.1 Različna raba pojmov glede na razvojno obdobje, na katero se pojem nanaša. Analiza rezultatov je pokazala, da mladi odrasli v svojih pripovedih o razvoju svojih spolnih vlog uporabljajo različno terminologijo v odvisnosti od tega, na katero razvojno obdobje se nanaša njihova pripoved.

Ko pripovedujejo o svojem otroštvu, izpostavljajo pretežno doživljajske vidike ter svoja opažanja spolnih vlog pri pomembnih odraslih osebah. V pripovedih je pozornost usmerjena pretežno na doživljanje psihološkega ugodja oziroma neugodja.

»Skrbel sem za sestro. Želel sem pomagati, nisem želel ostati brezbrizen. Bilo mi je prijetno, doživljal sem jo

kot živo bitje. /.../ Imel sem jo rad, vseeno pa mi je bilo smešno, da kot moški previjam svojo sestro.«

Ko pripovedujejo o sebi v času mladostništva, izpostavljajo različne vidike raziskovanja, iskanja in oblikovanja sebe. V pripovedih je pozornost osredotočena na raziskovanje telesa, na vzpostavljanje odnosa do spolnosti (pri čemer ima spolnost pretežno funkcijo raziskovanja, zaznamovana pa je z neizkušnostjo in nezrelostjo) ter na iskanje identitete (tako spolne kot tudi splošne).

»Zdi se mi pomembno, da sem raziskoval svoje lastno telo in občutke, saj sem lahko na tak način ugotovil, kaj se pravzaprav dogaja z menoj.«

Ko pripovedujejo o sebi v sedanjem, odraslem obdobju, še vedno izpostavljajo vidike iskanja, za razliko od iskanja v mladostništvu pa je to odraslo iskanje veliko bolj usmerjeno in osredotočeno k iskanju avtentičnosti. V veliki meri izpostavljajo tudi vidike prakticiranja in preverjanja spolnih vlog (pretežno znotraj partnerskih razmerij). Ko govorijo o spolnih vlogah, so pretežno osredotočeni na področje spolnosti (pri čemer ima spolnost več funkcij, ki so sicer značilna za odrasla razmerja).

»Doma res nisem imela pravega kompasa, v cerkvenih krogih, kot sem povedala, tudi ne, kjer koli drugje sem iskala, pa je bila spolnost prikazana kot šport, s čimer se pa tudi ne strinjam. Tako da na tem področju še vedno iščem in upam, da bom našla nekoč nekoga, ki bo imel res tako mnenje o tem, da bom rekla: ja, to je to, tako je prav.«

2.3.2 Težnja najti avtentične načine doživljanja, opredeljevanja, izražanja, prakticiranja spolnih vlog. Iz kategorij, ki smo jih identificirali, je razvidno, da dajejo odrasli ljudje v svojih pripovedih o svojem spolnem razvoju malo pozornosti na statične vidike spolnih vlog (npr. na specifične značilnosti posameznih spolnih vlog). Veliko večji poudarek dajejo procesnim vidikom (npr. iskanju, raziskovanju, oblikovanju, preoblikovanju spolnih vlog). Ob tem je zelo močno prisotna težnja iskanja avtentičnih načinov doživljanja, opredeljevanja, izražanja, prakticiranja spolnih vlog.

V procesu kodiranja in kategoriziranja smo na koncu izpostavili štiri glavne kategorije.

2.3.2.1 Rast v smeri pristnega jaza. V to kategorijo smo umestili vse podkategorije, ki so se nanašale na iskanje osebne avtentičnosti, sprejemanje izbir glede spolnih vlog, težnje k avtentični spolnosti, osebno rast na spolnem področju in razreševanje izzivov, ki ovirajo posameznika na poti do osebne pristnosti.

»Mora biti čim več tega raziskovanja med partnerjema, da spolnost ne postane neka rutina in neka navada. To se mi zdi največja škoda, če postane spolnost navada, in ni več vzburjenja in iskric in eksperimentiranja in raziskovanja.«

2.3.2.2 Iskanje in sooblikovanje avtentičnega okolja. V to kategorijo smo umestili vse podkategorije, ki so se nanašale na želje po bivanju v avtentičnem okolju oziroma na pripravljenost sooblikovati bolj avtentično okolje, pri čemer se je pojem okolja nanašal tako na zasebno partnersko oziroma zakonsko in družinsko okolje, kakor tudi na širše družbeno okolje.

»Sprejema me takega, kakršen sem, ni mi potrebno skrivati. Je lažje, saj se je od mene odvalil en kamen, ki me je toliko časa moril. S tem, ko sprejema mene, tudi jaz lažje gledam na to. Ne govorim, da je zaradi nje moja »težava« odpravljena. To nosim vsak trenutek s sabo, vendar sem z njo lažje moški, kateri sem v družbi.«

2.3.2.3 Avtentično življenje. V to kategorijo smo umestili vse kategorije, ki so se nanašale na prakticiranje in preverjanje svoje spolne vloge (v smislu, ali je posameznik s svojo spolno vlogo zadovoljen, oziroma ali jo doživlja kot avtentičen del sebe).

»Trudim se biti dober mož, voditi duhovno in intimno življenje v svoji družini. Prav tako želim biti poslovno uspešen /.../ Te vloge so mi v redu, čeprav mi je včasih težko, ko sem na primer z vseh strani obremenjen. Kljub temu jih vidim vredne in se splača zanje boriti.«

2.3.2.4 Dejavniki iz osebne zgodovine. Zadnja kategorija združuje podkategorije, ki jih lahko razumemo kot dejavnike posameznikovega avtentičnega življenja. Sem smo umestili vse kategorije, ki se nanašajo na posameznikova otroška doživetja in ponotranjene modele spolnih vlog iz otroštva, pa tudi mladostniške izkušnje, ponotranjena spoznanja ob lastnem raziskovanju in sprejete identitetne izbire.

»Mama svoje vloge, kot mama in ženska ni želela sprejemati: ni želela opravljati gospodinjskih del, ni se kaj dosti brigala za vzgojo svojih otrok. Samo kajenje in zabava, to ji je bila prioriteta njenega življenja.«

3 RAZPRAVA

3.1 Od prevzemanja spolnih vlog do iskanja avtentičnosti

Iz pripovedi mladih odraslih je razvidno, da spolnih vlog ne enačijo z nekimi statičnimi predstavami, ki bi bile enoznačno določene in stabilne skozi celotno posameznikovo življenje (kar je bilo morda bolj značilno za pretekla zgodovinska obdobja). Gre torej za koncept, ki je v mišljenju sodobnega odraslega človeka dinamičen in spremenljiv. Kljub spremenljivosti ne daje vtisa kaotičnosti, saj mladi odrasli svoje dojetanje spolnih vlog postavljajo v razmerje do avtentičnosti, težnja napredovati v avtentičnosti pa predstavlja jasno smer, v katero naj se koncept lastne spolne vloge spreminja. V ospredje torej niso postavljene dileme, ali sprejeti neko specifično vlogo, ki je v naprej določena, temveč teme, kako živeti svoje življenje čim bolj avtentično, pri čemer je avtentičnost dojeta kot bolj jedrna, spolna vloga pa je le odraz avtentičnega oziroma neavtentičnega udejanjanja samega sebe oziroma svojih sprejetih izbir.

V preteklosti smo gledali na spolne vloge kot na družbene konstrukte, ki so jih posamezniki prevzemali v procesih socializacije, in o katerih so se bistveno manj spraševali kot danes [14]. Z vidika teorije identitete, ki jo je pred nekaj desetletji razvil Marcia [15], bi lahko rekli, da je imela večina članov družbe zgolj prevzeto obliko spolne identitete, povezane s spolno vlogo, ki ni bila posledica aktivnega raziskovanja in izbiranja, temveč predvsem prevzemanja nečesa, kar je oblikoval nekdo drug.

V pripovedih udeležencev naše raziskave je »slepo« prevzemanje v naprej oblikovanih spolnih vlog zamenjala težnja

po iskanju avtentičnosti, ki jo spremlja povečana stopnja raziskovanja ne le v času mladostništva (za katero je identitetno iskanje sicer najbolj značilno), temveč tudi v obdobju odraslosti.

3.2 Podpora avtentičnemu razvoju spolnih vlog

Če predpostavimo, da je razvoj spolne identitete in spolne vloge v smeri večje avtentičnosti nekaj dobrega tako za posameznika kot za širšo družbo, potem si je v naslednjem koraku smiselno postaviti vprašanje, kako posameznika v tem razvoju podpreti.

Ko mladi odrasli govorijo o svojem razvoju v otroštvu, izpostavljajo pomen doživljanja ugodja in odraščanja ob primernih odraslih osebah. Z vidika razvoja avtentičnosti bi tako v otroštvu potrebovali množico izkušenj, v katerih bi se lahko doživljali kot avtentični posamezniki, sprejeti s strani pomembnih drugih v tem, kar so. Hkrati pa bi morali biti obdani s pomembnimi odraslimi osebami, ki živijo svoje avtentično življenje, kar pomeni tudi, da se na zdrav način sprejemajo kot spolna bitja z vsemi biološkimi danostmi vred.

Ko mladi odrasli govorijo o razvoju v času mladostništva, sebe zelo izrazito postavljajo v odnos s svojim telesom in telesnimi spremembami, s katerimi se v tem obdobju soočajo. Z vidika razvoja avtentičnosti bi potrebovali prostor za iskren pogovor o telesnih spremembah (na katere marsikateri udeleženec raziskave ni bil pripravljen in je ob njih doživljal precejšnje stiske), pa tudi dovolj spodbude za raziskovanje samega sebe in podpore pri sprejemanju svojega telesa ter drugih osebnih danosti.

Ko mladi odrasli govorijo o svoji odraslosti, po eni strani reflektirajo svoje pretekle izkušnje in izražajo želje po razreševanju nerešenih zadev, po drugi strani pripovedujejo o svojem sedanjem doživljanju in izražanju sebe, hkrati pa izražajo tudi potrebo po bolj avtentičnem okolju. V razvoju avtentičnosti se ne postavljajo več toliko v položaj, v katerem je njihov razvoj odvisen pretežno od podpore drugih, temveč se dojemajo kot pomembni akterji lastnega razvoja v smeri čedalje večje avtentičnosti.

3.3 Od avtentičnega jaza do avtentične družbe

Avtentičnost oziroma iskanje pristnega jaza ni nekaj povsem novega, saj se je ta vidik posameznikovega življenja uveljavil že z nastopom jaz-psihologije [16]. Kar morda v evropski kulturi ta hip ni najbolj močno poudarjeno, ali še ne dovolj razvito, pa je drugi pol avtentičnosti, na katerega kažejo rezultati naše raziskave, in sicer težnja po avtentičnem socialnem okolju. Posameznik, ki v sebi najde svojo avtentičnost, ne more biti povsem zadovoljen, če svoje avtentičnosti ne more zaživeti tudi znotraj socialne skupnosti, najprej znotraj socialne skupnosti s pomembnimi drugimi osebami (kar je npr. močno poudarjeno v teoriji navezanosti; [17], potem pa tudi v širšem socialnem okolju.

Ne glede na povečane potrebe po avtentičnosti je še vedno med ljudmi močno prisoten strah pred socialno zavrnitvijo, in z njim povezana prepričanja, da bomo v družbi sprejeti le, če bomo udeleženi vlogi, ki jo od nas pričakuje okolje [18]. Tako se posameznik nujno sooča z notranjim konfliktom, saj vzpostavitev avtentičnega življenja ni mogoča brez tveganja, da se posameznik izpostavi takšen kot v resnici je, neobremenjen s

pričakovani drugih. Prehod iz manj avtentičnih v bolj avtentične oblike življenja je tako povezan s povečanimi ravni napetosti in tesnobe, ki se jih mora posameznik naučiti obvladovati.

Ko mladi odrasli govorijo o avtentičnosti, izhajajo iz sebe, svojega doživetja in svojega notranjega doživljanja. V njihovem pojmovanju postaja prostor lastnega notranjega sveta vodilna avtoriteta. Toda takoj, ko postane notranji svet vodilna avtoriteta, se mora posameznik naučiti razlikovati, kateri motivi, ki jih prepozna, so bolj osrednji in kateri so bolj obrobni [19], oziroma kateri so dejansko izraz njegove pristne, prvobitne narave, in kateri so zgolj odziv na neugodne pretekle izkušnje, oziroma so izraz podedovanih nefunkcionalnih vzorcev preteklih generacij, ki pogosto zameglijo doživetje samega sebe.

Avtentične spolne vloge nikakor niso lahko dosegljiv cilj niti za posameznika, niti za družbo kot celoto, saj zahtevajo zelo poglobljene premisleke o človekovi prvobitni naravi, hkrati pa od posameznikov in družbe zahtevajo veliko mero zmožnosti razlikovanja med tem, kar je res pristno in avtentično ter tem, kar ustvarja le videz pristnosti in avtentičnosti.

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POVZETEK

Živimo v antropocenu, v katerem je človek dominantna geološka sila. Rast prebivalstva v 20. stoletju je bil spodbuden tudi za razvoj demografije in politik nadzora nad prebivalstvom. Bibliografija je vrsta popisa kot demografija, le da bibliografija popisuje "knjige", demografija ljudi. Rezultati iskanja po COBIB vzajemnimi bibliografskimi bazami podatkov so prikazani po izbranih kazalcih znanstvene uspešnosti, in sicer po tipu dela/dokumenta in avtorju v obliki diagramov, predstavljajo osnovo za nadaljnje bibliometrične raziskave literature v področju demografije v nacionalnih knjižničnih informacijskih sistemih Slovenije in Srbije v omrežju COBISS.net ter razkrivajo podobnosti glede odziva obeh sistemov in porazdelitve dokumentov/del po kategorijah in avtorjih.

KLJUČNE BESEDE

antropocen, demografija, bibliografija, COBISS.net

ABSTRACT

We live in the Anthropocene, in which man is a dominant geological force. Population growth in the 20th century was also a stimulus for the development of demography and population control policies. A bibliography is a type of census like demography, except that the bibliography lists "books", the demographics of people. The results of searching through COBIB union bibliographic database are shown according to selected indicators of scientific performance, namely by type of work/document and author in the form of diagrams, they represent the basis for further bibliometric research of literature in the field of demography in the national library information systems of Slovenia and Serbia in the COBISS.net network and reveal similarities in the response of the two systems and the distribution of documents/works by category and author.

KEYWORDS

Anthropocen, demography, bibliography, COBISS.net

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³ Anthropocen, gr. Anthropos človek, kainos nov.

⁴ Holocen, gr. holos ves, v celoti, kainos nov, najmlajša doba kvartarja (lat. quartus četrti). Holocen se je začel ob koncu zadnje ledene dobe, pred 11.500 leti.

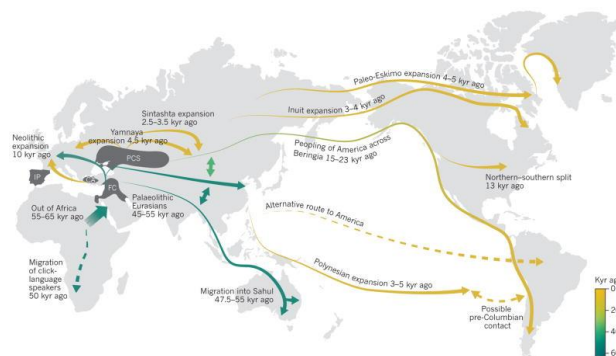
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1 ANTROPOCEN: RAZVOJ ČLOVEŠTVA VKLJUČNO Z RASTJO SVETOVNEGA PREBIVALSTVA KOT GEOLOŠKA SILA

Človeška vrsta je 99% evulucijske izkušnje doživela v Afriki. »Vzpon človeka« se je začel pred 5 do 6 milijonov let, ko so se v Afriki razšli ljudje in šimpanzi. Migracije majhnih skupin ljudi iz Afrike so se začele šele pred manj kot 100.000 let. Genetika afriških populacij kaže na razlike, ki so se medtem razvile [1]. Model "Out-of-Africa" predstavlja hipotezo, da sodobni ljudje izvirajo iz Afrike. Alternativni model, znan kot multiregionalni model, po katerem se je človek razvijal istočasno na več mestih, ki ga je olajšal "pretok genov" kot posledica migracij med temi kraji, je na splošno zavrnjen [2].



Slika 1: O večjih človeških migracijah po svetu sklepamo na podlagi analiz genomskih podatkov [2]

Živimo v antropocenu³ po holocenu⁴, v katerem je človek dominantna geološka sila.

Besedo "antropocen" je leta 2000 skoval nizozemski kemik Paul Crutzen, Nobelov nagradenec za kemijo, natanko za odkrivanje učinkov spojin, ki tanjšajo ozon, leta 1995. [Age of Man: Enter the Anthropocene.](#)

Tekoče klimatske spremembe, ozonske luknje nad Antarktiko, emisija CO₂, biokemijske spremembe življenja na Zemlji - kriza v biosferi, nastanek noosfere imajo antropogene vzroke v človeku in človeški civilizaciji [3].

Doba antropocena⁵ naj bi se začela Anno Domini 1800!

Začetki antropocena vključujejo industrijsko revolucijo v Veliki Britaniji v 1700-ih letih, termo industrijsko revolucijo v Zahodni civilizaciji v 1800-ih letih, predvsem rast prebivalstva v obdobju 1800-2000 od 1 milijarde na 6 milijard, energije 40-krat, proizvodnje 50-krat, emisije CO₂, CH₄ (metan), N₂O (dihidroksid) oksid)⁶...

Dramatične spremembe v obdobju 1945-2000+ so bile poimenovane Veliki pospešek (The Great Acceleration), ko je svetovno prebivalstvo naraslo od 3 na 6 milijard samo v razdobju pičlih 50 let! Še bolj dramatična je bila gospodarska rast, ki se je povečala za 15-krat, poraba nafte od 1960 za 3,5-krat, število avtomobilov je naraslo od 40 milijonov na koncu Druge svetovne vojne na 700 milijonov 1996. leta.

Več kot 3 milijarde ljudi živi v mestnih območjih in ta delež še naprej narašča, sproti pa potrošnja, kar je še eno gonilo Velikega pospeška.

Ob koncu 20. stoletja se je začela »doba genoma« z delom na dveh projektih, HGDP (Human Genome Diversity Project, Projekt raznolikosti človeškega genoma) v ZDA in HUGO (Human Genome Organization, Organizacija človeškega genoma) v Veliki Britaniji na področju populacijske genetike, antropologije in raziskav bolezni [4, 5].

Leta 2014 se je začela Stoletna študija o umetni inteligenci 2014-2114 [6]. Rezultat razvoja inteligentnosti bo doba nebiološke superinteligence [7]. Biološko človeštvo se že sooča z zamenjavo (replacement) z umetno inteligenco, ne pa samo z združitvijo (fusion) [8]. De Garis napoveduje "giga" vojno med ultra-intelligentnimi "artilekti" (umetnimi možgani, artificial intellects) in arhaičnimi biološkimi ljudmi v teku tega stoletja. Nekega dne lahko misleči stroji prevzamejo oblast v družbi in kolonizacijo vesolja nadaljujejo brez ljudi [9, 8].

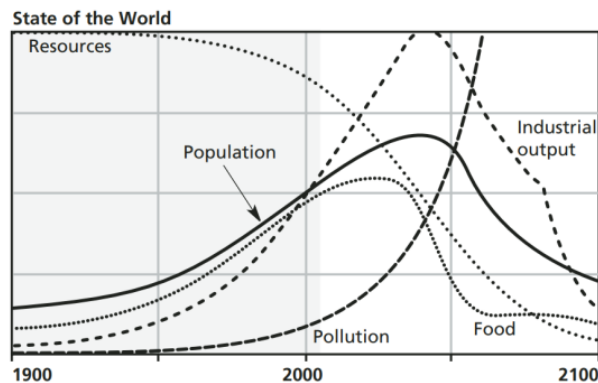
2 DEMOGRAFSKI POUKARI

Skupno število ljudi, ki so kdaj živeli, je približno 100 milijard.

Po predvidevanjih iz začetka 1970-ih let [10] bo leta 2030 prebivalstvo doseglo vrhunec in se bo začelo zmanjševati, ko bo stopnja umrljivosti naraščala zaradi pomanjkanja hrane in zdravstvenih storitev. Industrija lahko raste še 20 let dlje. Prebivalstvo doseže vrh pri 8 milijardah leta 2040, ob visokih ravneh potrošnje. Toda ravni onesnaženosti naraščajo, kar zmanjšuje donose zemlje in zahteva velike naložbe v obnovo kmetijstva. Prebivalstvo končno upada zaradi pomanjkanja hrane in negativnih učinkov onesnaževanja na zdravje.

⁵ Mednarodna komisija za stratigrafijo (International Commission on Stratigraphy – ICS) niti Mednarodna zveza geoloških znanosti (International Union of Geological Sciences - IUGS), katere del je ICS, nista uradno odobrili izraza kot priznane pod razdelitve geološkega časa!

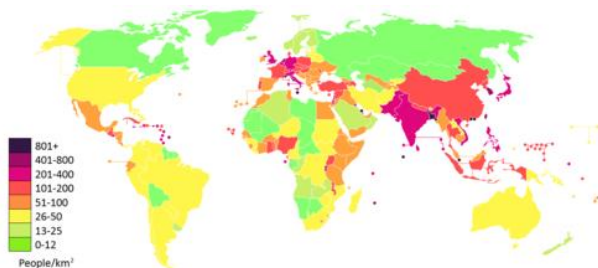
⁶ ARSO Kazalci okolja v Sloveniji | Okolijski kazalci (gov.si) Spletišče omogoča dostop do preko 180 kazalcev okolja, temelječih na številčnih podatkih, ki kažejo stanje, lastnosti ali razvoj kakšnega pojavnosti.



Slika 2: Stanje

»Trideset let je dokazalo, da je model Rimskega Kluba bil preroški; zdaj, v svoji najnovejši iteraciji, dobimo še zadnji izziv.« [11]

Zemlja lahko podpira 28 milijard prebivalcev! [12]



Slika 3: Zemljevid gostote prebivalstva po državah

Gostota poselitve je merilo prebivalstva na enoto površine. Večinoma se uporablja za ljudi, včasih pa tudi za druge žive organizme. Je ključni geografski in demografski kazalnik.

Največja država na svetu po površini je Rusija (približno 11,5 %, 17 milijonov km²), vendar se po številu prebivalcev uvršča šele na deveto mesto, za Kitajsko, Indijo, ZDA, Indonezijo, Brazilijo, Pakistanom, Bangladešem in Nigerijo.

Na kvadratnem kilometru površine Ruske federacije živijo povprečno 8,4 prebivalca/ km² (143.300.000/17.000.000 km²).

Z razpadom Sovjetske zveze se je v Rusiji začela demografska kriza, ki še vedno traja, vendar se je število prebivalcev po letu 2002 izboljšalo.

Velike države imajo lahko zelo nizko gostoto prebivalstva, gostota prebivalstva Kanade, druge države po velikosti, je le 3,8 osebe na kvadratni kilometer.

Največjo gostoto prebivalstva ima Makao (Kitajska) – 18.000 prebivalcev/km².

Najmanjšo gostoto prebivalstva ima Grenlandija (Danska) – 0,03 prebivalca/ km².

Včasih se uporabi obratna vrednost. Kolikšna je povprečna površina, ki jo ima na voljo en prebivalec določenega območja. Izračuna se tako, da se površina, izražena v m², deli s številom prebivalcev na tem območju.

Država z najmanjšo površino na prebivalca je Monako 63 m²/prebivalca, z največjo površino na prebivalca pa Grenlandija 30 milijonov m²/prebivalca.

Svetovno prebivalstvo se je v 20. stoletju povečalo z 1,6 milijarde leta 1900 na nekaj več kot 6 milijard leta 2000, s tem, da so se ¾ te rasti zgodile po letu 1950. Ta trend rasti prebivalstva je bil spodbuden tudi za razvoj demografije in politik nadzora nad prebivalstvom.

Med tem je rast prebivalstva po svetu začela upadati, hkrati se pričakovano trajanje življenja začelo podaljševati.

Število Zemljanov je novembra lani naraslo na osem milijard, le 11 let za tem, ko je doseglo sedem milijard. Leta 2020 je stopnja rasti prvič po letu 1950 upadla pod en odstotek na leto.

Po zadnjih ocenah ZN naj bi se svetovno prebivalstvo do leta 2052 povečalo na 9,8 milijarde in bi lahko doseglo vrh pri 10,4 milijarde sredi 80 let tega stoletja. [Rast prebivalstva upada, življenjska doba pa podaljšuje.](#)

Število svetovnega prebivalstva je najhitreje naraščalo v 60. letih prejšnjega stoletja, povprečno za 2 % na leto. Od takrat se rast postopoma upočasnjuje. V letu 2019 naj bi se število prebivalcev na svetu povečalo za približno 82 milijonov ali za 1,1 %. Letos naj bi se rodilo 140,1 milijona, umrlo pa 58,4 milijona ljudi. Rast svetovnega prebivalstva ni enakomerna. Najhitreje se povečuje število prebivalcev Afrike; letno število rojenih je tam kar štirikrat višje od števila umrlih. V Evropi narašča število prebivalcev zelo počasi; več prebivalcev umre kot se jih rodi; skupni prirast je pozitiven le zaradi priseljevanja (število priseljenih je višje od števila odseljenih). [Svetovni dan prebivalstva.](#)

3 GLOBALNI ZNAČAJ AMERIŠKE DEMOGRAFIJE

Kot referenčno delo, ki se ukvarja z demografijo in bibliometričnimi raziskavami demografske literature, sva izbrala članek Klancher Merchant A Digital History of Anglophone Demography and Global Population Control, 1915–1984 [13].

Demografija kot znanost in politike naravnane na posege, katerih cilj je omejiti rast prebivalstva, in vmešavanje državnih oblasti v življenja posameznikov, vključno z inženiringom družin in celotnih narodov, so se globoko prepletali [13].

Enkrat je demografija v službi politike (kot programa, ne pa izvajanja politike), drugič je politika v službi demografije!

Decembra 1959 je ameriški predsednik Dwight Eisenhower izjavil, da "kontrola rojstev ni naš posel ... Ne morem si bolj odločno predstavljati," je dodal, "temo, ki ni ne prava politična ali vladna dejavnost, ne funkcija ali odgovornost." [14]

To stališče naj bi v naslednjem desetletju močno spremenila najprej predsednik Lyndon Johnson in kasneje Nixon, ki je leta 1969 v posebnem poročilu Kongresu opozoril na "nujno potrebo po obravnavanju stopenj rasti svetovnega prebivalstva in njihovega negativnega vpliva na gospodarsko rast, o vedno večjem prepadu med bogatimi in revnimi narodi ter o življenjskem standardu, zlasti o prehrani in zdravju, pa tudi o pomanjkanju šol in stanovanj ..."

Podobno nasprotje je mogoče potegniti med stališči administracij Johnsona, Nixona, Forda in Carterja o dejavnostih v zvezi s svetovnim prebivalstvom ter tistimi administracij Reagana in Busha [14].

Posamični sponzorji oz. zasebni pokrovitelji in država v ZDA so vlagali finančna sredstva v institucionalizacijo (ustanavljanje populacijskih raziskovalnih centrov, strokovnih združenj in demografskih revij, predvsem v ZDA) in raziskave v področju demografije in na ta način vplivali na to, katera raziskovalna vprašanja bodo znanstveniki postavljali in kakšne metode bodo uporabljali. Demografija kot znanost in v tem primeru kot "ancilla" (služabnica) politike pa je zagotavljala populacijskim politikam posameznikov, organizacij in države, vključno z metodami evgenike in »rasne higijene« kot so množične sterilizacije, evtanazije in genocidi, znanstveno legitimnost in moralno upravičenost v očeh javnosti.

Zgodovina anglofonske demografije je hkrati globalna zgodovina in zgodovina ZDA.

Klancher Merchantova (2017) [13] je porazdelila relevantno demografsko literaturo časovno in jezikovno.

Vsebinsko demografskih člankov obravnava v dveh obdobjih: od leta 1915 do 1946, ko se je demografija združila v eno interdisciplinarno znanstveno področje, in od 1947 do 1984.

Do sredine dvajsetega stoletja je bila večina demografskih raziskav objavljena v angleščini in francoščini.

Znotraj znanstvenih področij so skupnosti praviloma omejene z jezikom in demografija ni izjema. Demografska literatura v angleškem jeziku je največja po geografskem dosegu, tematsko in politično pa je najtesneje povezana z nadzorom prebivalstva. Glavni pokrovitelj frankofonske demografije je načeloma "pronatalistična" francoska vlada. Frankofonska demografija poudarja probleme nizke rodnosti, anglofonska demografiji probleme visoke rodnosti.

Med anglofonskimi demografi prevladujejo avtorji s sedežem v ZDA. Večino člankov v angleškem jeziku so napisali znanstveniki, ki so živeli ali so se izobraževali v ZDA. Levji delež financiranja anglofonske demografije po vsem svetu, tako med vojnami kot po drugi svetovni vojni, je iz ameriških virov. Ameriške filantropije in pozneje ameriška vlada so bile največji pokrovitelji nadzora rojstev po vsem svetu. Financirale so raziskave in programe načrtovanja družin ter spodbujale razvoj populacijske politike na nacionalni in mednarodni ravni, posebej

po drugi svetovni vojni, ko je prebivalstvo v Aziji, Afriki in Latinski Ameriki začelo hitro naraščati.

Demografska literatura se je razvijala v skladu z dobredelnimi cilji in tudi političnimi interesi pokroviteljev demografije, medtem ko sociološka literatura o prebivalstvu tega ne pozna.

Financerji demografskih raziskav v ZDA so se izognili vprašanju ali je rast prebivalstva grožnja in komu, in so politično razpravo o prebivalstvu evfemistično, olepševalno preoblikovali v "tehnično" vprašanje o tem, kako najučinkoviteje zmanjšati globalno rodnost.

Vprašanje razumevanja nosilcev političnih prizadevanj v ZDA, ki so bila usmerjena na omejitve rasti svetovnega prebivalstva v dvajsetem stoletju, naj bi ločili od njihovega nespornega prispevka k rasti demografske znanosti, ki je te politične igralice vodila in jim zagotovila znanstveno legitimitnost.

4 DEMOGRAFIJA IN BIBLIOGRAFIJA

Bibliografija⁷ je oblika popisa tako kot demografija, le da bibliografija popisuje "knjige", demografija ljudi, pa tudi živali.

Platon primerja knjige in druga umetniška dela z otroki. Ko si ogleda pesmi Homerja, Hezioda in drugih dobrih pesnikov, bi si vsak želel, da se mu rodijo takšni »otroci« duha in so jim zaradi takšnih "otrok" zgrajeni mnogi hrami, zaradi bioloških pa nikomur.

Začetki bibliografije segajo v 5. stoletje pred našim štetjem. Bibliograf (gr. bibliographos) je bil pisatelj oziroma prepisovalec knjig. V 17. stoletju je bil postopek prepisovanja zamenjan s postopkom opisovanja. Pojem bibliografije kot znanosti o knjigah s stališča popisovanja in klasifikacije je uvedel Berthelot Marcelin v veliko francosko enciklopedijo leta 1885. Pomen se ni spremenil vse do danes. Sinonim za bibliografijo kot znanost je bibliologija. Bibliografija pomeni troje: znanost o knjigi, postopek izdelave seznama knjig in proizvod te dejavnosti. Bibliografija kot dejavnost predstavlja postopek ugotavljanja, urejanja in podajanja podatkov o knjigah. Proizvod te dejavnosti se tudi imenuje bibliografija (sistemiziran seznam knjig za določen namen). Sorodni z bibliografijo so izrazi katalog, indeks, biblioteka, leksikon, slovar, trezor, anali, literatura, repertorij (nlat. repertorium), inventar, manual, priročnik, tezaver, letopis [15].

⁷ Bibliografija, gr.biblion knjižica, grafein pisati, knjigopisje, popisovanje knjig, člankov itd.

⁸ Nacionalna pomembnost bibliografskega gradiva je bila prepoznana tudi v konvenciji o sukcesiji med Avstrijo in Kraljevino Srbov, Hrvatov in Slovencev z dne 26. junija 1923, po kateri se je Republika Avstrija kot ena izmed dedinj Avstro-ogrske monarhije obvezala vrniti vse umetnine, starine ter znanstveni in bibliografski material s področij, ki so bila vključena v novo državo Kraljevino SHS, nastalo konec leta 1918 (od 1929: Kraljevina Jugoslavija). Mednarodni dunajski konvenciji o sukcesiji sta bili sprejeti šele po 2. svetovni vojni leta 1978 in leta 1983 na Dunaju med časom SFRJugoslavije. Konvencij ni ratificiralo potrebno število držav in nista obvezni [20].

V RBU je bilo leta 1934 (zadnje leto vnosa zapisov), ko je belgijska vlada prekinila financiranje projekta, preko 15 milijonov zapisov. Zbirka je bila ohranjena do leta 1940, ko so nemški nacisti po okupaciji Belgije uničili njen večji del.

⁹ Danes rečemo, da so knjižnice internet+, kar pomeni, da nudijo uporabnikom storitve in proizvode, ki jih internet ne zmore.

Med dvema temeljnima funkcijama bibliografije je bolj pomembna njena funkcija zagotavljanja gradiva za bralca kot proces zbiranja.

Leta 1895 sta Paul Otlet in Henri La Fontaine ustanovila v Bruslju Mednarodni inštitut za bibliografijo, začela ustvarjati "Univerzalni bibliografski repertorij" (Repertoire Bibliographique Universel (RBU), ki je že do konca leta 1895 imel 400.000 vnosov, in uvedla storitev "analognega iskalnika" za poizvedbe po repertoriju na zahtevo in pošiljanje kopij katalognih listkov po pošti naročnikom. Do leta 1912 sta opravila povprečno več kot 1500 tovrstnih storitev na leto [16, 17, 18].



Slika 4: Répertoire Bibliographique Universel

Otlet si je zamislil postaviti »izvod« RBU v vsakem večjem mestu po svetu, pri čemer ima Bruselj glavni izvod. Med letoma 1900 in 1914 so bili narejeni poskusi pošiljanja izvodov RBU v Pariz, Washington, D.C. in Rio de Janeiro.

RBU naj bi predstavljal univerzalno bibliografijo vseh knjig in drugih publikacij iz vseh držav, vseh obdobjih in vseh predmetnih področij, razvrščenih po predmetu in avtorju. Prva stopnja RBU naj bi bili katalogi del. Postopoma bi se vsaki enoti dodajale analitične opombe.

Za katalog knjig naj bi bile odgovorne nacionalne knjižnice, za vnos podatkov iz periodičnih publikacij pa specializirana mednarodna združenja, vsako za svoje področje specializacije. Univerzalna bibliografija je zamišljena kot del Mundaneuma (svetovnega centra/knjižnice). Tako bi bilo človeško znanje v celoti obdelano le enkrat in shranjeno na enem samem mestu ter zaščiteno pred vojnami in revolucijami [18].

Bibliografska prizadevanja so ogledalo nacionalne kulture in ne samo ozko strokovno vprašanje⁸.

Za preverjanje pokritosti demografske literature v COBISS.net sva kot referenčna izbrala dva nacionalna sistema z največjim številom povezanih knjižnic⁹ v omrežju COBISS.net, in sicer COBISS.SI (928) in COBISS.SR (258).

Slovenija je prvič preseгла 2 milijona prebivalcev leta 2005. Julija 2022 je štela 2,108.732 prebivalcev. Na kvadratnem

kilometru površine Slovenije (površina kopnega 20.271 km²) živi povprečno 104 prebivalcev [19].

Za primerjavo, na kvadratnem kilometru površine Nizozemske, ki je 2-krat večja od Slovenije, živi 393 prebivalcev (16.491.461/40.000).

Bibliografska dejavnost v Sloveniji ima prek 150 let dolgo tradicijo.

Srbija ima 6,641.197 prebivalcev, površina države je 77.474 km² in na kvadratnem kilometru živi 83 prebivalcev. Popis leta 2022 je pokazal nadaljnji upad prebivalstva v Srbiji, ki je v popisnem obdobju 2011-2022 znašal 7,51 % [21].

Bibliografska dejavnost v Srbiji ima tradicijo dolgo prek 200 let.

Leta 1948 je bil preoblikovan Bibliografski institut NR Srbije v Beogradu v Jugoslovanski bibliografski institut (JBI), kasneje JUBIN), ki je bil v bivši Jugoslaviji na zvezni ravni zadolžen za izdelavo tekoče bibliografije (za knjige, brošure in muzikalije ter za članke in priloge v revijah in zbirnih delih) ter za retrospektivno bibliografijo.

V tem času je bilo upravljanje razvoja znanosti in tehnologije na federalnem nivoju v bivši Jugoslaviji v pristojnosti Zveznega sekretariata za razvoj (SSR, prej Odbor za koordinacijo nauke i tehnologije v SFRJ (OKNT)) federalne vlade, medtem ko je kultura vključno s knjižnicami bila v pristojnosti republik in avtonomnih pokrajin.

Republiške in pokrajinske akademije znanosti in umetnosti je na federalni ravni predstavljal Svet akademij znanosti in umetnosti SFRJ.

Znanstvena društva na nivoju R/AP so bila na zveznem nivoju združena v Asociacijo naučnih društev Jugoslavije (ANUJ) in preko ANUJ-a v Mednarodni svet za znanost (The International Council for Science (ICS), prej Mednarodni svet znanstvenih zvez (International Council of Scientific Unions (ICSU)).

Po črti samoupravnega interesnega organiziranja so bili R/P SISZ združeni v Skupnost R/P SISZ.

Leta 1962 je bila v Beogradu ustanovljena Skupnost nacionalnih bibliotek Jugoslavije.

5 OMREŽJE COBISS.NET

COBISS (Co-operative Online Bibliographic Systems and Services) je organizacijski model, ki povezuje knjižnice v nacionalne knjižnične informacijske sisteme in regionalno omrežje COBISS.net z vzajemno katalogizacijo, vzajemnimi bibliografskimi bazami podatkov COBIB in lokalnimi bazami podatkov sodelujočih knjižnic ter integriranim upravljanjem knjižničnih katalogov in bibliografij. [Institut informacijskih znanosti](#)

Na seji predsedstva Skupnosti nacionalnih knjižnic v SFRJ v decembru leta 1987 je bil sprejet sistem vzajemne katalogizacije

kot skupna osnova knjižničnega informacijskega sistema (KIS oz. BIS) ter sistema znanstvenih in tehnoloških informacij Jugoslavije (SZTIJ oz. SNTIJ).

IZUM je od 1987 host SZTI v Sloveniji in koordinator razvoja sistema vzajemne katalogizacije in host KIS-a v SFRJ; od 1988 generalni izvajalec (GI) izgradnje SZTIJ (prva faza 1988-1991), informacijski servis (host) SZTIJ; od 1990 med regionalni koordinacijski center v projektu izgradnje baze podatkov o znanstvenih knjižnicah v delovni skupnosti ALPE-JADRAN; od 1991 informacijski infrastrukturni servis za znanost, izobraževanje in kulturo, koordinator aktivnosti v mednarodnem projektu TRACE (CORDIS) za Slovenijo, informacijski (bibliografski) servis v sistemu COBISS (Cooperative Online Bibliographic System & Services) [22].

Leta 2002 je IZUM zagnal Projekt COBISS.net, leta 2003 pa je bila podpisana Pogodba o vzpostavitvi omrežja COBISS.net in prosti izmenjavi bibliografskih zapisov, ustvarjenih v avtonomnih knjižničnih informacijskih sistemih Bosne in Hercegovine, Črne gore, Makedonije, Slovenije in Srbije. <https://izum.si/en/aboutus/>

Leta 2012 sta Republika Slovenija in UNESCO (Organizacija Združenih narodov za izobraževanje, znanost in kulturo) sklenili sporazum o preoblikovanju IZUM-a v Mariboru v Regionalni center za knjižnične informacijske sisteme in informacijske sisteme o raziskovalni dejavnosti pod pokroviteljstvom Unesca. S tem je Unesco podprl mednarodno sodelovanje IZUM-a na območju jugovzhodne Evrope.



Slika 5: Mreža avtonomnih sistemov COBISS (Vir: <https://www.cobiss.net/map>)

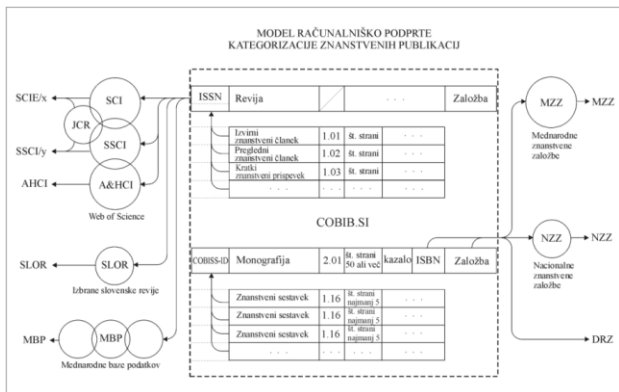
6 REZULTATI ISKANJ DEMOGRAFSKE LITERATURE V COBISS.SI IN COBISS.SR

Ciljano pokritost sva preverjala z iskanjem (information retrieval), ki je eden izmed glavnih načinov razvoja interdisciplinarnih odnosov informacijske znanosti z več drugimi vedami [23, 24].

Znanstvene publikacije so osnovni proizvod temeljnih in uporabnih raziskav in zato glavni neposredni kazalci

raziskovalne uspešnosti. Med znanstvenimi publikacijami sta najpomembnejši dve skupini: znanstveni članki ter kratki znanstveni prispevki v revijah ter znanstvene knjige oziroma posamezna poglavja oziroma prispevki v njih. Dobro polovico vseh zapisov v bibliografiji raziskovalcev predstavljajo prispevki s strokovnih in znanstvenih srečanj [25].

Tip bibliografske enote je določen po Tipologiji dokumentov/del za vodenje bibliografij v sistemu [26].



Slika 6: Model računalniško podprte kategorizacije znanstvenih publikacij [27]

Bibliografska enota za knjige in poglavja v knjigah (monografske objave) vsebuje tudi podatek o založniku dokumenta/dela [25, 28].

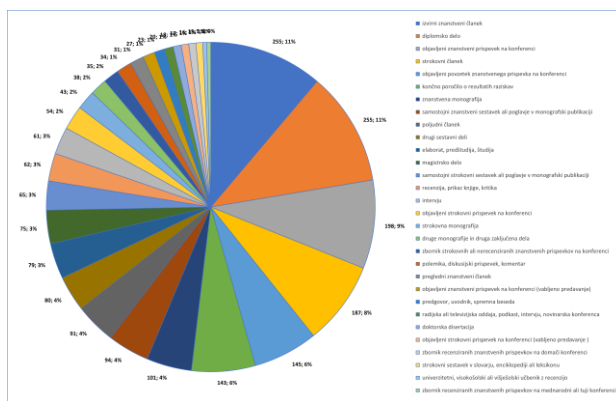
Rezultate iskanja po vzajemnih bibliografskih bazah podatkov (COBIB) prikaževa z grafičnimi diagrami po izbranih kazalcih znanstvene uspešnosti, in sicer po tipu dela/dokumenta (slika 1 in 2) in avtorjih (slika 3 in 4).

V tabeli 1 so prikazani rezultati iskanj po COBISS+ pri uporabljenem iskalnem izrazu (IZ) demografija in omejevanjih s filtrom (F) predmet: demografija, migracije, študije spolov.

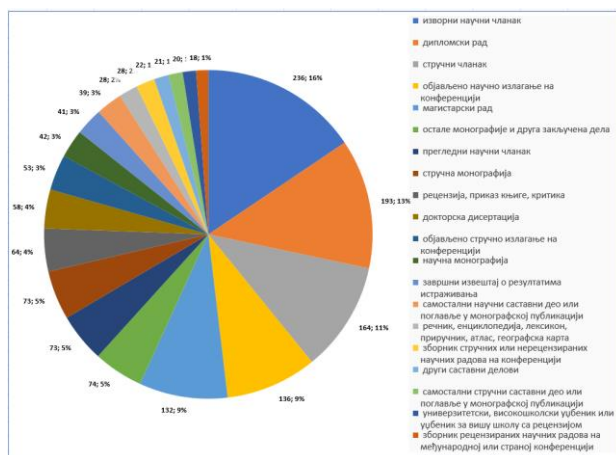
Table 1: Rezultati iskanj pri uporabljenem iskalnem izrazu in omejevanjih (10.8.2023)

sistem COBISS	IZ:demografija	F:demografija, migracije, študije spolov
COBISS.SI	9.978 zadetkov	6.140 zadetkov
COBISS.SR	6.952 zadetkov	5.041 zadetkov

Glede tipologije sva se omejila pri COBISS.SI na "zbornik recenziranih znanstvenih prispevkov na mednarodni ali tuji konferenci", to je prvih 30 od 41 tipov, in ta zadnji tip ima 9 zadetkov. Pri COBISS.SR pa je tip dela "zbornik recenziranih naučnih radova na mednarodni ili stranoj konferenciji" 20. tip po vrsti od 38 in ima 20 zadetkov.



Slika 7: demografija - porazdelitev dobljenih bibliografskih enot po tipologiji (COBISS.SI)

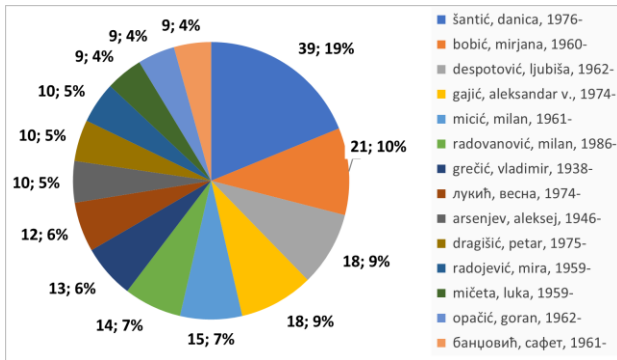


Slika 8: demografija - porazdelitev dobljenih bibliografskih enot po tipologiji (COBISS.SR)

Končnega števila avtorjev ne dobimo, ker se pri omejevanju s filtri izpiše le prvih 1.000 zadetkov zaradi omejitve v COBISS+. Zaradi boljše preglednosti smo se pri avtorjih omejili na prvih 15.

Lahko bi omejevali s filtri, ki jih končnemu uporabniku na enostaven način omogoča COBISS+, še bolj podrobno, recimo po jeziku. Vendar se seznam avtorjev in seznam po tipologiji bistveno ne spreminjata, se pa minimalno spremeni vrstni red znotraj top 15. Recimo avtor de Castro bi odpadel iz seznama rezultatov, ker je verjetno pisal v italijanščini.

Rezultatov iskanj nismo omejevali na jezik tudi zato, ker sama iskalna zahteva in predmet iskanja dokaj natančno opredeljujeta iskalni izraz zaradi pravil vnosa predmetnih oznak v bazo podatkov. Prav tako je zanimivo, da se spreminjanje iskalnega izraza do korena, pri demografij* ne povzroči spremembe pri prvih 16 avtorjih, če pa izberemo iskalni izraz demograf* pa se na 16 mesto prerine drug avtor.

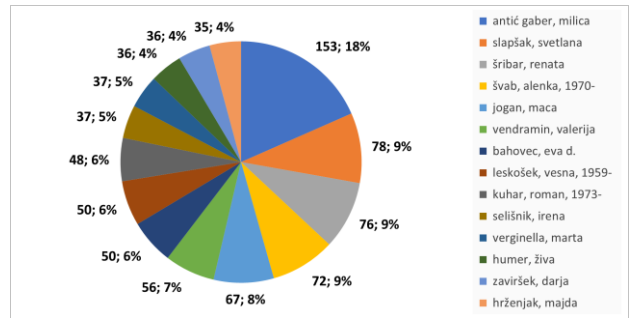


Slika 14: migracije - porazdelitev dobljenih bibliografskih enot po avtorjih (COBISS.SR)

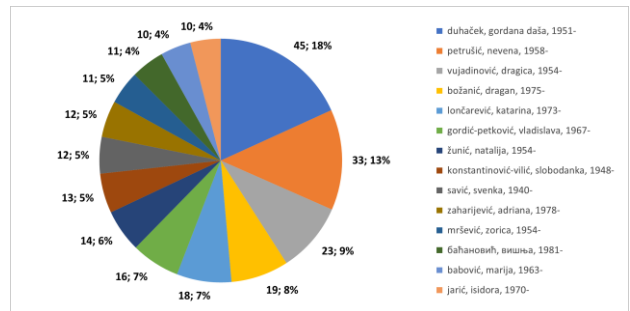
V tabeli 3 so prikazani rezultati iskanj po COBISS+ pri uporabljenem iskalsnem izrazu (IZ) študije spolov in omejevanjih s filtrom (F) predmet: demografija, migracije, študije spolov.

Table 3: Rezultati iskanj pri uporabljenem iskalsnem izrazu in omejevanjih (25.9.2023)

sistem COBISS	IZ:študije spolov	F:demografija, migracije, štud. spolov
COBISS.SI	5.184 zadetkov	4.561 zadetkov
COBISS.SR	1.958 zadetkov	1.682 zadetkov



Slika 17: študije spolov - porazdelitev dobljenih bibliografskih enot po avtorjih (COBISS.SI)



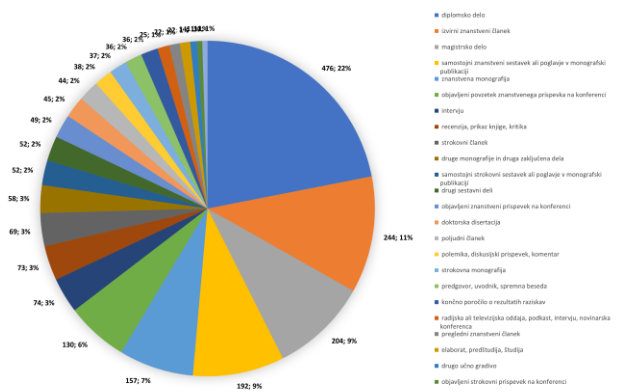
Slika 18: študije roda/rodne študije - porazdelitev dobljenih bibliografskih enot po avtorjih (COBISS.SR)

7 SKLEPNA PREMIŠLJEVANJA

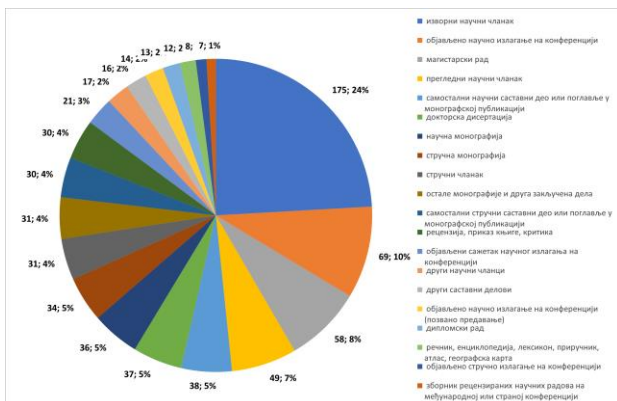
Kvartarno obdobje treh milijonov let je premajhen čas, antropocen pa je njegova neznatna zadnja doba, da bi bil viden na geološki časovni uri. Izraz "antropocen" kot geološkega doba še ni uradno priznan.

Po Rimskem klubu sodobna družba ni trajnostna, saj je trajnostna le tista družba, ki "zadovoljuje potrebe sedanosti, ne da bi ogrozila sposobnost prihodnjih generacij, da zadovoljijo svoje potrebe". Pred več kot 50 leti je knjiga z naslovom Meje rasti (Limits to Growth), ki jo je naročil Rimski klub, povzročila mednarodno senzacijo. Glavno spoznanje pa je bilo, da ima planet Zemlja nosilne zmogljivosti za varno rast tako glede rasti prebivalstva kot uporabe naravnih virov! [10]

Na tiskovni konferenci 14. oktobra 1980 v Los Angelesu je republikanski predsedniški kandidat, guverner Ronald Reagan zavrnil možnost napovedovanja rasti prebivalstva in opozoril na neupoštevanje prihodnjih znanstvenih odkritij. Rekel je: "Zdaj se lahko vrnemo še dlje od tega k Malthusovi teoriji. Svet bo umrl od lakote. Takrat še niso vedeli ničesar o umetnih gnojilih. Nič niso vedeli o pesticidih. In o mehanskem kmetovanju niso vedeli ničesar. Takrat je bil mož z motiko. Danes obstajajo študije, kmetijske študije, ki temeljijo na obdelovalni zemlji na Zemlji in na podlagi tega, če se obdelujejo na ravni ameriškega kmetovanja o vsem svetu, da lahko Zemlja vzdrži populacijo 28 milijard ljudi." [12]



Slika 15: študije spolov - porazdelitev dobljenih bibliografskih enot po tipologiji (COBISS.SI)



Slika 16: študije roda/rodne študije - porazdelitev dobljenih bibliografskih enot po tipologiji (COBISS.SR)

Leta 2020 je stopnja rasti prvič po letu 1950 upadla pod en odstotek na leto. [Rast prebivalstva upada, življenjska doba pa podaljšuje.](#)

Demografske osnove politike globalne kontrole prebivalstva ZDA predstavljajo predvsem NSSM200 [29, 30, 31, 14, 32], ki sledi demografsko politiko angleškega kralja Jurija VI [33, 34], rasna higiena v Nemčiji [35], evgenika in rasni zakoni v ZDA [36]. Navedene vire in dejstva Klancher Merchantova [13] ne izpostavlja in jih tolmači bolj evfemistično, olepševalno.

Razlikujemo "svobodne" in "uporabne" vede. Demografija naj bi bila "svobodna" veda, čeprav ni zanemarljivo število znanstvenikov v področju demografije (takih je veliko manj v sociologiji prebivalstva), ki si želijo, da bi jih vlade čim več "uporabljale" kot "služabnike" politike.

Najino delo je s stališča znanosti o podatkih (data science) metodološko šele na ravni vizualizacije podatkov in pri testiranju odzivnosti sistemov COBISS.SI in COBISS.SR z iskanjem po bibliografskih zbirkah podatkov z izbranimi iskalnimi izrazi vsebinsko in eksperimentalni fazi.

Znanstveno-raziskovalno delo se začne s pripravo podatkov. 80% se nanaša na obdelavo podatkov, 20% na analizo. Priprava podatkov se začne z vizualizacijo, ki je orodje za prikazovanje in posredovanje podatkov.

Kateri podatki se bodo zbirali v nadaljnjem tovrstnem delu pa je odvisno od definiranja problemov, ciljev, hipotez in strategije ter od izbranih populacijskih procesov (demografija v ožjem smislu) in populacijskih študij ekonomskih, socialnih, institucionalnih, kulturnih in bioloških procesov, ki vplivajo na prebivalstvo (širše interdisciplinarno področje demografije).

Opravljen raziskava je razkrila podobnosti glede odziva obeh sistemov in porazdelitve dokumentov/del po kategorijah in avtorjih.

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Trpeči člani človeške družbe

Suffering Members of Human Society

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POVZETEK

Evtanazija kot prostovoljno končanje trpljenja oz. človeškega življenja posameznikov in njihova izločitev iz človeške družbe je v nekaterih zahodnih državah že postala legitimna in že vpliva na demografsko sliko naroda. V mnogih državah pa se na tem področju krešejo mnenja o primernosti uzakonjenja samomora z medicinsko asistenco. V prispevku si postavljamo vprašanje ali so trpeči in ostareli zgolj breme družbe ali pa so tudi koristni, morda nujno potrebni za zdravo človeško družbo. Krščanski nauk v trpljenju prepoznava nujni sestavni del življenja vsakega človeka in trpeče ljudi kot nujno potrebne člane družbe. V razpravi življenje opredeljujemo s pomočjo teološke relacijske teorije: živeti pomeni biti v odnosu. Prav ta opredelitev nam pomaga spoznati, da nepopolnost posameznih ljudi, tudi trpljenje, v bistvu omogoča preživetje družbe. Civilizacija, ki se ne nauči sprejemati trpečih in ostarelih članov, je obsojena na propad.

KLJUČNE BESEDE

človeška družba, evtanazija, ostareli, religijski nauki o trpljenju, teološka relacijska teorija.

ABSTRACT

Euthanasia, as the voluntary termination of suffering and human life of individuals, and their removal from human society, has already become legitimate in some Western countries and it is already affecting the demographic picture of the nation. However, opinions on the appropriateness of legalizing assisted suicide vary in many nations. In this contribution, we pose the question of whether the suffering and elderly are merely a burden on society or if they are also beneficial, perhaps even essential, for a healthy human society. Christian doctrine recognizes suffering as an essential component of every human life and views suffering individuals as necessary members of society. In the discussion, we define life through the lens of theological relational theory: to live means to be in relationship. This very definition helps us understand that the imperfections of individual people, including suffering, essentially enable the

survival of society. A civilization that fails to embrace suffering and the elderly is destined for decline.

KEYWORDS

Human society, Euthanasia, Elderly, Religious teachings on suffering, Theological relational theory.

1 UVOD

Ker so razlogi za smrt, ki drastično zmanjšujejo število pripadnikov naroda, težko zanemarljiva tema demografov, je pomembno, da pri demografski analizi populacije obdelamo tudi vprašanje evtanazije. Statistike namreč kažejo, da v državah, kjer je samomor z medicinsko asistenco z zakonom omogočen, postaja tovrsten zaključek življenja na zelo visokem mestu razlogov za smrt. Na primer, v Kanadi je bila evtanazija uzakonjena leta 2016. Podatki kažejo, da je v kanadskih provincah Quebec in Britanska Kolumbija v letu 2021, prostovoljna smrt predstavljala 4,7% oz. 4,8% vseh smrti.

Leto kasneje se je v Quebecu ta procent dvignil na 5,1% in s tem ta pokrajina predstavlja največji odstotek uporabe evtanazije na svetu. Nizozemska beleži 4,9% evtanaziranih od vseh umrlih in Belgija 2,3%. Torej evtanazija pospeši zmanjševanje števila prebivalcev v narodu. Ne zmanjšuje le števila starih, temveč tudi mladih članov naroda. V Kanadi je »med razlogi za evtanazijo namreč tudi invalidnost, v teku je še razširitev na duševne motnje«. V Belgiji lahko zaprosijo za evtanazijo tudi otroci; o tej možnosti razmišljajo tudi na Nizozemskem, v Kanadi pa je »posebni kanadski odbor za smrt z medicinsko pomočjo izdal poročilo, v katerem priporočajo razširitev pravice na »zrele mladoletnika« (od 12. leta dalje), pri čemer bi otrokova volja imela prednost pred ugovorom staršev. »Vzorec v državah, ki so že legalizirale evtanazijo, kaže na nezadržno širjenje obsega in odpravo omejitev. Najprej je ta odprta le za skrajne primere, a se pojavijo vedno nove utemeljitve, zakonodajna ali sodna oblast pa prej ali slej oceni, da so omejitve diskriminatorne. Skoraj tretjina Kanadčanov se strinja, da bi med razloge za evtanazijo vključili brezdomstvo (28%) in revščino (27%), petina pa bi odpravila vse omejitve«. Zato postaja problematika evtanazije zelo pomembna za sleherni demografski analizo.

V naši razpravi bomo upoštevali dva vidika evtanazije. Prvi je pogled na prostovoljno končanje življenja z medicinsko pomočjo, ki ga ima oseba, ki trpi in je soočena z omejitvami svojih življenjskih funkcij. Drugi pa je pogled na evtanazijo s

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strani družbe, ki skrbi za ostarele in trpeče. Človeško je, da si trpeči človek želi čim prej zaključiti življenje; tudi zato, da ne bi bil v breme svojim bližnjim. Vsak človek, ki začuti, da se bliža konec njegovega biološkega bivanja na tem svetu, predvsem, če se sooča s trpljenjem, fizičnim ali psihičnim, si namreč želi, da bi konec prišel čim prej. Zato se je človeštvo že od vsega začetka soočalo z dejstvom samomora. Državni zakon o asistenci družbe pri prostovoljnem končanju življenja posameznika, ki trpi, s tega vidika postane pravica posameznika, ki lahko uresniči svojo željo po končanju življenja. Mi se bomo osredotočili na pogled na evtanazijo s strani družbe, v kateri bolnik živi.

Do sedaj je bilo namreč samo po sebi umevno, da so svojci in bližnji uporabili vse mogoče načine da bi trpečemu zmanjšali trpljenje, vendar so ga želeli hkrati čim dlje ohraniti v svoji sredi oz. pri življenju. Samomor je bil, predvsem v krščanski civilizaciji, viden kot nekaj slabega. Ne zgolj zaradi verskega nauka, temveč predvsem zato, ker je vsak človek del človeške skupnosti; smrt vsakega posameznika je zato bolečina za skupnost, predvsem nepričakovana in »nepotreben« odhod posameznikov iz skupnosti predstavlja bolečino za vse njene člane. Ko torej govorimo o evtanaziji, ki jo sodobna družba želi narediti za legalno možnost samomora, zdi se celo, da družba pričakuje ali celo želi, da se bo star in trpeči človek odločil za odhod od mladih in zdravih, torej ne mislimo na nič novega z vidika posameznika, ki želi čim prej umreti. Mislimo predvsem na družbo, ki je spremenila svoje mišljenje. Od prepričanja, da je potrebno reševati življenje vsakega človeka, je »prestopila Rubikon« in razmišlja, da je potrebno posamezniku, ki si to želi, omogočiti, pomagati in ga celo spodbuditi, da konča svoje življenje. Legalni samomor s pomočjo družbe, v kateri živi, je torej pristanek družbe, da posamezniki predčasno odidejo iz te iste družbe oz. je izraz mnenja, da družba svojih starejših članov, bolnikov in neproduktivnih oseb ne potrebuje. V nasprotnem primeru bi se zanje zavzela in bi jim odhod, če že ne preprečila, vsaj otežkočila.

Zgodovina nam govori o različnih poizkusih družb, ki so v preteklosti že želele izločiti nesamostojne in vzdrževane osebe iz svoje srede. Zgoraj pa smo tudi že zapisali, da so v preteklosti in še danes svojci pogosto skrbeli za starše vse do naravne biološke smrti. Zakaj ta razlika? Osnutek odgovora na to vprašanje se skriva v opredelitvi človeškega življenja. S sprejetjem zgolj materialistične opredelitve življenja sta namreč bolezen in starost resnično zaviralki razvoja družbe. Tu se sicer postavi še dodatno vprašanje, kdaj se bolezen in starost začneta. Ali z začetkom upadanja moči pri 30-tih letih, z nesamostojnostjo osebe pri 80-tih letih ali s pojavom prve depresije? Kdor pa življenje razume v duhovnem smislu, torej, da živeti pomeni biti v odnosu z drugim⁶, pa ostarele in bolnike vidi v popolnoma drugačni luči. V naši razpravi ne bomo omenjali zlorab, ki so možne pri uveljavljanju zakona o evtanaziji. Tudi se ne bomo opredeljevali o tem, kaj je z ekonomskega stališča ugodnejše, paliativa ali evtanazija. S pomočjo teološke relacijske teorije Guya Lafona bomo odgovorili na vprašanje, ali so trpeči zgolj breme, ki ga družba nosi, ali pa so omenjene osebe tudi koristne za razvoj družbe. V naši razpravi bomo pokazali, zakaj so bolniki, ostareli in trpeči nujno potrebni za preživetje družbe.

2 ŽIVETI POMENI BITI V ODNOSU

Človek živi istočasno v dveh svetovih: materialnem in duhovnem. S svojim fizičnim telesom je del sveta, kjer se meri dolžina, višina in širina; kjer tehtamo in lastninimo, kjer ustvarjamo in uničujemo. V materialnem svetu opredeljujemo življenje z rastjo in umiranjem naših telesnih celic. Istočasno pa človek kot oseba živi v duhovnem svetu, ki ga lahko imenujemo tudi svet odnosov. Odnos nas kot osebe povezuje in ločuje hkrati. Ne le povezuje, odnos tudi omogoča posamezne osebe. V svetu odnosov obstajata le dve dimenziji: prisotnost in odsotnost. Lahko bi ju opredelili tudi kot (istost) podobnost in (ne istost) različnost. »Jaz« in »ti« si ne moreta biti samo prisotna, ker v tem primeru ne bi bila več dva, ampak bi bil eden. Tudi samo odsotna si ne moreta biti, ker ju v tem primeru ne bi nič povezovalo in se ne bi zmogla znajti v odnosu.

V medosebnem odnosu ne tehtamo in ne lastninimo, temveč se drug drugemu približujemo in se drug od drugega oddaljujemo. V bistvu ljudje odnosov ne gradimo in ne uničujemo. Tudi vstopati ne moremo vanje. V odnosu se najdemo. Podobno, kakor nihče izmed nas ni načrtoval vstopa v življenje, temveč se je v njem znašel, tako se človek kot oseba znajde v odnosu. Ko se znajdem z nekom v odnosu, me on lahko nagovori s »ti« in takrat se rodim »jaz«, kot oseba, ki lahko tudi njega nagovorim s »ti«! Ni nujno, da me bo drugi sploh nagovoril. Zato smo uporabili besedo »lahko«!

Če je človek nagovorjen, bo lahko tudi sam »sogovornika« imenoval »ti«. V tem primeru se bo človek rodil kot »jaz«, kot oseba! Osebi bosta ostali v odnosu dokler se bosta nagovarjali s »ti«. Lahko pa se prenehata nagovarjati. Nista namreč sužnja odnosa in iz njega lahko »izstopita«. Iz odnosa v bistvu izstopita navidezno; zato ker je odnos dejansko neuničljiv, le tako drastično se lahko spremeni, da se nam zdi, da je prekinjen. Skratka, v svetu odnosov, torej v duhovnem svetu, živeti pomeni biti v odnosu. Ker smo ljudje kot osebe najprej bitja odnosov, zato zunaj odnosov ni človeškega življenja.

3 POTREBA PO DRUGEM

Človek se že zgodaj v svoji mladosti sreča z bolečino. Boli ga zob, boli ga glava, zboli za to ali ono boleznijo... Vse to je boleče. Ampak slabo telesno počutje še zdaleč ne more povzročati tako velike bolečine, ki jo človek občuti, ko izgubi ljubljeno osebo. Morda niti ni potrebno izgubiti ljubljene osebe, pa človeka močno boli. Dovolj je, da je z bližnjim »nekaj narobe«, da se z njim odnos »ohladi«, pa bo človek trpel. Pa četudi se zgolj seznanimo z novico, da je nekje v nesreči nekdo umrl, ne bo ostal indiferenten. To izkušamo, ko mediji obveščajo o žrtvah vojne, prometnih ali naravnih nesreč. Res je, da smo ljudje najprej materialna bitja. Toda ob priložnosti trpljenja ali smrti drugih se zavemo, da odnosi iz materialnih človeških bitij ustvarjajo osebe, ki ne živijo zunaj odnosa. Zavem se, da je moje bistvo »jaz«, torej oseba, ki sicer domuje v mojem telesu, ampak je veliko več kot zgolj materialno telo. Ker je bivanje osebe odvisno od odnosa z drugim, zato kot oseba trpim tudi zaradi bolečine druge osebe.

Iz tega dejstva lahko izluščimo dve resnici. Prvič, ljudje kot osebe smo drug z drugim zelo tesno povezani. To pomeni, da drug drugega potrebujemo, da sploh lahko živimo. Ker živeti pomeni biti v odnosu oz. ker zunaj odnosa ni življenja, človek za svoje preživetje potrebuje odnos, torej drugega. Ne zgolj nekoga, ki bi si ga izbral, temveč slehernega drugega. Znajti se v odnosu, živeti, namreč pomeni biti v odnosu s slehernim drugim. Dejstvo je namreč, da se človek znajde v odnosu do slehernega drugega. To je njegova danost. Zato je posameznik tako zelo pozoren in občutljiv na izgubo slehernega človeka. Kot smo že napisali, posebno ob vojnah in nesrečah nas zabolí smrt kogarkoli. Ljudje smo med seboj povezani, človeštvo je kot nek organizem. Drugič, oseba trpi, ker je drugemu prisotna in odsotna hkrati. V bistvu trpljenje nastopi zaradi spremembe odnosa. Bolj, ko se odnosi spreminjajo, bolj ljudje trpimo. Odnosi pa se stalno spreminjajo. Zato se vsak človek, kot oseba, kot bitje odnosov, stalno srečuje s trpljenjem. Teoretično bi lahko bila izbira med biti (ostati) v odnosu in trpeti in med ne ostati v odnosu in ne bivati. V drugi možnosti izbire ne bi bilo trpljenja; v ne bivanju namreč trpljenja ni. Torej, ljudje kot osebe živimo, ker smo v odnosih, ki se stalno spreminjajo; zato pa tudi trpimo! Trpljenje je nujni sestavni del življenja. Še najbolj pa medčloveški odnos spremeni smrt partnerja v odnosu. Smrt odnosa sicer ne more uničiti, ga pa ekstremno spremeni ter povzroči največjo bolečino. S pomočjo relacijske teorije smo pokazali, da ljudje drug drugega potrebujemo in da zato trpimo. Iz tega lahko izluščimo praktično dejstvo, da pri evtanaziji ne gre le za »končanje« življenja posameznikov, ki si to želijo in se to živečih članov družbe ne bi »dotikal«! Gre tudi in predvsem za njihov odhod iz družbe. V materialistični logiki jih družba ne potrebuje in se zato lahko strinja in odobrava njihov odhod. V duhovnem kontekstu pa gre za pomembno spremembo odnosa med člani družbe, ki še živijo in med »izločenimi«! Ta sprememba pa lahko na družbo vpliva v eksistencialnem pomenu.

4 ČLOVEKOVA NEPOPOLNOST

Ker za bivanje ljudje drug drugega potrebujemo, smo nepopolni. Ključna beseda v napisanem stavku je »potrebujemo«! Popolnost je namreč samozadostna. Človek pa za preživetje potrebuje drugega, zato je nepopoln. Z besedo nepopolnost pa bi lahko opredelili vse, kar nam v življenju ni všeč: bolezen, trpljenje, staranje ali smrt. V logiki materialističnega pojmovanja, kjer je življenje zgolj rast in odmiranje telesnih celic, je odgovor jassen: trpljenje in bolezen sta nekaj slabega, ker onemogočata želeni razvoj človekovega zdravega in dolgega življenja in produktivnost v družbi. Prav tako je v materialistični miselnosti nepopolnost nekaj slabega. Zato je v tem kontekstu razmišljanja razumljiv pristanek družbe na prostovoljno končanje življenja posameznika, ki si to želi. V evangeljski logiki pa življenje ni le »jed in pijača« (prim Rim 14, 17), temveč Kristus za najpomembnejšo dejavnost v življenju postavlja ljubezen do bližnjega. Zato francoski mislec Guy Lafon postavlja v središče svoje teologije predpostavko, da živeti pomeni biti v odnosu. Pravzaprav lahko tako govorimo zato, ker bivamo tudi sami; oz. ker smo se znašli v odnosu z »drugimi« ali z vsemi, o katerih in s katerimi lahko govorimo. Kakor namreč ne moremo govoriti o bivanju kot takem, temveč lahko govorimo samo zato, ker bivamo, tako ne moremo govoriti o odnosu, temveč lahko govorimo le v odnosu in iz odnosa.⁸ V tem kontekstu pa trpljenje

in potreba po drugem nimata več negativnega predznaka, temveč postaneta izraza človekove nepopolnosti, ki pa je konstruktivna za družbo. Zakaj?

Na prvi pogled nepopolnost izraža človekov manko. Ker namreč izraža to, kar ne zagotavlja posameznikovega razvoja na materialnem področju. Biti nepopoln pomeni biti odvisen od drugih. Neodvisnost je namreč v naši družbi pojmovana kot velika vrednota, odvisnost od drugih pa je razumljena kot pomanjkljivost. Ampak, ponavljamo, v materialistični logiki razmišljanja. Morda je ravno to tudi razlog, zaradi katerega so si mnogi misleci odrešenje predstavljali kot nekaj, kar nepopolno bitje stori popolno. Toda, po tej logiki človek, ki je rešen svoje nepopolnosti, sploh ne potrebuje ničesar in nikogar več. Če se izrazimo v bibličnem jeziku, lahko rečemo, da odrešen človek sploh ne bi več nikogar potreboval, niti Boga. Kar pa je popoln nesmisel. Še več, to bi bilo v nasprotju z bistvom življenja v duhovnem svetu.

Tisti, ki želi postati »neodvisen« in »samozadosten«, čeprav mu to nikoli ne bo uspelo, izgublja svoje življenje. To je namreč v polnosti podarjeno tistemu, ki, sprejemajoč svojo nepopolnost, priznava, da samo sleherni drugi, s katerimi se je znašel povezan, lahko zapolnjuje njegov manko. Toda, ta manko nikoli ne bo zapolnjen. Nasprotno, odnos do (D) drugega⁹ opominja, da bo človek vedno potreboval (D) drugega. Kot Kristus, ki na križu kliče Očeta. Dalj časa je osebek v odnosu do drugega, bolj spoznava potrebnost ohranjanja odnosa. Ko govorimo o »življenju v polnosti« na duhovnem področju, moramo potrditi, da se človek lahko uresničuje le, če sprejema svoje stanje nepopolnosti, to je stanje hrepenenja po (D) drugem. Največja človekova pomanjkljivost je njegovo prepričanje, da je popoln, torej, da ne potrebuje drugega. Če za »popolnega človeka« glagol »manjkati« izraža nekaj slabega, ker se sam ne more uresničiti, »nepopolni človek« prepozna svoje stanje »pomanjkljivosti« kot nekaj dobrega, ker se zahvaljujoč prav svoji nepopolnosti, najde povezan s slehernim drugim. Trpljenje, ki je povezano z »biti v odnosu«, je izraz človekove nepopolnosti, ki trpečega vabi k iskanju »d drugega«. Ravno to pa mu osmišlja bivanje. Če človek ne bi trpel, torej če ne bi bil v odnosu do (D) drugega, bi ostal »sam« oz. bi bil mrtev!

Šele tako razumevanje trpljenja nam namreč, v bibličnem kontekstu, razjasni, kaj pomeni »življenje rešiti oz. izgubiti« ali »življenje najti«! Apostol bi rad Kristusa obvaroval trpljenja (prim. Mt 16, 21-25). Učenik pa ga pouči, da je Božja volja, da trpljenje sprejme. Še več! Razjasni, da bi v primeru »izoginitve trpljenja«, kar bi površno gledano pomenilo življenje rešiti, v resnici bilo »življenje izgubljeno«! Kristus svojim učencem veli, naj se odpovedo svojemu življenju (naj se odpovedo želji po izoginitvi trpljenja) oz. naj sprejmejo trpljenje. Tako je storil tudi sam in dal zgled takrat, ko sta se mu približevala mučenje in smrt: »Začel se je žalostiti in trepetati. Tedaj jim je rekel: »Moja duša je žalostna do smrti. Ostanite tukaj in bedite z menoj! In šel je malo naprej, padel na obraz in molil: Moj Oče, če je mogoče, naj gre ta kelih mimo mene, vendar ne, kakor jaz hočem, ampak kakor ti« (Mt 26, 39-40).

5 VSI SMO NEPOPOLNI

Spoznali smo, da v logiki relacijske teorije trpljenje človeku koristi, ker ga kot nepopolnega sili v odnos z (D)drugim, V kontekstu materialističnega pojmovanja življenja je naša razlaga nerazumljiva. Le, če se strinjamo, da »živeti« pomeni »biti v odnosu«, lahko sprejmemo trditev, da sta nepopolnost in trpljenje nujno potrebna za človekov razvoj. Še več, prišli smo do spoznanja, da sprejeto trpljenje človeku lahko pomaga, da najde pravo življenje, ki je sestavljeno iz odnosov do vseh ljudi v družbi. Poudarek je na besedi »lahko«. Ker mnogim niti trpljenje drugih niti lastno trpljenje ne pomaga, če ga namreč ne sprejmejo, da bi se kaj spremenilo v njihovem življenju na boljše. Vendar si ne domišljajmo, da družbo sestavljajo popolni in nepopolni člani; torej stari in bolni na eni strani ter mladi in zdravi na drugi strani. Vsi ljudje, zato ker smo ljudje, smo nepopolni! Kdor se svoje nepopolnosti zaveda, se zaveda tudi dejstva, da potrebuje slehernega drugega, da bo lahko našel »življenje v polnosti«! Kdor pa se ne zaveda svoje nepopolnosti, v svoji iluziji živetari. Skupnost funkcionira, kadar so vsi njeni člani povezani med seboj do te mere, da se zavedajo, da drug drugega potrebujejo; ko ni nihče odvečen. V bistvu želimo reči, da je družba »zdrava«, ko se vsi njeni člani zavedajo svoje nepopolnosti in sprejemajo za »partnerja v odnosu« slehernega človeka. Nepopolnost posameznih članov družbe namreč to isto družbo naredi popolno. Sprejeti slehernega drugega za partnerja v odnosu pa pomeni tudi sprejeti obveznost. Kdor je »vezan«, je »obvezan«. Drugemu reči »ti«, zazreti se v njegovo obličje, zahteva odločitev in odgovornost zanj.

Družba je predvsem odgovorna, da prepriča vse svoje člane, da jih potrebuje, take, kakršni so! Sprejeti slehernega drugega za partnerja v odnosu, ne biti sam, pomeni sprejeti odgovornost za slehernega človeka in se hkrati odpovedati svoji samoljubnosti. To pa ni lahko. Zato je medosebni odnos trpljenje. Lažje je ne sprejeti drugega za partnerja v odnosu in ostati sam, v iluzorni »popolnosti«. Toda, kdor ostane sam, izgubi življenje. Gorje namreč tistim, ki jim je šlo vedno vse »kakor po maslu«, ki jim ni nikoli v življenju nič manjkalo in jih ni nič bolelo in so se zdeli sami sebi zadostni. Življenja v polnosti niso izkusili. Tisti namreč, ki je občutil svoj manko in svoje pomanjkljivosti, je zahrepenel po pomoči (D) drugega in v odnosu z njim našel življenje.

6 SKLEP

V našem razmišljanju smo materialistični način razmišljanja soočili z duhovnim. Spoznali smo, da pri vprašanju evtanazije ne gre za to, ali oseba, ki trpi sme ali ne sme prositi za končanje življenja. V tej problematiki gre za odločitev družbe, ali bo prošnji ustregla ali ne! Družba, ki pomaga posameznikom pri samomoru, si v bistvu predstavlja, da teh posameznikov ne potrebuje; zavestno se odreka starim, bolnim ter invalidnim osebam. S tem dejanjem hoče pokazati, da je popolna, samozadostna družba, ki neproduktivnih oseb ne potrebuje. S pomočjo Lafonove relacijske teorije pa smo pokazali, da pri starosti in onemoglosti ne gre samo za vprašanje produktivnosti, temveč predvsem za odnose. To nam potrjuje tudi dr. Timothy Stainton, strokovnjak za vprašanje invalidov, ki je povedal, »da jih pri odločitvi pogosto vodi strah pred življenjem v ustanovi: Za smrt se niso odločili, ker bi doživljali trpljenje, temveč zato, ker niso dobili ustrezne podpore v skupnosti.« Na podoben način

razmišlja tudi Alex Schadenburg iz koalicije za preprečevanje evtanazije, ki je mnenja, »da gre v večini primerov za duhovni, ne zdravstveni problem: Večina zahteva evtanazijo, ker so v težkem trenutku življenja, bodisi fiziološko ali psihološko, in doživljajo občutke osamljenosti, depresije in pomanjkanje smisla, namena ali vrednosti življenja.«

Vprašanje trpljenja in predvsem trpljenje nedolžnega pomeni za teologe enega največjih problemov. Če je Bog dober in vsemogóčen, zakaj dopušča na svetu zlo? Starodavni narodi so razlog trpljenja našli v nespremenljivi usodi ali pa so krivdo prelagali na zle bogove. Biblična tradicija pa je prepričana, da je Bog ustvaril človeka nepopolnega zato, da bi v hrepenenju po (D)drugem našel polnost življenja. Tomaž Akvinski je prepričan, da je zlo prišlo na svet z Božjo privolitvijo. Kakor je z Božjo privolitvijo tudi satan trpinčil svetopisemskega Joba in kakor je po Božji volji Jezus Kristus sprejel trpljenje in smrt na križu. Evangeljski nauk v središče krščanskega življenja postavlja sprejetje težav in trpljenja: »Če hoče kdo iti za menoj, naj se odpove sebi in vzame svoj križ ter hodi za menoj. Kdor namreč hoče rešiti svoje življenje, ga bo izgubil; kdor pa izgubi svoje življenje zaradi mene, ga bo našel« (Mt16, 21-25). Kot vidimo, je sprejetje trpljenja povezano s tem, kar vsi ljudje iščejo in želijo: pravo življenje, ki ni jed in pijača, temveč je sestavljeno iz odnosov. Sprejetje trpljenja pa v našem kontekstu pomeni sprejetje starejših in bolnih članov družbe do te mere, da se zavedamo, da je za družbo, torej za vse člane družbe, njihova prisotnost pomembna.

Družba, ki odobrava prostovoljni odhod njenih posameznih članov, ki to želijo, razmišlja zgolj v kontekstu materialistične logike in ne prepozna bistva življenja v odnosih. Taka družba se ne zaveda, da te posameznike potrebuje; ne zaveda se, da oni od družbe ne zahtevajo prekinitve življenja, temveč bi želeli pozornost. Enako razmišlja tudi Arthur Alderliesten: »Včasih ljudje pravijo, da želijo umreti, ker so izgubili smisel svojega življenja. Toda ljudje ne želijo umreti; želijo biti rešeni svojih težav, trpljenja, tistega, kar dojemajo kot brezsmiselnost življenja, eksistencialno osamljenost. Če si s človekom v njegovi osamljenosti, jo omiliš ali celo odpraviš, s tem pa lahko vztrajna želja po smrti celo izgine«. Ko pride naraven konec življenja, se s tem sprijaznimo. Nikakor pa nam ni v korist umetna prekinitve zemeljskega življenja. Bogomir Štefanič razlikuje »pustiti bolnika umreti« od »pasivne evtanazije«. V svojem prispevku navaja dr. Urha Grošlja, ki pravi, da evtanazija »v nobenem primeru ne more biti etično opravičljiva. Pustiti bolnika umreti pa je z etičnega vidika v nekaterih primerih, ko bolniku ni več mogoče pomagati, lahko etično sprejemljivo ali celo priporočljivo.« Nato pa nadaljuje, »da lahko dobra blažilna nega celo podaljša zadnje obdobje bolnikovega življenja, ki je ob ustreznih blažilni oskrbi hkrati tudi prijaznejše za bolnika.«¹⁶ Dr Matjaž Zwitter, onkolog z bogatimi izkušnjami dela s hudo bolnimi je dejal: »Do zdaj je nekdo, ki je bil hudo bolan, veljal za pogumnega, ko se je z vso močjo boril za življenje; če bo ta zakon (v Sloveniji) sprejet, pa bo morda začel veljati za sebičnega, ker noče odstopiti prostora drugim, mlajšim in sposobnejšim, ker odžira denar, ki ga v zdravstvu vedno manjka...«

Človek je človeku opora in breme hkrati. Če človek odloži to breme, si bo izpodmaknil tudi oporo.

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Problematična raba alkohola, težave v čustveni regulaciji in vloga spola

Problematic alcohol use, difficulties in emotion regulation and the role of gender

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POVZETEK*

Problematična raba alkohola in alkoholizem sta globalna izziva z negativnimi posledicami za posameznike, družino in družbo. Vzroki za problematično rabo alkohola in alkoholizem vključujejo genske, biološke, psihološke, socialne in okoljske dejavnike, ki delujejo v medsebojni interakciji. Moški pogosteje poročajo o večji rabi alkohola in problematični rabi kot ženske, kar je lahko povezano z razlikami v sposobnosti čustvene regulacije. Raziskava, v katero je bilo vključenih 422 udeležencev (315 žensk in 107 moških) je pokazala, da je pri moških prisotne več problematične rabe alkohola kot pri ženskah. Težave v čustveni regulaciji so pozitivno povezane s problematično rabo alkohola in napovedujejo njegovo rabo, vendar v večji meri pri moških kot pri ženskah. Spol je pomemben moderator med težavami v čustveni regulaciji in problematično rabo alkohola. Rezultati nakazujejo na to, da je pri razumevanju problematične rabe alkohola ter načrtovanju preventivnih in kurativnih strategij smiselno razmišljati tudi o mehanizmu čustvene regulacije, ki v tem kontekstu pri moških in ženskah igra različno vlogo.

KLJUČNE BESEDE

Alkoholizem, razlike med spoloma, čustvena regulacija, vzroki alkoholizma

ABSTRACT

Problematic alcohol use and alcoholism are global challenges with negative consequences for individuals, families and society. The causes of problematic alcohol use and alcoholism include genetic, biological, psychological, social and environmental factors that interact with each other. Men are more likely than women to report heavy alcohol use and problem drinking, which may be related to differences in difficulties in emotional regulation. A study of 422 participants (315 women and 107 men) showed that men have more problematic alcohol use than women. Difficulties in emotion regulation are positively correlated with problematic alcohol use and predict alcohol use, but to a greater extent in men than in women. Gender is a significant moderator between emotional regulation problems and problematic alcohol use. The results suggest that in understanding problematic alcohol use and in planning prevention and

curative strategies, it is useful to consider the mechanism of emotion regulation, which plays a different role in this context for men and women.

KEYWORDS

Alcoholism, gender differences, emotional regulation, causes of alcoholism

1 POJAVNOST PROBLEMATIČNE RABE ALKOHOLA

Problematična raba alkohola in z njim povezani alkoholizem, sta globalna izziva, ki imata za posameznike, družino in družbo številne negativne posledice. Po podatkih Svetovne zdravstvene organizacije [1] je alkoholizem vzrok za 5,3% smrti na svetu. Prav tako je problematična raba alkohola povezana z več kot 200 različnimi poškodbami in boleznimi (npr. boleznimi srca in ožilja, rak, bolezni jeter, psihiatrične motnje, prometne in druge nesreče, nasilje,...) [2]. Po ocenah Svetovne zdravstvene organizacije [3] je bila za leto 2018 ocena povprečne porabe alkohola na svetu 6,2 litrov čistega alkohola na osebo letno. Konzumiranje alkohola je socialno sprejemljivo v mnogih okoljih, v svetu tako pije alkoholne pijače skupaj 2,3 milijarde ljudi [2].

Tudi v Sloveniji je prisotnost problematične rabe alkohola precejšnja. Po podatkih Nacionalnega inštituta za javno zdravje [4] približno 11% odraslih prebivalcev lahko uvrstimo med problematične pivce alkohola. V letu 2020 je bilo 16,3 % oseb s tveganim ali škodljivim pitjem, ki običajno pijejo čez dnevno mejo manj tveganega pitja in so se v zadnjih 12 mesecih tudi najmanj 1-krat opili [5]. Problem prekomernega in problematičnega pitja alkohola v Sloveniji ima tudi negativne družbene posledice, kar vključuje zmanjšano produktivnost, nižjo kakovost življenja, več prometnih nesreč in pojavnosti različnih oblik nasilja [6]. Zaradi rabe alkohola v Sloveniji je izgubljenih 5,87 % zdravih let življenja, kar predstavlja med vsemi dejavniki tveganja boleznimi šesto mesto, pri čemer imajo večje tveganje moški [2].

Uživanje različnih psihogenih substanc (alkohol, droge, zdravila) se lahko giblje na kontinuumu od neproblematične socialne rabe do

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zlorabe in zasvojenosti [7]. Jasne opredelitve, ki bi razlikovala med »rabo« in »zlorabo«, ni. Vsaka raba je po svoje problematična. Zloraba substanc pa je kontinuirana raba substanc ne glede na to, da posameznik zaradi nje doživlja socialne, psihološke ali fizične probleme [8]. Ponavljajoča se škodljiva raba substanc, tudi alkohola, velikokrat vodi v sindrom zasvojenosti. Pri tem se pojavijo specifični vedenjski, kognitivni in psihični simptomi: močna potreba po substanci, težave pri kontroliranju njene rabe, nadaljevanje z rabo substance kljub škodljivim učinkom, dajanje prioritete substanci pred drugimi obveznostmi in aktivnostmi, povečana toleranca (vedno več substance za enak učinek) in včasih odtegnitveni simptomi [9].

2 DEJAVNIKI, KI PRISPEVAJO K PROBLEMATIČNI RABI ALKOHOLA

Prekomerna in problematična raba alkohola ter alkoholizem sta kompleksna pojava, k razvoju zasvojenosti pa prispeva kombinacija večih dejavnikov, ki se razlikujejo od posameznika do posameznika. Vzroki za alkoholizem so večplastni in vključujejo kombinacijo genetskih, bioloških, psiholoških, socialnih in okoljskih dejavnikov, ki so v medsebojni interakciji.

Raziskave kažejo, da genetski in biološki dejavniki igrajo pomembno vlogo pri dovzetnosti za alkoholizem [10]. Zaradi genetskih variacij encimov, ki metabolizirajo alkohol (pospešijo ali upočasnijo njegovo razgradnjo), naj bi prihajalo do večjega vpliva na nagnjenost posameznika k prekomernemu pitju [11]. Ljudje z družinsko anamnezo alkoholizma imajo višje tveganje za razvoj te motnje, kar nakazuje, da obstajajo dedne komponente, ki lahko prispevajo k nagnjenosti k alkoholizmu [12]. Na razvoj alkoholizma lahko vplivajo tudi nekateri biološki dejavniki, kot so nizka toleranca za alkohol, povečana občutljivost na učinke alkohola in nepravilnosti v možganskih sistemih za uravnavanje občutka nagrade in motivacije [13].

Družbeno okolje, kulturne norme, družinska zgodovina alkoholizma, socialni pritiski in dosegljivost alkohola so dejavniki, ki so povezani s tveganjem za alkoholizem. Kultura pitja v določenem družbenem okolju, družinsko vedenje in vzorci neprimernega ravnanja z alkoholom, vrstniški pritisk in socialno okolje, kjer se alkohol pogosto uživa, prispevajo k večji verjetnosti za razvoj alkoholizma [14, 15, 16]. Obenem je dostop do alkohola razmeroma enostaven, večja razpoložljivost in promocija alkoholnih pijač pa lahko spodbujata njihovo uživanje [17]. Različni pritiski iz okolja in travmatične izkušnje (npr. nasilje, zlorabe, izgube), ki ustvarjajo izpostavljenost kroničnemu stresu, prav tako lahko povečajo tveganje za zatekanje k alkoholu kot načinu soočanja s čustvenimi težavami [18, 19]. Tudi ekonomski dejavniki, kot so revščina in neenakost, so lahko povezani z alkoholizmom [20].

Med psihološke dejavnike, ki prispevajo k pojavnosti alkoholizma, lahko štejemo določene psihološke težave, kot so anksioznost, depresija, stres, nizka samopodoba in težave z obvladovanjem čustev. Ljudje se pogosto zatekajo k alkoholu kot načinu soočanja s stresom, tesnobo, depresijo in drugimi čustvenimi težavami. Čezmerno pitje alkohola lahko začasno zmanjša težke občutke zaradi stresa, vendar lahko dolgoročno privede do zlorabe alkohola [21, 22]. Ljudje z nizko samopodobo ali težavami pri samoregulaciji (nadziranju impulzov in vedenja) so lahko bolj nagnjeni k čezmernemu uživanju alkohola, da bi izboljšali svoje razpoloženje ali se izognili negativnim občutkom [23]. Posamezniki, ki se počutijo osamljene, izolirane ali imajo težave pri vzpostavljanju zdravih medosebnih odnosov, lahko iščejo olajšanje s pitjem alkohola [24, 25].

3 RABA ALKOHOLA IN ČUSTVENA REGULACIJA

Čustveni faktorji so v okviru teorij o pitju in težavah z alkoholom pogosto poudarjeni kot tisti, ki imajo pomembno ali celo centralno vlogo. Mnogi raziskovalci poudarjajo, da so čustva in njihova primerna regulacija centralnega pomena za človekovo življenje [26]. To se povezuje tudi s problemom pitja in še širše, s celotnim fenomenom rabe substanc. Seveda vsa raba alkohola ne temelji izključno na čustvenih motivih, je pa želja po regulaciji tako pozitivnih kot negativnih čustev pomembna motivacija pri njegovi rabi. Poleg tega, da spodbuja pozitivna čustva, je alkohol pogosto rabljen za preseganje negativnih čustev. Tako se smatra, da je alkohol ena izmed psihoaktivnih substanc, ki se lahko uporablja za regulacijo čustev in da je pitje alkohola s ciljem vplivanja na čustveno stanje lahko dojeno kot strategija čustvene regulacije [27].

Čustvena regulacija je kompleksen konstrukt, za katerega ne obstaja ena sama splošno sprejeta in priznana definicija ali soglasje o tem, kaj so njene glavne značilnosti [28]. Gross [29] ta koncept definira kot notranje in zunanje procese, s katerimi ljudje vplivajo na to, kakšna čustva imajo, kdaj jih imajo in kako jih doživljajo in izražajo. Gratz in Roemer [30] podajata konceptualizacijo temeljnih vidikov čustvene regulacije, ki vključuje: a) zavedanje in razumevanje čustev, b) sprejemanje čustev, c) sposobnost kontrolirati impulzivno vedenje in se vesti v skladu z zaželenimi cilji, ko se pričakuje negativna čustva in d) sposobnost fleksibilne rabe situaciji primernih strategij čustvene regulacije s ciljem oblikovanja čustvenih odzivov. Glede na ta multidimezionalen model je čustvena disregulacija ali težave v čustveni regulaciji povezana z odsotnostjo ene ali več teh sposobnosti. Raziskave potrjujejo, da so težave v čustveni regulaciji široko povezane ne samo s simptomi čustvenih motenj, ampak tudi s problematično rabo alkohola in z alkoholom povezanimi posledicami [31, 32]. Problematična raba alkohola služi kot učinkovita, a neprimerna strategija čustvene regulacije predvsem pri osebah, ki so nagnjene k čustveni disregulaciji [33].

4 SPOL IN PROBLEMATIČNA RABA ALKOHOLA

Zloraba alkohola naj bi bila bolj pogosta pri moških kot pri ženskah [34]. V letu 2019 je v EU dnevno in tedensko pitje alkoholnih pijač bilo pogostejše pri moških kot pri ženskah. S tem so povezane tudi razlike v stopnji prizadetosti zaradi posledic alkoholizma. Smrtnost, ki jo lahko neposredno pripišemo alkoholu, je pri moških višja kot pri ženskah. V letu 2016 so v svetu zaradi alkohola umrli približno trije milijoni ljudi, od tega 2,3 milijona moških in 0,7 milijona žensk. V Sloveniji je v obdobju 2013-2018 med umrlimi zaradi alkohola neposredno pripisljivih vzrokov bilo 4,1- krat več moških kot žensk [2], v letu 2021 pa 3,5- krat več moških kot žensk [6]. Moški 1,4-krat pogosteje kot ženske pijejo tvegano ali škodljivo [5].

Moški pogosteje poročajo o višji stopnji pitja alkohola, problematični rabi alkohola in odvisnosti od alkohola v primerjavi z ženskami [35, 36]. Razlike so tudi v okoliščinah pitja, posledicah, povezanih z alkoholizmom, vzdrževanjem abstinence itd. K nekaterim od teh razlik lahko prispevajo biološki (s spolom povezani) dejavniki, vključno z razlikami v farmakokinetiki alkohola ter njegovim vplivom na delovanje možganov in raven spolnih hormonov. Poleg tega lahko na razlike v pogostosti pitja in učinkih alkohola na vedenje vplivajo tudi bio-psiho-socialno-kulturni (s spolom povezani) dejavniki [37].

Ena izmed možnih smeri razlage pogostejše rabe alkohola pri moških v primerjavi z ženskami je tudi v razliki v sposobnosti primerne čustvene regulacije. Kot smo omenili, naj bi problematična raba

alkohola bila povezana z večjimi težavami v čustveni regulaciji [31, 32, 32]. Glede na nekatere študije o čustveni kompetentnosti, naj bi bile ženske boljše pri prepoznavanju čustev drugih ljudi in izražanju sočutja. Poleg tega se lahko bolj zavedajo svojih lastnih čustev in jih bolje verbalizirajo [38]. Na drugi strani pa moški bolje upravljajo in zatirajo svoja čustva v stresnih situacijah [39]. Čeprav raziskave niso dale konsistentnih ugotovitev glede razlik o tem, pri katerem spolu naj bi bilo prisotnih več težav v čustveni regulaciji (pri tem so pomembni tudi drugi individualni dejavniki), pa vseeno kažejo, da so nekatere razlike v načinih čustvene regulacije.

5 NAMEN RAZISKAVE IN HIPOTEZE

V naši raziskavi nas je na osnovi zgoraj omenjenih izhodišč zanimalo, kakšna je problematična raba alkohola glede na spol, kako se ta povezuje s težavami v čustveni regulaciji ter kakšno vlogo ima v tem odnosu spol.

Postavili smo sledeče hipoteze:

Hipoteza 1: Pri moških je prisotna višja stopnja problematične rabe alkohola kot pri ženskah.

Hipoteza 2: Več težav v čustveni regulaciji je povezano z višjo stopnjo problematične uporabe alkohola.

Hipoteza 3: Spol moderira povezavo med težavami v čustveni regulaciji in problematično rabo alkohola

6 METODA

4.1 Udeleženci

V raziskavi je sodelovalo 422 udeležencev, od tega 315 (75 %) žensk in 107 (25 %) moških. Povprečna starost vseh udeležencev je bila 36,17 let (min = 18 let; max = 74 let; SD = 13,79).

4.2 Pripomočki in postopek

Udeleženci so poleg splošnega vprašalnika o demografskih podatkih (spol, starost) izpolnjevali še naslednje vprašalnike:

1. Vprašalnik o rabi alkohola (The Alcohol Use Disorders Identification Test – AUDIT) [40], ki omogoča preverjanje nevarne in škodljive rabe alkohola in prepoznati trenutne težave s pitjem alkohola (npr. škodljivo rabo alkohola, zlorabo alkohola in odvisnost od alkohola). Poleg splošne dimenzije problematične rabe alkohola meri tri vidike zlorabe alkohola: nevarno uživanje alkohola (količina in pogostost), simptome odvisnosti od alkohola (toleranca, sposobnost kontrole) in z uživanjem alkohola povezane probleme. Višji rezultati kažejo na večjo možnost nevarne in škodljive rabe alkohola. Koeficient zanesljivosti (Cronbachov alfa) za celotni vprašalnik v naši raziskavi znaša $\alpha = 0,935$.

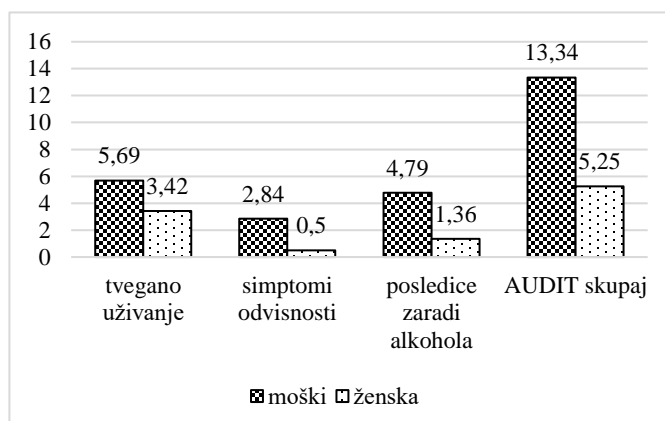
2. Lestvico težav pri regulaciji čustev – krajša verzija (Difficulties in emotion regulation scale – Short form - DERS – SF), ki je kratek samoporočevalni instrument za oceno različnih vidikov čustvene disregulacije oz. neprimerne regulacije čustev [30, 41] na šestih področjih: nesprejemanje čustvenih odzivov, težave pri vedenju, usmerjenemu k določenemu cilju, težave pri kontroli impulzov, pomanjkanje čustvenega zavedanja, omejen dostop do strategij čustvene regulacije in pomanjkanje čustvene jasnosti. Višji rezultat kaže na večjo prisotnost problemov v čustveni regulaciji. Koeficient zanesljivosti (Cronbachov alfa) za celotni vprašalnik v naši raziskavi znaša $\alpha = 0,823$.

Udeleženci so vprašalnik reševali v spletni obliki (povabilo za sodelovanje v raziskavi s povezavo do vprašalnika je bilo poslano na različne naslove in forume) in pisno (te udeležence smo pridobili na eni izmed klinik za zdravljenje alkoholizma). Anketiranje je potekalo od junija 2021 do maja 2022. Rezultate smo izračunali z uporabo programskega paketa SPSS 20.

7 REZULTATI

Hipoteza 1: Pri moških je prisotna višja stopnja problematične rabe alkohola kot pri ženskah.

Glede na spol smo primerjali podatke, ki se nanašajo na dimenzije problematične rabe alkohola na vprašalniku AUDIT. Primerjava povprečnih vrednosti teh dimenzij glede na spol je prikazane na Sliki 1.



Slika 1: Srednje vrednosti na posameznih dimenzijah problematične rabe alkohola na vprašalniku AUDIT pri moških in ženskah.

Ocene povprečnih vrednosti pri vseh vidikih problematične rabe alkohola kakor tudi na skupni vrednosti so višje pri moških kot pri ženskah. Statistično pomembnost razlik med skupinama smo zaradi nenormalne distribucije spremenljivk (ugotovljeno s Kolmogorov-Smirnov testom) preverili z Mann-Whitney U-testom za neodvisne vzorce. Rezultati so pokazali, da so razlike v problematični rabi alkohola glede na spol statistično pomembne. Moški v primerjavi z ženskami bolj tvegano uživajo alkohol (količina in pogostost) ($U = 13006,50$; $p = 0,00$), pri njih je prisotnih več simptomov odvisnosti od alkohola (toleranca, sposobnost kontrole) ($U = 11281,00$; $p = 0,00$), prav tako pa se pri njih pojavlja več z uživanjem alkohola povezanih problemov in posledic ($U = 11458,50$; $p = 0,00$). V splošnem je pri moških v primerjavi z ženskami prisotne več problematične rabe alkohola ($U = 11841$; $p = 0,00$). Hipotezo 1 lahko na osnovi teh rezultatov potrdimo.

Hipoteza 2: Več težav v čustveni regulaciji je povezano z višjo stopnjo problematične uporabe alkohola.

Nadalje smo na celotnem vzorcu ter ločeno za moške in ženske preverjali, kako se problematična raba alkohola povezuje s težavami v čustveni regulaciji. Zaradi nenormalne distribucije spremenljivk (ugotovljeno s Kolmogorov-Smirnov testom) smo za ugotavljanje povezanosti uporabili Spearmanov korelacijski koeficient. Iz rezultatov (Tabela 1) je razvidno, da obstaja trend, da več kot je težav v čustveni regulaciji, več je problematične rabe alkohola. To velja za skupen vzorec in za vzorec moških, medtem ko pri ženskah korelacije niso povsod statistično značilne.

Tabela 1: Korelacijski koeficienti (Spearmanov rho) med problematično rabo alkohola ter težavami v čustveni regulaciji za celoten vzorec in ločeno po spolu.

AUDIT	DERS-SKUPAJ		
	Celoten vzorec (N=422)	Ženske (N=315)	Moški (N=107)
tvegano uživanje	,099*	,044	,233*
simptomi odvisnosti	,221**	,146*	,340**
posledice zaradi alkohola	,241**	,170**	,359**
AUDIT SKUPAJ	,152**	0,091	,299**

Opombe: AUDIT – Vprašalnik o rabi alkohola; DERS – Lestvica težav pri regulaciji čustev; N – število udeležencev; * – statistično pomemben rezultat na nivoju 5 % tveganja; ** – statistično pomemben rezultat na nivoju 1 % tveganja.

Za napoved vpliva težav v čustveni regulaciji na problematično rabo alkohola smo v nadaljevanju uporabili enostavno linearno regresijo. Rezultati kažejo, da je na celotnem vzorcu 5,7% ($F = 24,15$; $p = 0,00$) variance problematične rabe alkohola lahko pojasnjene s težavami v čustveni regulaciji. Pri moških je mogoče 13% variance problematične rabe alkohola pojasniti s težavami v čustveni regulaciji ($F = 14,58$; $p = 0,00$), pri ženskah pa je mogoče le 1,7% variance problematične rabe alkohola pojasniti s težavami v čustveni regulaciji ($F = 5,23$; $p = 0,02$). Težave v čustveni regulaciji statistično pomembno pozitivno napovedujejo problematično rabo alkohola, se pa ta vpliv razlikuje glede na spol. Hipotezo lahko potrdimo.

Hipoteza 3: Spol moderira povezavo med težavami v čustveni regulaciji in problematično rabo alkohola.

Tabela 2: Prikaz moderatorske analize za napovedovanje problematične rabe alkohola s pomočjo interakcije med spolom in težavami v čustveni regulaciji.

	b	SE	t	p	95% interval zaupanja	
					spodnja meja	zgornja meja
Težave v čustveni regulaciji	0,66	0,13	5,23	0,00	0,41	0,90
Spol	4,04	2,90	1,39	0,16	-1,66	9,74
Težave v čustveni regulaciji*Spol	-0,30	0,07	-4,26	0,00	-0,44	-0,16

Opombe: b – nestandardizirani regresijski koeficient; SE – standardna napaka; t – t-statistika; p – stopnja statistične značilnosti.

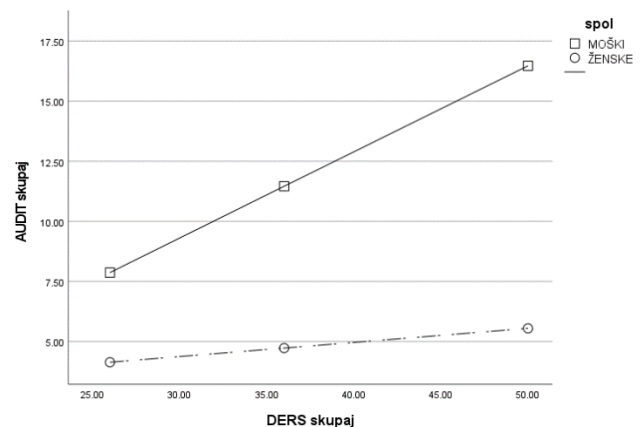
Rezultati moderirane regresije, kjer smo vključili težave v čustveni regulaciji kot neodvisno spremenljivko, problematično rabo alkohola kot odvisno spremenljivko in spol kot moderator, so pokazali, da omenjeni model pojasni 24,46 % variance odvisne spremenljivke. Regresijski model je je izkazal kot ustrezen ($p = 0,00$). Pregled posameznih regresijskih koeficientov je pokazal, da je interakcija med spolom in težavami v čustveni regulaciji statistično pomembna ($p = 0,00$), kar je razvidno iz Tabele 2. V Tabeli 3 je pregled pogojnih učinkov pokazal, da je rezultat statistično pomemben za moški spol (p

= 0,00), ne pa tudi za ženski spol ($p = 0,10$). Na podlagi teh rezultatov lahko sklepamo, da je odnos med težavami v čustveni regulaciji in problematično rabo alkohola različen za moške in ženske. Kot je razvidno iz Slike 2, imajo moški, ki imajo bolj izražene težave v čustveni regulaciji, tudi več problematične rabe alkohola kot moški, ki imajo manj izražene težave v čustveni regulaciji. Pri ženskah sprememba v težavah v čustveni regulaciji ne napoveduje več težav pri problematični rabi alkohola. Na podlagi teh rezultatov hipotezo, ki predpostavlja, da spol moderira povezavo med težavami v čustveni regulaciji in problematično rabo alkohola, sprejmemo.

Tabela 3: Prikaz pogojnih učinkov na povezanost težav v čustveni regulaciji s problematično rabo alkohola.

Spol	b	SE	t	p	95% interval zaupanja	
					spodnja meja	zgornja meja
Moški	0,36	0,06	5,95	0,00	0,24	0,48
Ženski	0,06	0,04	1,64	0,10	-0,01	0,13

Opombe: b – nestandardizirani regresijski koeficient; SE – standardna napaka; t – t-statistika; p – stopnja statistične značilnosti.



Slika 2: Prikaz učinka spola v povezanosti težav v čustveni regulaciji (DERS skupaj) s problematično rabo alkohola (AUDIT skupaj).

8 RAZPRAVA

Rezultati raziskave, ki je bila izvedena na vzorcu, ki sicer ni reprezentativen, kažejo, da obstajajo razlike v problematični rabi alkohola glede na spol. Pri tem moški dosegajo višje vrednosti na skupni lestvici problematične rabe alkohola, kakor tudi na poddimenzijah. Pri moški je prisotne več nevarne rabe alkohola, saj ga bolj prekomerno in pogosteje uživajo kot ženske. Prav tako je pri njih zaznanih več simptomov odvisnosti od alkohola (alkoholizem) kot pri ženskah. Pri njih so prisotni tudi pogostejši z alkoholom povezani problemi in posledice, kar pomeni, da je pri njih zaznati tudi bolj škodljivo rabo alkohola kot pri ženskah. Rezultati s tem potrjujejo konsistentne ugotovitve drugih raziskav, kjer je prav tako zabeležena višja stopnja problematične rabe alkohola pri moških v primerjavi z ženskami [2, 36], kar moške izpostavlja tudi za bolj ranljive za različne zdravstvene in psiho-socialne posledice alkoholizma.

Razlage, zakaj obstaja ta razlika, so različne. V naši raziskavi smo se osredotočili na vidik težav v čustveni regulaciji, ki jo študije in klinična praksa velikokrat omenjajo kot enega izmed pomembnih mehanizmov pri motivaciji za (prekomerno) rabo alkohola in

ohranjanje teh vzorcev [32, 33]. Rezultati v naši raziskavi kažejo, da obstaja povezanost med težavami v čustveni regulaciji in problematično rabo alkohola, saj obstaja trend, da več kot je težav v čustveni regulaciji, višja je stopnja problematične rabe alkohola. Statistično pomembne korelacije so na celotnem vzorcu in na vzorcu moških, medtem ko na vzorcu žensk obstaja samo statistično pomembna pozitivna povezanost med težavami v regulaciji čustev ter simptomi odvisnosti in posledicami zaradi alkohola, ne pa tudi med težavami v čustveni regulaciji in tveganim uživanjem ter splošno oceno problematične rabe alkohola. To kaže, da so morda pri ženskah v večji meri prisotni še drugi dejavniki, ki se močneje povezujejo s problematično rabo alkohola in k tej tudi prispevajo. Tudi rezultati regresijske analize potrjujejo, da je pri ženskah mogoče v veliko manjši meri s težavami v čustveni regulaciji pojasniti problematično rabo alkohola kot pri moških.

Spol se je izkazal za pomemben moderator med težavami v čustveni regulaciji in problematično rabo alkohola. Odnos med težavami v čustveni regulaciji in problematično rabo alkohola se razlikuje glede na spol, in sicer imajo moški, ki imajo več težav v čustveni regulaciji, tudi več problematične rabe alkohola kot moški, ki imajo manj težav v čustveni regulaciji. Pri ženskah pa sprememba v stopnji težav v čustveni regulaciji ne napoveduje več težav s problematično rabo alkohola.

9 SKLEP

Rezultati raziskave nakazujejo, da so morda težave v čustveni regulaciji dejavnik, ki je v ozadju razlik v problematični rabi alkohola glede na spol. Pri moških igrajo težave v čustveni regulaciji pomembnejšo vlogo pri problematični rabi alkohola kot pri ženskah. Čeprav raziskave ne dajejo konsistentnih rezultatov glede tega, kateri spol bi naj imel več težav v čustveni regulaciji, pa je videti, kot da pri moških ta dejavnik v kontekstu problematične rabe alkohola igra pomembnejšo vlogo kot pri ženskah.

Problematična raba alkohola in alkoholizem imata tudi kompleksen vpliv na demografske spremembe in družbene razmere. Alkoholizem lahko vpliva na starostno strukturo prebivalstva, saj je povezan z višjo smrtnostjo zaradi bolezni, nesreč in samomorov. Zaradi alkoholizma in problematične rabe alkohola je zmanjšana produktivnost posameznikov, kar povečuje tveganje za brezposelnost [42]. Močan je tudi njegov vpliv na strukturo družin in rodnost, saj lahko povzroča razpade družin in težave pri vzgoji otrok [43]. Alkoholizem lahko vodi v socialno izolacijo in stigmatizacijo posameznikov, kar lahko vpliva na njihovo družbeno vključenost. Dostikrat omeji izobraževalne in poklicne možnosti posameznikov, kar lahko vpliva na ekonomsko in demografsko strukturo družbe [44]. Zato je pomembno in smiselno odkrivanje mehanizmov, ki so podlaga za razlike pri uživanju alkohola in z njim povezanih posledic pri moških in ženskah. Ta spoznanja lahko prispevajo k razvoju strategij in priporočil za preprečevanje in zdravljenje motenj zaradi uživanja alkohola ter reševanje s tem povezanih težav, hkrati pa lahko pomagajo oblikovati politike za njegovo obvladovanje.

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Analiza selitvenih pričakovanj ameriških potrošnikov glede na njihovo starost

An analysis of US consumers' moving expectations by age

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POVZETEK

V tem prispevku analizirava selitvena pričakovanja ameriških potrošnikov glede na njihovo starost, s čimer dopolnjujeva literaturo o selitvenih pričakovanjih v Združenih državah Amerike. Ugotovila sva, da se selitvena pričakovanja ameriških potrošnikov polagoma zmanjšujejo in da med starostnimi skupinami obstajajo statistično značilne razlike v povprečni verjetnosti spremembe primarnega prebivališča v naslednjih 12 mesecih.

KLJUČNE BESEDE

potrošnik, pričakovanje, selitev, Združene države Amerike

ABSTRACT

In this paper, we analyse US consumers' moving expectations by age, adding to the literature on moving expectations in the United States. We find that US consumers' moving expectations are gradually declining and that there are statistically significant differences across age groups in the average probability of changing primary residence in the next 12 months.

KEYWORDS

consumer, expectation, moving, United States

1 UVOD

Za Američane (ameriške potrošnike) je značilno, da se večkrat selijo iz enega kraja v drugega oz. spremenijo svoje primarno prebivališče (angl. »primary residence«) [1, 2]. Med razloge za to avtorji navajajo študij, zaposlitev, zvezo ipd. Nekateri med njimi menijo, da je selitvena mobilnost ameriškega prebivalstva prednost ameriškega gospodarstva, saj prispeva k povečanju njegove učinkovitosti in odzivnosti. Raziskave [1, 2, 3] kažejo, da so se Američani med epidemijo covida-19 selili iz krajev z večjimi stroški (manjšo kakovostjo) bivanja v kraje z manjšimi stroški (večjo kakovostjo) bivanja.

[†] Dopisni avtor.

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V tem prispevku analizirava selitvena pričakovanja ameriških potrošnikov glede na njihovo starost, pri čemer uporablja mesečne podatke, ki jih je ameriška centralna banka (Sistem zveznih rezerv) pridobila z anketiranjem ameriških potrošnikov.

Ta prispevek ima še štiri poglavja. V poglavju 2 podajava metode, v poglavju 3 rezultate, v poglavju 4 pa razpravo in sklep.

2 METODE

V raziskavi, katere rezultate podajava v naslednjem poglavju, sva uporabljala metodi analiziranja in sintetiziranja. Razlike med starostnimi skupinami sva ugotavljala s Kruskal-Wallisovim testom (angl. »Kruskal–Wallis test«) in Dunn-Bonferronijevim testom (angl. »Dunn–Bonferroni test«), ki sva ju opravila z računalniškim programom IBM® SPSS® Statistics.

3 REZULTATI

V tem poglavju podajava rezultate raziskave, pri čemer najprej podajava rezultate analize selitvenih tokov v Združenih državah Amerike (ZDA), potem pa rezultate analize razlik v selitvenih pričakovanjih med ameriški potrošniki glede na njihovo starost.

3.1 Analiza selitvenih tokov

Podatki ameriške davčne uprave (Internal Revenue Service), ki na žalost niso popolni, kažejo, da se je v obdobju 2020–2021 največ ljudi priselilo v Kalifornijo (724.689), ki ji sledijo New York (489.117), Florida (451.633), Teksas (428.595) in Illinois (272385) (Tabela 1). Podatki ameriške davčne uprave kažejo tudi, da se je v istem obdobju največ tujcev priselilo v Virginijo (8679), ki ji sledijo Florida (7983), Kalifornija (7741), Teksas (7725) in Severna Karolina (3948).

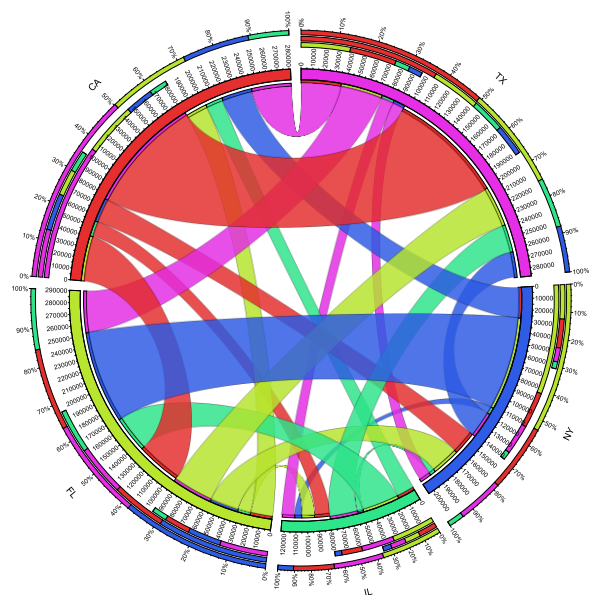
Tabela 1: Število priseljencev po ameriških zveznih državah

	Število priseljencev	Število domačih priseljencev	Število tujih priseljencev
AK	32.245	31.543	702
AL	85.886	84.735	1151
AR	57.065	56.666	399
AZ	183.341	181.480	1861

CA	724.689	716.948	7741
CO	201.247	199.093	2154
CT	85.886	85.293	593
DC	51.822	51.126	696
DE	28.311	28.009	302
FL	451.633	443.650	7983
GA	227.888	224.629	3259
HI	59.927	57.763	2164
IA	62.877	62.663	214
ID	54.080	53.699	381
IL	272.385	271.054	1331
KS	78.916	77.996	920
KY	84.548	83.836	712
LA	93.697	92.855	842
MA	154.393	153.487	906
MD	165.915	163.502	2413
ME	24.371	24.240	131
MI	130.742	130.163	579
MN	98.779	98.417	362
MO	122.638	121.675	963
MS	60.937	60.295	642
MT	28.181	27.976	205
NC	233.393	229.445	3948
ND	29.221	28.857	364
NE	43.236	42.700	536
NH	37.585	37.407	178
NJ	210807	209.390	1417
NM	58.883	57.817	1066
NV	109167	108.083	1084
NY	489117	486.344	2773
OH	169.106	167.886	1220
OK	73.786	72.656	1130
OR	118.473	118.050	423
PA	219.002	217.343	1659
RI	28.722	28.466	256
SC	121.372	119.598	1774
SD	23.376	23.085	291
TN	153.958	152.716	1242
TX	428.595	420.870	7725
UT	78.398	77.677	721
VA	251.896	243.217	8679
VT	16.419	16.360	59
WA	220.998	217.969	3029
WI	92.682	92.146	536
WV	35.179	35.037	142
WY	23.061	22.858	203

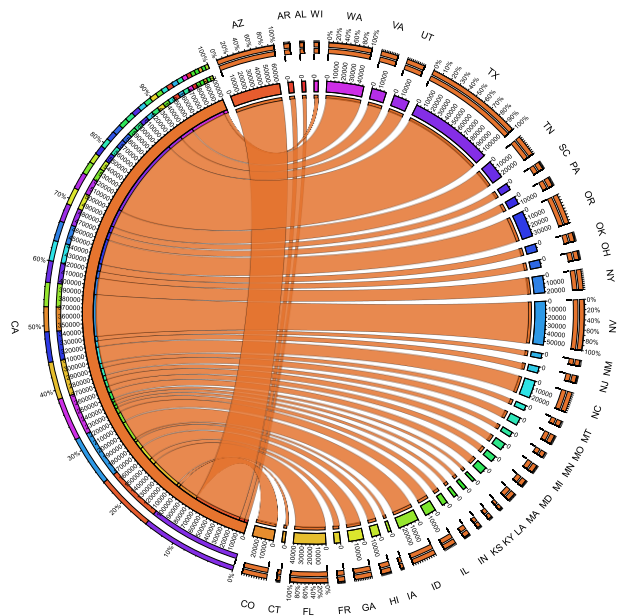
Vir podatkov: [4].

V nadaljevanju tega poglavja podajava tudi rezultate analize selitvenih tokov med petimi ameriškimi zveznimi državami z največjim številom priseljencev: Florido, Illinoisom, Kalifornijo, New Yorkom, Teksasom (Slika 1).



Slika 1: Selitveni tokovi med petimi ameriškimi zveznimi državami z največjim številom priseljencev (vir podatkov: [4])

S slike 1 je razvidno, da se je v obdobju 2020–2021 največ ljudi preselilo iz Kalifornije v Teksas (105.434), iz New Yorka v Florido (84.365) in iz Kalifornije v Florido (40.730). Zanimivo je, da se je v istem obdobju veliko ljudi preselilo tudi iz Kalifornije v Arizono (63.097) (Slika 2).

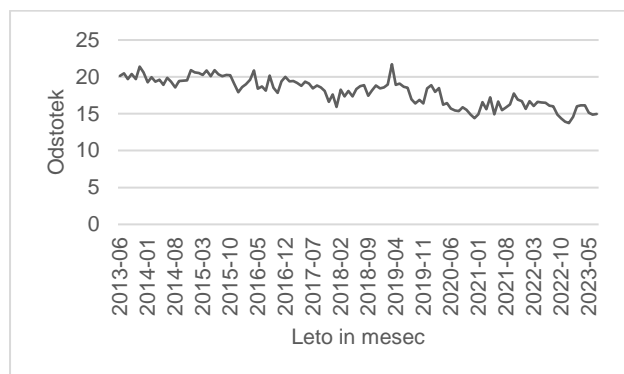


Slika 2: Selitveni tokovi med Kalifornijo in izbranimi ameriškimi zveznimi državami (vir podatkov: [4])

3.1 Analiza razlik v selitvenih pričakovanjih ameriških potrošnikov glede na njihovo starost

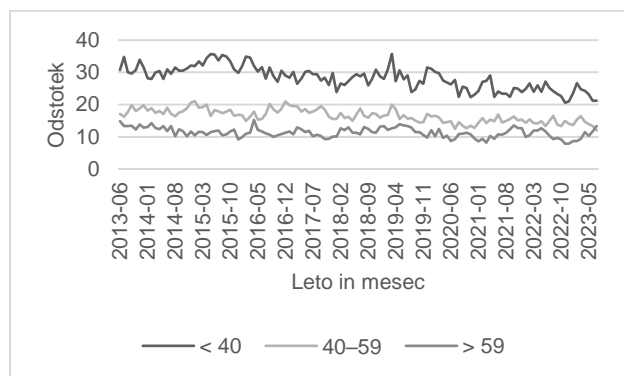
V tem poglavju podajava rezultate analize selitvenih pričakovanj ameriških potrošnikov glede na njihovo starost (mlajši od 40 let, stari od 40 do 59 let, starejši od 59 let). Zanima naju, ali so med starostnimi skupinami statistično značilne razlike v povprečni verjetnosti spremembe primarnega prebivališča v naslednjih 12 mesecih (angl. »mean probability of changing primary residence in the next 12 months«).

Najprej sva analizirala gibanje selitvenih pričakovanj ameriških potrošnikov ne glede na njihovo starost (Slika 3).



Slika 3: Gibanje selitvenih pričakovanj ameriških potrošnikov ne glede na njihovo starost (vir podatkov: [5])

S slike 3 je razvidno, da se selitvena pričakovanja ameriških potrošnikov polagoma zmanjšujejo, kar naju preseneča, saj je za Američane značilna selitvena mobilnost (prim. [6]). Tudi podatki o selitvenih pričakovanjih ameriških potrošnikov glede na njihovo starost kažejo, da se selitvena pričakovanja ameriških potrošnikov, mlajših od 40 let in starih od 40 do 59 let polagoma zmanjšujejo (Slika 4). To pa ne velja za ameriške potrošnike, starejše od 59 let. Deloma (verjetno) zato, ker pričakujejo, da se bodo po svoji upokojitvi preselili drugam.



Slika 4: Gibanje selitvenih pričakovanj ameriških potrošnikov glede na njihovo starost (vir podatkov: [5])

Rezultati Kolmogorov-Smirnovega testa (angl. »Kolmogorov–Smirnov«) in Shapiro-Wilkovega testa (angl. »Shapiro–Wilk test«) kažejo, da spremenljivka »selitvena pričakovanja« ni normalno porazdeljena ($p < 0,05$), zato lahko

uporabiva Kruskal-Wallisov test, saj imava tri neodvisne vzorce (mlajši od 40 let, stari od 40 do 59 let, starejši od 59 let). Njegovi rezultati kažejo, da so med starostnimi skupinami statistično značilne razlike v povprečnih rangih selitvenih pričakovanj (povprečne verjetnosti spremembe primarnega prebivališča v naslednjih 12 mesecih) ($H(2) = 319,276$; $p = 0,000$) (Tabela 2). To kažejo tudi rezultati parne primerjave (angl. »pairwise comparison«), ki sva jo naredila s pomočjo Dunn-Bonferronijevega testa. Izkazalo se je namreč, da so med pari statistično značilne razlike ($p < 0,05$) (Tabela 3).

Tabela 2: Rezultati Kruskal-Wallisovega testa

	< 40 (1)	40–59 (2)	> 59 (3)
N	122	122	122
Povprečni rang	305,47	181,59	63,44
H			319,276
Prostostna stopnja			2
Asimptotična značilnost			0,000

Vir: Lastni izračuni.

Tabela 3: Rezultati Dunn-Bonferronijevega testa

	3–2	3–1	2–1
Testna statistika	118,148	242,025	123,877
Standardna napaka	13,546	13,546	13,546
Standardna testna statistika	8,722	17,867	9,145
Značilnost	0,000	0,000	0,000
Prilagojena značilnost	0,000	0,000	0,000

Vir: Lastni izračuni.

4 RAZPRAVA IN SKLEP

Rezultati analize kažejo, da so med starostnimi skupinami statistično značilne razlike v povprečni verjetnosti spremembe primarnega prebivališča v naslednjih 12 mesecih, kar sva pričakovala glede na ameriški način življenja in mišljenja. Rezultati te raziskave so zanimivi zlasti za ameriške oblikovalce politike, ker opozarjajo na spremembe v selitveni mobilnosti Američanov.

VIRI

- [1] Whitaker, S. D. (2021). *Migrants from high-cost, large metro areas during the Covid-19 pandemic, their destinations, and how many could follow*. Federal Reserve Bank of Cleveland, Cleveland Fed District Data Brief. <https://doi.org/10.26509/frbc-ddb-20210325>
- [2] Whitaker, S. D. (2021). *Did the Covid-19 pandemic cause an urban exodus?* Federal Reserve Bank of Cleveland, Cleveland Fed District Data Brief. <https://doi.org/10.26509/frbc-ddb-20210205>
- [3] Lavelle, M., & Kepner, E. (2022). *U.S. migration patterns before and after the start of the Covid-19 pandemic*. <https://www.chicagofed.org/publications/blogs/midwest-economy/2022/migration-before-and-during-pandemic#ftn1>
- [4] Internal Revenue Service. (2022). *SOI tax stats – migration data 2020–2021*. <https://www.irs.gov/statistics/soi-tax-stats-migration-data-2020-2021>

[5] Federal Reserve Bank of New York. (2023). SCE Labor Market Survey.
<https://www.newyorkfed.org/microeconomics/sce/labor/>

[6] Kaplan, G., & Schulhofer, S. (2013). Why are Americans moving less?
<https://www.minneapolisfed.org/article/2013/why-are-americans-moving-less>

Pomen verske in narodne vzgoje pri misijonskem delu frančiškanov med slovenskimi izseljenci v Egiptu pred prvo svetovno vojno

The importance of religious and national education in Franciscan missionary work among Slovenian emigrants in Egypt before the First World War

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POVZETEK

Slovenski frančiškanski misijonarji, ki so od konca 19. stoletja delovali med slovenskimi izseljenci v Egiptu, so med rojaki širili katoliško vero in narodno zavest. Vzgoja verske in narodne pripadnosti sta bili za izseljenske duhovnike neločljivi kategoriji, ki omogočata preživetje posameznika in izseljenske skupnosti. Glede na to, da je bila večina slovenskih izseljencev v Egiptu ženskega spola (samo v letih pred prvo svetovno vojno jih je iz goriškega okraja v Egipt odšlo več kot tisoč), je bila zanje posebej pomembna tudi moralna vzgoja, saj so ženske kot narodove porodnice utelešale njegovo čast. Naravno pastoralnega dela slovenskih frančiškanov med t. i. »aleksandrinkami« v Egiptu odraža spis patra Benigna Snoja *Slovenka v Egiptu* (1910), ki služi ponazoritvi temeljnih idejnih izhodišč slovenskih izseljenskih misijonarjev na prehodu iz 19. v 20. stoletje.

Ključne besede: verska in narodna pripadnost, frančiškani, izseljenci, Egipt, aleksandrinke.

ABSTRACT

Slovenian Franciscan missionaries, who worked among Slovenian emigrants in Egypt from the end of the 19th century, promulgated the Catholic faith and national consciousness among their compatriots. The education of religious and national belonging, which enables the survival of both the individual and the emigrant community as a whole, were inseparable categories for emigrant priests. Given that the majority of Slovenian emigrants in Egypt were female (in the years before the First World War alone, more than a thousand of them left the Gorizia district to set out for Egypt), their moral education was also particularly important, since women,

as birth mothers of the nation, embodied its honor. The nature of the pastoral work of the Slovenian Franciscans among the so-called »Alexandrian women« in Egypt is reflected in the essay of Father Benigen Snaj *Slovenka v Egiptu* (1910), which serves to illustrate the fundamental ideological standpoints of Slovenian missionaries among emigrants in the transition from the 19th to the 20th century.

Keywords: religious and national belonging, Franciscans, emigrants, Egypt, Alexandrian women.

1 UVOD

Od druge polovice 19. stoletja, ko je v Egiptu cvetela bombažna industrija in so odprli sueški prekop (1869), so se v deželi ob Nilu začeli zaradi ugodnih gospodarskih razmer množično naseljevati tujci, med njimi zlasti evropski vlagatelji, trgovci, tehniki in arhitekti. S priseljevanjem omenjenih skupin posameznikov in njihovih družin je nastala potreba po gospodinjskih pomočnicah in varuškah. Ker domače muslimansko žensko prebivalstvo, ki je bilo omejeno na delo znotraj lastnega doma, ni bilo primerno za prevzem tovrstnega dela, so priseljenci zaposlovali varuške iz evropskih držav.¹ Med njimi so priložnost dobila tudi slovenska dekleta in žene, ki so se od šestdesetih let 19. stoletja do prve svetovne vojne in nato spet vse do začetka druge svetovne vojne v velikem številu izseljevala v Egipt. Med slovenskimi izseljenkami so prednjačile primorske žene z Goriške, ki je bila v 19. stoletju zaradi slabih prometnih povezav v težjem gospodarskem položaju. Po prvi svetovni vojni so se razmere zaradi uničujočih posledic soške fronte in fašističnega pritiska še poslabšale, zato se je žensko izseljevanje v Egipt povečalo. Precej težje so delo v Egiptu dobili moški, kjer so fizična dela opravljali domačini, medtem ko so bili obrtniški in trgovski poklici

¹ Koprivec, Daša. 2013. Dediščina aleksandrink in spomini njihovih potomcev. Ljubljana: ZRC SAZU, 29–30.

v domeni večjih izseljenskih skupnosti, kot sta bili grška in italijanska.

V egiptovskih mestih naj bi bilo na prelomu iz 19. v 20. stoletje po približnih ocenah sodobnikov 5300 Slovencev.² Novejši vir celo meni, da jih je bilo več kot 7000.³ Izseljevanje v Egipt sodi v okvir vsesplošnega migracijskega gibanja slovenskih prebivalcev po svetu, ki je značilno za obdobje od druge polovice 19. stoletja do začetka 20. stoletja. Do prve svetovne vojne se je iz Avstro-Ogrske monarhije izselilo več kot 20 % slovenskega prebivalstva.⁴ Med izseljenci so pomemben delež predstavljale ženske. Če se omejimo na podatke za goriški okraj (sodni okraji Ajdovščina, Gorica – okolica, Kanal) ugotovimo, da se je v letih 1907–1913 iz matične domovine izselilo 1714 moških in 1388 žensk. Od 1388 žensk se jih je v Egipt odselilo kar 1006.⁵ Podroben pregled podatkov pokaže, da je v tem obdobju iz goriškega glavarstva večina ženskih izseljenk odšla v Egipt, in sicer 72,3 % izseljenk.⁶ Množično izseljevanje slovenskega prebivalstva v tem času sodi v okvir t. i. demografske revolucije⁷, ki je z občutno demografsko rastjo zaznamovala širšo evropsko družbo po industrijski revoluciji. Intenzivnost izseljevanja je bila pogojena z naravnim prirastkom prebivalstva. V pokneženi grofiji Goriške-Gradiške je prebivalstvo od druge polovice 19. stoletja do prve svetovne vojne v splošnem naraščalo, zato je naraščalo tudi izseljevanje. V času naraščanja urbanega prebivalstva je prebivalstvo najbolj očitno naraščalo v glavnem deželnem mestu Gorici, kjer se je med letoma 1857 in 1910, tj. v času porasta migracij po svetu in posebej v Egipt, rast prebivalstva povečala za 113,2 % (od 13297 na 28353 prebivalcev).⁸ Goriška-Gradiška je sočasno z dvigovanjem prebivalstva v sedemdesetih, osemdesetih in devetdesetih letih 19. stoletja postala avstrijska provinca z največjim deležem odsotnega domovinskega prebivalstva.⁹ V začetku dvajsetega stoletja je z nadaljnjim dvigom naravnega prirastka nastopil tudi dodatni dvig migracij. Ti podatki do neke mere pojasnijo migracijske trende na Goriškem, a je potrebno v splošnem opozoriti, da je preučevanje izseljevanja Slovencev pred prvo svetovno vojno pogojeno s pomanjkanjem ustrezne statistike, saj so pristojne državne ustanove uradno izseljensko statistiko vodile le ozemeljsko, glede na upravno-politične enote, kjer so bili slovenski izseljenci zabeleženi skupaj z izseljenci drugih narodnosti.¹⁰ Zato je težko natančno ugotoviti tudi tedanje število slovenskih izseljencev v Egiptu, saj so bili (primorski) Slovenci tudi v Egiptu zabeleženi zgolj kot avstro-ogrski, pozneje pa kot italijanski ali jugoslovanski državljani.¹¹

Razmeroma številčna slovenska skupnost v Egiptu je bila v organizacijskem smislu sprva prepuščeni sama sebi. Zaradi potrebe po usmerjanju številčne slovenske skupnosti so po letu 1894 v Egiptu redno delovali slovenski frančiškani, ki so v Aleksandriji in Kairu organizirali svoje delo na treh področjih: versko, narodnobuditeljsko, socialno.¹² V dejavnostih izseljenskih duhovnikov je opazna prepletenost med skrbjo za ohranitev verske in narodne pripadnosti članov slovenske skupnosti. Srečevanje v cerkvi in v dveh zavetiščih mariborskih šolskih sester sv. Frančiška Kristusa Kralja, ki so v Egipt prišle leta 1908 na povabilo frančiškanov, sta bili osrednji točki izseljenskega življenja. Tam so Slovenci peli domače cerkvene pesmi, molili, brali slovenske knjige in pripravljali gledališke predstave v domačem jeziku. Šolske sestre so na pobudo frančiškanov v Aleksandriji pred prvo svetovno vojno vodile slovensko šolo za otroke izseljencev.

Vsekakor se je vodstvo Cerkve v Sloveniji zavedalo potreb izseljencev in se zavzelo za ukrepanje pri njihovem povezovanju v tujini.¹³ Pri tem ne moremo ločiti hkratnega prizadevanja cerkvenih organizacij za ohranitev vere in slovenske zavesti rojakov. Vera in narodnost sta bili v okviru nazorov tedanje slovenske družbe dve plati istega kovanca. Dober kristjan je pravi Slovenec in obratno. V prispevku najprej predstavimo stanje duha v evropskem oziroma slovenskem prostoru v poznem 19. stoletju, za katerega je bilo značilno oblikovanje nacionalne zavesti ter osvetlimo odnos med krščanstvom in narodno pripadnostjo, ki je zaznamoval misel in pastoralno metodo slovenskih duhovnikov v Egiptu. V drugem delu na podlagi izbranega spisa patra Benigna Snoja (1867–1942), ki je med leti 1901 in 1913 deloval med Slovenci v Aleksandriji in Kairu ter je v tem obdobju za slovenske izseljenke objavil navodila za življenje v tujini, orišemo način razmišljanja naših izseljenskih misijonarjev, ki odseva tesno povezavo med versko in narodno identiteto. Lahko rečemo, da omenjeni zapis odseva nazore vseh slovenskih frančiškanov, ki so do druge polovice 20. stoletja delovali med t. i. aleksandrinkami, slovenskimi izseljenkami v Egiptu, čeprav se prispevek glede na izbrani vir vsebinsko umešča v obdobje pred prvo svetovno vojno. Slovenski misijonarji v Egiptu so bili verujoči posamezniki, ki jim

² Pečnik, Karel. 1901. Slovenci v Egiptu. V: Koledar Družbe svetega Mohorja: za navadno leto 1902. Celovec: Družba sv. Mohorja, 54.

³ Drnovšek, Marjan. 2001. V: *Izseljenec: Življenjske zgodbe Slovencev po svetu*. Ur. Monika Kokalj Kočevar et al. Izseljenec: Življenjske zgodbe Slovencev po svetu, 11. Ljubljana: Muzej novejšo zgodovine Slovenije.

⁴ Vodopivec, Peter. 2006. Od Pohlinove slovnice do samostojne države: slovenska zgodovina od konca 18. stoletja do konca 20. stoletja. Ljubljana: Modrijan, 97.

⁵ Marušič, Branko. 2014. V: *Aleksandrinke*. Ur. Darja Skrt. Prispevki k poznavanju gospodarskih razmer na Goriškem v 19. in v začetku 20. Stoletja, 71. Nova Gorica: Goriški muzej Kromberk. Avtor navaja poročilo rektorja dekliškega liceja v Gorici dr. Josipa Srebrniča: Srebrnič, Josip. 1914. V: *Jahresbericht des Mädchenlyzeums der armen Schulschwesterin de Notre Dame in Görz. Veröffentlicht am Schlusse des Schuljahres 1913/14*. Die Wanderbewegung in der Umgebung von Görz, 7 in 14.

⁶ Devetak, Robert. 2022. V: *Kronika*, Aleksandrinstvo in aleksandrinke v slovenskem goriškem časopisu pred prvo svetovno vojno, 125.

⁷ Bardet, Jean-Pierre et al., ur. 1998. *Histoire des populations de l'Europe. II. La révolution démographique 1750-1914*. Paris: Fayard.

⁸ Kalc, Aleksej. 2013. V: *Acta Histriae*, Vidiki razvoja prebivalstva Goriške-Gradiške v 19. stoletju in do prve svetovne vojne, 688.

⁹ Kalc, Aleksej. 2013. V: *Acta Histriae*, Vidiki razvoja prebivalstva Goriške-Gradiške v 19. stoletju in do prve svetovne vojne, 694. Avtor navaja: Österreichische Statistik. 1912. *Bewegung der Bevölkerung*. Dunaj: Statistische Central-Commission.

¹⁰ Kalc, Aleksej. 1996. V: *Dve domovini*, Ladijske potniške evidence kot vir za zgodovino izseljenstva, s posebnim ozirom na izseljenske sezname tržaškega pristanišča, 56.

¹¹ Koprivec, Daša. 2013. Dediščina aleksandrink in spomini njihovih potomcev. Ljubljana: ZRC SAZU, 29.

¹² Trontelj, Nik. 2021. V: *Bogoslovni vestnik*, Frančiškanski misijonarji med slovenskimi izseljenci v Egiptu v 19. in 20. stoletju, 613.

¹³ Riman, Barbara. 2020. V: *Bogoslovni vestnik*, Slovenski duhovniki in njihovo delovanje v slovenskih društvih na Hrvaškem v prvi polovici 20. stoletja, 135.

je »srce bilo za Slovence in njihovo domovino«. ¹⁴ V tretjem poglavju ovrednotimo pomen misijonskega dela med Slovenci v Egiptu.

2 KATOLIŠKI POGLED NA RAZMERJE MED VERSKO IN NARODNO PRIPADNOSTJO OB KONCU 19. STOLETJA

Evropska družba druge polovice 19. stoletja, ko se je začelo slovensko izseljevanje v Egipt, je bila v znamenju krepitve narodne pripadnosti. Nacionalizem je bil do prve svetovne vojne razširjen družbeni pojav v evropskih deželah ¹⁵, ki se je razvil kot posledica težnj po večjih narodnih pravicah in osamosvajanju od fevdalizma in nadvlade tujih gospodarjev ter se je pretežno napajal v idealih francoske revolucije. Pojem naroda je v družbi pridobil status svetinje. Seveda je narodno prebujenje marsikje zapadlo v nasilna politična gibanja in postalo vsebina različnih nacionalnih ideologij. Katoliška Cerkev je bila v tem smislu kritična do revolucionarnih metod uveljavljanja narodne ideje, s katerimi bi narod s silo odpravil obstoječi pravni ali politični red, ni pa nasprotovala ljubezni do svojega naroda in gojitvi narodne zavesti. ¹⁶

Domoljubje je bilo v našem prostoru v poznem 19. stoletju zgodovinsko-sociološki pojav, ki pa se je v krščanskem okolju slovenske družbe miselno oblikoval v tesni povezavi z verskim naukom. Teolog Anton Mahnič je leta 1895 zagovarjal tezo, da je narod naravna in duhovna danost. ¹⁷ Človek izhaja iz nekega naroda po rojstvu in svoje narodnosti ne more zamenjati, saj je narodnost po človeški naravi del posameznika. Narod je obenem tudi presežna stvarnost, ker ima nadnaravni izvor, saj je Bog ustvaril človeka, družino in narod, ki je »razširjena družina«. ¹⁸ Podobno je v začetku 20. stoletja učil Janez Evangelist Krek, ki je povezoval naravno danost narodne pripadnosti in moralno obveznost za ljubezen in spoštovanje svojega naroda, maternega jezika, domovine. ¹⁹

Če želimo razumeti idejno povezavo med versko in narodno pripadnostjo v tistem obdobju in odgovoriti na vprašanje, zakaj je bilo izseljenskim misijonarjem v Egiptu tako pomembno spodbujati narodno zavest v želji po ohranitvi vere pri naših rojakih, moramo spoznati globlje temelje v načinu njihovega razmišljanja. V ozadju tedanje slovenske katoliške misli o narodu, ki narod razume kot izrazito naravno kategorijo, je tradicionalna teološka misel o človekovi naravi kot temelju za sprejetje vere. V skladu s starodavnim načelom »gratia supponit naturam« (milost predpostavlja naravo) je človek sposoben graditi svojo vero na temelju človeškosti, saj je po naravi vsakdo nujno najprej človek in pripadnik neke človeške skupnosti (naroda), šele potem lahko postane

kristjan. Teološko bi rekli, da nadnaraven dar podstavlja naravnega, da je torej biti kristjan sicer višja vrednota, ampak je biti človek in pripadati nekemu narodu osnovna naravna vrednota in pot do sprejema vere. ²⁰ Drugače povedano, človek sprejme vero v konkretnih okoliščinah svojih jezikovnih in kulturnih danosti. Kdor ni najprej človek, seveda v okvirih, kot mu jih določa (nad)narava, ne more biti vernik. Drugi vpliv, ki bi ga lahko pripisali slovenski katoliški misli o narodu v obravnavanem času, je sholastično razumevanje svetne oblasti kot delnega področja večnega božjega gospostva po nauku Tomaža Akvinskega. ²¹ Če imata človek in celotna človeška skupnost duhovni temelj, potem je njun obstoj odvisen od izpovedovanja vere. Pripadnost narodu je bila s katoliškega vidika po eni strani pomembna za posameznika in njegovo osebno sprejemanje vere, na drugi strani pa je na ravni družbe celotno človeško skupnost nagibala k podreditvi javnega življenja božji oblasti. Ta ugotovitev v kontekstu našega prispevka zarisuje nazore slovenskih misijonarjev v Egiptu v odnosu do slovenskih izseljenk: glavno poslanstvo njihovega delovanja med rojaki je bilo prebujati njihovo osebno vero ob istočasni krepitvi slovenske narodne zavesti, pri čemer so krščanstvo razumevali kot steber posameznikovega osebnega in narodovega javnega življenja.

Glede na povedano je možno ugotoviti, da je pomanjkanje domoljubja po katoliškem prepričanju pomenilo osebno kršitev moralne zapovedi (greh), saj je predstavljalo izdajstvo in zatajitev podarjenih naravnih danosti, s tem pa na neki način tudi opustitev vere. Možno je reči, da je v katoliški miselnosti pomanjkanje narodne zavesti pomenilo šibko vero. Ob dodatnem upoštevanju specifičnih zgodovinskih okoliščin v slovenskem prostoru, ki so se kazale v občutju ogroženosti pred vsiljivo germanizacijo in italijanizacijo, je pripadnost narodu postala moralna kategorija. ²²

3 VERSKA IN DOMOVINSKA VZGOJA IZSELJENCEV V SPISU BENIGNA SNOJA

Postavljeno trditev o prepletenosti skrbi za ohranitev verske in narodne identitete pri slovenskih rojakih, za katero so si dosledno prizadevali slovenski frančiškani v Egiptu, nazorno potrjuje spis patra Benigna Snoja, ki ga je napisal 1. julija 1910 v Kairu. Besedilo je v dveh delih objavil goriški frančiškanski časopis *Cvetje z vrtov sv. Frančiška*. ²³ V zapisu *Slovenka v Egiptu* je Snoj, znani dušni pastir Slovencev v Egiptu in pozneje v ZDA, zapisal praktična in moralna navodila za dobro in varno življenje aleksandrink sredi velikih egiptovskih mest, ki so zanj pomenila veliko nevarnost za duhovni in narodni blagor slovenskih deklet. Izbrani navedki naj služijo ponazoritvi temeljne ideje frančiškanskega razumevanja

¹⁴ Kuhar, Alojzij. 1998. Beg iz Beograda aprila 1941. Ljubljana; Washington: Studia Slovenica, 75.

¹⁵ Schulze, Hagen. 2003. Država in nacija v evropski zgodovini. Modra zbirka: Delajmo Evropo. Ljubljana: Založba / *cf., 268.

¹⁶ Simičič, Andrej. 2006. V: *Tretji dan*, Pogledi na 19. stoletje, III.: katolištvo in narodnost, 87.

¹⁷ Mermolja, Ace. 1998. Narod in drugi. Trst: ZTT EST, 22–23. Glej tudi: Mahnič, Anton. 1895. V: *Rimski katolik*, Deset poglavij iz narodnostnega katekizma, 41.

¹⁸ Janžekovič, Janez. 1977. Domoljubni spisi. Zbirka Izbrani spisi II. Celje: Mohorjeva družba, 86.

¹⁹ Mermolja, Ace. 1998. Narod in drugi. Trst: ZTT EST, 23. Glej tudi: Krek, Janez Evangelist. 1925. Izbrani spisi. 3. zvezek. Ljubljana: Jugoslovanska tiskarna, 131–132.

²⁰ Grmič, Vekoslav. 1995. V: *Koroški koledar 1996*, Narodnost in vera, 93 in 97.

²¹ Schulze, Hagen. 2003. Država in nacija v evropski zgodovini. Modra zbirka: Delajmo Evropo. Ljubljana: Založba / *cf., 38.

²² Mlekuž, Jernej. 2016. V: *Dve domovini*, Aleksandrinke kot nosilke časti narodne skupnosti v dopisu Karola Pečnika iz Egipta (1897), 152.

²³ Glej: Snoj, Benigen. 1910. V: *Cvetje z vrtov sv. Frančiška*, Slovenka v Egiptu [1. del], 237–241; Snoj, Benigen. 1910. V: *Cvetje z vrtov sv. Frančiška*, Slovenka v Egiptu [2. del], 269–275.

misijona med Slovenci v Egiptu: skrbi za ohranitev verske in narodne zavesti izseljenih rojakov. Pri branju zapisa sledimo ideji, da morajo biti rojakinje v Egiptu najprej ponosne Slovenke, če naj bodo tudi dobre katoličanke. Seveda velja tudi obratno: dobra katoličanka se zaveda narodne pripadnosti, ki je naravni in duhovni dar.

V misli patra Benigna, ki rojakinje v spisu redno naziva s »krščanske Slovenke«, se zato ves čas prepletata verski in narodni vidik posameznikove identitete, ki se kaže že v besednih zvezah:

»Ti pa, *verna Slovenka*, ki se radi resnične potrebe, po dobrem prevdanku in z dovoljenjem ter blagoslovom svojih starišev odpravljaš v Egipt, imaš tudi resno voljo, da hočeš ostati vedno *verna* in poštena *Slovenka*.«²⁴

»Ne glej v prvi vrsti na veliko plačo, ampak glej pred vsem na to, če je hiša ali družina taka, da boš mogla v njej ostati *verna* in poštena *Slovenka*.«²⁵

Čeprav naj bi se, kot razodevajo časopisne novice iz časa do prve svetovne vojne, katoliški (»klerikalni«) del slovenskega javnega in političnega življenja bolj zavzemal za ohranitev verskih, moralnih in družinskih vrednot, liberalni tabor pa v prvi vrsti za ohranitev narodne zavesti pri slovenskih izseljencih v Egiptu²⁶, je gotovo potrebno tudi v katoliških nazorih pri vrednotenju izseljenstva iskati bistveni poudarek na ohranjanju narodnosti in rodoljubja. Razumevanje vere in narodnosti v njuni enovitosti je opazno v Snojevi objavi, ki obenem predstavlja misijonski program vseh slovenskih izseljenskih duhovnikov v Egiptu in drugod v obravnavanem času. Delovanje Cerkve v izseljenskih skupnostih zaradi omogočanja rabe narodnega jezika prispeva k ohranjanju narodne identitete izseljencev in k zavedanju njihovih korenin.²⁷ Sramovanje ali zaničevanje maternega jezika je greh, ker odpad od naroda kaže na pomanjkanje posameznikove zvestobe in ljubezni.²⁸ Snoj je v svojem pismu močno poudaril pomen jezika za ohranjanje vere in narodne identitete ter spodbujal zdrav ponos in ljubezen do svoje domovine. Zavračanje narodnega ponosa pomeni tudi odtegotanje verski pripadnosti:

»Če tudi si v Egiptu mej tujimi ljudmi, zavedaj se vedno, da si Slovenka, in ljubi svoj dom! Mnoge Slovenke se tu, žal, odtujijo kaker lepemu kerščanskemu življenju, tako tudi svojemu materinemu jeziku. Marisiketera, ki je tu par let, že noče več znati in govoriti svojega materinega jezika, in še zabavlja čez njega; ugaja ji preveč 'sladka' italijanščina. Ti nezvesta Slovenka, kako ti kliče pesem? Jaz nisem Talijanka, pa tudi ne bom, sem vneta Slovenka in ljubim svoj dom!«²⁹

Izgubiti vero pomeni pozabiti tudi svojo narodno zavest, na drugi strani pa sramovanje svojega naroda vodi v brezbržnost do vere. Lahko rečemo, da človek pridobi ali izgubi obe vrednoti hkrati:

»Ketera Slovenka zajde v Egiptu na kriva pota, ona se ne zmeni več za svojo sveto vero, ne za svoj materin jezik, pa tudi ne za svoje stariše in domače v domovini.«³⁰

Zato se je zdelo našim misijonarjem pomembno, s kom so Slovenke v Egiptu sklenile zakonsko zvezo. Le v poroki s Slovencem, katoličanom, so videli jamstvo za ohranitev narodnosti in vere. Snoj je zapisal:

»Odtod izvira toliko nesrečnih nasledkov, toliko nesrečnih zakonov!! Veliko je v Egiptu različnih narodnosti, veliko raznovrstnih ver. Pa v vsaki narodnosti, v vsaki veri se dobi poročena Slovenka, in še koliko! So poročene s katoličani vseh obredov, so poročene z razkolniki, protestanti, judi in celo s turki.«³¹

Zgornji navedek v kontekstu časovnih razmer morda ne preseneča v delu, kjer avtor problematizira poroke Slovenk z nekatoličani in s predstavniki nekrščanskih verstev. Zanimivo pa je njegovo obsojanje porok s katoličani vzhodnih obredov. To znova potrjuje ugotovitev, da za misijonarje zgolj ohranitev prave, katoliške vere naših rojakov, ni bila dovolj. Slovenke so morale ostati zveste tudi svojemu narodu, kar so storile z rojevanjem slovenskih otrok in uporabo slovenskega jezika. V tem smislu je o razmerah v Egiptu leta 1927 pisal tudi pater Ferdinand Zajec: »Silno malo se jih poroči s katoličani. Pa še te so zgubljene za slovenski narod; njih otroci znajo že slabo materni jezik.«³² Med izseljenskimi duhovniki je prevladovala misel, da je družina osnovna celica narodnega tkiva, zato se narod lahko ohrani le z vzgojo primerne družine. Ženske so imele kot matere nalogo biološke reprodukcije naroda, kolikor razumemo narod kot naravno kategorijo, kar je bilo značilno vsaj za del slovenskih katoliških mislecev na prelomu iz 19. v 20. stoletje. Ženske niso bile le »posameznice«, ampak tudi predstavnice nacionalnih skupnosti, do katerih so imele naravne obveznosti.³³

Od tod je sledila skrb duhovnikov za moralno in narodno neoporečnost Slovenk v Egiptu. Prepričani so bili, da je osebna čistost žensk metala pozitivno luč na čistost naroda, ki so ga predstavljale v svetu, kot je bilo tedaj zakoreninjeno razmišljanje v širšem evropskem prostoru.³⁴ Šlo je za obliko kolektivne identitete, ki so jo predstavljale ženske v njihovi podobi matere, ki rojeva narodno skupnost.³⁵ Snoj je ob navajanju stranpoti nekaterih izseljenk zapisal, da svojeglave Slovenke delajo škodo ugledu celotne slovenske skupnosti:

²⁴ Snoj, Benigen. 1910. V: *Cvetje z vrto sv. Frančiška*, Slovenka v Egiptu [1. del], 237.

²⁵ Prav tam, 240.

²⁶ Mlekuž, Jernej. 2016. V: *Zgodovinski časopis*, »Oblastva morajo korigirati spokornišvo burno živeče aleksandrinke«: časopisne resnice o aleksandrinkah in aleksandrinstvu do prve svetovne vojne, 167.

²⁷ Riman, Barbara. 2020. V: *Bogoslovni vestnik*, Slovenski duhovniki in njihovo delovanje v slovenskih društvih na Hrvaškem v prvi polovici 20. stoletja, 134–135.

²⁸ Grmič, Vekoslav. 1995. V: *Koroški koledar 1996*, Narodnost in vera, 94.

²⁹ Snoj, Benigen. 1910. V: *Cvetje z vrto sv. Frančiška*, Slovenka v Egiptu [2. del], 273.

³⁰ Prav tam.

³¹ Prav tam, 274.

³² Zajec, Ferdinand. 1927. V: *Cvetje z vrto sv. Frančiška*, , Nekoliko pojasnila o Aleksandriji, zlasti za služkinje, 82.

³³ Yuval-Davis, Nira. 2009. Spol in nacija. Ljubljana: Sophia, 43; 60–61.

³⁴ Mlekuž, Jernej. 2016. V: *Dve domovini*, Aleksandrinke kot nosilke časti narodne skupnosti v dopisu Karola Pečnika iz Egipta (1897), 149–150.

³⁵ Yuval-Davis, Nira. 2009. Spol in nacija. Ljubljana: Sophia, 73.

»Ni čuda torej, da so take izprije Slovenke vzele vsem dobro ime! Da, ljudje govore kar splošno: 'Take so vse!' Da torej, zaradi njih terpe tudi vse poštene in vzgledne Slovenke!«³⁶

Slovenski misijonarji so si prizadevali bedeti nad slovenskimi izseljenci z ustanavljanjem društev za Slovence v Egiptu. Bili so odgovorni za delovanje društev Krščanska zveza Slovenk (1902) in Društvo sv. Cirila in Metoda (1908) ter redna nedeljska srečanja v dveh zavetiščih šolskih sester. Sodelovali so tudi pri društvi Sloga (od leta 1898 dalje Slovenska palma ob Nilu) in Jugoslovanski dom (od 1936). Namen društev, ki so jih ustanovili frančiškanski misijonarji, je bil povezati slovensko skupnost v okviru cerkvenih dejavnosti in tako preprečiti odpade od verske in narodne pripadnosti. Iz spodnjega zapisa patra Benigna odseva društveni namen medsebojnega srečevanja Slovencev ob utrjevanju vere in ljubezni do domovine:

»Kako lepo je videti ob nedeljah popoldne zbranih toliko poštenih Slovencev v imenovanih društvi. Tam se po domače mej seboj pogovore, tam čitajo dobre časnike in knjige, tam je preskerbljeno za pošteno razvedrilo in zabavo, tam se razlega domača pesem, tam so obvarovane grešnih priložnosti, tako nevarnih zlasti ob nedeljah popoldne. Skerbi torej, draga Slovenka, da boš tudi ti vnetna in stanovitna društvenica, tako boš tudi vedno dobra in verna Slovenka. Skušnja to poterjuje: Stanovitne društvenice so tudi poštene in vzgledne Slovenke.«³⁷

Slovenska društva v Egiptu so za tamkajšnje Slovence postala središča družabnega, narodnega in verskega življenja. Njihovo poslanstvo je bilo povsem skladno s ciljem duhovnega in narodnega delovanja slovenskih kuratov v Egiptu ter je obenem predstavljalo varno okolje za rojake, ki so bili med tednom razpršeni po različnih delih mesta, v nedeljo pa so obnovili svojo identiteto.

4 MISIJON MED IZSELJENCI: SLUŽENJE ALI GOSPODOVANJE?

Dodajmo še krajšo razpravo o naravi frančiškanskega misijona med Slovenci v Egiptu v razdobju 70 let (1894–1965), ko je bila tam razmeroma velika slovenska naselbina.

V nekaterih novejših znanstvenih objavah, ki so sicer plod argumentiranega premisleka, zasledimo ustvarjanje podobe slovenskih duhovnikov in cerkvenih organizacij v Egiptu kot oblikah nadzora oziroma kontrole nad pretežno ženskimi izseljenkami. Avtorji v kontekstu vrednotenja odnosa nekaterih cerkvenih predstavnikov do izseljevanja žensk v Egipt pišejo o vlogi duhovnika kot nadzornika deklet in žena, ki je svojo avtoriteto

uveljavljal na področju urejanja družinskih odnosov in vzpostavljanja cerkvene moči v javnem življenju.³⁸ Nadzoru nad žensko emigracijo naj bi poleg nudenja pomoči služila tudi omenjena društva, ki so jih ustanovili slovenski patri in prav tako šolska dejavnost slovenskih šolskih sester.³⁹ Ti nazori vzbujajo podobo frančiškanskega misijona med izseljenci predvsem kot oblike uveljavljanja moči in gospodovanja nad skupnostjo.

Nasproti temu je smiselno postaviti še drug vidik cerkvenega misijona med Slovenci v Egiptu. Res je Cerkev v primeru slovenskih izseljencev »sledila« svojim ljudem⁴⁰, vendar je pri tem treba upoštevati njen namen. Celotna slovenska misijonska zgodovina iz 19. in 20. stoletja izpričuje, da so misijonarji in misijonarke, ki so po svetu odhajali iz slovenskega prostora, svojo nalogo razumeli predvsem kot poslanstvo, ki naj služi celovitemu razvoju ljudi, med katere so bili poslani.⁴¹ Vera je v službi človeka in celotne skupnosti. Njena naloga ni gospodovati, ampak biti v pomoč. Tudi Cerkev kot institucionalizirano verstvo mora biti v službi ljudi.⁴² V spisu Benigna Snoja res beremo, da morajo izseljenke poslušati svojega dušnega pastirja in da ima ta nad njimi posebno obliko vodenja. To na eni strani izhaja iz splošnega pomena duhovniškega poklica, ki ljudi vodi k duhovnim dobrinam (verski pomen), na drugi strani pa je treba upoštevati tudi zgodovinsko dejstvo, da so se domala vsi slovenski izseljenci v Egiptu izrekli za katoličane in navzočnosti predstavnikov Cerkev v Egiptu niso dojemali kot oblike kontrole in poseganja v zasebno življenje, ampak kot duhovno in praktično podporo v novem in neznanem okolju. Misijonarji za rojake niso hodili zaradi utrjevanja svoje moči ali oblasti cerkvene institucije, ampak zaradi temeljnega poslanstva služenja ljudem, s katerimi so povsem delili usodo izseljenkega življenja in se z njimi povezali tudi na osebni ravni. Brezštevilna pisna in ustna pričevanja govorijo o nesebičnih oblikah pomoči slovenskih frančiškanov rojakom v Egiptu. Slovenke so slovenskega duhovnika v Kairu imenovali »naš očka«, samostan šolskih sester pa »naš dom.«⁴³ Sodobni poznavalci slovenske ženske emigracije v Egipt pravijo, da so bile šolske sestre tudi same »aleksandrinke«⁴⁴, izseljenke, ki so v dobrem in slabem živele sredi slovenske skupnosti. Kakor izseljenci, so se tudi frančiškani in sestre pri zagonu svojih dejavnosti srečevali z izzivi lokalnega okolja in nasprotovanjem cerkvenega vodstva. Potemtakem se zdita besedi »nadzor« ali »uveljavljanje oblasti« pri govoru o delu cerkvenih predstavnikov med izseljenci v Egiptu preveč negativni in vzbujata enosmerno vrednotenje njihovega misijona. V ospredje je bolje

³⁶ Snoj, Benigen. 1910. V: *Cvetje z vrtov sv. Frančiška*, Slovenka v Egiptu [1. del], 239.

³⁷ Snoj, Benigen. 1910. V: *Cvetje z vrtov sv. Frančiška*, Slovenka v Egiptu [2. del], 275.

³⁸ Mlekuž, Jernej. 2016. V: *Zgodovinski časopis*, »Oblastva morajo korigirati spokornišvo burno živeče aleksandrinke«: časopisne resnice o aleksandrinkah in aleksandrinstvu do prve svetovne vojne, 169.

³⁹ Verginella, Marta. 2011. V: *Po aleksandrijskih poteh*. Ur. Franco Però et al. Aleksandrinke med mitom in resničnostjo, 157. Trst: EUT.

⁴⁰ Riman, Barbara. 2020. V: *Bogoslovni vestnik*, Slovenski duhovniki in njihovo delovanje v slovenskih društvih na Hrvaškem v prvi polovici 20. stoletja, 135.

⁴¹ Kolar, Bogdan. 2022. V: *Bogoslovni vestnik*, Misijonske dejavnosti – v službi evangelizacije in vzgoje za vrednote, 892.

⁴² Grmič, Vekoslav. 1995. V: *Koroški koledar 1996*, Narodnost in vera, 93.

⁴³ Vigred. 1938. Iz Kaire, 155.

⁴⁴ Kozinc, Darinka. 2019. Les Slovēnes. Trst: Mladika, 5.

postaviti pomen služenja in skrbi, ki sta gnali posameznike in posameznice v službi Cerkev. Ne glede na zorni kot pri presojanju vloge slovenskih duhovnikov v Egiptu lahko mirno trdimo, da so imeli slovenski frančiškani veliko zaslug za versko oskrbo in vzdrževanje narodne zavesti med tamkajšnjimi izseljenci.⁴⁵

5 SKLEP

V pastoralnem delovanju slovenskih frančiškanov med izseljenci v Egiptu, ki ga nazorno odraža in povzema obravnavani zapis Benigna Snoja *Slovenka v Egiptu*, lahko prepoznamo sočasno prizadevanje za prebujanje verskega in narodnega življenja med rojaki v obliki zasebnega čutenja in javnega izražanja. Izseljenske duhovnike je vodilo prepričanje, da človeka naravno in duhovno opredeljuje narodna pripadnost, ki je most do sprejemanja vere, saj mora biti človek v polnosti zavezan svoji identiteti, da lahko sprejme vero. Če so hoteli oznanjati vero, so morali utrjevati ljubezen do naroda. Ljubezen do naroda pa so lahko dosegli s širjenjem verske zavesti, saj ima vera vlogo povezovanja rojakov in ustvarja čut pripadnosti zaradi skupnih vrednot in idealov. Oba procesa sta tesno prepletena, saj je človek zasebno in družbeno bitje.

Ko je Cerkev za slovenskimi izseljenci v Egiptu in po vsem svetu pošiljala misijonarje, je pokazala konkretno skrb za njihovo ohranitev istovetnosti, ki so jo pridobili v domovini. Treba je vedeti, da Cerkev v Sloveniji kot celota ni nasprotovala izseljevanju v Egipt, čeprav so posamezni župniki zaradi strahu pred moralnim propadom izseljenk ta proces zavirali. Še več, Cerkev je ob spoštovanju človekove svobodne izbire kot edina ustanova iz domovine celo organizirala dejavnosti za izseljence v tujini. Čeprav so bili njeni predstavniki s svojimi idejnimi izhodišči pri delu za Slovence po svetu predstavniki določenega zgodovinskega trenutka, nam imajo kaj povedati tudi danes.

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Ali se otrok ne da kupiti?

Is It Not Possible To Buy Children?

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POVZETEK

V prispevku skušamo odgovoriti na vprašanje, ali je odločanje za otroke odvisno od denarja in materialnih dobrin. Odgovor je pomemben, ker se evropske in ameriške države soočajo s prenizko rodnostjo in posledično občutijo vedno večjo kadrovska vrzel. Naš odgovor je pozitiven. Država in lokalne skupnosti lahko s preudarnimi politikami denarne in drugačne materialne podpore vplivajo na odločanje mladih parov za več otrok. Je pa graditev dražja, bolj zapletena in dolgotrajnejša od podiranja. Zmanjšanje rodnosti je bilo dosti cenejše, enostavnejše in hitrejše, kot bo njeno okrevanje.

KLJUČNE BESEDE

Demografija, denar, vrednote, rodnost, primanjkljaj rojstev, otroci, delovna starost, vlada, lokalne skupnosti politike, okolje, kadrovska vrzel.

ABSTRACT

In the paper we try to answer the question, whether deciding to have children depends on money and material goods. The answer is important because European and American nations are facing too low fertility, and as a consequence also a growing personnel gap. Our answer is positive. With smart policies of financial and other material support state and local communities can influence young couples to have more children. Construction however is more expensive, more complicated and takes more time than destruction. To reduce fertility was much cheaper, simpler and faster, than its recovery is going to be.

KEYWORDS

Demography, money, values, fertility, lack of births, children, working age, government, local communities, policies, environment, personnel gap.

^{*}Article Title Footnote needs to be captured as Title Note

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1 UVOD – OTROK SE NE DA KUPITI!

V vladnem mandatu 1992-1996 sem kot državni sekretar za družino od blizu spremljal dogajanje v družinski politiki in v njem sodeloval. V razpravah in izračunih so nekateri utemeljevali svoje predloge za večje vlaganje v družinsko politiko tudi s prenizkim številom rojstev, ki čez 25 in več let prinese húdo pomanjkanje ljudi v delovni starosti. Leta '94 ali '95 je eno od takih živahnih razprav zaključil poslanec - predstavnik nasprotnikov večjih vlaganj - z gromkim: "**Otrok se ne da kupiti!**" Odločanje zanje da je odvisno od vrednot. S tem etično dopadljivim sloganom je svoje stališče prebrisano zavaroval pred ugovori. Kdo bo oporekal misli, da so vrednote pomembnejše od umazanega denarja? Sram jih bodi, ki so z njim hoteli kupovati otroke! Na vladnem odboru smo nekoliko pozneje razpravljali o zakonskem predlogu, ki je dajal možnost staršem, ki bi to želeli, dlje ostati doma pri otroku. V svojem nagovoru proti zakonu je znani poslanec poudaril zglede Hudobivške Mete iz Prežihovih Samorastnikov, ki je kmalu po porodu šla na dnino. Spomnimo: "Z najmlajšim v zibelki na glavi pa še dva, tri hlačarje ob sebi je odhajala ob prvi zori na delo in prihajala ponoči domov." Stališče, da se z denarjem ne da podpreti odločanja za novo življenje, je prepričalo tudi mnoge, ki vztrajno in s prizadetostjo opozarjajo, da nas je premalo. Tako smo na primer v Družini [1] nedavno prebrali, da "**denar ne pomaga**".

Leta 1995 in pozneje nekateri niso znali iz podatkov o rojstvih - ne napovedati - prebrati sedanjega hudega pomanjkanja ljudi v starosti 25 do 64 let niti njegovega povečevanja za 12 tisoč letno, če bi ne bilo migracij; odločnih ukrepov ni bilo; in zdaj beremo in poslušamo, kako je iznenada zmanjkalo na tisoče in desetisoče zdravnikov, šolnikov socialnih delavcev, natararjev, varilcev, prevzemnikov kmetij, informatikov, gradbenih delavcev.... In še hujša kadrovska vrzel nam grozi. V 25 letih se bo število oseb v delovni starosti zmanjšalo za 270 tisoč oziroma 24 odstotkov, če ne bo migracij [2]. Sedanji premier se zaveda resnosti tega primanjkljaja; dne 24.5.2023 je v pogovoru na Radio Prvi za gospodarstvo skupaj z javnim sektorjem povedal: »glavni problem v celem gospodarstvu je delovna sila ...danes govoriti, da je problem nekje drugje, je smešno.« Danes vemo tudi, ne samo, da se otroke dobesedno da kupiti, ampak se jih v kar velikem obsegu dejansko prodaja in kupuje. Vendar poslanec takrat ni imel v mislih takega

kupovanja. Hotel je povedati, da z denarjem ne moremo vplivati na odločanje za novo življenje.

Namen tega prispevka je razmisliti o vlogi vrednot in pokazati, da se z denarjem in materialnimi dobrinami da močno vplivati na odločanje posameznikov. Zakaj je ta razmislek pomemben? Prvič, da sploh opozorimo na to možnost. Kajti, ko vodilni v posameznih panogah tarnajo nad primanjkljajem delavcev, se navadno ne spomnejo, da jih je premalo zato, ker se jih je pred desetletji premalo rodilo, in da bi bilo danes modro poskrbeti, da jih bo čez 25 let več. Med zdravili za to pomanjkanje niti premier niti UMARjeva poročila, na primer letošnje [3], ne predlagajo ukrepov za več rojstev. Tudi dokumenti Evropske komisije, kot na primer *The impact of demographic change – in a changing environment*[4] in *Harnessing talent in Europe's regions* [5], ne. Drugič, zato, ker je poglavitno orodje vlade denar, proračun. Tudi pomembni ukrepi za spodbujanje rojstev, ki ne prinesejo denarja neposredno staršem, kot so programi vzgoje, izobraževanja in podpore družini v javnosti, predstavljajo za oblast strošek in zahtevajo svojo proračunsko postavko. Če se z denarjem ne da, potem državni in lokalnim vladam tega sploh ni mogoče narediti, in jim zato ni treba: ni jim treba zapravljati in si beliti glave s tem, česar ne morejo spremeniti. "Denar ne pomaga" podeljuje vnaprejšno odvezo vsaki oblasti, ki ne bo naredila ničesar za povečanje števila otrok, in popolni odpustek, tistim, ki so za to premalo storile, ter jemlje veter iz jader vsem, ki si prizadevajo za stvarne spodbude družinam. Naše sporočilo torej bodi: "Ne izgubite upanja, ne izgubite volje: tudi denar pomaga, pa še kako!"

2 ČLOVEK ŽIVI TUDI OD KRUA

"Človek naj ne živi samo od kruha" (Mt 4,4), brez kruha pa le ne more. Deset zapovedi in z njimi povezane vrednote nas vodijo tudi v tostranski blagor. Družinska, "spoštuj očeta in mater", je celo določno utemeljena s pričakovanim učinkom "da boš dolgo živel in ti bo dobro na zemlji". Vrednote nam prinašajo dobrote. In obratno. Dobrote, ki smo jih deležni, ko živimo v skladu z vrednotami, jih utrjujejo in potrjujejo. Če vrednote nehajo prinašati dobrote, jih lahko še nekaj časa ohranimo, vendar jih naslednji rodovi že postopoma pozabijo. Govorim o ljudeh, kakršni po večini smo, in ne kakršni naj bi bili; ne o izbrancih, svetnikih in herojih.

Zakaj ima revnejši Afričan več otrok kot bogat Evropejec? Tudi zato, ker je v njegovem rodovnem načinu zagotavljanja blaginje in socialne varnosti jasno (sicer s krepitvijo države vedno manj jasno, zato tudi rodnost upada), da jo lahko zagotovijo le otroci. Evropejcu pa varnost in blaginjo zagotavlja delo v dobri službi z visoko plačo, pri čemer ga otroci ovirajo. Takó je ravnanje obeh - eden vlaga v otroke, drugi v plačo - razločljivo s prizadevanjem za materialno blaginjo. Pred tri tisoč leti, ko je psalmist zapisal "blagor človeku, ki jih ima obilo, ne bo osramočen in ne pozabljen" (Psalm 126), to ni bilo nobeno odkritje, saj je presežek njihovega zaslužka ostal družini, ki je predstavljala zdravstveno, pokojninsko in druge vrste varnosti. Odkar je

država vzpostavila svoje sisteme varnosti, pa je za višino bolniškega nadomestila in pokojnine pomembna višina plače in število let zaposlenosti, število otrok pa ne več. Ko starši otroke spravijo h kruhu, jih država "nacionalizira" (tako je imel navado reči nekdanji državni sekretar na MDDSZ, takrat največji poznavalec našega pokojninskega sistema), da polnijo državne blagajne, katerih vsebine pa država ne razdeljuje v skladu s številom otrok. Sčasoma postane očitno, da tisti z manj otroki dolgoročno živijo na račun večjih družin, da se z manj otroki bolje živi, in velika večina ravna racionalno. Blagra, ki ga sicer še vedno prinašajo otroci, ne čuti več posameznik, ampak skupnost. Psalmist bi morebiti lahko zdaj zapisal: "blagor narodu, ki jih ima obilo".

Do sredine prejšnjega stoletja je za rojstva skrbela tudi privlačnost med moškim in žensko, s katero je narava zagotavljala nadaljevanje človeškega rodu. Vodila je v spočetje, spočetje pa v nosečnost, ki je oznanjala rojstvo. Ko smo to privlačnost ločili od spočenja in rojevanja, ko skupnost postelje ne vodi v spočetje in posledica spočetja, če do njega pride, ni rojstvo, smo naravo prinesli okrog - kot običajno seveda v svojo škodo. To nekateri imenujejo doprinos vrednot liberalne družbe. Vrednote v tem primeru prispevajo k manj rojstev. Prinesle naj bi svobodo odločanja, a so prinesle le njeno slabšo polovico, svobodo reči otroku "ne". Države, ki hočejo imeti otroke in s tem prihodnost, poskrbijo tudi za drugo, boljšo polovico svobode, svobodo reči otroku "da"; in da so tudi starši deležni blagra, ki ga državi prinašajo njihovi otroci. Kot vsaka stvar, to nekaj stane. Vlaganje v spodbude je cena za preživetje liberalne družbe in socialne države. Če je kdo računal, da bodo krščanske vrednote, posebej katoliške, uspešna protiutež liberalizaciji družbe in njenim sistemom socialne varnosti ter bodo same poskrbele za dovolj otrok, se je motil. Najbolj katoliške države Italija, Španija, Malta imajo najnižjo rodnost.

3 KAJ PRAVIJO PODATKI?

Državna vlaganja močno vplivajo na odločanje za otroke. V drugi polovici prejšnjega stoletja, v obdobju, v katerem se je število rojstev v Sloveniji razpolovilo, je vlaganje v to področje strmo padlo. Otroški dodatki so padli od več kot 4% tedanjega nacionalnega dohodka v petdesetih letih na manj kot odstotek BDP; vsi družinski prejemki - otroški dodatki, porodniške, starševski dodatki, zavitek za novorojenca in dodatek za nego - pa pod 1.7%. Delež upravičencev do otroških dodatkov je padel od 100% zaposlenih brez zemlje v petdesetih letih, na 8% v osemdesetih. Padla je višina posamezne otroške doklade: v petdesetih letih je povprečna višina znašala 27 odstotkov povprečne plače, konec osemdesetih pa nekajkrat manj. [6]. Več o tem bo bralec našel v monografiji [7].

V učinkovitost denarnih spodbud verjame eden največjih poznavalcev evropskega gospodarstva in politike, Mario Draghi. Ko so ga povabili, naj pride reševati italijansko gospodarstvo sredi najhujše pandemije, je njegova vlada nemudoma sprejela radodaren zakon v podporo družinam in to vključila tudi v italijanski načrt za okrevanje in odpornost.

Ni skrival namena, doseči večje število rojstev, in mu ni bilo nerodno povedati, da mu gre tudi za obstoj Italije in s tem italijanstva.

Verjamejo tvorci programov za zmanjševanje rodnosti. Memorandum podpredsednika Planned Parenthood Federation of America iz leta 1969 [8], ki ga je avtor pripravil za mednarodno konferenco o prebivalstvu, med ukrepi za zmanjšanje rodnosti navaja tudi zmanjšanje porodniškega dopusta, ukinitvev davčnih olajšav, davek na otroka, pokojnino za ženske z majhnim številom otrok, zmanjšanje otroških dodatkov in popolno ukinitvev pri več kot dveh otrokih. Ne glede na to, kateri predlogi so bili uveljavljeni in v katerih državah, je prepričanje strokovnjakov, da so učinkoviti, očitno.

Otrok v devetdesetih letih res še ni bilo mogoče kupovati. Je pa zanje tudi takrat bilo treba plačati, zato so tvorni pogoji, na katere lahko odločilno vpliva država, bili in so še, bistvenega pomena za odločanje zanje. Danes je svet tako zelo "napreduval", da že ptički čivkajo, da je otroka mogoče kupiti: ilegalno ali po zakoniti poti na osnovi pogodbe z nadomestno materjo. Pa tudi posvojitvev po zakoniti poti v večini primerov precej stane. Slogan, da se ga ne da kupiti (da denar ne pomaga) torej ne velja ne dobesedno ne v prenesenem pomenu.

Graditi je dražje in bolj zamudno kot rušiti. Zato je trend rodnosti res zelo težko obrniti navzgor. Treba se je potruditi. Kdor se je res potrudil, je uspel. Ko sem leta 1966 v švicarski vasici St. Sergue ob francoski meji na benzinski črpalki BP služil študentski denar za naslednje študijsko leto, je sanjski avto bila žaba, izdelek tovarne Citroen. Največji modeli so imeli zelo prostoren zadnji del. Francozi so prihajali natakati švicarski cenejši benzin in tako sem večkrat videl, kako iz avta najprej veselo in ponosno vstaneta oče in mati s prednjih sedežev, potem pa se iz zadnjega dela prikaže eden, dva, tri, štiri, pet,... otrok. Pravim gospodarju črpalke, ki je imel dva otroka: "Pri nas pa družine s toliko otroki ne pridejo do takih avtov." On pa: "Tudi v Švici ne. Ampak to so Francozi. "Les familles nombreuses" so tam carji. Če imaš tri otroke, lahko mati pusti službo, pri štirih ali petih pa imaš zagotovljeno stanovanje in tudi tak avto ni problem". Ohranili so svoj moderni socialni sistem in liberalne vrednote ter rodnost nad 2 otroka na žensko, v posameznih letih tudi do 2,1, leta 2022 pa po oceni CIA 2,03. Res manj, ampak zelo, zelo malo manj od rodnosti enostavnega obnavljanja 2,1. Očitek vlaganjem v družinsko politiko - vsak otrok pomeni dodatnega brezposelnega - so zavrnili s podatkom, da družina s petimi otroki z materjo doma v 40 letih prinese državni blagajni 6 do 9 milijonov frankov dobička. [9] Več izračunov in modelov vzdržnosti socialne države bo bralec našel v [10]. Potrudila se je tudi Madžarska in v prejšnjem desetletju z vlaganji v ustrezno družinsko politiko uspela povečati totalno mero rodnosti z 1,2 na 1,6. Ni še dovolj, je pa dokaz, da se da.

Zagotoviti stanovanje, ali ni to za državo predrago? Minister za zdravstvo je 18.2.2023 povedal, koliko ljudi manjka v zdravstvu, pa tudi, da ne ve, kje bo katerega našel. Kamorkoli ga bo šel iskat, mu bo moral ponuditi stanovanje v Sloveniji. Ali bo politiki kdaj pogled segel tako daleč, da bo spoznala, da bi bilo vsaj tako smotrnno, da bi s stanovanjem tudi našo družino spodbudila, da poskrbi, da bo čez 30 let kak zdravnik več?

Pokojninski sistem, od katerega je odvisna blaginja stotisočev, bo na več stebrih. A vsi so na isti premici - ukvarjajo se samo z denarjem in premoženjem - in sistem se bo, tako kot miza, ki jo podpirajo tri noge v eni vrsti, prekucnil in zrušil. Ne smemo prezreti temeljnega najbolj nosilnega stebra pokojninskega in vseh sistemov socialne varnosti in gospodarske uspešnosti: ljudi. Stoji zunaj linije ostalih stebrov in sistemu zagotavlja stabilnost. Njegov kapital se ustvarja z izbiro življenja, povezano s tisoč drobnimi gospodinjstvi opravili, pleniciami in vnetimi ritkami, preverjanjem domačih nalog in branjem pred spanjem - deli, ki se pri višini pokojnine in bolniškega nadomestila sedaj ne upoštevajo.

V potrošniški družbi, kjer se za denar vse dobi, da denar ne pomaga?! O, pomaga, pomaga! Pa še kako pomaga! Če ga vlada vložiti dovolj in po pameti, bo zaslužna za blaginjo, socialno varnost in gospodarsko uspešnost čez 25 let in naprej.

Treba bo pomagati toliko, da se res pozna. Otroški dodatki v višini četrte povprečne plače, bi morda števila rojstev ne dvignili na raven iz petdesetih let, bi ga pa krepko povečali. Če bi po zgledu Francozov odvzeli staršem skrb za stanovanje, smo skoraj na konju. Vendar: različni ljudje - različne želje in potrebe. Naselja neprofitnih stanovanj verjetno niso zanimiva za prevzemnike kmetij. Kdor že ima hišo, bi morda potreboval spodbudo s področja dela in zaposlitve. S finim občutkom za njihove potrebe bo treba vzpodbujati različne skupine na različnih področjih.

Pri načrtovanju spodbud in ocenjevanju učinkov je treba upoštevati, da se slovenska družina ne primerja z afriško ali tisto izpred tri tisoč let, ampak z današnjo sosedovo. Ali ji nov otrok prinese dodatno blaginjo in družbeni ugled, ki pritiče ljudem, zaslužnim zaradi svojega prispevka skupnosti? Bodo državne spodbude tolikšne in takšne, da bodo starši z več otroki postali "carji" in "kul", vzor, ki mlade in sosede vabi k posnemanju?

O ukrepih je treba doseči nacionalno soglasje, da bi zakonodaja preživela vlade različnih barv. Družina je dolgoročen projekt. Za odgovorno načrtovanje in odločitve so potrebni znani pogoji. Vzpodbud in uvedenih ugodnosti nobeni skupini ne smemo ukinjati ali zmanjševati: treba je graditi in podpirati, a zgrajenega ne podirati. Da ne spravljamo staršev v položaj slalomista, ki mu med vožnjo premikajo vratca.

4 ZAKLJUČEK

Ali je to mogoče? Je! Desetletni otrok sem videl po notranjski Reki plavat ribe z navzgor obrnjenimi belimi trebuh, starši pa so mi prepovedali v njej napajati živino in se kopati. Danes, po skoraj 70 letih, so v Reki spet ribe in ljudje se v njej kopajo. Dosegli smo nacionalno soglasje o potrebnosti varovanja okolja. Na to opozarjajo mediji, učbeniki, politiki, gospodarstveniki. Ni hitrih učinkov, vendar v parlamentu pred sprejemom obvezno ocenijo okoljski učinek novih zakonov, drugje to delajo za nove zgradbe, proizvodnje, .. Vlagamo velika sredstva. Ljudje in organizacije prejemajo pohvale in nagrade za svoje doprinose.

Večini Slovencev narodno preživetje in obstoj države, vsaj po izjavah ob praznikih sodeč, pomeni vsaj toliko kot vreme in okolje. Posebej, ker se naš prispevek k podnebnju meri v desetinkah promila, za svoje preživetje pa moramo stoodstotno poskrbeti sami, da bomo tudi trend odločanja za življenje uspeli obrniti navzgor. Vzpodbujajo nas zgledi drugih. Italijanska premierka je na demografskem vrhu v Budimpešti 14.9. 2023 svojo družinsko politiko utemeljila z izjavo, da morajo "veliki narodi prevzeti odgovornost za gradnjo lastne prihodnosti". Za maloštevilčne pa je to še bolj ključno. Našli bomo dovolj moči in sredstev. Kot smo jih za okolje. In ko bomo desetletja nova življenja tako podpirali, kot že desetletja skrbimo za okolje, bomo imeli dovolj otrok. Se pa, tako kot pri okolju, zelo mudi. Bolj kot kateremukoli drugemu narodu.

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Problematična raba alkohola, funkcionalnost v družini ter individualne težave*

Problematic use of alcohol, family functionality and individual problems

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POVZETEK

Tvegana raba alkohola sodi med pomembne dejavnike tveganja za razvoj bolezni in prezgodnjo umrljivost, posledice pitja pa se odražajo tako na ravni posameznika, družine, okolice, kot tudi širše družbe. Namen raziskave je bil ugotoviti povezanost tvegane rabe alkohola, družinske funkcionalnosti in individualnih problemov glede na status aktivnosti. V raziskavi je sodelovalo 432 udeležencev, podatki pa so bili zbrani s pomočjo z Vprašalnikom o stopnji tveganosti pitja alkohola (AUDIT), Lestvico individualnih problemov in moči (IPS), Lestvico izvorne družine (FOO) in Lestvico sedanje družine (FH). Rezultati so pokazali, da so znotraj statusnih skupin po nevarni rabi alkohola najbolj posegali brezposelni in zaposleni, manj pa študentje in upokojeni. Pri brezposelnih udeležencih, je bila problematična raba alkohola povezana s slabšo funkcionalnostjo v izvorni družini. Pri študentih je bilo tvegano uživanje alkohola statistično pomembno povezano s slabšo funkcionalnostjo izvorne, kot tudi sedanje družine. Pri zaposlenih in upokojenih pa je bila zloraba alkohola povezana z individualnimi problemi. Tako funkcionalnost v sedanji, kot tudi izvorni družini in zloraba alkohola so bili statistično pomembni prediktorji za napovedovanje individualnih težav.

KLJUČNE BESEDE

Alkohol, družinski odnosi, izvorna družina, individualne težave, zaposlitveni status

ABSTRACT

Risky alcohol use is a major risk factor for disease and premature mortality. Consequences of alcohol misuse felt at the level of the individual, the family, environment and wider society. The aim of the study was to investigate the association between risky alcohol use, family functionality and individual problems socio-economic activity status. The study involved 432 participants and data were collected using the Alcohol Use Risk Inventory Questionnaire (AUDIT), the Individual Problems and Strengths Scale (IPS), the Family of Origin Scale (FOO) and the Family

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Household (FH). The results showed that unemployed and employed people were most affected by hazardous alcohol use, while students and retired people were less affected. For unemployed participants, problematic alcohol use was associated with poorer functionality in the family of origin. For students, risky alcohol use was statistically significantly associated with poorer functionality in both the original and current family. Among employed and retired people, however, alcohol abuse was associated with individual problems. Both current functioning, as well as families of origin and alcohol abuse, were statistically significant predictors of individual problems.

KEYWORDS

Alcohol, family relationships, family of origin, individual problems, employment status

1 UVOD

Svetovna zdravstvena organizacija (SZO) uvršča rabo alkohola med pomembne dejavnike tveganja za razvoj bolezni in prezgodnjo umrljivost ter prispeva k neenakostim v zdravju prebivalcev. Posledice pitja se odražajo tako na ravni posameznika, družine, okolice, kot tudi širše družbe. Po podatkih NIJZ je registrirana poraba alkohola v letu 2019 v Sloveniji znašala 11,05l čistega alkohola na odraslega prebivalca, starega 15 in več, in se je v primerjavi z letom prej zvišala za več ko ten liter (1,06l). Med ranljive skupine pa spadajo moški in ženske z osnovnošolsko izobrazbo ali manj, moški in ženske v starosti od 15 do 17 in od 18 do 24 let, moški in ženske, ki živijo brez partnerja, šolajoči se ženske in moški in moški iz spodnjega socialnoekonomskega razreda. Podatki iz leta 2018 so pokazali, da je 10,1 % prebivalcev Slovenije, starih 15–64 let, v zadnjih 12 mesecih pilo alkoholne pijače čez mejo manj tvegane pitja, 68,9 % jih je pilo znotraj meje manj tvegane pitja, 21,0 % pa je bilo abstinentov. Delež abstinentov je bil 1,6-krat višji med ženskami (26,3 %) kot med moškimi (16,0 %). Delež pivcev, ki pijejo čez mejo manj tvegane pitja, pa je bil dvakrat višji med moškimi (13,3 %) kot ženskami (6,6 %) [1]. Tvegano uživanje alkohola je opredeljeno kot odvisniško vedenje, za katerega za značilna visoka motivacija z iskanjem užitka ali s samodekstruktivnimi motivi. Odvisnost od alkohola se odraža v posameznikovem vedenju, mišljenju in čustvovanju, obenem pa

povzročata tudi trajne spremembe v delovanju možgan, predvsem vpliva na okrnjeno delovanje frontalnega režnja ter poškodbe v neurotransmitskem sistemu [2]. Eden od pomembnih dejavnikov tveganja za razvoj alkoholizma pa je tudi motnja samoregulacije, do katere pride zaradi doživljanja prekomernega psihičnega stresa, travmatičnih izkušenj in bolečih izkušenj ter nefunkcionalnih vedenj v medosebnih odnosih [3, 4]. V ozadju zasvojenosti z alkoholom so tako lahko neuspešno regulirane psihične vsebine, ki izhajajo iz preteklih travmatičnih doživetij, odvisnost pa predstavlja način neprimerne regulacije teh notranjih stanj [5]. Izkušnje in odnosi s starši in primarnimi skrbniki v zgodnjem obdobju mehanizem samoregulacije. Odrasla oseba je tako sposobna učinkovitega uravnavanja svojih občutkov, čustev, misli, vedenj, kar pomeni, da spremembo pri sebi zazna, jo prepozna in se zmore nanjo tudi primerno odzvati. Osebe s travmatičnimi izkušnjami in zlasti čustveno zanemarjenostjo v svoji primarni družini, pa imajo pogosto težave pri samoregulaciji, kar se na čustveni ravni odraža kot bodisi pretirano ali odrezano doživljanje čustvenih stanj, na vedenjski ravni pa kot odvisniško vedenje [6, 7].

Namen raziskave je bil ugotoviti, a katera statusna skupina (zaposleni, brezposelni, upokojeni in študentje) poroča o pogostejši rabi alkohola ter v kakšni meri je problematična raba alkohola povezana z odnosi v izvorni in sedanji družini ter individualnimi težavami.

2 METODA

2.1 Udeleženci

V raziskavi je sodelovalo 432 udeležencev s povprečno starostjo 37,2 let ($SD = 15,0$). Najmlajši udeleženec je bil star 18 let, najstarejši pa 74 let. Slaba polovica udeležencev (44,5 %, $N = 191$) je bilo zaposlenih, 8,2 % ($N=35$) jih je bilo brezposelnih, 36,1 % je bilo študentov in 11,2 % ($N=48$) je bilo upokojenih. Osnovnošolsko izobrazbo je imelo 3,5 % ($N = 15$) udeležencev, poklicno izobrazbo je imelo 8,9 % ($N = 38$) udeležencev, srednješolsko izobrazbo je imelo 32,6 % ($N = 139$) udeležencev, 104 udeleženci so imeli višje oz visokošolsko izobrazbo ali izobrazbo prve bolonjske stopnje (24,4 %), enak delež (24,4 %) jih je imelo univerzitetno izobrazbo ali izobrazbo druge bolonjske stopnje, 26 (6,1 %) je imelo specializacijo, znanstveni magistririj ali doktorat. Poročenih je bilo 128 (30,0%) udeležencev, v izvezakonski partnerski zvezi je bilo 138 (32,3 %) udeležencev, 125 udeležencev (29,3 %) je bilo samskih, 17 (4,0 %) je bilo ločenih, 7 (1,6%) je bilo ovdovelih in 12 (2,8%) udeležencev se ni opredelilo.

2.2 Pripomočki

Vprašalnik o stopnji tveganosti pitja alkohola (AUDIT)

Za preverjanje nevarne in škodljive rabe alkohola in prepoznavanje trenutnih težav s pitjem alkohola (npr. škodljivo raba alkohola, zlorabo alkohola in odvisnost od alkohola) je bil uporabljen Vprašalnik o stopnji tveganosti pitja alkohola (The Alcohol Use Disorders Identification Test). Poleg splošne dimenzije problematične rabe alkohola meri tri vidike zlorabe alkohola: nevarno uživanje alkohola (količina in pogostost),

simptome odvisnosti od alkohola (toleranca, sposobnost kontrole) in z uživanjem alkohola povezane probleme. Vprašalnik ima 10 postavk. Vprašanja 1-8 se vrednotijo na 5-stopenjski lestvici, vprašanja 9 in 10 pa na 3-stopenjski lestvici. Max. rezultat je lahko 40. Višji rezultati kažejo na večjo možnost nevarne in škodljive rabe alkohola. Rezultat 8 ali več kaže na nevarno ali škodljivo rabo alkohola, kot tudi že na možnost odvisnosti od alkohola [8].

Lestvica individualnih problemov in moči (IPS)

Lestvica individualnih problemov in moči (Individual Problems and Strengths Scale) je del instrumenta Systemic Therapy Inventory of Change (STIC) [9]. Uporablja se za oceno posameznikovih problematičnih in močnih področij. Vsebuje 22 postavk, razdeljenih na področja, ki ocenjujejo stanje posameznikovih problematičnih in močnih področij: izraženost negativnih afektov – depresivnost, anksioznost, odsotnost inhibicije močnih impulzov, življenjska funkcionalnost, odprtost samoizražanja, (ne)fleksibilnost oz. odpornosti, nerazumevanje samega sebe, zloraba substanc in samosprejevanje. Posamezne postavke udeleženci ocenjujejo na 5-stopenjski lestvici Likertovega tipa. V analizo je bila vključena skupna dimenzija individualnih problemov. Višji kot je rezultat na tej lestvici, več težav oz. individualnih problemov ima posameznik.

Lestvica izvorne družine (FOO)

Odnosi v izvorni družini: Lestvica izvorne družine (Family of Origin) je ena izmed lestvic vprašalnika STIC (Systemic Therapy Inventory of Change) [9], ki vsebuje 22 postavk, razdeljenih na naslednja področja: pozitivnost vzdušja v izvorni družini, negativnost vzdušja v izvorni družini, vzajemnost in jasnost pričakovanj v izvorni družini, prisotnost fizične zlorabe v izvorni družini, vsiljivost in zlorabo substanc v izvorni družini.

Lestvica sedanje družine (FH)

Lestvica sedanje družine (Family/Household) je ena izmed lestvic vprašalnika STIC (Systemic Therapy Inventory of Change) [9] in obsega 28 postavk, ki ugotavljajo, kakšna je v trenutni družini udeleženca stopnja pozitivnega vzdušja, negativnega vzdušja, fizične zlorabe, odločanja, jasnosti mej, občutenja nerazumevanja in družinskega ponosa.

2.3 Postopek

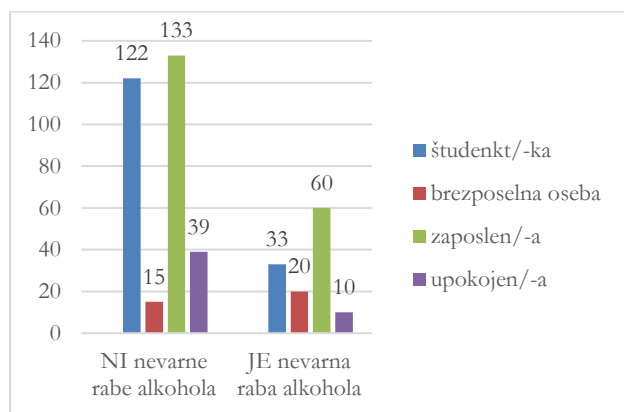
Vzorec je sestavljala splošna populacija ljudi iz Slovenije in Hrvaške. Raziskovalni vprašalnik je bil pripravljen v elektronski obliki. Povabilo za sodelovanje v raziskavi s povezavo do vprašalnika je bilo poslano na različne naslove (društva anonimnih alkoholikov) ter forume (npr.). V papirnati obliki pa je bil vprašalnik pripravljen za tiste udeležence, ki so se k sodelovanju v raziskavi odzvali na eni izmed klinik za zdravljenje alkoholizma. Etičnost raziskave je odobrila Komisija za medicinsko etiko Republike Slovenije ter vodstvo klinike za zdravljenje alkoholizma. Anketiranje je potekalo od junija 2021 do maja 2022. Sodelovanje v raziskavi z izpolnjevanjem vprašalnika je bilo prostovoljno, prav tako nismo imeli formalnih meril za izključitev, razen nesoglasja ali nezmožnosti odgovaranja na vprašalnike. Metoda vzorčenja je bila priročno vzorčenje v obeh državah.

Pridobljene statistične podatke smo obdelali s statističnim programom IBM SPSS 26. Izračunali smo osnove deskriptivne

statistike ter uporabili Kolmogorov-Smirnov test za preverjanje normalnosti distribucij dimenzij uporabljenih merskih instrumentov, test homogenosti za ugotavljanje linearosti, Welchev test za preverjanje razlik med skupinami, Pearsonov korelacijski koeficient za ugotavljanje povezanosti med variablami.

3 REZULTATI

O nevarni rabi alkohola je poročalo 123 udeležencev (28,5 %) udeležencev. Od teh je bilo 48 % zaposlenih (N = 60), 26,8 % študentov (N = 33), 16,3 % (N = 20) brezposelnih ter 8,1 % (N = 10) upokojenih. Udeležence smo razdelili v dve skupini, in sicer glede na to, ali je bila pri njih prisotna nevarna raba alkohola ali ne. Hi-kvadrat test je pokazal, da se skupine statistično pomembno razlikujejo v nevarni rabi alkohola ($X^2(3) = 20,266$, $p < 0,001$). Po nevarni rabi alkohola so bolj posegali brezposelni in zaposleni, manj pa študentje in upokojeni, kar je razvidno tudi iz slike 1.



Slika 1: Prisotnost (ne)varne rabe glede na zaposlitveni status

Iz zgornje slike 1 je prav tako razvidno, da je več brezposelnih poročalo o nevarni rabi alkohola. Najmanjši delež udeležencev, ki so posegali po nevarni rabi alkohola, pa so predstavljali upokojenci.

Table 1: Opisne statistike za lestvice tveganega pitja alkohola (AUDIT) glede na zaposlitveni status udeležencev

Status aktivnosti	N	AUDIT		
		tvegano uživanje	AUDIT odvisnost	AUDIT posledice
študenti	N	155	155	155
	M	3,65	0,33	1,02
	SD	2,43	0,68	1,87
brezposelni	N	35	35	35
	M	6,80	4,14	6,31
	SD	3,89	4,23	6,17
zaposleni	N	193	192	194
	M	4,33	1,64	3,35
	SD	3,65	3,16	5,09

upokojeni	N	49	48	49
	M	3,06	1,35	2,12
	SD	3,51	3,01	3,67
skupaj	N	432	430	433
	M	4,14	1,34	2,61
	SD	3,38	2,84	4,43

Primerjava povprečnih vrednosti na vprašalniku AUDIT med skupinami, ločenimi glede na zaposlitveni status, je pokazala, da obstajajo statistično pomembne razlike med skupinami tako na skupni dimenziji vprašalnika AUDIT ($p < 0,001$), kot pri vseh poddimenzijah ($p < 0,001$) (Tabela 1). Tamhanejev post-hoc test je pokazal, da obstaja statistično pomembna razlika pri tveganem uživanju alkohola med brezposelnimi in zaposlenimi ($M_{razlika} = 2,47$; $p = 0,007$), brezposelnimi in študenti ($M_{razlika} = 3,16$; $p < 0,001$) ter brezposelnimi in upokojenimi ($M_{razlika} = 3,74$; $p < 0,001$). Pri odvisnosti od alkohola, so imeli največ težav brezposelni v primerjavi z zaposlenimi ($M_{razlika} = 2,50$; $p = 0,011$), brezposelni v primerjavi s študenti ($M_{razlika} = 3,81$; $p < 0,001$), brezposelni v primerjavi z upokojenimi ($M_{razlika} = 2,79$; $p = 0,009$) in zaposleni v primerjavi s študenti ($M_{razlika} = 1,31$; $p < 0,001$). V problemih, povezanih z uživanjem alkohola, pa so prav tako imeli največ težav brezposelni v primerjavi s študenti ($M_{razlika} = 5,30$; $p < 0,001$), brezposelni v primerjavi z upokojenimi ($M_{razlika} = 4,19$; $p = 0,004$) in zaposleni v primerjavi s študenti ($M_{razlika} = 2,33$; $p < 0,001$).

Pri ugotavljanju povezanosti med problematično rabo alkohola in odnosi v izvorni in sedanji družini ter individualnimi problemi glede na status udeležencev pa smo ugotovili, da se je najmočnejša povezava pokazala pri brezposelnih udeležencih, kjer je bila problematična raba alkohola povezana s slabšo funkcionalnostjo v izvorni družini (Tabela 2). Pri študentih je bilo tvegano uživanje alkohola statistično pomembno povezano s slabšo funkcionalnostjo izvorne, kot tudi sedanje družine. Pri zaposlenih je bilo problematična raba alkohola povezana z več individualnimi problemi. Pri upokojenih pa so bile posledice zaradi problematične rabe alkohola povezane z več individualnimi problemi.

Tabela 2: Pearsonovi korelacijski koeficienti med AUDIT vprašalnikom in ostalimi merjenimi spremenljivkami

Status aktivnosti	FOO	FH	IPS PROBLEMI	
študenti	AUDIT	0,231**	0,207*	-0,093
	tvegano uživanje			
	AUDIT	0,089	0,065	0,008
brezposelni	AUDIT	0,105	0,084	0,034
	odvisnost			
	AUDIT	0,511**	0,046	0,253
zaposleni	tvegano uživanje			
	AUDIT	0,417*	-0,052	0,346
	odvisnost			
AUDIT	0,526**	0,058	0,252	
brezposelni	odvisnost			
AUDIT	0,526**	0,058	0,252	
zaposleni	odvisnost			
AUDIT	0,526**	0,058	0,252	
upokojeni	odvisnost			
AUDIT	0,526**	0,058	0,252	

zaposleni	AUDIT tvegano uživanje	0,057	-0,130	0,340**
	AUDIT odvisnost	0,029	-0,110	0,328**
	AUDIT posledice	0,056	-0,096	0,373**
upokojeni	AUDIT tvegano uživanje	0,038	-0,002	0,131
	AUDIT odvisnost	0,026	-0,113	0,219
	AUDIT posledice	-0,033	-0,105	0,376**

V nadaljevanju pa smo s standardno multiplo linearno regresijo želeli ugotoviti moč prediktorjev AUDIT, FO in FHH na odvisno variabla individualni problemi. Pogoji za uporabo multiple linearne regresije (linearnost, normalnost in kolinearnost) so bili izpolnjeni. Rezultati multiple regresije je pokazal, da so manjša funkcionalnost v izvorni družini, manjša funkcionalnost v sedanji družini in pogostejša raba alkohola pomembni prediktorji za več individualnih problemov. Z omenjenimi prediktorji je bilo pojasnjeno 30,0 % variance individualnih problemov. Od vseh prediktorjev ima največjo moč funkcionalnost v sedanji družini, sledi mu pogostejša raba alkohola in funkcionalnost v izvorni družini. Vsi trije prediktorji pa so se izkazali kot statistično pomembne.

Tabela 3: Multipla regresijska analiza za napovedovanje individualnih problemov

Neodvisna variabla	B	SE B	β	t	p
AUDIT	0,20	0,04	0,22	4,54	< 0,001
FH	-0,49	0,06	-0,42	-7,48	< 0,001
FOO	-0,07	0,03	-0,13	-2,46	0,015

4 RAZPRAVA

V raziskavi smo želeli ugotoviti, pri kateri skupini, ločeni glede na zaposlitveni status, udeleženci poročajo o najpogostejši rabi alkohola. Ugotovili smo, da po alkoholu bolj posegajo brezposelni in zaposleni, manj pa študentje in upokojeni. Ugotovitev je skladna tudi s predhodnimi raziskavami, ki ugotavljajo, da je višji tudi delež čezmernih pivcev med brezposelnimi moškimi v primerjavi z aktivnimi in neaktivnimi prebivalci [1]. Pri ugotavljanju povezanosti med problematično rabo alkohola in odnosi v izvorni in sedanji družini ter individualnimi problemi glede na status udeležencev smo ugotovili, da se je najmočnejša povezava pokazala pri brezposelnih udeležencih, kjer je bila problematična raba alkohola povezana s slabšo funkcionalnostjo v izvorni družini. Pri študentih je bilo tvegano uživanje alkohola statistično pomembno povezano s slabšo funkcionalnostjo izvorne, kot tudi sedanje družine, nismo pa odkrili povezanosti z individualnimi problemi. Rezultati so skladni tudi z ugotovitvami drugih

raziskav, ki kažejo na to, da pri mladih z boleznimi odvisnosti veliko bolj prevladujejo vzorci neangažiranega družinskega delovanja, starševski stil, ki temelji na zavračanju in pretirani zaščiti [10]. Pri zaposlenih in upokojenih pa je bila problematična raba alkohola povezana z več individualnimi problemi, kar lahko vodi v predvidevanje, da prekomerna raba alkohola postane neučinkovit način regulacije težav.

Številne psihološke teorije predvidevajo, da ljudje uživajo alkohol kot odziv na negativna in pozitivna čustva. Metaanalitična raziskava, ki je ugotavljala, ali ljudje zaužijejo več alkohola ob dnevih, ko v vsakdanjem življenju doživljajo več negativnih in pozitivnih čustev, je ugotovila, da ljudje ne pijejo pogosteje na dneve, ko doživljajo visok negativni afekt, vendar pa pogosteje pijejo in veliko pijejo na dneve z visokim pozitivnim afektom. Ljudje, ki so sami poročali o motivacijski nagnjenosti k pitju za obvladovanje in pitju za izboljšanje, so zaužili več alkohola, vendar ne na dneve, ko so doživljali večji negativni in pozitivni vpliv [11]. Tudi rezultati naše raziskave so pokazali, da je problematična raba alkohola statistično pomemben prediktor pri doživljanju individualnih problemov, prav tako pa sta se izkazala tudi slabša funkcionalnost v izvorni in sedanji družini. Ugotovitve kažejo na pomen razumevanja uživanja alkohola kot način obvladovanja težavin psiholoških stisk ter poudarjajo pomembnost preteklih in sedanjih družinskih odnosov.

ZAHVALA

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Demografske značilnosti zaposlenih v poklicih neotipljivega kapitala: primerjava javnih in zasebnih organizacij

Demographic characteristics of employees in intangible capital occupations: a comparison of public and private organizations

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POVZETEK

V članku analiziramo demografske značilnosti zaposlenih v poklicih neotipljivega kapitala, kjer ločujemo (i) organizacijski, (ii) raziskovalno-razvojni in (iii) informacijski neotipljivi kapital. Te značilnosti primerjamo z zaposlenimi ostalih poklicev, ob tem pa ločujemo med zaposlenimi v zasebnem in javnem sektorju. Analiza je osnovana na podatkih združene baze delodajalec-zaposleni (*angl. employer-employee dataset*) za obdobje 2011-2017. Rezultati kažejo, da je povprečna starost zaposlenih v poklicih neotipljivega kapitala v splošno nižja kot pri zaposlenih v ostalih poklicih, kar velja predvsem za zaposlene v poklicih informacijskega neotipljivega kapitala. Ugotavljamo tudi, da je odstotek zaposlenih žensk v poklicih informacijskega neotipljivega kapitala znatno nižji od deleža moških in znaša le okrog 10 %, medtem ko delež žensk, zaposlenih v poklicih organizacijskega neotipljivega kapitala, celo presega delež moških.

KLJUČNE BESEDE

Neotipljivi kapital, starost, razlike med spoloma, javni sektor, Slovenija.

ABSTRACT

In this paper, we analyse the demographic characteristics of employees in the intangible capital occupations, distinguishing between (i) organizational, (ii) research and development, and (iii) informational intangible capital. We compare these characteristics with those of employees in other occupations, distinguishing between employees in the private and public sectors. The analysis draws on data from the

employer-employee dataset for 2011-2017. The results show that the average age of employees in intangible capital occupations is generally lower than that of employees in other occupations, which is particularly true for employees in informational intangible capital occupations. At the same time, we find that the share of women employed in information intangible capital occupations is significantly lower than the share of men, amounting to only about 10%, while the share of women employed in organizational intangible capital occupations even exceeds the share of men.

KEYWORDS

Intangible capital, age, gender differences, public sector, Slovenia.

1 UVOD

Staranje prebivalstva vodi v implementacijo številnih reform, ki zvišujejo udeležbo na trgu dela, predvsem posameznikov v starosti 55–64 let in žensk [3]. V skladu s tem trendom narašča tudi zanimanje raziskovalcev za analizo vpliva vključevanja starejših delavcev in žensk na trg dela. Literatura kaže, da lahko staranje prebivalstva pozitivno vpliva na produktivnost dela, če so starejši delavci zaposleni v panogah z visokim deležem informacijsko-komunikacijske tehnologije (IKT) [5]. Poleg tega lahko robotska tehnologija ublaži negativne učinke staranja prebivalstva na rast produktivnosti [6]. Tako lahko učinkovito razporejanje resursov, v kombinaciji z vseživljenjskim učenjem, pomaga ohranjati produktivnost starejših delavcev [4].

Skozi čas se moški in ženske vse pogosteje odločajo za podobna področja študija in zaposlitve [2]. Kljub temu je v EU le 20 % diplomantk in 18 % zaposlenih žensk na področjih, povezanih z IKT. Razlika med spoloma je še bolj izrazita pri znanstvenikih in inženirjih v sektorjih visoke tehnologije [1].

V prihodnosti torej pričakujemo, da se bo delovno aktivno prebivalstvo staralo in da bo v njem delež žensk višji. Poleg tega bodo delavci opravljali manj fizičnega in več inovativnega dela. Namen članka je analizirati demografske značilnosti zaposlenih v Sloveniji, pri čemer ločujemo med inovativnimi in ne inovativnimi poklici. Inovativni poklici so definirani kot poklici neotipljivega kapitala [8]. Ob tem razlikujemo med zaposlenimi v zasebnem in javnem sektorju. S tem pomembno prispevamo k obstoječi literaturi neotipljivega kapitala, ki le redko analizira podatke na ravni javnega sektorja.

2 METODOLOGIJA IN PODATKI

Analiza je osnovana na podatkih združene baze delodajalec-zaposleni (*angl. employer-employee dataset*) za obdobje 2011-2017 [10]. Pri tem ločujemo tri vrste neotipljivega kapitala: (i) organizacijski, (ii) raziskovalno-razvojni in (iii) informacijski neotipljivi kapital. Vrsta neotipljivega kapitala je določena glede na poklic zaposlenega ter njegovo stopnjo in vrsto izobrazbe.

Zaposleni, ki imajo terciarno izobrazbo družbenih ved, novinarstva in informacijskih znanosti, ali poslovnih in upravnih ved ter prava, in opravljajo poklice kot na primer generalni direktorji/generalne direktorice, člani/članice uprav, menedžerji/menedžerke, strokovnjaki/strokovnjakinje za finančno poslovanje, upravljanje procesov dela in ljudi, prodajo, trženje in odnose z javnostjo, pravni strokovnjaki/pravne strokovnjakinje so tisti zaposleni, ki sodijo v skupino zaposlenih z organizacijskim neotipljivim kapitalom.

V skupino zaposlenih z raziskovalno-razvojnimi neotipljivim kapitalom sodijo posamezniki s terciarno izobrazbo naravoslovja, matematike in statistike in opravljajo poklice kot na primer strokovnjaki/strokovnjakinje fizikalnih in zemeljskih ved, tehnično-tehnoloških strok ali elektrotehnik, zdravstveni strokovnjaki/strokovnjakinje, tehniki/tehničarje tehnično-tehnoloških strok.

V skupino zaposlenih z informacijskim neotipljivim kapitalom so uvrščeni zaposleni s terciarno izobrazbo informacijske in komunikacijske tehnologije in

upravljajo poklice kot na primer razvijalci in analitiki/razvijalke in analitičarke programske opreme in aplikacij, strokovnjaki/strokovnjakinje za podatkovne zbirke in računalniška omrežja, tehniki/tehničarje za telekomunikacije in oddajanje.

Posamezniki, ki niso razvrščeni v nobeno izmed treh skupin neotipljivega kapitala, so zaposleni, ki predstavljajo ne inovativno vrsto dela (v nadaljevanju »ostali zaposleni«) [9].

Ločnica med zasebnim in javnim sektorjem je pravno-organizacijska oblika. Pri tem zasebni sektor predstavljajo gospodarske družbe, samostojni podjetniki in zadruga. Vse ostale pravno-organizacijske oblike predstavljajo javni sektor.

3 REZULTATI

V letu 2017 je bil, ne glede na vrsto poklica neotipljivega kapitala, delež zaposlenih v teh poklicih v zasebnem sektorju višji kot v javnem sektorju. Najvišji delež zaposlenih je pripadal poklicem organizacijskega neotipljivega kapitala (6,77 % v zasebnem in 5,09 % v javnem sektorju), sledijo raziskovalno-razvojni poklici, kjer je bil delež zaposlenih v zasebnem sektorju enak 3,21 %, v javnem sektorju pa 2,10 %. Znatno nižji delež zaposlenih, ne glede na sektor, je pripadal poklicem informacijskega neotipljivega kapitala, kjer je delež zaposlenih znašal 0,46 % v zasebnem in 0,27 % v javnem sektorju.

Tabela 1 prikazuje povprečno starost zaposlenih v poklicih neotipljivega kapitala ter povprečno starost zaposlenih v ostalih poklicih. V splošno je, ne glede na sektor in vrsto neotipljivega kapitala, povprečna starost zaposlenih v ostalih poklicih višja od povprečne starosti v poklicih neotipljivega kapitala. Izjemo predstavljajo zaposleni v poklicih organizacijskega neotipljivega kapitala v javnem sektorju, kjer je povprečna starost v letu 2017 znašala 43,1 let, medtem ko je bila povprečna starost v ostalih poklicih javnega sektorja 42,9 let.

V letu 2017 je bila najnižja povprečna starost zaposlenih značilnost poklicev organizacijskega neotipljivega kapitala, in sicer je ta znašala le 34,1 let v zasebnem in 36,4 let v javnem sektorju. Ob tem pa je iz tabele 1 razvidno, da so ravno poklici organizacijskega neotipljivega kapitala tisti, kjer se je povprečna starost v preučevanem obdobju najbolj zvišala, saj je v letu 2011 v obeh sektorjih znašala 31,9 let. Ta starost se je znatno zvišala že do leta 2012, ko je znašala 33,9 let v zasebnem in 35,7 let v javnem sektorju. To je možna posledica varčevalnih ukrepov v času globalne

gospodarske krize, ko so bile organizacije prisiljene v zmanjšanje števila novo zaposlenih.

Tabela 1: Povprečna starost zaposlenih v poklicih neotipljivega kapitala, Slovenija, 2011-2017

Leto	Zasebni sektor				Javni sektor			
	ORG	RR	IKT	Ostali	ORG	RR	IKT	Ostali
2011	38,2	38,9	31,9	40,5	40,3	40,0	31,9	40,7
2012	38,4	38,8	33,9	40,7	40,7	40,0	35,7	41,0
2013	38,9	39,0	33,8	41,1	41,3	40,1	35,7	41,5
2014	39,3	39,1	33,5	41,3	41,6	40,4	35,7	41,9
2015	39,7	39,1	33,5	41,4	42,1	40,9	35,4	42,2
2016	40,1	39,1	33,7	41,5	42,6	41,0	35,8	42,6
2017	40,5	39,1	34,1	41,5	43,1	41,3	36,4	42,9

*Opomba: Ostali – skupina zaposlenih, ki ni uvrščena v nobeno izmed skupin neotipljivega kapitala; ORG – organizacijski neotipljivi kapital; RR – raziskovalno-razvojni neotipljivi kapital; IKT – informacijski neotipljivi kapital.

Vir: [10].

V Tabeli 2 prikazujemo delež žensk, ki opravlja posamezno vrsto poklica. Rezultati kažejo, da je delež žensk v javnem sektorju znatno višji kot v zasebnem sektorju, ne glede na poklic. Znatne razlike med javnim in zasebnim sektorjem je zaznati pri ostalih poklicih (brez neotipljivega kapitala), kjer je delež žensk v zasebnem sektorju v letu 2017 znašal 36,6 %, v javnem sektorju pa 57,9 %. V raziskovalno-razvojnih poklicih je delež žensk v javnem sektorju celo približno dvakrat tolikšen kot v zasebnem sektorju. Te razlike v deležu žensk, zaposlenih v javnem in zasebnem sektorju, so verjetno rezultat v splošnem stabilnejše zaposlitve v javnem sektorju ter stabilnejšega delovnega časa, kar je pomembno predvsem v primeru družine z majhnimi otroki [7].

Iz tabele 2 je razvidno tudi, da je delež žensk, zaposlenih v poklicih organizacijskega neotipljivega kapitala znatno višji od deleža moških (63,6 % v zasebnem in 70,2 % v javnem sektorju). Na drugi strani je delež žensk, zaposlenih v poklicih informacijskega neotipljivega kapitala, izredno nizek in znaša 9,7 % v zasebnem in 11,0 % v javnem sektorju. Ob tem je potrebno dodati, da se je delež zaposlenih ženk v teh poklicih v zasebnem sektorju znatno zvišal glede na leto 2011, ko je znašal le 5,7 %.

Tabela 2: Delež žensk, zaposlenih v poklicih neotipljivega kapitala, Slovenija, 2011-2017

Leto	Zasebni sektor				Javni sektor			
	ORG	RR	IKT	Ostali	ORG	RR	IKT	Ostali
2011	0,627	0,235	0,057	0,369	0,690	0,437	0,104	0,547
2012	0,632	0,238	0,100	0,370	0,692	0,439	0,178	0,556
2013	0,634	0,231	0,103	0,368	0,694	0,439	0,152	0,562
2014	0,633	0,230	0,098	0,364	0,696	0,440	0,138	0,568
2015	0,635	0,231	0,096	0,364	0,703	0,441	0,117	0,571
2016	0,634	0,230	0,095	0,366	0,704	0,447	0,114	0,574
2017	0,636	0,232	0,097	0,366	0,702	0,451	0,110	0,579

*Opomba: Ostali – skupina zaposlenih, ki ni uvrščena v nobeno izmed skupin neotipljivega kapitala; ORG – organizacijski neotipljivi kapital; RR – raziskovalno-razvojni neotipljivi kapital; IKT – informacijski neotipljivi kapital.

Vir: [10].

4 ZAKLJUČEK

V članku analiziramo demografske značilnosti zaposlenih v poklicih neotipljivega kapitala, ki jih primerjamo z zaposlenimi v ostalih poklicih (brez neotipljivega kapitala). Ob tem ločujemo med zaposlenimi v zasebnem in javnem sektorju.

Rezultati kažejo, da je bila v preučevanem obdobju 2011-2017 povprečna starost zaposlenih v poklicih neotipljivega kapitala v splošno nižja kot pri zaposlenih v ostalih poklicih, kar velja predvsem za zaposlene v poklicih informacijskega neotipljivega kapitala. Hkrati pa so to ravno poklici, kjer se je povprečna starost zaposlenih v preučevanem obdobju najbolj zvišala.

Ugotavljamo tudi, da je odstotek zaposlenih žensk v poklicih informacijskega neotipljivega kapitala znatno nižji od deleža moških in je v letu 2017 znašal le okrog 10 %, medtem ko je delež žensk, zaposlenih v poklicih organizacijskega neotipljivega kapitala, celo presegal delež moških in znašal 63,6 % v zasebnem in 70,2 % v javnem sektorju.

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Predstavitev delnih rezultatov raziskave: ocena finančne toksičnosti pri bolnikih z rakom v Sloveniji

Presentation of partial research results: Assessment of financial toxicity in cancer patients in Slovenia

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POVZETEK

Finančna toksičnost je pojem, s katerim opredeljujemo objektivno in subjektivno finančno breme, ki nastaja zaradi bolezni in/ali zdravljenja in pomembno vpliva na kakovost življenja bolnikov. Z raziskavo želimo preveriti, kakšna je stopnja finančne toksičnosti pri bolnikih z rakom v Sloveniji, in ugotoviti, ali lahko s posameznimi izboljšavami zdravstvenega sistema bistveno izboljšamo kakovost življenja bolnikov. Glede na podatke, zbrane od 251 priložnostno izbranih bolnikov, je razvidno, da med bolniki z rakom v Sloveniji obstaja zmerna stopnja finančne toksičnosti. Prvi rezultati nakazujejo, da pri bolnikih zaradi bolezni in zdravljenja prihaja do upada osebne zadovoljstva s finančno zmožnostjo, hkrati pa beležimo tudi objektivni upad finančne zmožnosti. Glavni razlogi za slednje so upad ali izpad dohodka pri bolnikih zaradi bolniškega staleža, zaposlitve za skrajšan delovni čas in delne ali popolne invalidske upokojitve ter dodatni finančni izdatki za dodatke, pripomočke in storitve, ki niso v celoti kriti iz zdravstvenega zavarovanja. Med najpogostejšimi so prehranski dodatki, zdravila brez recepta, samoplačniški pregledi, lasulje in konopljni dodatki.

KLJUČNE BESEDE

Finančna toksičnost, finančno breme, rak, vprašalnik, stroški, finance, COST-FACIT

ABSTRACT

Financial toxicity is the term used to define the objective and subjective financial burden of an illness and/or treatment that has a significant impact on patients' quality of life. The aim of the study is to estimate the level of financial toxicity among cancer patients in Slovenia and to find out whether specific improvements in the healthcare system can significantly improve the patients' quality of life. Based on data collected from a convenience sample of 251 patients, it is clear that there is a moderate level of financial toxicity among cancer patients in Slovenia. Initial results suggest that patients are experiencing a decline in personal satisfaction with their finances as a result of their illness and treatment, while at the same time there is an objective deterioration of their financial capacity. The main reasons for the latter are the decrease or loss of income for patients due to sick leave, part-time employment and partial or total disability retirement, and the additional financial outlay for supplements, aids and services not fully covered by health insurance. The most common are dietary supplements, over-the-counter medicines, self-pay examinations, wigs and cannabis supplements.

KEYWORDS

Financial toxicity, financial burden, cancer, questionnaire, costs, finances, COST-FACIT

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1 UVOD

S staranjem prebivalstva in spremembo demografske strukture ter naraščajočim deležem ter tudi številom starejšega prebivalstva se bo povečevalo tudi breme raka v družbi. Incidenca raka je med prebivalstvom, ki so starejši od 65 let, bistveno višja kot pri mlajših. Rak v tej starostni skupini predstavlja dobro polovico vseh, v Evropi celo 2,7 od 4,4 milijona novih primerov (ocena za 2020), tako da se pri starejših pojavi skoraj 1900 obolelih na 100 tisoč prebivalcev, v populaciji kot celoti pa zboli približno 590 oseb na 100 tisoč prebivalcev. S staranjem prebivalstva se bo povečevalo tudi družbeno-ekonomsko breme raka, tako na ravni družbe kot tudi na ravni posameznika [1].

V literaturi se za objektivne finančne posledice raka (neposredna in posredna finančna bremena) in subjektivne finančne skrbi bolnikov uporablja pojem finančna toksičnost [2]. Po podatkih iz tuje literature je finančna toksičnost povezana s številnimi klinično pomembnimi izhodi boleznimi, in sicer kakovostjo življenja, simptomi boleznimi, sodelovanjem pri zdravljenju (komplianca) in preživetjem [3-6]. Ni pa poznano, kako bolniki z rakom v Sloveniji ter družinski člani in/ali negovalci občutijo finančno breme med onkološkim zdravljenjem in po njegovem zaključku. Namen raziskave je preveriti finančno toksičnost pri bolnikih z rakom v Sloveniji z razvojem vprašalnika o finančni toksičnosti za slovensko okolje ter uporabo mednarodno standardiziranih vprašalnikov. Z izsledki raziskave želimo ugotoviti, ali lahko s posameznimi izboljšavami zdravstvenega sistema, predvsem tistimi, ki vplivajo na finančno toksičnost, bistveno izboljšamo kakovost življenja bolnikov z rakom v Sloveniji, ter tako prispevati predloge za spremembe na področju zdravstvene in socialnih politik.

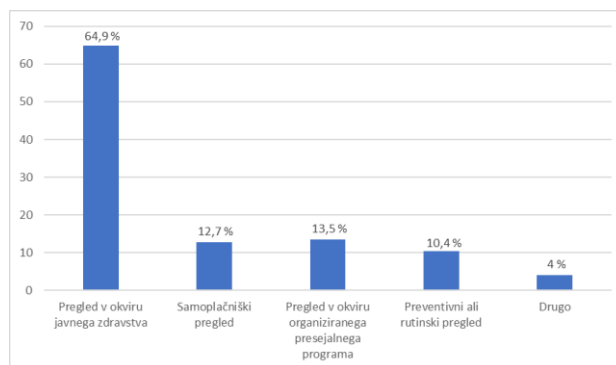
2 METODE

Raziskavo izvajamo na Onkološkem inštitutu Ljubljana (OIL) od junija 2023, vključili smo bolnike, ki so imeli v času trajanja raziskave obravnavo na OIL. Raziskava poteka tako, da bolnikom razdelimo anketni vprašalnik, ki poleg vprašanj, ki smo jih za potrebe raziskave zasnovali sami, vsebuje tudi slovenski različici mednarodnih standardiziranih vprašalnikov za oceno finančne toksičnosti pri bolnikih z rakom "Comprehensive Score for Financial Toxicity - Functional Assessment of Chronic Illness Therapy" (COST-FACIT) in temeljni vprašalnik o kakovosti življenja (angl. Core quality of life Questionnaire, QLQ - C30) Evropske organizacije za raziskovanje in zdravljenje raka (angl. European Organisation for Research and Treatment of Cancer, EORTC) za oceno kakovosti življenja pri bolnikih z rakom. Vprašalnik COST-FACIT smo prevedli v slovenski jezik in ga tudi validirali (vprašalnik je dostopen na povezavi: <https://www.facit.org/measure-languages/FACIT-F-Languages>). Vključitveni kriteriji za sodelovanje v raziskavi so bili polnoletnost, diagnoza rakave bolezni in zmožnost podati osebno privolitev za sodelovanje v raziskavi. V pričujočem prispevku predstavljamo prve delne rezultate vprašalnikov, ki so jih izpolnili bolniki na Onkološkem inštitutu Ljubljana od 1. 6. 2023 do 5. 9. 2023.

3 REZULTATI PO SKLOPIH VPRAŠALNIKA

3.1 Bolezen in zdravljenje

V obravnavanem obdobju smo prejeli 251 popolno izpolnjenih vprašalnikov, primernih za statistično analizo. Izmed anketiranih se je 55 % (139) oseb identificiralo kot ženski spol, 44 % (110) kot moški, 2 osebi na vprašanje nista želeli odgovoriti. Povprečna starost anketiranih je bila 59 (SD ± 13,7) let. Izmed anketiranih največji delež diagnoz predstavlja rak dojke (24 %), sledi rak prostate (19 %), rak materničnega telesa (11 %), rak pljuč (10 %), limfomi (9 %), rak debelega črevesa in danke (6 %), rak glave in vratu (3 %), kožni rak vključno z melanomom (2 %), rak požiralnika ali želodca (2 %), ledvični rak (1 %) in rak sečnega mehurja (1 %). Preostalih 14 % smo uvrstili v kategorijo drugo. V 92 % je šlo za bolnike, ki so imeli prvič postavljeno diagnozo raka, pri 7 % se je bolezen ponovila po več kot enem letu, pri 1 % pa po manj kot enem letu. Pri 60 % (151) bolnikov je bila bolezen odkrita zgolj na osnovi kliničnih simptomov in znakov potrjenih v okviru javnega zdravstva, pri 9 % (22) zgolj na osnovi kliničnih simptomov in znakov potrjenih na samoplačniškem pregledu, pri 13 % (33) preko organiziranega presejalnega programa, pri 9 % (23) na preventivnem ali rutinskem pregledu. Preostali bolniki so navajali različne kombinacije. Povzetek rezultatov, ki upoštevajo tudi kombinacije poti, je prikazan na sliki 1.



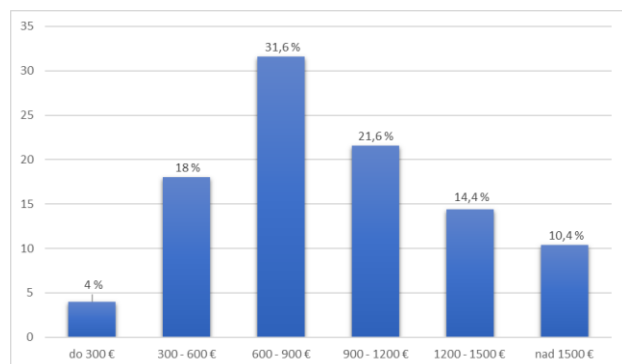
Slika 1: Pot do diagnoze (možnih je bilo več odgovorov)

Izmed skupno 32 bolnikov, ki so opravili samoplačniški pregled, jih je največ, slabih 69 % (22), kot razlog navedlo predolgo čakalno dobo v javnem zdravstvu, 6 slabo komunikacijo z izbranim osebnim zdravnikom, 2 kakovostnejšo obravnavo na samoplačniškem pregledu, 8 bolnikov pa je navedlo druge razloge. Med njimi nihče ni izbral možnosti, da svojega osebnega zdravnika nima ali pa z njim težko pride v stik. Izmed 251 bolnikov jih je bilo v času izpolnjevanja ankete 78 % na aktivnem zdravljenju, pri 7 % se uporablja pristop opazuj in čakaj, 13 % ozdravljenih in slaba 2 % na paliativni oskrbi. Za enega bolnika podatkov o zdravljenju nimamo. Med bolniki, ki so bili v času anketiranja na aktivnem zdravljenju, je bilo 64 % takšnih, ki so bili zdravljeni multimodalno.

3.2 Socialno-ekonomsko stanje

Med anketiranimi 13 % (33) oseb živi samih in samostojno, 86 % (216) v gospodinjstvu z vsaj eno osebo, slab odstotek (2) z oskrbo na domu. Pri eni osebi je bila diagnoza, ki so jo podali na začetku vprašalnika, razlog za bivanje v oskrbovanem stanovanju. Oseb iz domov za ostarele med anketiranimi ni bilo. Dobrih 98 % oseb ima sklenjeno obvezno zdravstveno zavarovanje, 76 % jih ima poleg obveznega urejeno tudi dopolnilno zdravstveno zavarovanje, 9 % oseb ima sklenjeno dodatno zavarovanje. Ena oseba ima zdravstveno zavarovanje urejeno v tujini, ena ima stroške krite preko začasne zaščite za razseljene osebe, za 2 osebi podatka o vrsti zdravstvenega zavarovanja nimamo. Med drugimi zavarovanji sta 2 osebi navedli zavarovanje za težke bolezni.

Anketirance smo prosili, da označijo razpon, v katerem je zajet neto dohodek na člana njihovega gospodinjstva. Ena oseba na vprašanje ni odgovorila, rezultati so predstavljeni na sliki 2.

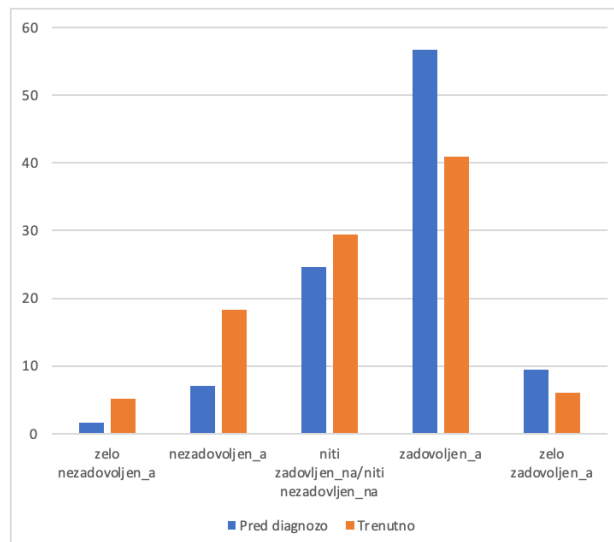


Slika 2. Porazdelitev neto dohodka na člana gospodinjstva.

3.3 Usmerjena vprašanja finančne toksičnosti

V nadaljevanju anketiranci opredelijo svoje zadovoljstvo z osebnimi financami. Anketirance prosimo, da na petstopenjski lestvici opredelijo zadovoljstvo s svojo finančno zmožnostjo tako pred boleznijo kot tudi trenutno. Primerjava porazdelitve odgovorov, kjer se bolniki opredelijo glede svojega zadovoljstva s financami pred boleznijo in svojo trenutno finančno zmožnostjo, je prikazana na sliki 3.

Pri vprašanju, kako so se ob koncu meseca običajno »iztekle« finance pred pojavom bolezni, je 53 % (132) ljudi odgovorilo, da jim je nekaj denarja še ostalo, 38 % (96) jih je imelo denarja ravno dovolj, 9 % (23) pa jih je imelo denarja premalo. Na vprašanje, kako se trenutno ob koncu meseca »iztečejo« njihove finance, pa je 37 % (94) oseb odgovorilo, da jim nekaj denarja še ostane, 40 % (100) oseb, da imajo denarja ravno dovolj, 23 % (57) oseb pa ima denarja premalo.



Slika 3: Zadovoljstvo z osebnimi financami pred boleznijo in glede na trenutno stanje.

Kot kaže tabela 1, je bilo dobrih 47 % anketirancev pred pojavom bolezni upokojenih ali invalidsko upokojenih, dobrih 43 % pa zaposlenih za polni delovni čas. Ostali so bili v bolniškem staležu, samozaposleni, brezposelni ali še v procesu izobraževanja. 28 % (70) oseb je zaradi bolezni trenutno v bolniškem staležu, dobra 2 % (6) jih dela za skrajšan delovni čas, slab odstotek (2) jih je delno invalidsko upokojenih, dober odstotek (3) pa polno invalidsko upokojenih. Tri osebe so zaradi bolezni izgubile zaposlitev, ena izmed naštetih je zaposlitev v času anketiranja aktivno iskala, dve osebi zaradi bolezni zaposlitve ne želita ali nista zmožni iskati.

Tabela 1: Zaposlitveni status anketiranih pred pojavom rakave bolezni

	Frekvenca	Delež (%)
V bolniškem staležu	6	2,4
Zaposlen_a, samozaposlen_a za polni delovni čas	109	43,4
Zaposlen_a, samozaposlen_a za skrajšan delovni čas	5	2,0
Brezposeln_a, aktivno iščem zaposlitve	3	1,2
Brezposeln_a, zaradi bolezni ne želim/ne zmorem iskati zaposlitve	3	1,2
Delno invalidsko upokojen_a	0	0,0
Polno invalidsko upokojen_a	7	2,8
Upokojen_a	112	44,6
Se še izobražujem	1	0,4
Drugo	5	2,0

41 % (103) bolnikov na OIL prihaja z lastnim prevozom in ne uveljavlja potnih stroškov, 25 % (62) jih pride z lastnim prevozom in uveljavlja potne stroške, 24 % (60) jih koristi nenujne ali sanitetne medicinske prevoze, ki jih krije zdravstveno zavarovanje, 10 % (26) pa jih uporablja javni prevoz ali taksi. Bolniki so za mesečne stroške, namenjene prevozu, vključno s parkirnami, v času aktivnega zdravljenja navajali celo do 1700 evrov.

Najpogostejši izdatki, ki so jih anketiranci delno ali v celoti pokrili iz lastnega žepa od odkritja bolezni, so za prehranske dodatke, zdravila brez recepta, samoplačniške preglede, lasulje, in konopljne pripravke. Prehranske dodatke je kupilo 49 % (122) anketiranih, od tega jih je 73 % (89) v celoti plačalo samih, pri 21 % (26) so bili delno kriti iz zavarovanja, pri dobrih 3 % (4) v celoti iz zavarovanja in slabih 3 % (3) jih je deloma krilo samih. Za prehranske dodatke so bolniki tekom zdravljenja odšteli od 20 do 5000 evrov.

Zdravila brez recepta je kupilo skoraj 30 % (74) oseb, 88 % (65) oseb je tovrstna zdravila v celoti plačalo samih, pri 7 % (5) so bila deloma krita iz zavarovanja, pri 4 % (3) v celoti iz zavarovanja, ena oseba je stroške deloma krila sama. Za zdravila brez recepta so ljudje odšteli od 20 do 1200 evrov.

Samoplačniške preglede je opravilo 20 % (50) bolnikov, konopljne pripravke je kupilo 15 % (39) bolnikov, oba stroška so vsi anketirani v celoti krili sami. Za samoplačniške preglede so bolniki odšteli od 30 do 3000 evrov.

17 % (44) oseb je med izdatki navedlo nakup lasulje, med temi jo je pri 73 % (32) delno in pri 16 % (7) v celoti krilo obvezno zavarovanje, 9 % (4) jo je v celoti plačalo samih, ena oseba deloma. Stroški za lasulje so se gibali med 40 in 1200 evri, povprečno so bolniki za nakup lasulje porabili 229 evrov.

Rezultati vprašalnika COST – FACIT so predstavljeni v tabeli 2.

Tabela 2: Izračunane točke iz vprašalnika COST-FACIT

Točkovanje finančne toksičnosti	
Povprečna vrednost	26,5
Mediana	27,0
Standardni odklon	8,0
Minimum	6
Maksimum	44

Maksimalno število točk, ki jih lahko anketiranci dosežejo pri tem vprašalniku, je 44, minimalno pa 0. Pri tem 44 predstavlja nizko finančno toksičnost, 0 pa zelo visoko finančno toksičnost. Delni rezultati so pokazali, da je povprečna vrednost finančne

toksičnosti pri bolnikih z rakom v Sloveniji nekoliko nad polovico, to je pri 26,5 točkah od 44 možnih.

4 UGOTOVITVE IN ZAKLJUČKI

Iz do sedaj zbranih podatkov je razvidno, da med bolniki z rakom v Sloveniji, ki so sodelovali v raziskavi, obstaja zmerna finančna toksičnost. Med bolniki beležimo upad osebnega zadovoljstva s finančno zmožnostjo, hkrati pa smo zaznali, da je prišlo med bolniki zaradi bolezni in zdravljenja tudi do objektivnega upada finančne zmožnosti. Razlogov za slednje je več, bolniki na eni strani beležijo izpad ali upad dohodka zaradi bolniškega staleža, zaposlitve za skrajšan delovni čas in delne ali popolne invalidske upokojitve. Hkrati se pojavijo še dodatni finančni izdatki za dodatke, pripomočke in storitve, ki jih njihova zavarovalna shema ne pokriva. Med najpogostejšimi so prehranski dodatki, slednje jemlje skoraj polovica bolnikov, sledijo zdravila brez recepta, ki jih jemlje slaba tretjina bolnikov, samoplačniški pregledi, ki jih je opravila petina bolnikov in lasulje ter konopljni dodatki, ki jih koristi približno šestina bolnikov. V nadaljnji statistični analizi podatkov se bomo osredotočili predvsem na to, kako na finančno toksičnost vplivajo zavarovalna shema, vrsta primarnega tumorja, razširjenost bolezni, večmodalnost zdravljenja ter različni socioekonomski in demografske profili. Pomembno je poudariti, da trenutni podatki omogočajo zgolj ocene za obravnavani vzorec, ne pa tudi za populacijo.

ZAHVALA

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Razvoj vprašalnika o finančni toksičnosti pri bolnikih z rakom v Sloveniji

Development of a questionnaire on financial toxicity for cancer patients in Slovenia

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POVZETEK

Zaradi vse večje pojavnosti raka v starajoči se populaciji narašča tudi njegovo finančno breme tako za družbo kot za bolnike. Finančna toksičnost ali finančno breme predstavlja vse objektivne in subjektivne finančne posledice, ki jih občutijo bolniki z rakom in ki negativno vplivajo na njihovo kvaliteto življenja. Dejavniki, ki vplivajo na pojav finančne toksičnosti so raznoliki, in jih v grobem lahko razdelimo na tiste, ki so povezani z značilnostmi bolezni, zdravljenja in zdravstvenega sistema, s socioekonomskim stanjem ter neposrednimi in posrednimi stroški bolezni. Na pojav finančne toksičnosti vplivajo tudi sociodemografske značilnosti bolnika. V Sloveniji finančne toksičnosti še nismo merili. To vrzel smo naslovili z razvojem vprašalnika, prilagojenega za slovenske posebnosti, ki upošteva omenjene dejavnike iz literature in mednarodno uveljavljenih vprašalnikov. Slovenski vprašalnik vključuje tudi validirano slovensko verzijo vprašalnika COST-FACIT. Vprašalnik so pregledali strokovnjaki z vsebinskega in metodološko-statističnega področja in odobrile ustrezne komisije. Testiranje in pilot sta bila izvedena na bolnikih, ki so takrat prišli na Onkološki inštitut Ljubljana. Pri tem smo naleteli na določene metodološke izzive; največja težava so bila nekatera prezahtevna anketna vprašanja in obsežnost vprašalnika, kar smo skušali s popravki omiliti. Končni vprašalnik predstavlja dobro izhodišče za oceno finančne toksičnosti pri bolnikih z rakom v Sloveniji.

KLJUČNE BESEDE

Finančna toksičnost, finančno breme, rak, vprašalnik, stroški, finance, testiranje

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ABSTRACT

An increasing incidence of cancer in an ageing population leads to an increasing financial burden for both the society and patients. Financial toxicity includes all objective and subjective financial consequences that cancer patients feel and negatively influence the quality of their lives. Factors that affect the occurrence of financial toxicity are diverse and roughly divided into characteristics of the disease, treatment and health system, socio-economic situation, and direct and indirect costs of the disease. The occurrence of financial toxicity also depends on sociodemographic characteristics of the patient. Financial toxicity has not been measured in Slovenia, yet. We addressed this gap by developing a questionnaire, adapted to Slovenian specifics, that considers aforementioned factors from literature and internationally recognized questionnaires. The Slovenian questionnaire incorporates a validated Slovenian version of the COST-FACIT questionnaire. The questionnaire was reviewed by subject-matter, methodological and statistical experts, and approved by relevant committees. The testing and the pilot were conducted on patients that came to the Institute of Oncology Ljubljana at that time. We encountered certain methodological challenges; the main issues were too demanding survey questions and questionnaire length, which we tried to alleviate with adjustments. The final questionnaire represents a good starting point for estimating financial toxicity for cancer patients in Slovenia.

KEYWORDS

Financial toxicity, financial burden, cancer, questionnaire, costs, finances, testing

1 UVOD

Staranje prebivalstva je eden od ključnih dejavnikov višje incidence in prevalece raka [1] in s tem tudi njenega družbeno-ekonomskega bremena. Med letoma 1990 in 2019 se je pojavnost raka povečala za 129%, pri čemer je delež starejših med vsemi

novimi primeri raka narasel z 48,6% na 56,4%, med vsemi smrtmi zaradi raka pa z 52% na 62%. Do povečanja je prišlo tudi zaradi drugih kompleksnih epidemioloških razlogov, vendar pa so glavni dejavniki hitrega povečevanja števila rakavih obolenj postali demografski trendi, ne več epidemiološki [1].

Zaradi strmega naraščanja rakavih obolenj in z njimi povezanih stroškov dobiva finančno breme za bolnike z rakom vse večjo pozornost v strokovni in znanstveni literaturi. Finančno breme ali finančna toksičnost (angl. financial toxicity) vključuje vse stroške, ki padejo na bolnikova ramena zaradi bolezni [2]. Sem sodijo tako neposredni stroški (npr. (do)plačilo za zdravila, prehranske dodatke, terapije, zdravstvene pripomočke, opremo, prilagoditve za življenje doma itd.), kot tudi posredni (npr. izpad dohodka, nezmožnost napredovanja, vpliv na družino itd.). Koncept pokriva tudi subjektivne zaznave finančnih posledic, ki jih občutijo bolniki z rakom po postavljeni diagnozi in pomembno negativno vplivajo na njihovo kakovost življenja, s tem pa tudi na kakovost življenja njihovih družin in družbe.

Finančna toksičnost se za bolnike z rakom precej razlikuje po državah, saj je finančno breme v veliki meri odvisno od organiziranosti zdravstvenega sistema. V državah, kjer so zdravstvene storitve v večji meri del zasebnega sektorja, je finančno breme za bolnika precej večje v primerjavi z državami, ki imajo organiziran javni zdravstveni sistem; prav tako je razlika med razvitimi državami in državami v razvoju [3]. Pa vendar je raziskava, ki je bila narejena na Japonskem, pokazala, da tudi v razvitih državah, ki imajo javni zdravstveni sistem, pomemben delež bolnikov občuti finančno toksičnost [4]. Pretekle raziskave so pokazale, da naj bi približno polovica vseh bolnikov z rakom po svetu občutila finančno toksičnost [5]. Posledice prevelikega finančnega bremena se lahko kažejo kot slabša kakovost življenja, odlaganje zdravljenja in posledično slabši izidi [6], zato ocena finančne toksičnosti predstavlja pomembno informacijo za zdravstveno in socialno politiko.

Za Slovenijo še ni bilo narejene raziskave, ki bi opredelila finančno toksičnost in ocenila finančno breme za bolnike z rakom. S pričujočo raziskavo želimo zapolniti to vrzel. Ob tem je naša osrednja teza naslednja: »Finančna toksičnost je prisotna tudi pri bolnikih z rakom v Sloveniji in pomembno vpliva na kakovost življenja.« Ker ima finančna toksičnost tudi subjektivni vidik, je nujno uporabiti raziskovalno metodo, ki bo bolnike povprašala po mnenju, zaznavah, občutkih ipd. Ker za merjenje prisotnosti in vpliva potrebujemo kvantitativne podatke, smo za zbiranje podatkov uporabili anketno metodologijo. V vzorec smo vključili osebe, starejše od 18 let, ki imajo rakavo obolenje ali so bile zdravljenе zaradi rakavega obolenja ter so zmožne podati osebno privolitve za sodelovanje v raziskavi.

V nadaljevanju najprej predstavljamo konceptualni okvir z dejavniki, ki vplivajo na finančno toksičnost, nato predstavimo korake v razvoju anketnega vprašalnika za oceno finančne toksičnosti in naslovimo metodološke izzive, nazadnje pa podamo predloge za nadaljnje metodološko raziskovalno delo.

2 KONCEPTUALNI OKVIR Z DEJAVNIKI FINANČNE TOKSIČNOSTI

Za celovito obravnavo finančne toksičnosti smo najprej iz literature izluščili dejavnike, ki nanjo vplivajo. Te dejavnike lahko razvrstimo v tri vsebinske skupine:

1. značilnosti bolezni, zdravljenja in zdravstvenega sistema;
2. socioekonomsko stanje;
3. neposredni in posredni stroški bolezni.

Med značilnostmi bolezni je treba v prvi vrsti omeniti vrsto raka. Dosedanje raziskave so pokazale, da je finančna toksičnost močno prisotna med bolniki z rakom glave in vratu [6], predpostavljamo pa, da prihaja do pomembnih razlik tudi pri ostalih vrstah rakov. Finančno breme se skozi čas kopiči, zato je pričakovati večjo finančno toksičnost pri bolnikih, ki jim je bil rak odkrit pred več časa. Večjo finančno toksičnost je pričakovati tudi pri ponovitvi raka. Na finančno toksičnost vpliva tudi vrsta zdravljenja, saj so različne vrste zdravljenja povezane z različnimi stroški, ki predstavljajo različne obremenitve bolnika. Tako so npr. za bolnika pričakovani manjši stroški pri operativnem posegu kot pri obsevanju, saj pri slednjem pričakujemo več bolniškega staleža, izdatkov za hrano in potnih stroškov. Na finančno breme zdravstvenega sistema in posameznika vpliva tudi zgodnje odkritje bolezni, pri čemer igrajo pomembno vlogo presejalni programi, preventivni in rutinski pregledi, dostopnost do zdravnika ipd.

Na finančno toksičnost nadalje vpliva socio-ekonomsko stanje bolnika in njegovega gospodinjstva, ki je odvisno od višine dohodka in njegove razporeditve med družinske člane. Enako finančno breme je relativno lažje prenesti, če je v gospodinjstvu več oseb z rednimi oz. visokimi dohodki (npr. redno zaposleni, osebe z rednimi dohodki). Nasprotno, je finančno breme za bolnika relativno večje, če je sam, če ima v gospodinjstvu vzdrževane člane ali člane z nerednimi dohodki in če največ prispeva v skupni proračun. Koliko finančnega bremena bolezni bo na koncu padlo na ramena bolnika, je odvisno od razpoložljivih in sklenjenih zdravstvenih zavarovanj.

Finančno breme sestavljajo neposredni in posredni stroški. Odvisno od vrste raka in zdravljenja nastanejo potrebe, ki vodijo v neposredne stroške (npr. potreba po lasulji, prilagoditvah kopalnice, terapijah, prevozu do mesta zdravljenja itd.). Koliko teh stroškov bo padlo na bolnika, je odvisno od vrste sklenjenega zavarovanja. Možno pa je, da ti stroški sploh ne nastanejo, ker si jih bolnik ne more privoščiti. Posredni stroški lahko izvirajo iz poslabšanja zaposlitvenega statusa (npr. skrajšanje delovnega časa, (delna) upokojitvev, slabše delovno mesto), bolniškega staleža in vključevanja (zaposlenih) družinskih članov ali drugih spremljevalcev.

Poleg navedenih skupin dejavnikov je potrebno upoštevati sociodemografske značilnosti bolnikov, ki lahko vplivajo na finančno toksičnost (npr. spol, starost, regija, vrsta naselja, stopnja izobrazba in veroizpoved) in služijo kot kontrolne spremenljivke.

3 FAZE RAZVOJA VPRAŠALNIKA

Po pripravi konceptualnega okvirja na osnovi pregleda literature in opredelitvi pomembnih dejavnikov finančnega bremena smo se lotili oblikovanja anketnih vprašanj. Do končne verzije smo prišli v treh fazah.

3.1 Dosedanji merski inštrumenti

V prvi fazi smo opravili pregled obstoječih merskih inštrumentov za anketno raziskovanje. V tujini je že bilo izvedenih več

raziskav, ki so preučevale finančno toksičnost za bolnike z rakom. Na mednarodni ravni so se uveljavila tri orodja:

- Finančni indeks toksičnosti (angl. *Financial Index of Toxicity, FIT*) [7]
- Celovita ocena finančnega bremena - -Funktionalna ocena zdravljenja kronične bolezni (angl. *Comprehensive Score for financial Toxicity – Functional Assessment of chronic Illness Therapy, COST-FACIT*) [8]
- Anketa za oceno financ pri raku dojke (*Breast Cancer Finances Survey Inventory, BCFS*) [9].

Nobeno od teh orodij ne ponuja celovitega merjenja finančne toksičnosti. Zaradi mednarodne primerljivosti je bil kot del vprašalnika vključen vprašalnik COST-FACIT, ki se osredotoča na subjektivno doživljanja finančne stiske pri bolnikih z rakom [8]. Sestavljen je iz 12 trditvev, ki jih respondenti ocenjujejo na lestvici od 0 (Sploh ne) do 4 (Zelo). Ostala vprašanja so bodisi prevzeta iz vprašalnikov ali pa predstavljajo nadgradnjo, pri čemer smo upoštevali tudi specifike slovenskega okolja.

3.2 Strokovni pregledi

Vprašalnik so pred testiranjem pregledali in popravili onkologi in strokovnjaki s področja ekonomije, metodologije in statistike. Odobrile so ga tudi Etična komisija Onkološkega inštituta Ljubljana (EK OIL), Komisija za strokovno oceno protokolov raziskav Onkološkega inštituta Ljubljana (KSOPKR) in Komisija Republike Slovenije za medicinsko etiko (KME RS).

Pri tem velja izpostaviti, da je za prevod vprašalnika COST-FACIT organizacija, ki skrbi za mednarodno primerljivost jezikovnih različic tega vprašalnika (FACIT.org), zahtevala sledenje strogemu protokolu ter dodatne strokovne preglede in odobritve [10]. Postopek se je začel z dvema neodvisnima prevodoma v ciljni jezik (slovenščino), ki ju je pregledal tretji prevajalec. Usklajen slovenski prevod je prevedel nazaj v angleščino naravni govorec angleščine. Tako dobljeni angleški prevod smo primerjali z originalnim angleškim vprašalnikom ter s pomočjo jezikoslovca razčistili pomen posameznih besed ter odpravili odstopanja. Šele tako pripravljen prevod je bil vključen v naslednjo fazo testiranja.

3.3 Testiranje

Fazo testiranja smo začeli z vprašalnikom COST-FACIT. Trditve smo najprej testirali na 10 bolnikih. Izpolnjevanje vprašalnika je potekalo kot intervju 1 na 1, izpraševalec je bil ves čas na voljo za dodatno razlago, vse opombe udeležencev smo si zapisali, dodali še svoje opombe, ki smo jih med izpolnjevanjem zaznali sami, in vprašalnik prilagodili tako, da je bil razumljiv slovenski populaciji. Vprašalnik je nato potrdila tudi organizacija FACIT.org [10].

Za nadaljnje korake smo vprašalnik COST-FACIT združili z ostalimi anketnimi vprašanji, ki so bila predhodno strokovno pregledana. Celotno anketo smo začeli pilotno izvajati na OIL z bolniki, ki so prišli na ambulantni pregled, in sicer v obliki osebnih intervjujev s pomočjo dveh anketark, ki sta bili vključeni v razvoj vprašalnika in tako dobro poznali ozadje raziskave ter namen posameznih anketnih vprašanj. Ob vsakem intervjuju sta anketarki skrbno preverjali razumevanje posameznih vprašanj,

pomagali respondentom pri njihovi pravilni interpretaciji ter si beležili njihove pripombe. Po približno 50 opravljenih intervjujih smo ponovno izvedli skupni strokovni pregled, v katerem so sodelovali strokovnjaki s področja onkologije, ekonomije, metodologije in statistike ter anketarki. Izkazalo se je, da si je nekaj vprašanj zelo podobnih, zato smo »podvojena« vprašanja izločili. Nekatera vprašanja pa so bila težje razumljiva, zato smo jih še nekoliko spremenili in jim dodali razlago. Ker se vprašanja vsebinsko niso spremenila in ker so pri večini intervjujev respondenti dobili dodatna pojasnila od anketark, smo se odločili, da bomo tudi te začetne intervjuje obdržali v končni analizi.

3.4 Struktura vprašalnika

Na osnovi pregleda literature, dosedanjih mednarodno uveljavljenih vprašalnikov, strokovnih pregledov in testiranj smo oblikovali anketni vprašalnik s 35 vprašanji. Razporeditev vprašanj po vsebinskih sklopih predstavljamo v Tabeli 1.

Tabela 1: Vsebinski sklopi vprašalnika

Bolezen in zdravljenje
Trenutna diagnoza raka
Čas postavitve diagnoze
Prva ali ponovna diagnoza istega raka
Način odkritja raka
Aktivnost zdravljenja
Vrste terapij
Socioekonomsko stanje
Tip gospodinjstva
Številčnost skupnega gospodinjstva
Redno zaposlene osebe v skupnem gospodinjstvu
Največji prispevek dohodka pred diagnozo
Največji prispevek dohodka po diagnozi
Vrsta zdravstvenega zavarovanja
Neto mesečni dohodek na družinskega člana
Usmerjena vprašanja finančne toksičnosti
Subjektivna ocena finančne zmožnosti pred boleznijo
Subjektivna ocena trenutne finančne zmožnosti
Iztek financ pred boleznijo
Trenuten iztek financ
Zaposlitveni status pred boleznijo
Zaposlitveni status po bolezni
Koriščenje bolniškega staleža
Vrsta prevoza za prihod na OIL
Spremljevalci na poti na OIL
Vpliv na delovni čas družinskih članov
Drugi dodatni stroški in višina le-teh
Višina stroškov zdravljenja
Vprašalnik COST-FACIT
Sociodemografski podatki
Spol
Starost
Regija bivanja
Vrsta naselja
Izobrazba
Veroizpoved

4 METODOLOŠKI IZZIVI

Merjenje finančne toksičnosti vključuje vrsto metodoloških izzivov. Že sama vsebina združuje dve zelo občutljivi področji, zdravje in finance. Zdravstveni podatki so zakonsko opredeljeni kot občutljivi osebni podatki. Finančni podatki sicer zakonsko nimajo tega statusa, vendar pa se v praksi ravno pri zbiranju tovrstnih podatkov srečujemo z največjimi stopnjami neodgovora. Ker gre za osebne podatke, je nujno pridobiti pisno privolitev za sodelovanje v raziskavi. Pri zbiranju občutljivih osebnih podatkov je tudi pomembno vzpostaviti ozračje zaupanja, kar je najbolj enostavno doseči z anketiranjem brez prisotnosti anketarja. Vprašalnik smo zato pripravili tako v tiskani obliki za samoizpolnjevanje kot tudi v spletni obliki (na platformi lka.si). Po prvotni fazi s prisotnostjo anketark je večina respondentov odgovore podajala samostojno, predvsem na papir. Tudi odgovore s papirja smo vnesli v spletno orodje lka, da smo lahko podatke obdelovali skupno.

Povedati je potrebno, da so nekatera vprašanja za respondente še vedno zahtevna, zato ne moremo povsem izključiti merskih napak. En vir napak je spomin, saj se vprašanja lahko nanašajo tudi na večletno časovno obdobje. Drug vir napak izvira iz terminologije, ki vsem respondentom morda ni domača (dodatne razlaga pa so jim predolge – glej tretji vir). Tretji vir napak je sama motivacija za izpolnjevanje, ki pada z dolžino vprašalnika in zahtevnostjo ter občutljivostjo vprašanj. Za odpravo teh napak je pomembna tudi temeljito izvedena faza urejanja podatkov, saj iz neskladnosti med posameznimi odgovori in ob poznavanju virov napak lahko bistveno izboljšamo kakovost podatkov. Četrty vir napak so zahtevno zastavljena vprašanja v obliki matrik. Tiskani vprašalniki tu ne dajejo veliko manevrskega prostora, zato velja rešitev iskati v spletnem načinu anketiranja.

Metodološki premislek zahteva tudi vključitev trditve iz vprašalnika COST-FACIT. Čeprav je mednarodna primerljivost močan argument za vključitev, pa trditve izvirajo iz ameriškega konteksta, za katerega je značilen zasebni zdravstveni sistem in zato prisotna bistveno večja finančna toksičnost kot v državah z javnim zdravstvenim sistemom. Tako se zdijo posamične trditve za naše okolje brezpredmetne, kar odvrča respondente, ki se v možnih odgovorih ne najdejo.

5 ZAKLJUČEK

Ob pomoči tuje literature in že uveljavljenih obstoječih vprašalnikov smo sestavili anketni vprašalnik, ki smo ga dodatno nadgradili in prilagodili za naše okolje. S tem smo dobili prvo orodje za preučevanje finančnih bremen in finančne toksičnosti pri bolnikih z rakom v Sloveniji. Kot pri vsaki raziskavi, se tudi ta sooča z metodološkimi izzivi, ki terjajo nadaljnji razvoj. Ugotavljamo, da bi bilo smiselno izdelati tudi ožje usmerjen vprašalnik po posamezni vrsti raka, saj so od diagnoze odvisne

zdravljenje in druge posledice, s čimer pa je povezana tudi finančna toksičnost, ki jo občutijo bolniki. S tem bi deloma naslovili tudi problem prevelike dolžine vprašalnika, ki je bila deležna največ kritik. V prihodnje bi bilo zato smiselno izluščiti najpomembnejše dejavnike, ki vplivajo na pojav finančne toksičnosti, oz. jih nasloviti na krajši način. Predvidoma bi s krajšim vprašalnikom k sodelovanju privabili večje število bolnikov, pričakovali bi bolj natančno branje in s tem tudi točnejše odgovore, z večjim in bolj verodostojnim vzorcem pa bi izsledke raziskave lažje prenesli na celotno populacijo onkoloških bolnikov.

Smiselno bi bilo tudi ponoviti anketiranje istih bolnikov čez 2-3 leta. Na ta način bi lahko ugotovili, ali se je finančno breme spremenilo, saj se nekateri dejavniki, ki vplivajo na pojav finančne toksičnosti pokažejo šele čez čas. Zagotovo so v prihodnje možne dodatne izboljšave vprašalnika, verjamemo pa, da bomo tudi z izsledki na podlagi tega vprašalnika prispevali k razumevanju finančne toksičnosti pri bolnikih z rakom v Sloveniji in iskanju boljših rešitev znotraj zdravstvenega sistema.

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The impact of cancer on individuals' career development

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ABSTRACT

Breast cancer significantly impacts patients' participation in the labour market in the short, medium and long run due to a number of reasons, including sick leave, income loss, career disruption, reduced work ability, sick leave, early retirement, and premature mortality. This paper examines the impact of breast cancer on patients' work lives using bibliometrics, text mining, and traditional literature review approach to investigate the key aspects of cancer's effect on career development. Bibliometric analysis, conducted on 97 Web of Science papers from 68 sources published between 1995 and 2023 shows that breast cancer and its treatment impact careers in the short term due to disruptions because of treatment, which can cause reduced work ability, financial strain, and lead also to potential career changes. Return to work depends on both the individual, the health and social system, and employers. Potential career demotion and labour market discrimination further increase the cancer-related stress, as do individual's characteristics. Understanding the labour market effects of cancer is vital for developing policies to support patients' return to work and occupational rehabilitation.

KEYWORDS

Breast cancer, employment, income loss, career development

POVZETEK

Rak dojke kratkoročno, srednjeročno in dolgoročno pomembno vpliva na vključenost bolnic in bolnikov na trg dela. Razlogov je več, od bolniške odsotnosti, izgube dohodka, vpliva na začrtano poklicno pot, zmanjšane delovne sposobnosti, bolniške odsotnosti, prezgodnje upokojitve ali celo smrti. Prispevek analizira s pomočjo bibliometrije, tekstovnega rudarjenja in s tradicionalnim pristopom k pregledu literature vpliv raka dojke na poklicno življenje bolnic in bolnikov z namenom identifikacije ključnih vidikov vpliva raka na poklicno pot. Bibliometrična

analiza, izvedena na 97 člankih iz 68 virov na Web of Science iz obdobja 1995-2023, kaže, da rak dojke in njegovo zdravljenje kratkoročno vplivata na poklicno pot preko motenj zaradi zdravljenja, ki lahko povzročijo zmanjšano delovno zmožnost, finančno obremenitev in vodijo tudi do morebitnih kariernih sprememb. Vrnitev na delo je odvisna tako od posameznika kot od zdravstvenega in socialnega sistema ter delodajalcev. Morebitni vpliv bolezni na kariero posameznika in diskriminacija na trgu dela dodatno povečata stres zaradi bolezni, pri čemer pa so pomembne tudi posameznikove značilnosti. Razumevanje učinkov raka na trg dela je bistvenega pomena za razvoj politik, ki podpirajo vrnitev bolnikov na delo in poklicno rehabilitacijo.

KLJUČNE BESEDE

Rak dojke, zaposlenost, izguba dohodka, poklicni razvoj

1 INTRODUCTION

Breast cancer can have a major impact on professional lives of patients. Besides the immediate adverse effects related to sick-leave, immediate income loss, financial strain due to increased expenses, and career disruption, the disease can have effects later, after treatment, such as reduced ability to work, career change, workplace accommodation, lower wage, discrimination in the workplace or labour market and even job loss [9, 13, 15].

This paper provides a systematic review of the literature on the impact of breast cancer on patient's work life during and post treatment. The analysis relies on a combination of bibliometric methods, text mining and standard literature review, which is used to investigate the main impacts of cancer on career development.

The results show that cancer, cancer treatment and survivorship have a multitude of impacts on individuals' professional life, where not only the end results is important, but primarily the understanding of the causalities and the transmission mechanisms that can contribute to building policies and networks to enable easier return to work after the disease to different groups of patients.

The paper first presents the body of literature using bibliometric and text-mining methods to identify the key topics,

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authors, outlets, and topic development. In continuing, a standard literature review is used to analyse the key topics in the most relevant references, identify the main findings and provide guidelines for future (empirical) research.

2 BIBLIOMETRIC ANALYSIS

Web of Science was selected as the relevant database due to the interdisciplinary nature of the topic. Its core collection, which we referred to, covers almost 22 thousand journals, 143 thousand books and over 300 thousand conferences [12] To identify the core papers, we used “breast cancer” as a key word in combination with one of the labour market-oriented keywords (employment, unemployment, job, career, earning, wage). The search was done in titles of the papers only, in order to identify those papers that indeed focus primarily on this relationship and where working life is not a residual or secondary topic. Of the initial 147 papers, chapters, etc., we used only those in English and excluded 4 papers. In the following step, abstracts were examined in detail, to further identify the papers that are exploring this topic alone, i.e., where the topic is not a residual or supporting one (Figure 1).

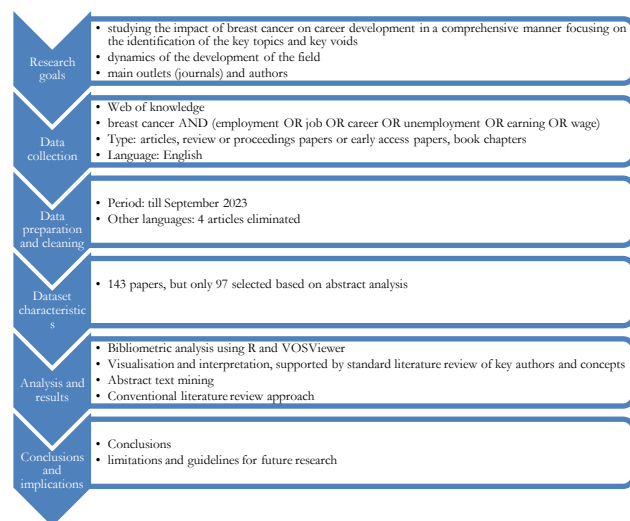


Figure 1: Research steps
Source: Authors’ own, but motivated by Roblek et al. [16]

The final dataset comprised 97 papers from 68 different sources, published between 1995 and 2023. 92 were articles, 2 were proceedings papers, 1 review and 1 early access paper. The dataset included in total 468 different authors and each paper was on average cited 22.4 times. The topic has become increasingly popular since 2013, when annual production of papers on average first doubled in comparison to the pre-2010 period and earlier and then quadrupled. The most important journals publishing in the field were Supportive care in cancer, Cancer and Journal of Cancer Survivorship as well as Psycho-oncology. C.J. Bradley, V.S. Blinder, S.T. Hawley and S.T. Katz were some of the more productive authors. Bradley was also the co-author of the two most cited papers [5, 6], followed by a paper by Lauzier [11] and Blinder [3]. Schernhammer et al. [17] and Banning et al. [2] as well as a number of other papers made a significant impact on the development of the field.

In terms of cooperation, a strong link between the US and Australian research was found, while the link between the US and the EU was weaker. Also, several strong groups of authors’ connections were identified, revolving around C.J. Bradley, S.J. Katz and others (Figure 2).

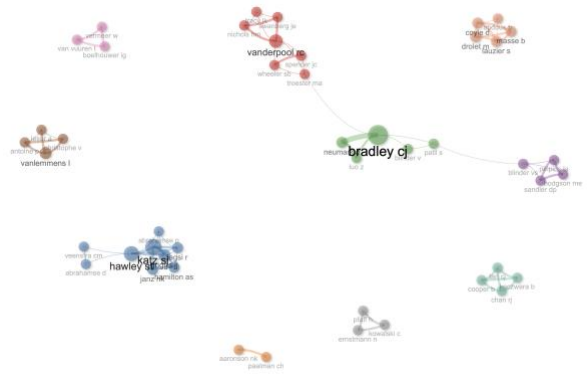


Figure 2: Collaboration network
Source: Authors’ own.

Content and topic analysis of the abstract texts was done in WordStat for Stata, including only terms with a frequency of at least 30. The co-occurrence analysis shows that the major topics, identified in the studied literature expectedly revolve around (breast) cancer and employment, focusing on different aspects of the career development (work, job, occupation, employment status, unemployment, quality of life) as well as medical aspects, from treatment, treatment consequences, outcomes and survivorship. The linkages are strongest, expectedly between the terms breast and cancer treatment, employment but the results also reveal that the stage is relevant (Figure 3).

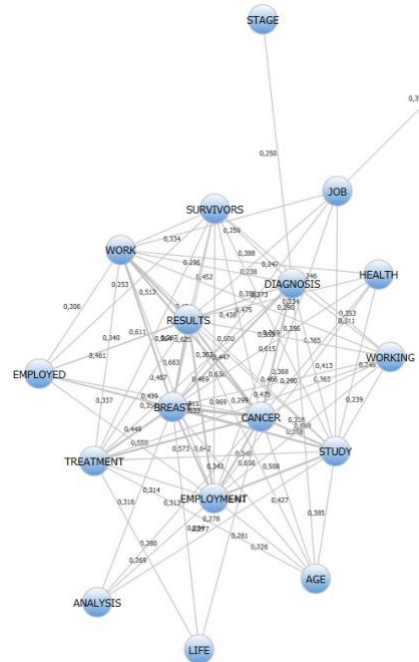


Figure 3: Co-occurrence network*
Source: Authors’ own. *Only linkages between the most important terms depicted. Coefficient indicating linkage strength.

Table 1: Key topics

Topic	Keywords	Coherence (q)	Eigenvalue	Cases
Breast cancer related	Survivors; employment; financial; factors; work; treatment; status; stress; impact; risk; wage; loss; outcomes; job; breast cancer;	0.969	2.1	78
Breast cancer study	Breast; cancer; women; diagnosed; methods; study; young; age; career; years;	0.962	2.57	97
Employment after diagnosis	Diagnosis; years; after; time; year; months; status; employment; working; unemployment; age; patients; stage; results; employment status;	0.95	1.9	80
Cancer broader effects	Insurance; health; problems; effects; jobs; reported; women; job; loss; treatment; physical; related; income; outcomes; included; young; life; health insurance; job loss; quality of life; related quality of life; young women;	0.94	1.83	86
Higher risks	Higher; risk; high; low; job; compared; ci; lower; income; loss; women; jobs; unemployment; job loss; higher risk; job demands; risk of breast cancer; job strain;	0.909	2.16	73

Source: Authors’ own.

WordStat was used also to identify key topics in the abstracts. In total 5 topics were extracted, where the first relates primarily around the breast cancer consequences, in particular to work and employment. Cancer also has broader quality of life effects, which were studied in the papers, in particular those related to broader quality of life dimensions. Higher risk was a common term, which referred primarily to two aspects – first, a comparative one, stating that cancer was related to higher risk of job loss, income loss, unemployment, etc. in comparison to those without the disease. Some papers also referred to cancer risk in medical terms as risk of repetition or higher grade risk. A major aspect was also studying the medium and longer term effects, which is visible in “employment after diagnosis” topic, where papers referred to studying the effects for example 6 months, 1 year, 5 years after the diagnosis.

Although the literature does not focus solely on the links between employment, work, income and cancer, but also addresses some broader well-being aspects, the focus in continuing will be primarily on the career development of individuals, their work status and material position (earnings).

3 THE IMPACT OF CANCER ON CAREER DEVELOPMENT

Cancer can, according to the literature, have a number of adverse effects on individuals and their career status and development, which can be divided into short, medium and long-run effects. In the short run, these negative outcomes of cancer diagnosis and treatment are related to the diagnosis itself and the disruption of individuals’ careers due to treatment [14], which can reduce an individual’s ability to work and their productivity. Patients may need to be absent from work over an extended period of time, may need to reduce working hours during treatment or upon return to work [10] Nielsson et al. [14] stressed that the return to work depends on a number of stakeholders (employers, caregivers and the information they share with patients, their attitudes) as well as adjustments to their needs (for example at the workplace).

Absence from work, reduced working ability and work hours as well as potential impacts of costs associated with cancer

treatment which are perhaps not covered by public or private insurance impose significant financial strain on the individuals, related also to lower wages and income inequality. Bradly et al. [8] find in their longitudinal study on a sample of 6708 women that breast cancer had a negative impact on employment, focusing on ability to work, work hours, wages and earnings and get to robust findings that the cancer survivors were affected in their earnings in comparison to the control group. However, they also stress that there is significant variation in the outcomes, from having women, where cancer had no adverse effects, in some cases even positive due to various reasons. Some women might be afraid of the potential discrimination, which might stimulate them to work more. As Bradley et al. [7] find, the effect of breast (and prostate) cancer is highest 6 months after the diagnosis, while within 12 and 18 months after the diagnosis many returned to work. However, they highlight the importance of diversity (especially minorities) as well as insurance coverage.

Some patients might face career change and even job loss due to extended periods of treatment, health related limitations at work and being unable to perform the tasks, they used to do. A meta-analysis reports that within 2-14 years after the diagnosis, 3/4 of patients retained work, which is a good result, however it still implies that that around ¼ did not [4]. The authors stress that surviving cancer is linked to a variety of persistent physical and psychological consequences, encompassing prolonged fatigue, feelings of depression, ongoing physical discomfort, and limitations in cognitive functioning. A review of most relevant 29 papers (following a detailed study of over 5000 papers) showed that in different countries, from Brazil, Netherlands, Canada, USA, Israel, Ireland and other, from 56% of breast cancer survivors were working after 3 years in USA, California, to for example 84% in Sweden after 2 years.

It is also important whether the job or workplace can facilitate adjustment needed after treatment. Some employees might need different tasks due to inability to perform the same tasks as before, some, as noted by Aguiar-Fernandez et al. [1] stress also the psychological aspect. Namely, as they say, “the physical and psychological effects of the treatment undermined survivors’ self-esteem”. Financial strain on the other hand forced the patients to return to work. However, they highlight another important aspect, which is the possible employer attitude and workplace discrimination, also highlighted by Stergiou-Kita et al. [18]. These aspects come on top of their physical and psychological constraints, problems with job accommodations, and limited support from various government agencies.

4 DISCUSSION AND FUTURE RESEARCH ORIENTATION

The interdisciplinary research in the field of cancer impact on working life of individuals has been developing fast in recent years, leading to a solid body of research results, focusing on both short and long-term effects. However, the field remains under-investigated with many voids still needed to be addressed in more detail. Despite the fact that the impact of cancer on work life, income and career development on average is negative, there has been indication in the literature, that this effect is not the same across all occupations, also not all age groups. Furthermore, diverse impacts can also result from cancer stage and treatment

type. So both medical and demographic factors should be studied in more detail.

Table 2: Key fields of analysis and guidelines for future research

Challenges for future research	
Short-term effects	
Disruption of individuals' careers due to treatment	Impacts by education, occupation and career stage (seniority)
Reduction of ability to work, productivity	Gender differences, age differences, combined effects
Financial strain, impact on wages and income inequality	Impacts by cancer stage, treatment type, access to health system
Psychological effects	The impact of remote work option on occupational rehabilitation
	Population-wide studies Personal characteristics and impact of cancer on presentism and absenteeism and career development
Medium and long-term effects	
Career change	Intersectionality, comparative impacts of educational, occupational, gender and age (seniority) differences
Job loss	
Workplace discrimination	Labour market mobility, job stability and individual's well-being
	Comparative career progression

Furthermore, it would be interesting to see the possibly diverse impact of cancer depending on work organization and the relationship between occupational rehabilitation and modern work organization (remote work). On the other hand, even remote work could be perceived by cancer survivors as negative or a form of discrimination. Thus the personal aspects also require a more detailed analysis. The impact of cancer on career progression, the impact of disability on employment type and stability, labour market mobility are also requiring more attention. With the development of methodology and increased data availability, significantly more detail will be available, allowing a more comprehensive analysis, which can also support the development of policies to promote faster rehabilitation.

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Understanding financial barriers to the implementation of new technologies in Slovenian companies

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ABSTRACT / POVZETEK

The purpose of this paper is to contribute to the understanding of how a lack of financial health, operationalized through value added per employee, affects investments in new technologies and employee training. Based on the Resource/Capability-Based View, we analyze 223 Slovenian companies. The findings suggest that financially less healthy companies have lower levels of digitalization and perceive the costs of implementing new technologies as a greater barrier than financially healthier companies. Moreover, companies with higher value added invest more in new technologies as well as employee training due to the implementation of new technologies. Taken together, our paper contributes in complementing the existing stream of research focused on internal resources and new technology implementation.

KEYWORDS / KLJUČNE BESEDE

Firm performance, financial barriers, digitalization, new technology implementation

1 THEORETICAL BACKGROUND

Population ageing in developed countries is expected to enhance the productivity slow-down due to a number of reasons, from lower labour supply, lower savings, increased tax burden and other. Consequently, implementation of new technologies, including robots can help reduce the negative effects of population ageing on productivity and well-being.

Different barriers may prevent companies to adopt new digital-based technologies. Neto et al. [1] discuss a number of

obstacles for new technologies adoption, namely cultural (related to the lack of intellectual capacity and willingness of employees and owners/managers), financial (related to companies' limited capabilities to finance new technology purchases and implementation), technical (resulting among other things from low-skilled labor), organizational, and governmental. Theoretical support for such conceptualization of adoption barriers can be found in the Resource/Capability-Based View (RCBV), which suggests that, in order to gain competitive advantage, companies must invest resources and capabilities that allow them to operate their chosen lines of business efficiently and effectively [2,3].

This paper focuses on only one type of barriers to adopt digital technologies, namely the financial ones. Financially unhealthy companies, according to the slack resource theorists' [4], lack the key foundation for a company to invest in strategically important areas such as new technologies. Financial health therefore plays a key role in allowing companies to undertake investments they would otherwise have to bypass [5–7]. The need for financial health as a key enabler of technological investments also finds a basis in the literature on firm-level financial constraints [8]. Financial constraints that prevent firms from funding desired investment opportunities [9] are not directly observable empirically, i.e. no specific items (in accounting statements) or indicators clearly indicate whether a firm is financially constrained or not [10]. As no consensus has yet emerged on what constitutes a good measure of financial constraint, different measures are applied in the literature as proxies [11,12]. Authors typically relate financial constraints to a firm's liquidity or solvency problems, i.e. the company's inability to settle short- and long-term liabilities [10,13]. Yet, empirical studies also suggest profitability indicators are important measures of financial constraints because unprofitable firms not only fail to finance their investments from internal sources but also face difficulties obtaining new debt financing at an acceptable cost [11,14]. In this study, the lack of financial health, i.e. the financial barrier to invest in the digital technologies, is operationalized through value added per employee.

*Article Title Footnote needs to be captured as Title Note

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Previous studies on the links between financial health and company investments in new technologies mostly reveal that financially healthy companies are more likely to use new technology than financially weaker companies [15]. This may be due to the fact that financially sound companies perceive the same level of investment as a smaller sacrifice. Furthermore, the availability of finance enables companies to better withstand negative consequences if the new technology adoption fails [16]. When it comes to securing the financial resources for new technology usage, large companies usually have an advantage as they are able to take on more risk than smaller companies [17]. Thong [18] found that larger companies that possess adequate financial and organizational resources are more likely to adopt new information technology. On the other hand, smaller companies are less likely to adopt such technology due to disproportionately large financial risk [19]. Several other authors also conclude that difficulties in accessing adequate financing [20] and consequently lack of investment capital [21] represent the main barriers for adopting and using new technologies in SMEs.

2 METHODOLOGY AND SAMPLE

In order to analyse the characteristics and effects of digitisation, we developed a questionnaire based on several different sources [22–28]. The questions were divided into several thematic strands:

(1) General information about the company, (2) Characteristics of digitisation, (3) Drivers of digitisation, (4) Analysis of barriers to digitisation, (5) Innovativeness of the firm, (6) Investment in intangible capital, (7) Impact of digitisation, (8) Strategic aspects and digitalisation, (9) The role of the State.

Data were collected through the online platform Ika. The data was collected in October and November 2022. 223 respondents answered the questionnaire partially or fully, of which 131 were fully completed.

The sample comprised 24% of micro enterprises with 9 or fewer employees, 37% of small enterprises (10–49 employees), 25% of medium-sized enterprises (50–249 employees). The largest share of enterprises was in manufacturing, almost 35%, followed by trade with 12.9% and "professional, scientific and technical activities" with 9.6%, then transport and storage, ICT activities and construction.

3 RESULTS

The paper studies the relationship between financial barriers to investment and firms' investment in digital technologies.

Table 1 shows the structure of the sample by value added. The value added classes were determined on the basis of population values using AJPES data and in line with the AJPES definition, which defines value added as the difference between gross operating profit, the cost of goods, materials and services, and other operating expenses (Agency of the Republic of Slovenia for Public Records and Services, 2021; AJPES, 2022). The classes represent the 10th, 25th, 50th, 75th, 90th percentile of value added in the year 2021 for corporations. Relative to the population values, there were slightly more productive firms in the sample, but this is also related to the size and industry structure of the sample.

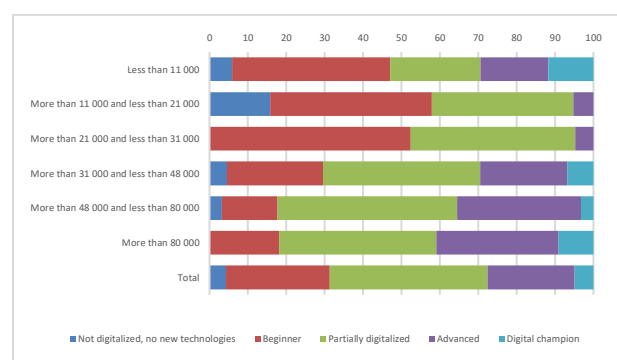
Smaller companies were in general less digitalized, measured based on respondents' self-classification of their firms in terms of the stage of digitalization, and based on the number of digital technologies used by the firms. Half of the micro companies were either not yet digitalized or use new technologies or were just starting, compared to just 15% among large companies reporting (at least) just starting. Size also allows more technologies to be appropriate or cost-efficient to use. Among large companies even 63% reported using 11 or more different technologies (21 were measured), while among small companies, more than ¾ used 6 or less technologies, a third even only 1. Manufacturing lagged slightly behind services with 27% of companies being advanced or digital champions, while in services there were around 36% of such companies. Interestingly, there were no major differences between companies that were more intensely involved in exports (EU15 and other EU markets were either important or very important).

Table 1: Value added per employee (euros)

	%
Less than 11 000	10.5
More than 11 000 and less than 21 000	10.0
More than 21 000 and less than 31 000	11.9
More than 31 000 and less than 48 000	24.3
More than 48 000 and less than 80 000	31.0
More than 80 000	12.4
Total (n = 223)	100

Data: Survey, 2022, own calculations.

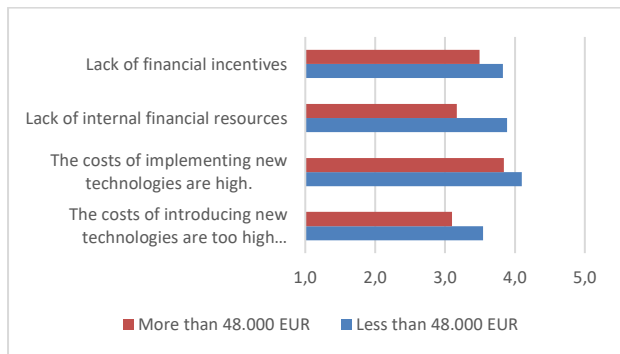
In 2022, median value added per employee was 31 thousand euros. Results (Figure 1) indicate that companies with higher value added (above median) are generally more advanced in digitalization. Among sub-median companies, around 50% of companies were either not digitalized or were just beginners, while among those with higher value added, there was less than a third of such companies. Companies with the highest two classes of value added were using around 9 different technologies, while those with less than 31 thousand only around 4.



Data: Survey, 2022, own calculations.

Figure 1: The level of digitalization by value added categories, %

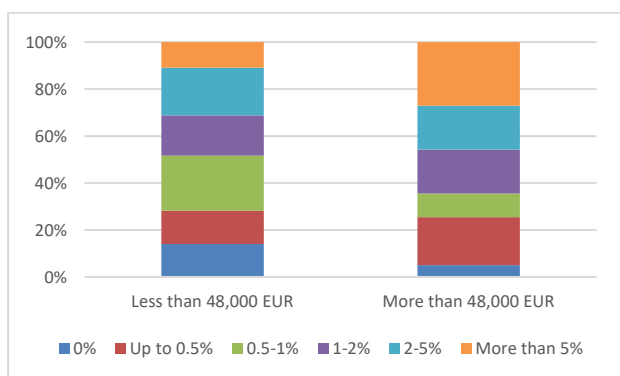
In terms of financial barriers to investing in digital technologies (Figure 2), there are statistically significant differences between firms with higher (above 48,000 EUR) and lower value added per employee in terms of lack of internal financial resources, with firms with lower value added seeing this as a greater barrier. Compared to firms with lower value added per employee, firms with higher value added per employee on average agree to a lesser extent with the statement that the costs of introducing new technologies are too high compared to the expected benefits, which means that for firms with higher value added per employee, the costs of new technologies are perceived as a lower barrier to investment.



Data: Survey, 2022, own calculations

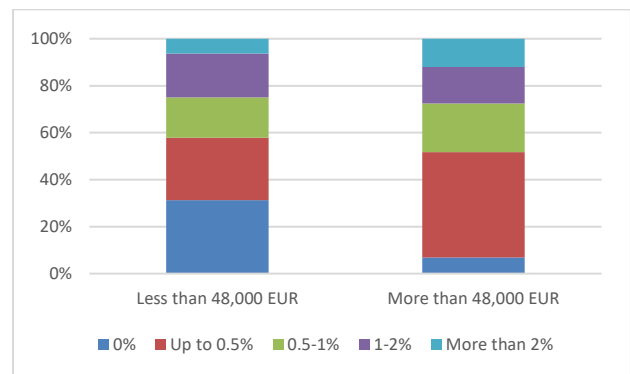
Figure 2: Financial barriers to investment in new technologies by value added categories

The results also show the difference in investment in new technologies (Figure 3) and investment in training due to the introduction of new technologies (Figure 4) by value added categories. Among firms with lower value added per employee, 14% (compared to 5% of the firms with higher value added) did not invest at all in new technologies and 31% (compared to 7% of the firms with higher value added) did not invest in training employees due to the introduction of new technologies. On the other hand, 11% of firms with lower value added (compared to 27% of firms with higher value) invested more than 5% in new technologies and 6% of firms with lower value added (compared to 12% of firms with higher value) invested more than 2% in employee training due to the introduction of new technologies. These results support previous findings that financial barriers play an important role in investments in new technologies.



Data: Survey, 2022, own calculations.

Figure 3: Investment in new technologies by value added categories, %



Data: Survey, 2022, own calculations.

Figure 4: Investment in training due to the introduction of new technologies by value added categories, %

4 DISCUSSION AND CONCLUSION

4.1 Theoretical implications

Our study holds important implications for the research streams of resource management and technology implementation in companies. First, the paper corroborates the existing discussion of the importance of resources within RCBV theory. The study indicates that internal financial resources play a key role in the successful implementation of new technology, as the results clearly show that companies that had higher availability of financial resources were more inclined to invest in newer technologies [15] and perceived the cost of new technologies as a lower barrier compared to less financially healthy companies. Access to capital, internal budgeting, and allocation of financial resources for testing and validation of new technology solutions are critical to successful implementation [29]. In the framework of RCBV [2,3], we therefore argue that companies must prioritize the provision of finance in order to first implement and afterwards successfully exploit new technologies.

Second, our study may be seen as contributing by complementing the existing literature on new technology implementation. Existing research already emphasizes the need for qualified personnel when implementing new technologies [30,31]. Companies need highly skilled employees that possess sufficient knowledge to operate with new technologies [32]. Our research complements the aforementioned authors by highlighting that financially healthier companies invest more in employee training due to the introduction of new technologies. Thus, such companies promote the development of another important organizational resource, which indirectly leads to higher changes in the successful implementation of new technologies.

4.2 Practical implications

Our research provides meaningful insights for practical implications for resource management and new technology implementation. Most importantly, previous research

conclusions stating that companies interested in adopting new technologies must be financially healthy are confirmed. Companies should make significant efforts to ensure sufficient funds in order to have a change to successfully implementing new technologies.

In relation to financial health and human capital in the context of new technology implementation, companies should ensure that they not only have sufficient funds to invest in new technology components, such as hardware or software. Instead, companies should also consider allocating a proportion of those funds to employee training. If employees do not have adequate competences to work with new technologies, the reasonableness and justification for investing in new technologies may be hindered. These findings should guide managers in establishing such conditions.

4.3 Limitations and future research directions

Like any study, our study has certain aspects that suffer from limitations. First, we chose to operationalize financial health of companies with value added per employee. Other financial characteristics of a company could have been considered as a measure of financial health. Moreover, a comparison between companies in different industries could have provided interesting findings.

Second, while our data and results suggest that there is a difference between companies with different financial status when it comes to investing in new technologies, a different methodological approach could have provided more details about the causal relationship of the constructs. Future researchers could use structural equation modeling (SEM) to test the direct relationship between financial resources availability and new technology implementation. To even further extend our understanding on the matter, future studies could apply a longitudinal approach to examine the dynamics of the relationships between financial health and new technology implementation and afterwards the relationship between financial health and actual use of new technologies.

5 CONCLUSION

Implementing new digital technologies has become almost a necessity for companies in order to survive. The reason for the study is to understand the role financial barriers play in the process of implementation of new technology and how financially stable companies can further improve the changes of successful technology utilization by additionally investing in employee training. Our aim is to complement the existing body of knowledge within the RCBV [2,3] and to stimulate further discussion on the topic of resource management in technology implementation.

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Blaženje ekonomskega pritiska starajočega se prebivalstva z izboljševanjem izobrazbene strukture

Alleviating Economic Pressure of Population Ageing with the Improving Educational Structure

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ABSTRACT / POVZETEK

V članku preučujemo, ali bi izboljševanje izobrazbene strukture prebivalstva, ki smo mu priča, lahko v prihodnje ublažilo pritisk staranja prebivalstva na ekonomsko vzdržnost. Z uporabo metodologije računov nacionalnih transferjev (angl. *National Transfer Accounts, NTA*) razčlenimo dohodek iz dela in potrošnjo po starosti in stopnji izobrazbe (osnovno izobraženi, srednješolsko izobraženi in terciarno izobraženi). Te rezultate nato kombiniramo s projekcijami prebivalstva po starosti in stopnji izobrazbe do leta 2060. Ugotovimo, da bo boljša izobrazbena struktura v prihodnje pomembno omilila pritisk staranja prebivalstva na ekonomsko vzdržnost.

KEYWORDS / KLJUČNE BESEDE

Dohodek iz dela, potrošnja, izobrazbena raven, staranje prebivalstva, ekonomska vzdržnost

ABSTRACT

In the article, we examine whether the improving educational structure of the population, which we are witnessing, could potentially alleviate the pressure of an aging population on economic sustainability in the future. Using the methodology of National Transfer Accounts (NTA), we analyse labour income and consumption by age and level of education (basic education, secondary education, and tertiary education). We then combine these results with population projections by age and level of education until the year 2060. We observe that a better educational structure will play a significant role in mitigating the

pressure of an aging population on economic sustainability in the future.

KEYWORDS

Labour income, Consumption, Educational level, Population ageing, Economic sustainability

1 UVOD

Hitro staranje prebivalstva, ki je posledica nizke rodnosti v preteklih štirih desetletjih in hitre rasti življenjskega pričakovanja, povzroča zmanjševanje deleža prebivalcev v delovni starosti in povečuje delež starejših, ki so ekonomsko odvisni. Ustaljeni kazalniki kot so koeficient starostne odvisnosti, primerja število starih 65+ in 0 19 s številom prebivalcev v delovni starosti (20 64 let). Te starostne meje so arbitrarno določene in ne upoštevajo, koliko posamezniki v posamezni starosti dejansko proizvajajo in koliko trošijo. Metodologija računov nacionalnih transferjev (angl. *National Transfer Accounts, NTA*) izračuna dejanski dohodek iz dela in potrošnjo v posamezni starosti in s tem omogoča mnogo bolj realistično analizo prihodnjih ekonomskih pritiskov staranja prebivalstva na ekonomsko vzdržnost.

Sambt in Istenič [1] na primeru Slovenije prikazujeta, da obstajajo velike razlike v dohodkih iz dela in potrošnji tudi med posamezniki z različno stopnjo izobrazbe. V članku analizo razširimo na 15 držav EU, hkrati pa izdelamo projekcije prihodnjega gibanja dohodka iz dela in potrošnje, upoštevaje spreminjajoče se izobrazbene strukture v prihodnje. Trenutne mlajše generacije imajo namreč mnogo višjo izobrazbeno raven kot starejše generacije. V prihodnjih desetletjih se bodo ti, danes mlajši posamezniki z višjo stopnjo izobrazbe, pomikali v višje starostne razrede. Glede na to, da imajo terciarno izobraženi posamezniki bistveno višje dohodke iz dela, njihova potrošnja pa ni višja za enako vrednost [1], bi to v prihodnje lahko blažilo pritisk staranja prebivalstva na zniževanje razmerja med agregatnim dohodkom iz dela in agregatno potrošnjo. Prispevek je razdeljen na štiri dele: najprej predstavimo metodologijo in uporabljenе podatke. V tretjem poglavju prikazujemo izračunane

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starostne profile po starosti in stopnji izobrazbe, ki jih kombiniramo s projekcijami prebivalstva, z namenom oceniti vpliv spremenjene izobrazbene strukture na ekonomsko vzdržnost. Nato sledijo zaključki.

2 METODOLOGIJA IN PODATKI

Za porazdelitev dohodka iz dela in potrošnje po starosti smo uporabili metodologijo računov nacionalnih transferjev (angl. National Transfer Accounts, NTA). Pri tem smo uporabili podatke na ravni posameznika iz ankete EU SILC 2011 (ki vsebujejo podatke o dohodkih v letu 2010) in iz ankete o porabi v gospodinjstvih (angl. Household budget Survey, HBS) iz leta 2010, ki vsebuje podatke o potrošnji na ravni gospodinjstev v letu 2010. Na koncu dobljene rezultate smo uskladili z agregatnimi podatki o dohodku iz dela in potrošnji iz sistema nacionalnih računov (SNA), in sicer na način, da iz individualnih podatkov dobljena povprečja pomnožimo z ustreznim faktorjem popravka, tako da po množenju s številom prebivalcev po starosti dobimo ravno agregatno vrednost iz SNA.

Osnovno metodologijo NTA smo nato dopolnili z razčlenitvijo dohodka iz dela in potrošnje glede na stopnjo izobrazbe posameznikov. Za določitev prebivalstva po starosti in stopnji izobrazbe smo uporabili podatke popisov iz leta 2011 [7]. Podatke smo razčlenili v tri glavne izobrazbene skupine: osnovno izobraženi (kategorije 0-2 po mednarodni standardni klasifikaciji izobraževanja ISCED), srednješolsko izobraženi (ISCED kategoriji 3 in 4) in terciarno izobraženi (ISCED kategorije 5 in več). Izračun dohodka iz dela in potrošnje (javne in zasebne) na prebivalca se po stopnji izobrazbe izvede z enakim pristopom kot je to v osnovni verziji NTA (torej nerazčlenjeni po izobrazbi), vendar se poleg starosti upošteva tudi stopnjo izobrazbe.

Javni izdatki za izobraževanje so razdeljeni na podlagi ciljne ravni izobrazbe posameznika, ocenjene iz ankete EU SILC. Zasebni izdatki za izobraževanje so ocenjeni s pomočjo ankete o porabi v gospodinjstvih (HBS). Zasebni izdatki za zdravstvo, razčlenjeni po stopnji izobrazbe, so ocenjeni z regresijsko analizo, kjer so odvisna spremenljivka izdatki za zdravstvo na ravni gospodinjstva, pojasnjevalna spremenljivka pa število posameznikov v posamezni starosti (konkretno, 10 letnih starostnih skupinah), nadalje razdeljeni v tri izobrazbene skupine.

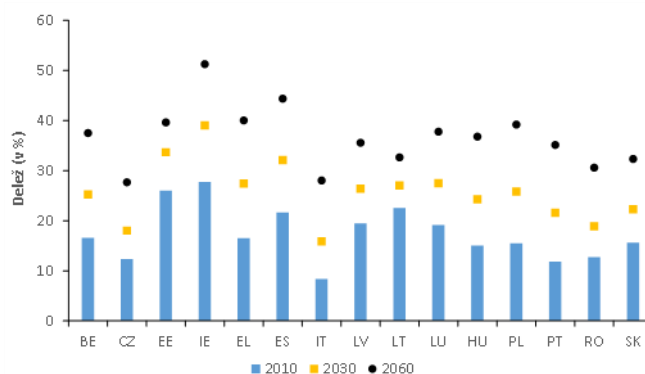
Javnih izdatkov za zdravstvo ni bilo mogoče razdeliti po izobrazbenih skupinah, ker zahtevani podatki niso bili na voljo. Zasebna potrošnja, razen izobraževanja in zdravstva, je bila ocenjena glede na starost in izobrazbo z uporabo ekvivalenčne lestvice.

Pri projekcijah ekonomske vzdržnosti uporabimo demografske projekcije, razčlenjene po omenjenih treh stopnjah izobrazbe, ki jih pripravlja Wittgenstein Centre for Demography and Global Human Capital (WIC). Prej omenjene porazdelitve dohodka iz dela in potrošnje po starosti in izobrazbeni skupini smo množili s številom prebivalcev v posamezni starosti in izobrazbeni

skupini. V analizi torej predpostavljamo, da starostni vzorci NTA za leto 2010 ostanejo nespremenjeni. Na ta način smo dobili projekcije agregatnega dohodka iz dela in agregatne potrošnje na ravni države. Pri tem primerjamo projekcije dohodka iz dela in potrošnje (1) brez upoštevanja dimenzije starosti in (2) z upoštevanjem dimenzije starosti.

Kot je razvidno iz slike 1, se bo v prihodnje delež terciarno izobraženih močno povečal. V nadaljevanju bomo prikazali, da ravno terciarno izobraženi posamezniki prejemajo bistveno višje dohodke iz dela kot ostali, kar bo imelo močan vpliv na rezultate projekcij, tudi še po tem, ko bomo upoštevali, da je pri terciarno izobraženih višja tudi njihova potrošnja.

Slika 1: Delež prebivalcev s terciarno izobrazbo v celotnem prebivalstvu v izbranih EU državah (v %)



Viri: [2], [3].

3 REZULTATI

V izračunih uporabimo primerljive starostne profile (tj. povprečja po starosti) dohodka iz dela in potrošnje glede na stopnjo izobrazbe za 15 držav EU, ki so bili za leto 2010 izračunani v okviru AGENTA projekta [4], [5]. Analiza je pokazala, da konvencionalno izračunan dohodek iz dela tvori zvonasto krivuljo, ki začne naraščati od 15. leta starosti dalje, nato doseže vrh in začne v višjih starostnih razredih upadati. Celotna potrošnja (zasebna in javna) se poveča v mladosti, nekoliko zmanjša v delovni dobi, v starosti pa se ponovno poveča zaradi višjih izdatkov za zdravstvo in dolgotrajno oskrbo.

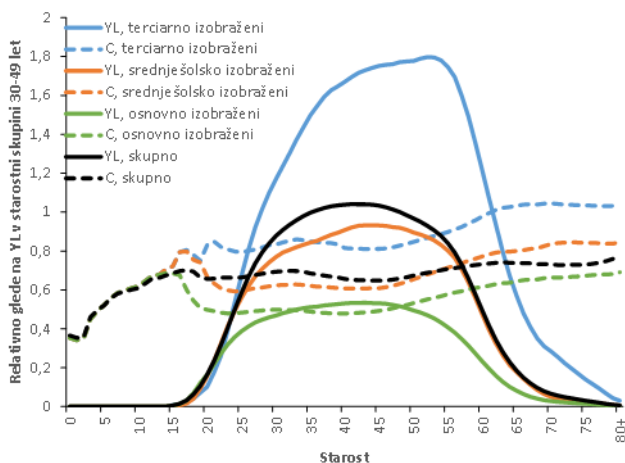
Starostni razpon, v katerem dohodek iz dela presega potrošnjo, se med državami razlikuje in je v veliki meri odvisen od upokojitvene starosti. V Grčiji, na primer, je dohodek iz dela večji od potrošnje le v starostnem razponu od 32 do 54 let, torej le 23 let, in je od drugih držav manjši zaradi nizke upokojitvene starosti (57 let). Poleg tega dohodek iz dela na tem razponu 23 let ne presega bistveno potrošnje, kar nakazuje na možne težave pri financiranju ekonomske vzdrževanega dela prebivalstva. Za prikaze rezultatov po državah glej [3].

Rezultati NTA po izobrazbenih skupinah kažejo, da višje izobraženi posamezniki zaslužijo in porabijo več, vendar so razlike v potrošnji veliko manjše od razlik v dohodkih iz dela. Pri terciarno izobraženih posameznikih dohodek iz dela strmeje

narašča in je presežek življenjskega cikla (tj. razlika med dohodkom iz dela in potrošnjo) bistveno višji kot pri srednješolsko in osnovno izobraženih. Terciarno izobraženi tudi delajo najdlje, s tem pa njihov dohodek iz dela presega njihovo potrošnjo v daljšem starostnem razponu. V Litvi, na primer, presežek dohodka iz dela nad potrošnjo proizvajajo skoraj izključno terciarno izobraženi, medtem ko je v Belgiji presežek dohodka iz dela nad potrošnjo bolj enakomerno porazdeljen po izobrazbenih skupinah, čeprav je skupni presežek, ki ga ustvarjajo terciarno izobraženi, še vedno bistveno višji od presežka srednješolsko in osnovno izobraženih.

Slika 2 prikazuje potrošnjo in dohodek iz dela na prebivalca po stopnji izobrazbe za povprečje 15 držav EU. Kot pričakovano, je dohodek iz dela najvišji za terciarno izobražene, saj terciarno izobraženi zaslužijo bistveno več, hkrati pa je višja tudi njihova stopnja zaposlenosti. Dohodek iz dela je najnižji pri posameznikih z osnovno izobrazbo. Enako zaporedje velja tudi za potrošnjo, vendar so razlike tu manjše zaradi davčne progresivnosti in socialnih programov v javnem sektorju. Črni liniji v sliki 2 predstavljata »skupno« povprečje, torej tisto, kjer dimenzije izobrazbe ne uvajamo v analizo (tj. običajni rezultati NTA). Predstavljene rezultate bomo v nadaljevanju uporabili v naših izračunih, hkrati z demografskimi projekcijami po izobrazbi, za kar smo osnovne rezultate prikazali že na sliki 1. Pri tem bomo rezultate, ki jih dobimo upoštevaje dimenzijo izobrazbe, primerjali z običajnimi rezultati NTA, kjer se dimenzija izobrazbe ne upošteva.

Slika 2: Starostni profil dohodka iz dela in potrošnje po izobrazbenih ravneh, povprečje 15 držav EU, 2010



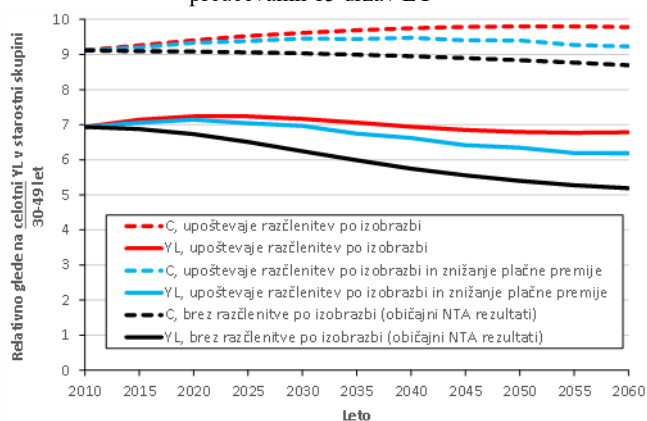
Opomba: YL označuje dohodek iz dela, C pa potrošnjo.
Vir: [1], [3], [4].

Na ta način dobimo rezultate, predstavljene na sliki 3. Določena razlika med celotno potrošnjo in celotnim dohodkom iz dela obstaja že v izhodiščnem letu 2010, saj se določen del potrošnje krije s pomočjo prerazdeljevanja iz naslova sredstev kot so npr. kapitalski dohodki, zadolževanje oz. izposojanje sredstev. Nasploh lahko na dolgi rok vzdržno trošimo nekoliko več kot ustvarjamo z delom, ker imamo od preteklih generacij veliko zalogo (stog) kapitala, ki daje donos. Problem pa je, če nam

projekcije kažejo, da se bo razmerje med dohodkom iz dela in potrošnjo v prihodnje bistveno zmanjševalo.

Če ne upoštevamo razčlenitve po izobrazbi, bi se skupna potrošnja v prihodnje gibala na približno nespremenjeni ravni (slika 3), celotni (tj. agregatni) dohodek iz dela pa bi se od leta 2010 do leta 2060 znižal za okrog četrtino. Če je torej v letu 2010 dohodek iz dela uspel financirati 76 % celotne potrošnje, bi jo v letu 2060 samo še 60 %, kar predstavlja znatno zmanjšanje ekonomske vzdržnosti iz naslova demografskih sprememb. Če pa upoštevamo še razčlenitev po izobrazbi, bi bilo to zmanjšanje bistveno nižje. Izobrazbena struktura se bo namreč v prihodnje bistveno izboljšala, hkrati pa terciarno izobraženi prejemajo bistveno višje dohodeke iz dela (zaradi višje produktivnosti njihovega dela).

Slika 3: Analiza občutljivosti projekcij celotnega dohodka iz dela (YL) in potrošnje (C) do leta 2060 kot netehtano povprečje preučevanih 15 držav EU



Vir: [1], [2], [3], [4], [6].

Na sliki 3 je poleg tega razvidno, da bi ob obstoječih starostnih vzorcih dohodka iz dela in potrošnje ostal celotni dohodek iz dela, ob danih predpostavkah (ne predpostavlja se nobena realna rast) in upoštevaje izobrazbeno strukturo v celotnem obdobju, približno enak kot je bil v letu 2010. Torej bi izboljševanje izobrazbene ravni praktično v celoti kompenziralo negativen učinek staranja prebivalstva na število in delež oseb, ki prejemajo dohodek iz dela. Na drugi strani bi bila tudi potrošnja nekoliko višja, saj posamezniki z višjo stopnjo izobrazbe trošijo nekoliko več, vendar bi bistveno pretehtal učinek višjega dohodka iz dela. Na koncu smo preverili še scenarij, če bi se plačna premija terciarno izobraženih glede na nižje izobražene zmanjšala. Ko se bo v prihodnje delež terciarno izobraženih bistveno povečal, bodo namreč ti posamezniki vedno manj redki in zato njihov dohodek iz dela mogoče več ne bo za toliko višji glede na nižje izobražene kot to velja sedaj oziroma je veljalo v letu 2010. Pri tem smo uporabili OECD-jeve podatke o padajoči plačni premiji visoko izobraženih v preteklosti [6]. Vidimo, da je tudi v tem primeru pozitiven učinek izobrazbene strukture na dolgoročno ekonomsko vzdržnost še vedno pozitiven (glej sliko 3).

4 ZAKLJUČEK

Z množenjem dohodka iz dela in potrošnje po starosti in stopnji izobrazbe s projekcijami števila prebivalcev po starosti in stopnji izobrazbe smo naredili projekcije prihodnjega gibanja celotnega dohodka iz dela in celotne potrošnje do leta 2060. Rezultate smo izračunali za 15 držav EU, ki so imele na voljo vse potrebne podatke. Z upoštevanjem dimenzije izobrazbe ugotovimo, da bo tekom obdobja projekcij dohodek iz dela bistveno višji kot pa če bi upoštevali samo povprečne vrednosti po starosti, brez upoštevanja dimenzije izobrazbe. Terciarno izobraženi sicer tudi nekoliko več trošijo, vendar je razmerje med celotnim dohodkom iz dela in celotno potrošnjo do konca obdobja projekcij še vedno bistveno višje kot če dimenzije izobrazbe ne bi upoštevali. Izboljšana izobrazbena struktura bo torej v prihodnje pomembno omilila pritisk staranja prebivalstva na ekonomsko vzdržnost.

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ZAHVALA

Delo v okviru tega članka je bilo deloma financirano s strani projekta AGENTA (Sedmi okvirni program Evropske skupnosti za raziskave, tehnološki razvoj in predstavitvene dejavnosti, po pogodbi 613247) ter s strani Javne agencije za znanstvenoraziskovalno dejavnost RS (po pogodbah P5-0128, J5-4575, V5-2264). Ta članek uporablja podatke Eurostata: Cross sectional EU-SILC UDB, 2011 in HBS, 2010. Za uporabo se avtorji zahvaljujejo Eurostatu in Evropski komisiji. Prav tako se zahvaljujemo skupini Ageing Working Group in nacionalnim timom, ki so nam posredovali podatke o izdatkih za zdravje in dolgotrajno oskrbo. Za vse zaključke, ki izhajajo iz podatkov, so v celoti odgovorni avtorji članka.

Telesna neaktivnost kot dejavnik tveganja za srčno-žilne bolezni po starostnih razredih

Physical Inactivity as Risk Factor for Cardiovascular Diseases across Age Segments

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POVZETEK

Prispevek se osredotoča na telesno neaktivnost, ki povečuje tveganje za kronična obolenja, predvsem za srčno-žilne bolezni. Le-te zaznavamo tako med odraslim prebivalstvom kot tudi med otroki in mladino. Na podlagi podatkov Inštituta za zdravstvene metrike in vrednotenje se v prispevku osredotočamo na relativna tveganja za srčno-žilne bolezni po starostnih razredih, spolu in po državah. Pri tem podajamo primerjavo med Slovenijo in svetovnim povprečjem. Na podlagi analize avtorji ugotavljamo, da se dejavniki tveganja za srčno-žilne bolezni v Sloveniji razlikujejo glede na starostne razrede. Ugotavljamo tudi, da nizka telesna aktivnost ni med prevladujočimi dejavniki tveganja za srčno-žilne bolezni, postaja pa s starostjo vse bolj pomemben dejavnik. Ker telesna aktivnost pomembno vpliva na vedenjske, prehranske in druge dejavnike in je hkrati med dejavniki, ki najbolj vplivajo na nastanek srčno-žilnih bolezni, je spremljanje navedenih povezav za ukrepe in priporočila zdravstvene politike nujno.

KLJUČNE BESEDE

Telesna neaktivnost, relativno tveganje, srčno-žilne bolezni, ekonomsko breme bolezni

ABSTRACT

The article focuses on physical inactivity, which increases the risk of chronic diseases, especially cardiovascular diseases, among the adult population as well as among children and youth. Based on data from the Institute for Health Metrics and Evaluation, the article reports relative risks of cardiovascular disease by age group, gender, and country. In doing so, we focus

on the comparison between Slovenia and the world average. Based on the analysis, we conclude that cardiovascular diseases impact people in different age segments; as such they become one of the important risk factors through aging. Also, physical activity importantly influences behavioral, nutrition and other factors, which contribute to cardiovascular diseases. For that reason, it is very important to systematically analyze and monitor these factors to contribute to better guidelines and measures of policy makers.

KEYWORDS

Physical inactivity, relative risk, cardiovascular diseases, economic burden of disease

1 UVOD

Po poročanjih [2] so nenalezljive kronične bolezni glavni razlog za kar 74 odstotkov vseh smrti na globalni ravni in v Sloveniji predstavljajo 11 odstotno verjetnost za prezgodnjo umrljivost. Med njimi so najštevilčnejše srčno-žilne bolezni, ki so razlog za 39% vseh smrti v Sloveniji. Ustrezna in zadostna raven športno/gibalne aktivnosti je povezana z izrazitim zmanjšanjem tveganja za prezgodnjo umrljivost in je uveljavljeno sredstvo za zmanjšanje tveganja za mnoga kronična zdravstvena stanja [7, 10]. Študije potrjujejo pozitivne učinke tako z vidika fizičnega zdravja, kot tudi z vidika drugih kroničnih metabolnih, srčno-žilnih, pljučnih in nevroloških bolezni ter psihičnih motenj [3, 7, 8, 10]. Pri odraslih telesna neaktivnost oz. nezadostna aktivnost predstavlja kar 20-30 % večje tveganje za umrljivost v primerjavi s tistimi, ki se večino dni v tednu ukvarjajo z vsaj 30-minutno zmerno intenzivno športno/gibalno aktivnost.

V tem prispevku se tako osredotočamo na nezadostno telesno aktivnost kot faktor tveganja za srčno-žilne bolezni. Glede na to, da se prevalenca srčno-žilnih bolezni razlikuje glede na starost, smo oblikovali tri starostne razrede: mladostnike (stare od 10 do 24 let), delovno aktivno prebivalstvo, ki je v letih, ko je najbolj produktivno (stari med 25 in 49 let) ter starejše (stare med 50 in

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74 let). Za posamezne starostne razrede poročamo nezmožnosti prilagojenih letih življenja (*angl. Disability-Adjusted Life Year - DALY*), kjer Slovenske podatke za leto 2019 primerjamo s svetovnimi. Namen prispevka je tako osvetliti problematiko nezadostne telesne aktivnosti kot faktorja tveganja za bolezni in s tem prispevati k diskusiji o pomenu intervencij, ki bi spodbujale telesno aktivnost v Sloveniji in ekonomskemu bremenu neustrezne telesne aktivnosti. Telesna neaktivnost se s starostjo namreč povečuje in se s tem tveganje za nastanek srčno-žilnih bolezni tudi povečuje. To pomeni, da bo v luči staranja prebivalstva problem telesne neaktivnosti in s tem ekonomsko breme telesne neaktivnosti, potencialno še večji.

2 METODOLOGIJA IN PODATKI

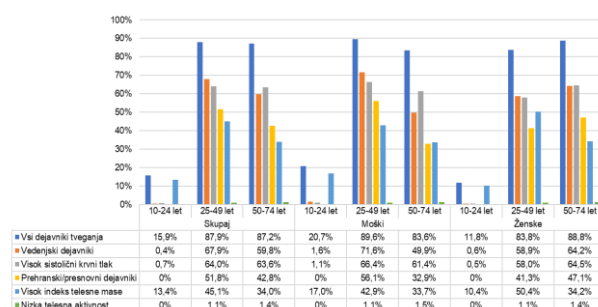
V prispevku uporabljamo metodologijo namenjeno izračunu bremena bolezni. Ta se izraža z izračunom nezmožnosti prilagojenih let življenja (*angl. Disability-Adjusted Life Year - DALY*), izraženo kot število izgubljenih let zaradi slabega zdravja, invalidnosti ali prezgodnje smrti. DALY je seštevek izgubljenih let življenja zaradi prezgodnje smrti (*Years of Life Lost - YLL*) ter letih življenja z invalidnostjo (*Years Lived with Disability - YLD*) [11]. Izračuna se kot sedanja vrednost prihodnjih let zdravega življenja, izgubljenih zaradi obolevnosti/invalidnosti, in prihodnjih let življenja, izgubljenih zaradi prezgodnje umrljivosti [5, 9]. Osredotočamo se na nezmožnosti prilagojenih leta življenja srčno-žilnih bolezni.

K pojavnosti posamezne bolezni prispevajo različni dejavniki tveganja. Moč povezave med dejavniki tveganja oziroma izpostavljenostjo in zdravstvenim izidom, torej boleznijo, merimo z relativnim tveganjem, ki ga izračunamo kot razmerje med tveganjem v skupini, ki izpostavljena dejavniku tveganja in skupino, ki ni izpostavljena dejavniku tveganja. Glede na to, da se v prispevku osredotočamo na prenizko telesno aktivnost je relativno tveganje izračunano kot razmerje med tveganjem za pojav srčno-žilnih bolezni skupine, ki ni dovolj telesno aktivna in tveganjem za pojav srčno-žilnih bolezni skupine, ki je dovolj telesno aktivna. Relativno tveganje in nezmožnosti prilagojena leta življenja zaradi srčno-žilnih bolezni izračunamo po spolu in treh starostnih skupinah: mladostniki (stari med 10 in 24 let), delovno aktivno prebivalstvo, ki je v svoji delovno najbolj produktivni dobi (25-49 let) in starejšim prebivalstvom (50-74 let). Selekcijo starostnih razredov smo izvedli na podlagi sistematične analize za študijo o globalnem bremenu bolezni iz leta 2019. Uporabili smo podatke Inštituta za zdravstvene metrike in vrednotenje za leto 2019 (*angl. Global Health Data Exchange*) (Natačen opis podatkov je v [6]). Ustrezna telesna aktivnost je definirana kot 3000–4500 metaboličnih ekvivalentov minut na teden, prenizka telesna aktivnost je torej nižja aktivnost od 3000 metaboličnih ekvivalentov minut na teden.

3 REZULTATI

Dejavniki tveganja v populaciji, ki vodijo v več nezmožnosti prilagojenim letom življenja (DALY) zaradi srčno-žilnih bolezni se med različnimi starostnimi obdobji spreminjajo (Slika 1). Največjo razliko je možno opaziti ravno v obdobju odrasčanja in adolescence, kjer je najpogostejši dejavnik tveganja visok indeks telesne mase otrok in mladostnikov, medtem ko v kasnejših obdobjih življenja prednjačijo predvsem

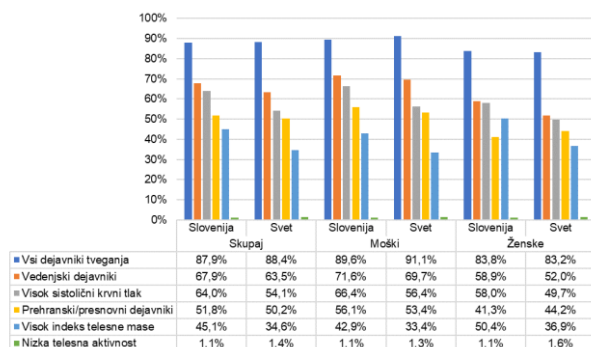
vedenjski dejavniki (med 49,9-71,6%). Medtem ko so moški bolj izpostavljeni dejavnikom tveganja med starostjo 25-49 let, se pri ženskah dejavniki tveganja za DALY zaradi srčno-žilnih bolezni večinoma pojavljajo po 50. letu starosti. Pri obeh spolih prevladujejo vedenjski dejavniki tveganja in visok sistolični tlak, vendar pa opazamo pomembne razlike v prehranskih dejavnikih. V delovno aktivni populaciji prehranski dejavniki predstavljajo do 14,7% večje tveganje za moške v primerjavi z ženskami. Nasprotno pa so starejše ženske (za 14,2%) bolj izpostavljene tem prehranskim dejavnikom. Četudi podatki Inštituta za zdravstvene metrike in vrednotenje kažejo, da nizka telesna aktivnost nima velikega vpliva na breme bolezni, so predhodne študije [1, 4] dokazale, da le-ta pomembno vpliva na izboljšanje kakovosti življenja. Posledično seveda tudi na zmanjšanje števila tako vedenjskih, prehranskih in drugih dejavnikov, ki dokazano vplivajo na breme bolezni.



Slika 1: Dejavniki tveganja za srčno-žilne bolezni, po starostnih razredih in spolu v Sloveniji

Vir: Inštitut za zdravstvene metrike in vrednotenje (2019), lastni preračuni

V starostni skupini od 25 do 49 let imajo visok in razmeroma primerljiv vpliv vedenjski ter prehranski dejavniki (do 5% razlike), ob enem pa sta visok indeks telesne mase in visok sistolični krvni tlak zelo pomemben dejavnik tveganja za srčno-žilne bolezni v Sloveniji, njune vrednosti pa odstopajo od svetovnega povprečja. Spodbudni podatki kažejo na to, da je vpliv nizke telesne dejavnosti v primerjavi s svetovnim povprečjem v Sloveniji nekoliko manjši. To je lahko indikator telesno aktivnejše populacije, v kateri bi lahko s pravim pristopom/intervencijami spodbudili povečanje števila telesno aktivnega prebivalstva ter posledično preko spreminjanja njihovega življenjskega sloga/navad (uravnotežena prehrana, ozaveščanje o dejavnikih tveganja, telesna aktivnost...) zmanjšali tudi preostale dejavnike tveganja.



Vir: Inštitut za zdravstvene metrike in vrednotenje (2019), lastni preračuni.

Slika 2: Dejavniki tveganja za srčno-žilne bolezni, 25-49 let, po spolu

4 ZAKLJUČEK

V prispevku ugotavljamo, da se dejavniki tveganja za srčno-žilne bolezni v Sloveniji razlikujejo glede na starostne razrede. Ugotavljamo, da nizka telesna aktivnost ni med prevladujočimi dejavniki tveganja za srčno-žilne bolezni, postaja pa s starostjo bolj pomemben dejavnik (0 % v mladosti pa do 1,4% v starosti). To posledično pomeni, da bodo zaradi staranja prebivalstva potrebne intervencije na nacionalni ravni, ki bodo spodbudile predvsem starejše prebivalce k ustrezni telesni aktivnosti. Nizka telesna aktivnost tudi pomembno vpliva na vedenjske, prehranske in druge dejavnike [1, 4], ki so med tistimi, ki najbolj vplivajo na nastanek srčno-žilnih bolezni. To še dodatno povečuje ekonomsko breme telesne neaktivnosti, kar bo s staranjem prebivalstva postalo še večjo.

Glede na to, da se dejavniki tveganja v delovno aktivni starostni skupini skladajo s svetovnim povprečjem, lahko to kaže na potrebo po skupnih prizadevanjih tako na nacionalni kot tudi mednarodni ravni za obvladovanje teh dejavnikov tveganja. Slovenija lahko postane primer dobre prakse za implementacijo preventivnih in kurativnih programov za zmanjšanje vpliva teh dejavnikov tveganja. Uspešno uvedba takšnih programov bi ne le izboljšala zdravje prebivalcev Slovenije, ampak bi lahko tudi služila kot zgled in navdih za druge države in mednarodne organizacije.

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Analiza upokojitvenih pričakovanj ameriških potrošnikov glede na njihove demografske značilnosti

An analysis of US consumers' retirement expectations by demographic characteristics

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POVZETEK

V tem prispevku analizirava upokojitvena pričakovanja v Združenih državah Amerike glede na demografske značilnosti ameriških potrošnikov. Pri tem uporablja podatke Zvezne rezervne banke v New Yorku, ki meri, opazuje in spremlja upokojitvena pričakovanja v Združenih državah Amerike. Ugotovila sva, da so med ameriški potrošniki razlike v njihovih upokojitvenih pričakovanjih glede na njihovo starost.

KLJUČNE BESEDE

potrošnik, pričakovanje, upokojitve, Združene države Amerike

ABSTRACT

In this paper, we analyse retirement expectations in the United States by demographic characteristics of US consumers. We use data from the Federal Reserve Bank of New York, which measures and monitors retirement expectations in the US. We found that there are differences in retirement expectations among US consumers depending on their age.

KEYWORDS

consumer, expectation, retirement, United States

1 UVOD

Pričakovanja potrošnikov glede datuma njihove upokojitve so aktualna tema v Združenih državah Amerike (ZDA) [1, 2], zlasti zato, ker si marsikateri Američan ne more privoščiti, da bi se upokojil pri zahtevani starosti (67 letih za rojene leta 1960 ali pozneje) [3]. Razlog za to je, da nimajo dovolj denarja ali drugega premoženja, da bi lahko tudi po upokojitvi zadovoljevali svoje osebne potrebe oz. si zagotavljali ustrezen življenjski standard. Poleg tega ima marsikateri izmed njih tudi dolgove (težave z njihovim poplačevanjem), zato odlaša z upokojitvijo. To med ameriški oblikovalci politike povzroča potrebo po merjenju, opazovanju in spremljanju pričakovanj ameriških

[†] Dopsni avtor.

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potrošnikov glede datuma njihove upokojitve. V ta namen Zvezna rezervna banka v New Yorku meri, opazuje in spremlja pričakovanja ameriških potrošnikov glede datuma njihove upokojitve [4]. Raziskave kažejo, da pričakovanja ameriških potrošnikov glede datuma njihove upokojitve vplivajo na njihove odločitve (načrte) glede potrošnje in varčevanja [1].

Izkazalo se je, da so odločitve ameriških potrošnikov glede datuma njihove upokojitve odvisne od marsičesa, še zlasti pa od privarčevanega denarja (prihrankov) za starost, zato jim strokovnjaki svetujejo, da si naredijo načrt glede potrošnje in varčevanja v drugi in tretji fazi življenja. Na ta način namreč lahko zmanjšajo tveganje revščine po upokojitvi (socialne ogroženosti) [1, 2].

V tem prispevku analizirava pričakovanja ameriških potrošnikov glede datuma njihove upokojitve glede na njihove demografske značilnosti, pri čemer uporablja podatke Zvezne rezervne banke v New Yorku. S tem dopolnjujeva literaturo v slovenskem jeziku o pričakovanjih potrošnikov glede datuma njihove upokojitve, ki je aktualna tema tudi v Sloveniji, še zlasti zaradi negotovosti (glede) politike upokojevanja.

Ta prispevek ima v nadaljevanju še tri poglavja. V poglavju 2 podajava metode raziskovanja, ki jih uporabljava v tem prispevku, v poglavju 3 rezultate raziskovanja, pri čemer uporabljava tudi tabele in slike, v poglavju 4 pa razpravo o rezultatih raziskovanja, pri čemer se osredotočava na najpomembnejše, in sklep.

2 METODE

V tem prispevku uporabljava različne metode raziskovanja. Najprej uporabljava metodo kompiliranja, potem pa metodo analiziranja in sintetiziranja. V raziskavi, katere rezultate podajava v poglavju 3, uporabljava podatke o pričakovanjih ameriških potrošnikov glede datuma njihove upokojitve, ki so dostopni na spletni strani Zvezne rezervne banke v New Yorku.

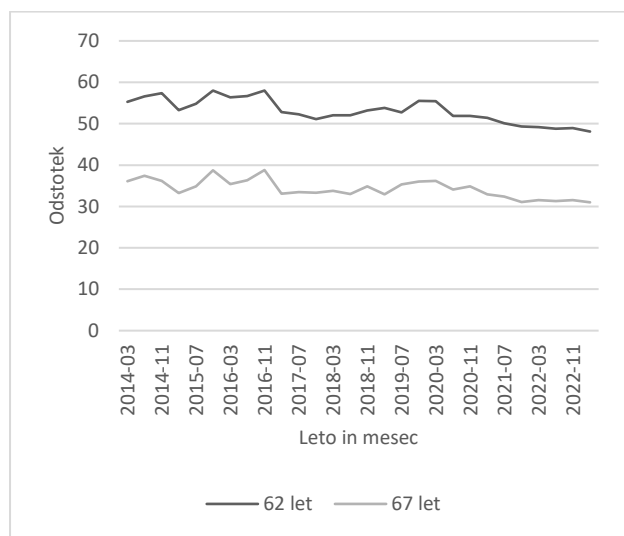
3 REZULTATI

V tem poglavju podajava rezultate raziskave o pričakovanjih ameriških potrošnikov glede datuma njihove upokojitve glede na njihove demografske značilnosti (spol, starost, raven izobrazbe, raven dohodka). Zanima naju, ali so med ameriški potrošniki statistično značilne razlike v njihovih pričakovanjih glede datuma njihove upokojitve glede na njihove demografske značilnosti.

3.1 Pričakovanja ameriških potrošnikov glede datuma njihove upokojitve (ne glede na njihove demografske značilnosti)

V tem poglavju analizirava gibanje pričakovanj ameriških potrošnikov glede datuma njihove upokojitve (ne glede na njihove demografske značilnosti), pri čemer naju zanimata:

- gibanje deleža ameriških potrošnikov, ki pričakujejo, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti;
- gibanje deleža ameriških potrošnikov, ki pričakujejo, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 67. letu starosti.



Slika 1: Gibanje upokojitvenih pričakovanj ameriških potrošnikov (vir podatkov: [4])

S slike 1 je razvidno, da se v zadnjih letih delež ameriških potrošnikov, ki pričakujejo, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti, in delež ameriških potrošnikov, ki pričakujejo, da bodo zaposleni za polni delovni čas tudi po 67. letu starosti, zmanjšujeta, kar pomeni, da se delež tistih, ki se nameravajo upokojiti pred dopolnjenim 62. oz. 67. letu starosti, povečuje.

3.2 Pričakovanja ameriških potrošnikov glede datuma njihove upokojitve glede na njihov spol

V tem poglavju skušava ugotoviti, ali so med moškimi in ženskami statistično značilne razlike v njihovih pričakovanjih glede datuma njihove upokojitve.

Zanima naju, ali so med moškimi in ženskami statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila *t*-test (angl. »*t*-test«), saj rezultati Kolmogorov-Smirnovskega testa (angl. »Kolmogorov-Smirnov test«) in Shapiro-Wilkovega testa (angl. »Shapiro-Wilk test«) kažejo, da je opazovana spremenljivka normalno porazdeljena ($p > 0,05$).

Zanima naju tudi, ali so med moškimi in ženskami statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za

polni delovni čas tudi po dopolnjenem 67. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila *t*-test, saj rezultati Kolmogorov-Smirnovskega testa in Shapiro-Wilkovega testa kažejo, da je opazovana spremenljivka normalno porazdeljena ($p > 0,05$).

Tabela 1: Rezultati *t*-testa

62 let	N	\bar{y}	<i>t</i>
Moški	28	50,50	-5,651
Ženske	28	55,86	($p = 0,000$)
67 let	N	\bar{y}	<i>t</i>
Moški	28	33,87	-1,150
Ženske	28	34,69	($p = 0,255$)

Vir: Lastni izračuni.

Iz tabele 1 je razvidno, da v povprečju 50,5 odstotka žensk pričakuje, da bodo zaposlene za polni delovni čas tudi po dopolnjenem 62. letu starosti, kar je za 5,36 odstotne točke manj kot pri moških. Rezultati *t*-testa kažejo, da je razlika med spoloma statistično značilna ($p < 0,05$).

Iz tabele 1 je razvidno tudi, da v povprečju 33,87 odstotka žensk pričakuje, da bodo zaposlene za polni delovni čas tudi po dopolnjenem 67. letu starosti, kar je za 0,82 odstotne točke manj kot pri moških. Rezultati *t*-testa kažejo, da razlika med spoloma ni statistično značilna ($p > 0,05$).

3.3 Pričakovanja ameriških potrošnikov glede datuma njihove upokojitve glede na njihovo starost

V tem poglavju skušava ugotoviti, ali so med ameriški potrošniki, mlajšimi od 45 let, in ameriški potrošniki, starejšimi od 45 let, statistično značilne razlike v njihovih pričakovanjih glede datuma njihove upokojitve.

Zanima naju, ali so med ameriški potrošniki, mlajšimi od 45 let, in ameriški potrošniki, starejšimi od 45 let, statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila *t*-test, saj rezultati Shapiro-Wilkovega testa kažejo, da je opazovana spremenljivka normalno porazdeljena ($p > 0,05$).

Zanima naju tudi, ali so med ameriški potrošniki, mlajšimi od 45 let, in ameriški potrošniki, starejšimi od 45 let, statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 67. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila *t*-test, saj rezultati Shapiro-Wilkovega testa kažejo, da je opazovana spremenljivka normalno porazdeljena ($p > 0,05$).

Tabela 2: Rezultati *t*-testa

62 let	N	\bar{y}	<i>t</i>
Mlajši od 45 let	28	54,34	3,013
Starejši od 45 let	28	51,65	($p = 0,004$)
67 let	N	\bar{y}	<i>t</i>

Mlajši od 45 let	28	36,23	6,205
Starejši od 45 let	28	31,98	($p = 0,000$)

Vir: Lastni izračuni.

Iz tabele 2 je razvidno, da v povprečju 54,34 odstotka ameriških potrošnikov, mlajših od 45 let, pričakuje, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti, kar je za 2,69 odstotne točke več kot pri ameriških potrošnikih, starejših od 45 let. Rezultati t -testa kažejo, da je razlika med skupinama statistično značilna ($p < 0,05$).

Iz tabele 2 je razvidno tudi, da v povprečju 36,23 odstotka ameriških potrošnikov, mlajših od 45 let, pričakuje, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 67. letu starosti. Rezultati t -testa kažejo, da je razlika med skupinama statistično značilna ($p < 0,05$).

3.4 Pričakovanja ameriških potrošnikov glede datuma njihove upokojitve glede na njihovo raven izobrazbe

V tem poglavju skušava ugotoviti, ali so med ameriški potrošniki, ki imajo nižjo izobrazbo (nimajo diplome), in ameriški potrošniki, ki imajo višjo izobrazbo (imajo diplomo), statistično značilne razlike v njihovih pričakovanjih glede datuma njihove upokojitve.

Zanima naju, ali so med ameriški potrošniki, ki imajo nižjo izobrazbo (nimajo diplome), in ameriški potrošniki, ki imajo višjo izobrazbo (imajo diplomo), statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila Mann-Whitneyjev test, saj rezultati Shapiro-Wilkovega testa kažejo, da opazovana spremenljivka ni normalno porazdeljena ($p < 0,05$).

Zanima naju tudi, ali so med ameriški potrošniki, ki imajo nižjo izobrazbo (nimajo diplome), in ameriški potrošniki, ki imajo višjo izobrazbo (imajo diplomo), statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 67. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila t -test, saj rezultati Kolmogorov-Smirnovega testa in Shapiro-Wilkovega testa kažejo, da je opazovana spremenljivka normalno porazdeljena ($p > 0,05$).

Tabela 3: Rezultati Mann-Whitneyjevega testa in t -testa

62 let	N	Povprečni rang	U
Brez diplome	28	16,05	43,500
Z diplomo	28	40,95	($p = 0,000$)
67 let	N	\bar{y}	t
Brez diplome	28	33,51	-3,203
Z diplomo	28	35,63	($p = 0,002$)

Vir: Lastni izračuni.

Iz tabele 3 je razvidno, da v povprečju 16,05 odstotka ameriških potrošnikov, ki imajo nižjo izobrazbo, pričakuje, da

bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti, kar je za 24,9 odstotne točke manj kot pri ameriških potrošnikih, ki imajo višjo izobrazbo. Rezultati Mann-Whitneyjevega kažejo, da je razlika med skupinama statistično značilna ($p < 0,05$).

Iz tabele 3 je razvidno tudi, da v povprečju 33,51 odstotka ameriških potrošnikov, ki imajo nižjo izobrazbo, pričakuje, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 67. letu starosti, kar je za 2,11 odstotne točke manj kot pri ameriških potrošnikih, ki imajo višjo izobrazbo. Rezultati t -testa kažejo, da je razlika med skupinama statistično značilna ($p < 0,05$).

3.5 Pričakovanja ameriških potrošnikov glede datuma njihove upokojitve glede na njihovo raven dohodka

V tem poglavju skušava ugotoviti, ali so med ameriški potrošniki, ki zaslužijo na leto manj kot 60.000 USD, in ameriški potrošniki, ki zaslužijo na leto več kot 60.000 USD, statistično značilne razlike v njihovih pričakovanjih glede datuma njihove upokojitve.

Zanima naju, ali so med ameriški potrošniki, ki zaslužijo na leto manj kot 60.000 USD, in ameriški potrošniki, ki zaslužijo na leto več kot 60.000 USD, statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila t -test, saj rezultati Kolmogorov-Smirnovega testa in Shapiro-Wilkovega testa kažejo, da je opazovana spremenljivka normalno porazdeljena ($p > 0,05$).

Zanima naju tudi, ali so med ameriški potrošniki, ki zaslužijo na leto manj kot 60.000 USD, in ameriški potrošniki, ki zaslužijo na leto več kot 60.000 USD, statistično značilne razlike v njihovih pričakovanjih, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 67. letu starosti. Da bi odgovorila na to vprašanje, sva uporabila Mann-Whitneyjev test, saj rezultati Kolmogorov-Smirnovega testa in Shapiro-Wilkovega testa kažejo, da opazovana spremenljivka ni normalno porazdeljena ($p < 0,05$).

Tabela 4: Rezultati t -testa in Mann-Whitneyjevega testa

62 let	N	\bar{y}	t
Manj kot 60.000 USD	28	49,30	-7,105
Več kot 60.000 USD	28	56,39	($p = 0,000$)
67 let	N	Povprečni rang	U
Manj kot 60.000 USD	28	35,59	193,500
Več kot 60.000 USD	28	21,41	($p = 0,001$)
		($\bar{y} = 32,91$)	

Vir: Lastni izračuni.

Iz tabele 4 je razvidno, da v povprečju 49,30 odstotka ameriških potrošnikov, ki zaslužijo na leto manj kot 60.000 USD, pričakuje, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 62. letu starosti, kar je za 7,09 odstotne točke manj kot pri ameriških potrošnikih, ki zaslužijo na leto več kot 60.000

USD. Rezultati *t*-testa kažejo, da je razlika med skupinama statistično značilna ($p < 0,05$).

Iz tabele 4 je razvidno tudi, da v povprečju 35,80 odstotka ameriških potrošnikov, ki zaslužijo na leto manj kot 60.000 USD, pričakuje, da bodo zaposleni za polni delovni čas tudi po dopolnjenem 67. letu starosti, kar je za 2,89 odstotne točke več kot pri ameriških potrošnikih, ki zaslužijo na leto več kot 60.000 USD. Rezultati Mann-Whitneyjevega testa kažejo, da je razlika med skupinama statistično značilna ($p < 0,05$).

4 RAZPRAVA IN SKLEP

Rezultati te raziskave ameriškim raziskovalcem omogočajo vpogled v stanje na področju upokojitvenih pričakovanj v ZDA. Izkazalo se je, da so med ameriški potrošniki razlike v njihovih upokojitvenih pričakovanjih, kar sva pričakovala.

Meniva, da bi morali upokojitvena pričakovanja meriti, opazovati in spremljati tudi v Sloveniji, kjer marsikdo že taktizira glede datuma njegove upokojitve. Izkušnje iz ZDA učijo, da je taktiziranje zaposlenih glede datuma njihove upokojitve predvsem posledica njihovega gmotnega položaja, ki se lahko spreminja. Zanimivo bi bilo npr. ugotoviti, ali obstajajo med

belimi in modrimi ovratniki statistično značilne razlike glede upokojitvenih pričakovanj. V Sloveniji namreč prevladuje mnenje, da so samo beli ovratniki pripravljeni delati po določeni starosti ali po poteku določenega časa zaposlenosti.

Strokovnjaki se strinjajo, da bi morali Slovenci več varčevati za starost. Za marsikoga je namreč to edini način, da si zagotovi ustrezen življenjski standard v tretjem življenjskem obdobju. To učijo tudi izkušnje iz ZDA, kjer je socialna varnost manjša kot v Sloveniji, kar med zaposlenimi povzroča potrebo po varčevanju za starost. To pomeni, da bi morali v Sloveniji že mlade (novozaposlene) spodbujati k (dolgoročnemu) varčevanju za starost in skrbeti za njihovo finančno opismenjevanje.

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Zbornik 26. mednarodne multikonference
INFORMACIJSKA DRUŽBA – IS 2023
Zvezek G

Proceedings of the 26th International Multiconference
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Vzgoja in izobraževanje v informacijski družbi
Education in Information Society

Urednika / Editors

Uroš Rajkovič, Borut Batagelj

<http://is.ijs.si>

13. oktober 2023 / 13 October 2023
Ljubljana, Slovenia

PREDGOVOR

Pred vami je zbornik 26. konference Vzgoja in izobraževanje v informacijski družbi, ki je potekala 13. oktobra 2023 na Institutu Jožef Stefan v Ljubljani. Letošnja konferenca je bila izjemno uspešna, saj smo imeli priložnost prisluhniti več kot 40 prispevkom iz vseh stopenj izobraževanja, od vrtca do izobraževanja odraslih. Poudarek je bil na uporabi informacijske tehnologije, še posebej smo se osredotočili na najnovejše dosežke na področju generativne umetne inteligence in strojnega učenja.

Ko pogledamo nazaj na prejšnje konference, vidimo, kako smo se skozi četrto stoletja trudili iskati sinergijo med človekom in informacijsko tehnologijo v procesih vzgoje in izobraževanja. Vsako leto je bilo posebno, a letošnje je prav gotovo izstopalo. Zakorakali smo v novo šolsko leto brez posebnih zdravstvenih omejitev, ki so nas ovirale v preteklih letih. Hkrati smo bogatejši za izkušnje, ki smo jih pridobili pri izobraževanju na daljavo. Ta izkušnja je odprla nova vprašanja in izzive, predvsem v povezavi s hibridnimi načini poučevanja.

Konferenca je ponudila priložnost, da se udeleženci poglobijo v raznolike tematike, ki so bile predstavljene, od pomembnosti digitalnih kompetenc učiteljev, raziskovali smo nove oblike učenja in različne načine poučevanja programiranja in računalniških veščin, razvijali smo digitalne rešitve za izobraževanje, če naj najštejejo le nekaj tem.

Konferenca je bila priložnost za deljenje izkušenj in znanj med udeleženci ter za spodbujanje razvoja novih idej in rešitev za izobraževanje v informacijski družbi. Prispevki, predstavljeni na konferenci, so dragocen prispevek k razvoju izobraževanja in izmenjavi najnovejših spoznanj na tem dinamičnem in hitro spreminjajočem se področju.

Hvala vsem udeležencem, predavateljem, avtorjem prispevkov ter organizatorjem za njihov prispevek k uspehu letošnjega dogodka. Verjamemo, da smo skupaj naredili korak naprej v razvoju izobraževanja v informacijski družbi.

Naj bo ta zbornik vir navdiha in znanja za vse, ki se ukvarjamo s področjem vzgoje in izobraževanja v informacijski dobi.

Uredniški odbor

FOREWORD

Here are the proceedings of the 26th Conference on Education in Information Society, which took place on October 13, 2023, at the Jožef Stefan Institute in Ljubljana, Slovenia. This year's conference was a success, as we had the privilege of listening to over 40 contributions spanning all levels of education, from kindergarten to adult education. The primary focus was on the utilization of information technology, with a special emphasis on the latest advancements in the realms of generative artificial intelligence and machine learning.

Reflecting on past conferences, it becomes evident how, over the course of a quarter of a century, we have diligently sought synergies between human beings and information technology in the realms of education and training. Every year has been unique, yet this year has unquestionably stood out. We embarked upon the new school year free from the specific health constraints that have previously hindered us. Simultaneously, we have gained meaningful experience from the realm of distance education, an experience that has unveiled new inquiries and challenges, particularly concerning hybrid teaching methodologies.

The conference provided an invaluable platform for participants to delve deeper into a diverse array of topics. These encompassed the significance of digital competences for educators, exploration of innovative learning modalities, diverse approaches to teaching coding and computing skills, and the development of digital solutions for education, among numerous other subjects.

This conference offered an opportunity for attendees to exchange experiences and knowledge, fostering the proliferation of novel ideas and solutions for education in our information-driven society. The papers presented during the conference constitute a substantial contribution to the evolution of education and the dissemination of the latest knowledge within this dynamic and swiftly evolving field.

Our heartfelt thanks extend to all participants, speakers, authors, and organizers for their invaluable contributions to the success of this year's event. We firmly believe that together, we have taken a significant stride towards the advancement of education in our information-centric society.

May these proceedings serve as an enduring source of inspiration and knowledge for all those dedicated to the field of education in the information age.

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Spremljanje kakovosti zraka med poukom

Air quality monitoring during classes

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POVZETEK

Dijaki v šoli preživijo kar nekaj časa, zato je pomembno kakšen zrak dihajo. V članku je predstavljeno spremljanje ključnih parametrov, ki definirajo kvaliteto zraka. Osredotočili smo se na merjenje koncentracije ogljikovega dioksida, temperature in vlage. S tem namenom smo razvili merilni sistem, ki vključuje senzorje in krmilno vezje Arduino UNO. V programskem okolju LabView smo razvili aplikacijo s katero lahko opazujemo gibanje parametrov v odvisnosti od prisotnosti dijakov ter spremljamo vpliv zračenja.

Ugotovili smo, da se koncentracija ogljikovega dioksida povečuje s prisotnostjo dijakov. Dlje časa so bili dijaki prisotni, bolj je koncentracija narasla. Z zračenjem smo dosegli, da se je koncentracija ogljikovega dioksida znižala na sprejemljive vrednosti. Med zračenjem sta malenkost padla tudi vlažnost in temperatura.

V članku smo želeli opozoriti na pomen rednega prezračevanja učilnic, saj na ta način opazneje znižamo nivo ogljikovega dioksida. Dlje časa povišane vrednosti ogljikovega dioksida lahko slabo vplivajo na zdravje in počutje dijakov, ki so zaradi tega manj učinkoviti v procesu učenja.

KLJUČNE BESEDE

Ogljikov dioksid, prezračevanje, Arduino, LabView

ABSTRACT

Students spend a lot of time at school, so it is important what kind of air they breathe. The article presents the monitoring of key parameters that define air quality. We focused on measuring carbon dioxide concentration, temperature and humidity. With this aim in mind, we developed a measurement system that includes sensors and an Arduino UNO control circuit. In the LabView software environment, we have developed an application with which we can observe the movement of parameters depending on the presence of students and monitor the influence of ventilation.

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We found that the concentration of carbon dioxide increases with the presence of students. The longer the students were present, the more the concentration grew. With ventilation, we achieved that the concentration of carbon dioxide decreased to acceptable values. During the ventilation, the humidity and temperature also dropped a little.

In the article, we wanted to draw attention to the importance of regular ventilation of classrooms, because in this way we lower the level of carbon dioxide more noticeably. Long-term elevated levels of carbon dioxide can have a negative impact on the health and well-being of students, who are therefore less effective in the learning process.

KEYWORDS

Carbon dioxide, ventilation, Arduino, LabView

1 UVOD

Kakovost zraka je dejavnik, ki vpliva na naše zdravje in počutje. Med poukom naši možgani za učinkovito delovanje potrebujejo svež zrak. Še posebej v času korona virusa smo, po priporočilih NIJZ postali pozorni na to, kakšen zrak dihajo. Poleg nošenja mask in skrbi za higieno smo večkrat tudi prezračili prostore in na ta način zmanjšali prisotnost morebitnih virusov. Velikokrat pa se zgodi, da pozabimo na pomen prezračevanja učilnic.

V projektu, ki je predstavljen v nadaljevanju nas je zanimalo kako se spreminja kakovost zraka v učilnici med izvajanjem pouka. Merili smo koncentracijo ogljikovega dioksida (CO₂), ki je dober pokazatelj kvalitete zraka. Dodatno nas je zanimalo tudi kako se spreminjata temperatura in vlaga v prostoru.

S tem namenom je bil izdelan merilni sistem, ki vključuje senzorje CO₂, temperature in vlage. Podatke prikazujemo na grafih, ki nam podajajo spreminjanje omenjenih parametrov v odvisnosti od časa in prisotnosti dijakov. Prikazan je tudi vpliv prezračevanja na gibanje CO₂, temperature in vlage.

Kako torej doseči kvaliteten zrak v prostoru? Najboljša rešitev je prezračevanje. Največkrat je to naravno prezračevanje, kjer sami po potrebi odpiramo okna. Tak način povzroča izgubo toplote, pojavi se prepih in nihanje kvalitete zraka. Boljša izbira je mehansko prezračevanje, ki je v novejših stavbah že zagotovljeno.

V trenutni situaciji se dijaki na naši šoli selijo iz učilnice v učilnico. Dostikrat se zgodi, da pred začetkom nove šolske ure že takoj zaznamo slab zrak, saj je bila prejšnjo uro učilnica

polna dijakov. Slednje se rešuje tako, da se odpre okna in počaka, da se zrak zamenja.

2 MERJENI PARAMETRI

2.1 Ogljikov dioksid

Najboljši pokazatelj kvalitete zraka je ogljikov dioksid. Gre za brezbarven plin, ki je prisoten v ozračju. Je težji od zraka, zato se zadržuje pri tleh. Človeško telo pri dihanju sprejema kisik in oddaja ogljikov dioksid. V vdihanem zraku je približno 21 % kisika in 0,04 % ogljikovega dioksida. V izdihanem zraku pa 16 % kisika ter 4 % ogljikovega dioksida. Izdihan zrak je tudi bolj vlažen in topel [1]. Ob povečani aktivnosti se količina CO₂ v izdihanem zraku običajno poveča. Prav tako se količina CO₂ v prostoru povečuje sorazmerno s številom oseb. Še posebej so problematični majhni zaprti prostori, kjer je hkrati prisotnih veliko ljudi. Tam lahko koncentracija CO₂ hitro naraste. Priporočena vrednost CO₂ je do 1000 ppm [2]. Pri vrednostih od 1000 do 2500 ppm se lahko pojavijo motnje koncentracije in slabo počutje, nad mejo 2500 ppm pa tudi utrujenost, glavobol in zaspanost.

2.2 Vlažnost

Poleg CO₂ smo pri kvaliteti zraka pozorni tudi na vlažnost. Posebej pozimi pri zračenju prostor napolni mrzel, suh zrak. Preveč suh zrak lahko povzroča zdravstvene težave kot so pekoče in utrujene oči, težave s kožo, izsušena in vneta sluznica. Nasprotno pa preveč vlažen zrak pospeši razmnoževanje plesni, bakterij, pršic in glivic. Slednje lahko povzročijo alergijske in astmatske reakcije. Temu se lahko izognemo z zagotavljanjem ustrezne vlažnosti v prostoru. Primerna relativna vlažnost naj bi bila med 45 in 55 %. Obstajajo vlažilci in razvlažilci zraka, ki nam pomagajo dosegati željeno vlažnost v prostoru.

2.3 Temperatura

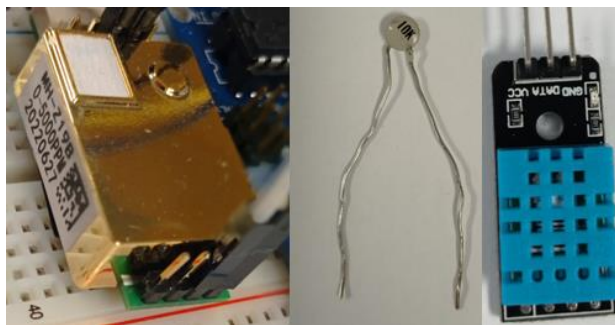
Pomemben parameter, ki ga spremljamo je tudi temperatura. Priporočena temperatura v bivalnem prostoru je 22 °C. Dostikrat je temperatura v zimskem času zaradi pretiranega ogrevanja višja od omenjene. Slednje ni ekonomično, prav tako ne vpliva dobro na počutje. V poletnem času pa temperatura naraste predvsem v učilnicah v višjih nadstropjih šole, ki imajo tudi veliko skupno površino oken. Predvsem junija in začetek septembra je slednje lahko moteče, saj učilnice niso klimatizirane.

3 MERILNI SISTEM

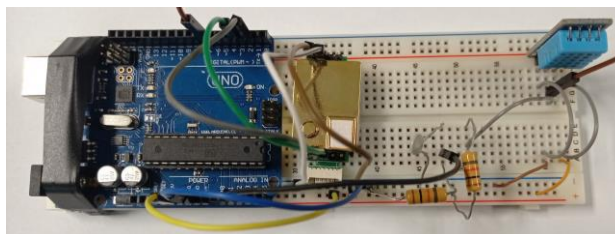
Kako torej v šoli, kjer ni urejeno mehansko prezračevanje zagotavljati primerno kakovost zraka? V učilnici bi lahko imeli nameščene senzorje CO₂, temperature in vlažnosti ter sistem, ki bi nas opozoril na presežene vrednosti in na potrebo po odpiranju oken.

Za potrebe spremljanja kakovosti zraka smo razvili prototip merilnega sistema s krmilnim vezjem Arduino in različnimi senzorji. V programskem okolju LabView je bila narejena aplikacija, ki omogoča prikaz različnih parametrov.

Sistem vsebuje senzor CO₂ z oznako MH-Z19B (Slika 1, levo) [3]. Senzor je bil nameščen približno 1,5 metra nad tlemi, saj je pri tleh koncentracija CO₂ običajno višja. Prav tako senzor ne sme biti v bližini oken ali vrat oz. blizu močnejših zračnih tokov. Vlažnost merimo s senzorjem DHT11 (Slika 1, desno) [4], temperaturo pa z 10 kΩ NTC termistorjem (Slika 1, v sredini). Vsi elementi so priključeni na vhode Arduino UNO plošče.

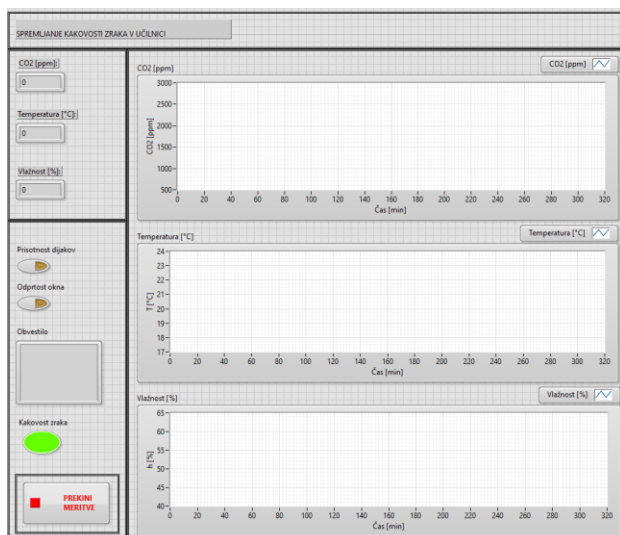


Slika 1: Senzorji



Slika 2: Merilni sistem

Celoten sistem, ki je prikazan na Sliki 2, je preko USB-kabla povezan na računalnik, na katerem je nameščeno programsko okolje LabView. Slednje omogoča prikaz izmerjenih parametrov na grafu (Slika 3). V sami aplikaciji je možno preko virtualnih stikal tudi označiti prisotnosti dijakov ali odprtost okna za potrebe zračenja. Ob preseženi koncentraciji CO₂ nam sistem prikaže obvestilo in prižge rdeč indikator. Med samo meritvijo lahko na ločenih grafih spremljamo gibanje temperature, vlažnosti in CO₂. Podatki se osvežujejo vsaki 2 sekundi. Po končani meritvi pa na dodatnem grafu vidimo kako se je gibala koncentracija CO₂, če so bili v razredu prisotni dijaki in kako smo izvajali prezračevanje.



Slika 3: Aplikacija v LabView

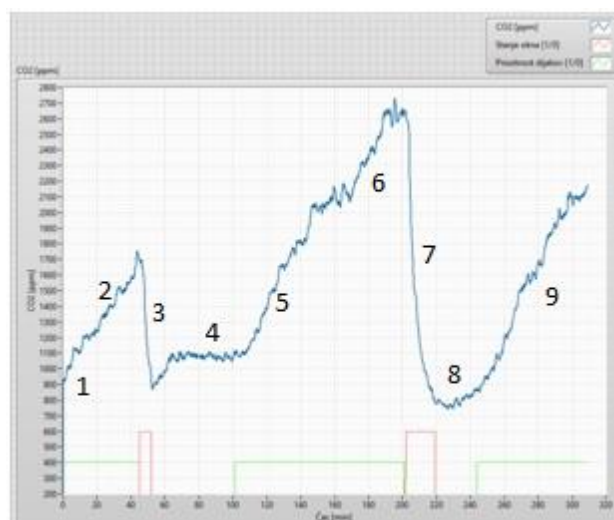
4 REZULTATI

Oglejmo si rezultat merjenja, ki je bilo izvedeno dne 23. 2. 2023. Pouk je potekal v učilnici velikosti približno 60 m^2 , kjer se izvaja praktični pouk. Prisotnih je bilo 15 dijakov.

Tabela 1: Potek meritve

Zaporedna številka aktivnosti	Aktivnost	Trajanje
1	zračenje	5 minut
2	pouk	45 minut
3	zračenje	5 minut
4	prazna učilnica	45 minut
5	pouk	45 minut
6	pouk	45 minut
7	zračenje	15 minut
8	prazna učilnica	30 minut
9	pouk	45 minut

Protokol merjenja prikazuje Tabela 1. Na Sliki 4 pa lahko opazujemo kako se je pri različnih aktivnostih spreminjala vrednost ogljikovega dioksida.

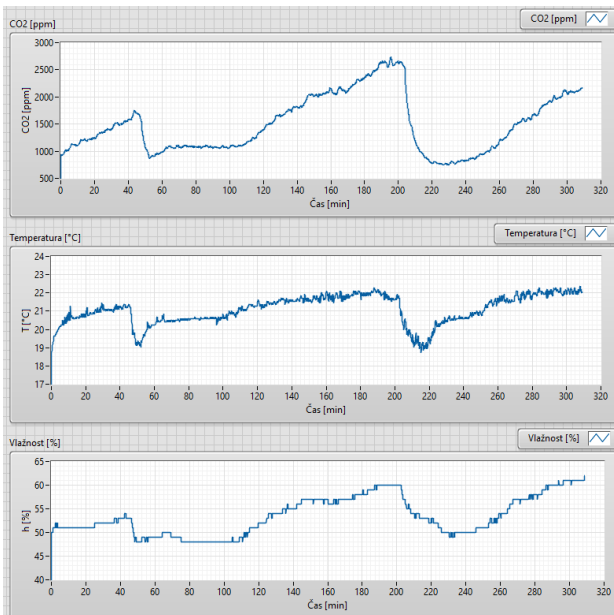


Slika 4: Gibanje ogljikovega dioksida

Na ločenih grafih lahko vidimo potek vseh parametrov (Slika 5). Opazimo, da se je tekom prvega zračenja, ki je trajalo 5 minut, temperatura znižala za približno $2 \text{ }^{\circ}\text{C}$. Prav tako je padla tudi vlažnost za $5 \text{ } \%$. Drugo zračenje je trajalo 15 minut. V tem primeru se je temperatura znižala za približno $3 \text{ }^{\circ}\text{C}$, vlažnost pa za $10 \text{ } \%$. Koncentracija ogljikovega dioksida je po prvem zračenju padla za 1000 ppm , po drugem pa za 2000 ppm .

Ugotovimo lahko, da trajanje zračenja vpliva na spremembo merjenih parametrov. Dlje časa bomo zračili, večja bo sprememba merjenih parametrov. Tudi prisotnost dijakov v učilnici vpliva na dvig ogljikovega dioksida. Dlje časa kot se bodo dijaki zadrževali v učilnici, večji bo dvig ogljikovega dioksida. Smiselno bi bilo torej izvajati kratko zračenje pred začetkom vsake šolske ure. Na ta način bi znižali nivo ogljikovega dioksida, hkrati pa temperatura ne bi preveč padla.

Na grafu s Slike 4 je z rdečo barvo prikazano kdaj se je izvajalo zračenje. Zelena barva pa prikazuje koliko časa so bili dijaki prisotni v učilnici.



Slika 5: Gibanje ogljikovega dioksida, temperature in vlažnosti

5 ZAKLJUČEK

Z rezultati dela smo lahko zadovoljni, saj nam je uspelo narediti sistem, ki nam omogoča spremljanje ključnih pokazateljev kvalitete zraka v učilnici. Postavili smo tudi temelje za

nadaljnje delo. Le-to lahko vključuje nadgradnjo merilnega sistema. Razmisliti je potrebno o ustreznosti senzorjev. Lahko bi spremenili lokacijo senzorjev v učilnici, izbrali več senzorjev in računali povprečje meritev. Celoten sistem bi lahko vgradili v plastično ohišje, ki bi ga natisnili s 3D tiskalnikom. Možne so tudi nadgradnje aplikacije v okolju LabView. Projekt se lahko razširi na celoten šolski prostor in v vsako učilnico namesti sistem za spremljanje parametrov. Podatke se nato pošilja na centralni strežnik in preko aplikacije na daljavo dostopa do podatkov. Spremlja se lahko tudi kdaj je bila učilnica zasedena in ali se je izvajalo prezračevanje.

V članku smo želeli opozoriti na pomen rednega prezračevanja učilnic in pokazati na potrebo po postopnem uvajanju mehanskega prezračevanja v šolah ali pa vsaj ozaveščanju učiteljev, da je zračenje učilnic pomembno. Slednje vsekakor prispeva k boljšemu počutju in zdravju dijakov ter s tem posledično tudi k bolj učinkovitemu procesu učenja.

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Kreativno kodiranje v digitalnih medijih

Creative coding in digital media

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POVZETEK

Pomembnost konceptualnega mišljenja bodočih medijskih tehnikov je skozi medijsko produkcijo tesno povezana z analitičnim načinom reševanja izzivov pri nastajanju izraznih medijskih izdelkov. Naš cilj je bil sestaviti strokovni programski modul odprtega kurikula programiranje digitalnih medijev, s katerim bi nadgrajevali osnovne koncepte programiranja, ki jih dijaki spoznajo pri modulu kreativno kodiranje, hkrati pa bi bil neposredno povezan z nadaljnjo karierno potjo dijakov. Temeljno vodilo za njegovo realizacijo je bilo poiskati ustrezne učne cilje, učne aktivnosti in načine ocenjevanja, v okviru katerih bi lahko vsak dijak ob koncu zaključnega letnika sam ali v paru dokončal projekt, ki bi po njegovem mnenju predstavljal resnično nalogo, hkrati pa ohranil osnovne in abstraktne gradnike programiranja v središču dejavnosti. Poleg tega za večino dijakov predstavlja nov pogled na delovni proces uporaba kode v programski opremi za 3D modeliranje in simulacijo za konstrukcijo fizičnih izdelkov. Tako je eden od ciljev modula predstaviti, kako lahko koda omogoči kreativnost pri delu medijskega tehnika. V prispevku bomo predstavili implementacijo in integracijo dveh orodij za nadaljevalno učenje pristopov programiranja in 3D modeliranja: Python in Blender. Ustvarjalne zmožnosti znotraj te implementacije, v nasprotju z omejitvami, ki jih obstoječa programska orodja postavljajo dijakom, vajenim vizualnega, fizičnega in konkretnega dela in mišljenja, predlagajo priložnost za rabo ustreznih programskih orodij, ki združujejo postopkovno in ročno ustvarjanje. Pričakuje se, da bodo kakršni koli zaključki, ki izhajajo iz tega prispevka, vodili k boljšemu razumevanju ustvarjalnega procesa v kontekstu integracije, ki temelji na povezovanju programske kode enega in ustvarjalnega okolja drugega orodja, saj večinoma vizualni rezultati kreativnega kodiranja niso neposredno predvidljivi vnaprej.

KLJUČNE BESEDE

Programiranje, integracija, Python, Blender, modeliranje

ABSTRACT

The importance of the conceptual thinking of future media technicians through media production is closely related to the

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analytical way of solving challenges in the creation of expressive media products. Our goal was to create a professional programming module of the open curriculum digital media programming, which would build on the basic programming concepts that students learn in the creative coding module, and at the same time, it would be directly related to the students' further career path. The fundamental guide for its realization was to find suitable learning goals, learning activities and methods of assessment, within the framework of which each student could complete a project at the end of the final year alone or in pairs, which in his opinion would represent a real task, while at the same time preserving the basic and abstract programming building blocks at the heart of the activity. In addition, for most students, using code in 3D modelling and simulation software to construct physical products represents a new perspective on the work process. Thus, one of the objectives of the module is to present how code can enable creativity in the work of a media technician. In this paper, we will present the implementation and integration of two tools for continuing learning approaches to programming and 3D modelling: Python and Blender. Creative opportunities within this implementation, in contrast to the limitations that existing software tools place on students accustomed to visual, physical and concrete work and thinking, suggest the opportunity to use appropriate software tools that combine procedural and manual creation. It is expected that any conclusions derived from this paper will lead to a better understanding of the creative process in the context of integration, which is based on connecting the programming code of one tool and the creative environment of another tool, since mostly the visual results of creative coding are not directly predictable in advance.

KEYWORDS

Programming, Integration, Python, Blender, Modeling

1 UVOD

Z naraščajočo vseprisotnostjo tehnologije je polje poučevanja medijske produkcije postalo bolj večplastno. Z osredotočenim izobraževanjem o najnovejših tehnologijah in digitalnih metodologijah ter podporo pri razvojnem procesu ustvarjalnega projekta želimo izboljšati spretnosti in kompetence dijakov medijske produkcije na analognem in digitalnem področju, s tem pa razvijati njihovo tehnološko pismenost. Biti tehnološko pismen v kodi velja za ključno sposobnost v današnji družbi. Ta pogled, ki prodira skozi vse dele sodobne kulture, vpliva tudi na izobraževanje v medijski produkciji, hkrati pa dijake spodbuja k preoblikovanju svojih obstoječih spretnosti, da bi ustrezale

mediju programske kode, in učitelje, da razvijejo nove tematske vsebine, ki pomagajo graditi in ohranjati to pismenost. Bodoči medijski tehniki se običajno učijo razmišljati zelo odprto in konceptualno. Čeprav je to izjemno koristno, se pojavi težava, ko znotraj pedagoškega procesa nimajo dovolj razvitih pristopov za analitično reševanje problemov, zaradi česar so v slabšem položaju, ko se ukvarjajo s tehnologijami, ki jih uporabljajo za ustvarjanje lastnih izraznih medijskih izdelkov z ustreznimi vsebinami. Ključnega pomena je, da se programski moduli, ki vključujejo osnovne pristope v programiranju, uvedejo do zaključka njihove vpetosti v izobraževalni proces in jih izpostavijo znanju o delovanju njihovih orodij. Programiranje je eno od orodij v njihovi orodjarni, pisanje algoritmov pa lahko izboljša učinkovitost njihovega dela in preoblikuje njihov delovni proces.

2 METODA DELA

2.1 Programiranje digitalnih medijev

Poučevanje večšin reševanja problemov je sestavni del računalniškega izobraževanja pri spodbujanju globljega razumevanja temeljnih konceptov. Teoretične študije in praktične analize so pokazale, da je pomanjkanje takšnih pristopov povzročilo, da dijaki omejijo svoje razumevanje in »namesto da bi dobili celotno sliko računalništva, se zožijo na to, da bi ta program deloval« [1]. To ne velja le za področje računalništva, ampak tudi pri ustvarjalnem delu s programsko kodo v kreativnih disciplinah. Glede na to, da dijaki na področju kreativnega kodiranja pogosto pristopijo k strokovnemu modulu kot programerji začetniki, čeprav imajo določena znanja in veščine v svojih strokovnih spremljajočih disciplinah, je pomembno vključiti ponavljanje, ki jim omogoča, da se »aktivno ukvarjajo z vsebino, delajo skozi to z drugimi, povežejo se z njo skozi analizo« [2]. Z vključitvijo učnih primerov, ki namenoma vključujejo takšne strategije reševanja problemov, spodbujamo ustvarjalno delovanje in podpiramo prihodnje samoraziskovanje v nadaljnji karierni poti. Za ta namen smo ustvarili programski modul programiranje digitalnih medijev. Programiranje digitalnih medijev je novi strokovni programski modul odprtega kurikula, znotraj katerega bodoče medijske tehnike pripravljamo na integracijo med različnimi programskimi okolji/platformami in programskimi jeziki. Obstoječa programska orodja namreč omogočajo uporabo tehnik hibridnega 2D animiranja in 3D modeliranja s pomočjo različnih skriptov ter običajnega oblikovanja, s poudarkom na implementaciji in integraciji bistvenih tehnik za ustvarjanje izraznih medijskih izdelkov z edinstvenimi estetskimi slogi. Ena izmed rešitev za to je uporaba odprtokodne programske opreme Blender za ustvarjanje vsebin v 3D okolju z več funkcionalnostmi za ustvarjanje fotorealističnih digitalnih podobotvorij, realističnem modeliranju, visokokakovostnih animacij in simulacij, različnih vizualizacij v zabavnih in kreativnih industrijah ter v znanstvene namene in nenazadnje video iger ter njena integracija s skriptnim jezikom Python. S slednjim se kompleksnost in rokovanje Blenderjevega vmesnika ublaži, hkrati pa zaradi močne podpore Pythonu in odprtega vmesnika za programiranje aplikacij (API) se lahko Blender uporablja kot integrirano razvojno okolje za ustvarjanje novih orodij in spreminjanje obstoječih.

V poučevalnem slogu učnega procesa skozi konstruktivno usklajevanje iščemo usklajenosti med učnimi cilji, učnimi aktivnostmi in ocenjevanjem. Posledično je še vedno potreben pedagoški pristop, osredotočen na dijake, v katerem je učitelj del podpornega okolja, hkrati pa je avtonomija pomemben motivacijski dejavnik v učnem procesu. Praktično delo je opredeljeno kot ključna dejavnost, ki dijakom omogoča, da postanejo kompetentni v programiranju tovrstnih.

V procesu učenja ustvarjanja z integracijo obeh omenjenih orodij sloni delo dijakov na treh metodah:

- generativni pristopi v ustvarjanju vsebin v modeliranju kot tudi v fizičnih izdelkih,
- kreativno kodiranje in avtomatizacija v procesu konceptualne zamisli in
- hibridni pristopi k ustvarjanju in oblikovanju na osnovi besedilne programske kode v izbranem programskem jeziku.

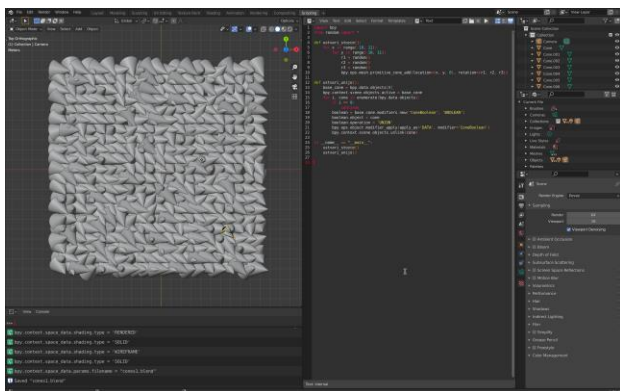
Generativni pristop v ustvarjanju vsebin dijakom omogoča, da se približujejo uporabi programske kode kot ustvarjalnega medija, ki daje življenje idejam in ponuja smiselne izhode za izražanje. Kreativno kodiranje in avtomatizacija v procesu konceptualne zamisli od dijakov zahteva, da lahko s kreativnimi in funkcionalnimi pristopi v uporabi programske kode rešijo tudi konkretne izzive, kar ne spremeni le učinkovitosti v razvoju iskanja rešitev, temveč vpliva tudi na ustvarjalni proces. Na splošno je uporaba programiranja povezana z obstoječo programsko opremo za modeliranje, da se takoj izkoristijo možnosti modeliranja in vizualizacije. Ob tem se od dijakov pričakuje, da razumejo osnovne koncepte, sintakso in semantiko skriptnega jezika ter so sposobni izvajati osnovne tehnike kodiranja in skriptiranja kot orodja za vizualizacijo in ustvarjanje izrazno-estetskih medijskih izdelkov. Programska koda je mogoče uporabiti tudi na začetku procesa načrtovanja, preden je 3D digitalni model izdelan ali realiziran. Med fazo prehoda iz konceptualne zamisli do oblikovanja se programska koda včasih uporablja za ustvarjanje vrste modelov, ki temeljijo na različnih mehanskih ali fizičnih postopkih, s čimer dijakom omogoča ustvarjanje, spreminjanje in dodajanje geometrije modelom z določeno natančnostjo in ponavljanjem, kar je oboje težko predstaviti z ročnimi drsniki na zaslonu. Hibridni pristopi v procesu ustvarjanja in oblikovanja pa dijakom omogočajo razumeti 3D navidezni prostor oz. okolje, temeljne koncepte 3D digitalnih modelov, izvajati temeljne tehnike generiranja 3D digitalnih objektov z modeliranjem, upodabljanje 3D modele za ustvarjanje virtualnih okolij in uporabo usvojenih večšin 3D modeliranja v kombinaciji z lastnim ustvarjalnim prispevkom. S poučevanjem 3D modeliranja spodbujamo pri dijakih kognitivne sposobnosti za ustvarjanje tako preprostih kot kompleksnih 3D digitalnih objektov. Ključno za dijake je usvojiti te temeljne tehnike, ki jim bodo kasneje pomagale pri izdelavi ali oblikovanju kakršnih koli predmetov, prizorov ali likov v izraznih izdelkih.

2.2 Implementacija in integracija orodij Python in Blender

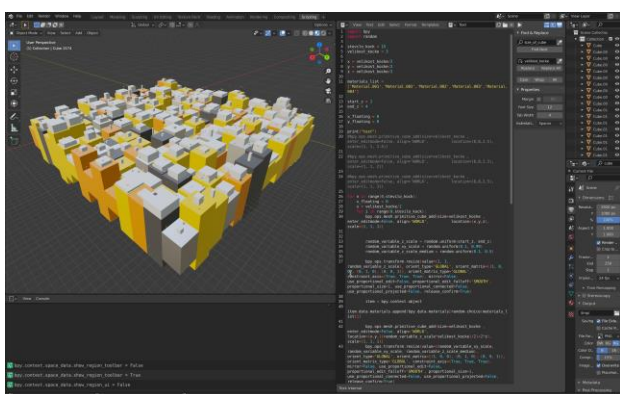
Skripte, napisane v programskem jeziku Python, so vsestranski način za razširitev funkcionalnosti v Blenderju. Programski vmesnik aplikacije Blender Python (API) omogoča skriptiranje večine področij Blenderja, vključno z že omenjeno animacijo,

ustvarjanjem objektov, upodabljanjem različnih podobotvorij in avtomatizacijo nalog. To odpira široko paleto možnosti in ima številne primere uporabe. API uporabnikom omogoča urejanje vseh podatkov, ki jih lahko premore uporabniški vmesnik, zaradi česar je primerno orodje za uporabo pri poskusu programskega urejanja parametričnih 3D modelov. Skripte v Blenderjevi datoteki lahko registriramo za samodejni zagon, ko se datoteka odpre, kar omogoča izvajanje nalog pred upodabljanjem, ko se zažene iz ukazne vrstice. Poleg tega pythonске skripte v Blenderju ohranijo zmožnost izvajanja pogostih nalog, kot je branje ali pisanje v datoteko in izvajanje omrežnih zahtev.

Ena od res zanimivih možnosti z Blenderjem je, da lahko vizualiziramo algoritem, ko ustvarja in manipulira s 3D sceno, da pokažemo, kako algoritem deluje. Ustvarjalec, v našem primeru dijak, ima natančen nadzor nad tem, kako se scena posodablja, in izvajanje pythonškega skripta je mogoče preprosto začasno ustaviti, če postopek teče prehitro, da bi bil viden. Primerka integracije pythonškega skripta v Blenderjevem vmesniku za pisanje skripta (*Scripting*) in z njim 3D modeliranjem objektom v zgornji ortografski projekciji znotraj objektnega pogleda (*Object Mode*) prikazuje Slika 1, v perspektivni projekciji pa Slika 2.



Slika 1: Ortografska projekcija generiranega 3D modela s pythonovskim skriptom



Slika 2: Perspektivna projekcija generiranega 3D modela s pythonovskim skriptom

3 REZULTATI

Učni cilji, ki jih želimo dosegati s kreativnim kodiranjem v digitalnih medijih, na informativni ravni obsegajo predvsem razumevanje, kako se lahko programiranje uporablja pri izdelavi fizičnih izdelkov kot eno od razpoložljivih orodij v programski opremi za 3D modeliranje in razumevanje osnovnih konceptov programiranja, kot so spremenljivke, sezname, zanke, pogoji in funkcije. Na formativni ravni pa vključujejo delno ročno ustvarjanje in delno ustvarjanje v programski kodi, z namenom videti, kako se koda kot orodje primerja z drugimi orodji, uporaba naključne generacije in fizične simulacije kot orodij za konstrukcijo potenciala algoritmov za reševanje izzivov v ustvarjalnem procesu, vizualizacija algoritmskega procesa, tako da lahko dijaki spremljajo zmožnosti programske kode, izvajanje velikega števila poskusov na modelih ter nato preverjanje in razvrščanje modelov za prikaz obsega algoritmskega potenciala.

Za doseganje ravnovesja med že omenjeno avtonomijo in načinom izobraževanja, ki temelji na učiteljevem mentorstvu, programiranje digitalnih medijev temelji na pragmatičnem dejstvu, da dijaki delajo na vrsti izzivov v generiranju izraznih medijskih izdelkih. To med drugim vključuje:

- Praktične vaje delo v tehnološko urejenem učnem okolju, podprto s podrobnimi navodili po korakih o tem, kako rešiti izziv in kako napisati programsko kodo. Vaje se razlikujejo po zahtevnosti.
- Naloge s podrobnimi navodili, kako rešiti izziv, ne pa tudi, kako kodirati posamezne korake. Znanje o kodiranju, pridobljeno na praktičnih vajah, se tukaj uporablja in ponavlja.
- Projektna naloga, kjer študentje dobijo samo izziv na visoki ravni in ga morajo ustrezno razčleniti in kodirati.

Dijaki delajo v parih in se ocenjujejo predvsem z osebno demonstracijo svoje rešitve. Preverjanje praktičnih vaj in nalog je usmerjeno v to, da dijaki ustrezno pojasnijo, kako rešitve danih izzivov delujejo, ocenjevanje pa se izvaja na podlagi odobritve načeloma ustreznih rešitev. Učitelji zagotavljamo sprotne formativne povratne informacije o tem, kako izboljšati pristope v reševanju naslednjih izzivov. Projektna naloga je predstavljena na zaključnem seminarju z diaprojekcijo. Menimo, da če lahko dijak dokaže zadostne sposobnosti za zadnje praktične vaje, naloge ali projektno nalogo, potem se je naučil osnov programiranja v implementaciji dveh različnih orodij. Da bi dosegli cilj razumevanja, kdaj in zakaj pisati programsko kodo, smo izzive prilagodili za ponazoritev, kako lahko koda dijakom pomaga doseči stvari, ki jih praktično ne morejo narediti ročno v enem samem orodju/okolju.

Ob vsem navedenem smo ne glede na skrbno pripravljene učne situacije opazili tudi nekatere ponavljajoče se težave, ki lahko negativno vplivajo na sodelovanje dijakov v učnem procesu in njihove učne rezultate. Mednje sodijo težja povezljivost same dejavnosti programiranja s svojim delom, nezadovoljstvo zaradi rabe matematike in logike, slabši odziv na pomanjkanje estetske kakovosti v rezultatu, ki ga ustvari njihova koda. Nekatere dijake je motilo, ko smo jih opozorili, naj razmislijo o estetskih vprašanjih v ustvarjanju izraznih izdelkov. Čeprav je treba za doseganje izraznosti in funkcionalnosti razumeti načela oblikovanja, so zelo hitro pozabili, da je njihov glavni cilj naučiti se programirati. Zaznali smo tudi nekaj nejevolje na nekatera pasivna predavanja in na abstraktne, verbalne razlage. Nekaj dijakov pa je od ustvarjalnega dela

odvrnila čudna sintaksa in nerazložljiva sporočila o napakah, predvsem v Blenderjevem vmesniku za pisanje pythonovih skriptov.

Da bi ublažili te težave, smo vpeljali pedagoško metodo, posebej prilagojeno učnim potrebam dijakov medijske produkcije. Smernice v pedagoškem procesu učnih situacij jasno opredeljujejo naslednje:

- povezava med programiranjem in izdelavo vizualnih artefaktov mora biti jasno vidna;
- rezultati praktičnih vaj in nalog iz programiranja morajo biti vizualni;
- rezultat mora imeti estetsko kakovost, ki ga naredi uporabnega in prodajnega na profesionalni ravni;
- dijakom je treba dati fiksne cilje, da se nanje jasno osredotočijo in jim bodo služili kot merilo njihovega napredka;
- od dijakov, če ne bo treba, ne bomo zahtevali, da upoštevajo estetska vprašanja, da bi ostali osredotočeni na učenje programiranja;
- matematiko in logiko je treba poučevati le, ko učenci naletijo na potrebo po tem, po možnosti tako, da jim dovolimo, da sami raziskujejo temo, pod vodstvom učitelja;
- dijaki morajo biti aktivno vključeni v proces programiranja, da pridobijo praktične izkušnje;
- dijaki morajo delati v programskem okolju, ki zagotavlja nizek prag (enostaven vstop v uporabo za novince), visok strop (za zahtevnejše uporabnike) in široko steno (majhen, dobro izbran nabor funkcij, ki podpirajo širok razpon možnosti) [3].

4 ZAKLJUČEK

Mnenja smo, da je veliko praktičnega dela osrednja značilnost uvodnih ur pri programiranju digitalnih medijev, vendar je prav tako pomembno najti dobre načine za spodbujanje dijakov, da postanejo bolj usmerjeni v poglobljeno učenje. Na začetku smo se zelo trudili, da bi našli ravnotežje med uporabljenimi izzivi in ohranjanjem osredotočenosti na osnove programiranja. V prihodnosti želimo rahlo spremeniti dejavnosti in metode ocenjevanja, da bi se izognili plitkemu učenju in obravnavali čustveno izkušnjo uvajanja v programiranje. Pričakujemo, da bodo kakršni koli zaključki, ki izhajajo iz tega prispevka, vodili k boljšemu razumevanju ustvarjalnega procesa v kontekstu integracije, ki temelji na povezovanju programske kode enega in ustvarjalnega okolja drugega orodja, saj večinoma vizualni rezultati kreativnega kodiranja niso neposredno predvidljivi vnaprej.

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Učenje analize okoljskih podatkov za vsakogar

Learning environmental data analysis for everyone

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POVZETEK

Digitalizacija in zeleni prehod sta v tem trenutku najbolj aktualni temi mnogih razprav v različnih organizacijah, saj ju je Evropska unija postavila v ospredje ciljev za naslednje obdobje. V prispevku predstavljamo Erasmus Plus projekt EverGreen, v okviru katerega naslavljamo obe aktualni temi ter ju želimo uspešno vključiti v izobraževalni proces. Glavni cilj projekta je priprava izobraževalnih vsebin o podatkovni analitiki na primeru okoljskih podatkov. Podatkovna analitika bo v prosto dostopnih študijskih gradivih predstavljena celovito in ne bo zahtevala predhodnega poznavanja teme. Analiza okoljskih podatkov bo izvedena na treh različnih primerih iz prakse z orodjem Oracle Analytics Cloud, ki je za študente v omejenem obsegu dostopno v Oracle Cloud Infrastructure.

KLJUČNE BESEDE

podatkovna analitika, okoljski podatki, analiza okoljskih podatkov, Oracle Analytics Cloud, Oracle Cloud Infrastructure

ABSTRACT

Digitalisation and the green transition are currently the most topical issues in many debates in various organisations, as the European Union has placed them at the forefront of its objectives for the next period. In this paper, we present the Erasmus Plus project EverGreen, which addresses both topics and aims to successfully integrate them into the educational process. The main objective of the project is to

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develop educational content on data analytics using environmental data as an example. Data analytics will be presented comprehensively in freely available study materials and will not require prior knowledge of the topic. The analysis of environmental data will be carried out on three different practical cases using the Oracle Analytics Cloud tool, which is under some constraints available to students through the Oracle Cloud Infrastructure.

KEYWORDS

Data Analytics, Environmental Data, Environmental Data Analysis, Oracle Analytics Cloud, Oracle Cloud Infrastructure

1 UVOD

Po mnenju Evropske komisije (EK) sta dva ključna izziva, s katerima se morajo države članice spopasti v prihodnjih desetletjih, narediti Evropo bolj zeleno in bolj digitalno [1]. Oba izziva sta med seboj povezana, saj je napredek v tehnologiji pogosto predstavljen kot edini možni način za doseg ravnotežja med gospodarskim napredkom in okoljsko trajnostjo. Po drugi strani pa napredek v tehnologiji in vse širša uporaba tehnologije ustvarja vedno večje količine podatkov.

Po podatkih Statiste [2] se bo količina podatkov iz leta 2020 že do leta 2025 podvojila, v skladu s tem pa se letno povečuje tudi poraba energije za obdelavo velikih podatkov in poslovno analitiko. Ocenjujejo, da se bo v obdobju 2023–2028 poraba energije povečala za 11 % [3]. Tehnologije za analizo podatkov in poslovno analitiko ter algoritmi na osnovi umetne inteligence so ključni "sestavni deli", ki omogočajo pretvorbo surovih podatkov v uporabne informacije. Te tehnologije pomagajo podjetjem, pa tudi vladam in družbam, razumeti trende in pasti, graditi napovedne modele in najti rešitve za lokalne in globalne izzive. Analiza podatkov ima torej potencial reševanja

vprašanj, povezanih s podnebnimi spremembami in globalnim segrevanjem, pa tudi drugih družbenih izzivov. Pri analizi okoljskih podatkov zbiramo in analiziramo podatke o različnih okoljskih kazalcih ter izsledke analiz uporabimo kot osnovo za sprejemanje upravljaljskih, finančnih in skupnostnih odločitev (odločanje na podlagi podatkov).

Vse bolj razširjena uporaba podatkovne analitike zaposluje nov profil strokovnjakov, ki razumejo ogromne količine podatkov ter so sposobni s pomočjo različnih orodij iz teh podatkov pridobiti koristne informacije za odločanje. Da bi izobrazili tovrstne strokovnjake, izobraževalne ustanove potrebujejo tako infrastrukturo kot tudi pedagoški kader, ki bo usposobljen za poučevanje podatkovne analitike. V okviru Erasmus+ projekta Including EVERYone in GREEN Data Analysis (EverGreen) naslavljamo vrzel med povpraševanjem in ponudbo usposobljenih podatkovnih analitikov. Z uvedbo inovativnega skupnega učnega gradiva, ki bo na voljo predavateljem in študentom, bomo prispevali k razvoju digitalne pripravljenosti, odpornosti in zmogljivosti študentov na tem pomembnem, razvijajočem se področju.

V projektu EverGreen sodeluje pet partnerjev: Univerza iz Žiline (Slovaška), kot vodilni partner, Univerza Pardubice (Češka), Univerza v Šibeniku (Hrvaška), Inkubator za nove tehnologije in podjetništvo Trokut (Hrvaška) ter Univerza v Mariboru.

2 PREGLED PODROČJA

Združeni narodi so leta 2015 predstavili 17 ciljev trajnostnega razvoja, ki so vezani na svetovno najbolj perečo problematiko s področja družbe, gospodarskega razvoja in okolja [4] in so prikazani na sliki 1.



Slika 1: Cilji trajnostnega razvoja [4]

Leta 2017 so v skladu s cilji predstavili tudi seznam kazalnikov, s katerimi je možno meriti napredek pri doseganju posameznih ciljev. V bazi je tako na voljo več kot 210 različnih kazalnikov, za katere UN [5] zbira podatke in so prosto dostopni za izvajanje različnih analiz, s katerimi bi dosegli boljši vpogled v napredek in pospešili doseganje ciljev. Nekaj kazalnikov ciljev trajnostnega razvoja je na voljo tudi na platformi Our World in Data [6], poleg tega pa obstaja tudi spletni sledilnik ciljev trajnostnega razvoja [7], interaktivno orodje, s katerim lahko sami izvajamo

vizualizacije. Poleg splošno dostopnih podatkov se z analizo okoljskih podatkov ukvarjajo tudi različne organizacije, podjetja in ustanove, ki želijo na osnovi tovrstnih analiz izboljšati svoj okoljski odtis. Kot primer lahko navedemo Mestno občino Kranj, ki s senzorji na petih različnih lokacijah na področju občine spremlja vrednosti polutantov in meteorološke podatke [8].

Kot je jasno, sami podatki ne prinašajo dodane vrednosti, pač pa jih je potrebno analizirati, da iz njih pridobimo koristne informacije. V primeru okoljskih podatkov gre največkrat za velike podatke, ogromne količine podatkov, ki jih ni mogoče učinkovito analizirati s tradicionalnimi statističnimi metodami. Poleg velikega obsega je zanje značilna visoka hitrost generiranja, raznolikost podatkovnih tipov ter problem pravilnosti samih zapisov. Zaradi omenjenih značilnosti moramo za analizo velikih podatkov uporabljati posebna orodja, ki podpirajo uporabo različnih podatkovnih tipov, omogočajo čiščenje podatkov pred analizo ter so dovolj zmogljiva za procesiranje velikih količin podatkov.

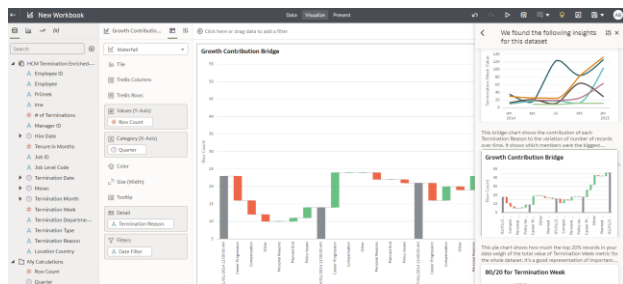
Obstaja nekaj orodji, ki se najpogosteje uporabljajo za analizo velikih podatkov. Python je na primer programski jezik, ki je zaradi velikega števila knjižnic in orodij za analizo podatkov pogosto prva izbira podatkovnih analitikov [9]. Čeprav je sintaksa programskega jezika Python relativno enostavna, pa kljub temu uporaba Python okolja zahteva znanje programiranja. Podobno velja tudi za programski jezik R, ki ga uporabljamo v različnih okoljih, na primer R Console ali R Studio [10]. Tudi programski jezik R ima širok nabor knjižnic, ki omogočajo učinkovito analizo podatkov. Apache Spark je večjezična platforma, ki poleg programskih jezikov Python in R omogoča tudi uporabo jezikov SQL, Java in Scala za analizo podatkov [11]. Enako kot pri predhodno omenjenih orodjih, tudi Apache Spark zahteva poznavanje programskih jezikov.

Druga vrsta orodij, ki jih uporabljamo za analizo podatkov, pa so orodja, ki uporabljajo grafične vmesnike in zato znanje programskih jezikov ni potrebno. Med tovrstnimi orodji velja izpostaviti Tableau [12], SAS [13], Power BI [14], Orange [15], JupyterLab [16] in KNIME [17]. Navedena orodja delujejo na zelo podoben način, so uporabniku prijazna, potek dela je relativno enostaven, proces učenja uporabe posameznega orodja pa ni zahteven. Večina orodij je na voljo kot namizna aplikacija, pri čemer seveda omogoča različne načine deljenja podatkov in rezultatov analiz.

3 ORACLE ANALYTICS CLOUD

Podobne lastnosti, kot smo jih navedli pri orodjih z grafičnimi uporabniškimi vmesniki, lahko pripišemo tudi orodju Oracle Analytics Cloud (OAC), ki ga predstavlja korporacija Oracle [18]. OAC vključuje širok nabor orodij za vizualizacijo podatkov, izvajanje analitike po izbiri, poslovno obveščanje ter napredno analitiko. Povezovanje z različnimi viri podatkov je zelo preprosto, prav tako je enostavna priprava in transformacija podatkov v ustrezno obliko. Za

napovedne vpogleda OAC uporablja metode strojnega učenja. Ena od prednosti platforme je tudi integracija s širšim ekosistemom Oracle, ki zagotavlja varnost in skalabilnost. Kot pove že samo ime orodja, je OAC na voljo kot oblačna storitev, kar bistveno poenostavi uporabo orodja znotraj organizacije in omogoča delo v okolju le z uporabo brskalnika. Na sliki 2 je prikazana delovna površina v okolju OAC.



Nadzorna plošča Oracle Analytics Cloud

Za uporabo OAC Cloud moramo imeti dostop do platforme Oracle Cloud Infrastructure (OCI), ki jo predstavljamo v naslednjem poglavju.

Slika 2: Nadzorna plošča Oracle Analytics Cloud

Za uporabo OAC Cloud moramo imeti dostop do platforme Oracle Cloud Infrastructure (OCI), ki jo predstavljamo v naslednjem poglavju.

4 ORACLE CLOUD INFRASTRUCTURE

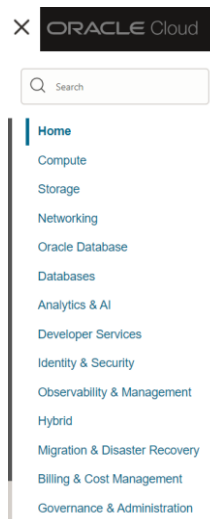
Oracle Cloud Infrastructure (OCI) je produkt, ki podpira vse arhitekture računalništva v oblaku (javni, zasebni in hibridni oblak) ter vse vrste oblačnih storitev (infrastrukturo kot storitev IaaS, platformo kot storitev - PaaS, in programsko opremo kot storitev - SaaS). Vsebuje rešitve v oblaku, ki so bile v preteklosti na voljo le lokalno. Rešitev uporablja Oracle avtonomne storitve, integrirano varnostno plast, robustno funkcionalnost in tehnike optimizacije ter na ta način ponuja številne prednosti pri uporabi vključenih orodij. Kot najpomembnejše, OCI ponuja izvrstno lokacijo za avtonomno bazo podatkov Oracle, ki se v oblaku obnavlja, popravlja in dopolnjuje brez potrebnih posegov skrbnika baze podatkov. Z uporabo strojnega učenja za avtomatizacijo rutinskih opravil zagotavlja avtonomna podatkovna baza večjo zmogljivost, boljšo varnost in izboljšano operativno učinkovitost ter tako razvijalcem ponudbi več časa za izdelavo poslovnih aplikacij [19].

OCI ponuja širok nabor orodij, ki jih lahko uporabljamo:

- Oracle Analytics uporablja strojno učenje in umetno inteligenco za pomoč pri odločanju. Med drugim ponuja storitve Oracle Analytics Cloud, Oracle Big Data Service, Oracle Big Data SQL Cloud Service, Oracle Data Science in Oracle Cloud Infrastructure Data Flow.

- Okolje za razvoj aplikacij, vključno z orodji API Gateways, Blockchain, Data Science, Digital Assistants, Oracle MySQL Database Service. Med orodji velja izpostaviti tudi Oracle Application Express (APEX) in Visual Builder, ki omogočata hiter in enostaven razvoj spletnih aplikacij z SQL, PL/SQL in JavaScript funkcionalnostmi.
- Baza podatkov, ki vključuje avtonomno procesiranje transakcij, avtonomno podatkovno skladišče, JSON bazo podatkov, bazo podatkov kot oblačno storitev (virtualni računalnik), exadata oblačno storitev ipd.
- Orodja za integracijo, kot so API Gateway, Application Integration, Oracle GoldenGate, Oracle Data Integrator, Oracle Cloud Infrastructure Data Integration, SOA Cloud Service.
- Orodja za nadzor in upravljanje, ki omogočajo beleženje, spremljanje, obveščanje, upravljanje virov ipd.
- Orodja za povezljivost in delo v omrežju, kot so DNS strežnik, e-pošta, FastConnect, preverjanje stanja (ang. Health Checks), uravnoteženje obremenitev (ang. Load Balancing), virtualno omrežje v oblaku.
- Orodja za shranjevanje, ki omogočajo arhiviranje, shranjevanje v blokih, prenos podatkov, shranjevanje datotek, uporabo lokalnega pomnilnika NVMe SSD, objektno shranjevanje ipd.

Na sliki 3 je predstavljen glavni meni s pregledom funkcionalnosti, ki jih ponuja OCI.



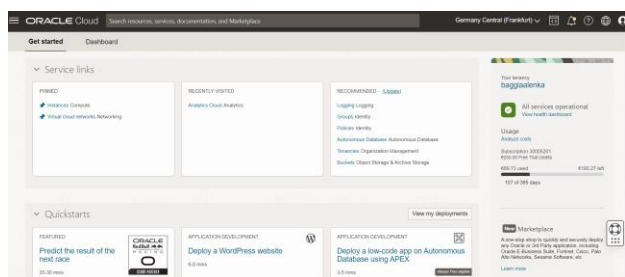
Slika 3: Funkcionalnosti Oracle Cloud Infrastructure

Pri tem OCI uporablja napredne tehnologije, kot je umetna inteligenca, veriga blokov, strojno učenje, podatkovna znanost, digitalni pomočniki ipd. Za dobro delovanje spletnih rešitev pri uporabi navedenih tehnologij je ključnega

pomena visoka računska zmogljivost ob visoki stopnji varnosti, skladnosti in upravljanju identitet, ki jih omogoča OCI. Tehnologija Oracle Cloud je postavljena na različnih lokacijah po svetu. V Evropski uniji so podatkovni centri fizično locirani v Amsterdamu, Zürichu in Frankfurtu, od leta 2021 pa nastajajo tudi novi podatkovni centri na Švedskem, v Franciji in Italiji [19]. OCI je prvotno postavljena za uporabo v organizacijah, saj način plačevanja na osnovi porabe virov za organizacije predstavlja ključno prednost z vidika optimizacije stroškov. Poleg plačljive možnosti, pa OCI ponuja tudi storitev za študente v okviru iniciative Oracle Cloud Always Free, preko katere lahko študenti spoznajo ključne funkcionalnosti platforme. Uporaba storitev preko študentskega računa je časovno omejena, prav tako pa je omejena tudi uporaba virov. Študent lahko uporabi:

- dve avtonomni bazi podatkov (1 OCPU in 20GB diskovnega prostora za vsako),
- virtualne računalnike,
- dva blokovna pomnilnika (skupaj 100 GB),
- 10 GB objektne shrambe,
- 10 GB arhivske shrambe.

V okviru projekta EverGreen bomo študentom predstavili uporabo Oracle Cloud Free Tier, ki ponuja 365-dnevno brezplačno preskušanje. Študent ima na voljo brezplačni kredit za uporabo storitev v oblaku v višini 300 USD. Na sliki 4 je predstavljeno osnovno okno OCI.



Slika 4: Domača stran Oracle Cloud Infrastructure

5 UČNO GRADIVO ZA ANALIZO OKOLJSKIH PODATKOV EVERGREEN

V okviru projekta EverGreen bomo pripravili nov študijski predmet in učna gradiva o podatkovni analitiki, s poudarkom na analitiki okoljskih podatkov. Na ta način želimo okrepiti digitalno pismenost, odpornost in zmogljivost udeležencev izobraževanja ter hkrati graditi na njihovih digitalnih in trajnostnih kompetencah.

Z rezultati projekta želimo pomagati pri odpravljanju vrzeli med znanji in spretnostmi diplomantov s področja IT, ki so usposobljeni za analizo podatkov, zaznavanje trendov, napovedovanje in pridobivanje informacij za pomoč pri

odločanju. Razviti učni načrti in gradiva, ki jih bomo pripravili v okviru projekta, bodo prosto dostopni tudi mladim, ki niso vključeni v formalno izobraževanje. Gradiva bodo vključevala tudi praktične vaje, s katerimi bodo udeleženci izobraževanja še poglobili svoje znanje.

Študijska gradiva, ki bodo razvita v okviru projekta, bodo poleg osnovne, angleške verzije, prevedena v 4 različne jezike (slovaščina, češčina, hrvaščina in slovenščina), da jih bodo sodelujoče ustanove lahko ponudile tudi v svojih lokalnih okoljih. Med gradivi bodo predstavljeni 3 realni primeri analize okoljskih podatkov, na osnovi katerih bodo udeleženci izobraževanja pridobili še dodaten vpogled v iskanje trajnostnih rešitev okoljskih izzivov na lokalnem, nacionalnem in EU nivoju.

V okviru projekta bosta izvedena dva tečaja, namenjena izobraževanju pedagoškega osebja, ki bosta udeležence usposobila za izvajanje pedagoškega procesa s področja analize okoljskih podatkov. Vsak od sodelujočih partnerjev bo za ostale partnerje pripravil vsebine, ki so ključnega pomena za uspešno poučevanje o analitiki okoljskih podatkov. Na ta način bo pedagoški kader pridobil ključne veščine za pripravo kvalitetnih študijskih gradiv in uspešno usposabljanje študentov. Konzorcij je v tej fazi projekta že pripravil seznam ključnih poglavij, ki jih bodo vključevala študijska gradiva in so predstavljena v tabeli 1.

Tabela 1: Poglavlja v študijskem gradivu EverGreen

Št.	Naslov poglavja
1	Uvod
2	Uvod v podatkovno znanost
3	Cilji trajnostnega razvoja
4	Osnove uporabne statistike
5	Oblike vhodnih podatkov
6	Orodja za analizo podatkov
7	Analiza podatkov z SQL
8	Podatkovna skladišča
9	Oracle Data Integrator
10	Analiza podatkov s Python-om
11	Apache Spark
12	Oracle Cloud Infrastructure
13	Uporaba OCI Analytics
14	Vizualizacija podatkov
15	Primeri podatkovne analitike
16	Izkoriščanje podatkov
17	Strategija poslovnih podatkov
18	Odličnost podatkov
19	Zaključek

6 ZAKLJUČEK

V prispevku predstavljamo prve korake pri izvajanju Erasmus Plus projekta EverGreen. Glavni cilj projekta je prispevati k digitalni in zeleni preobrazbi visokega šolstva, kar želimo doseči z medsektorskim internacionalnim

sodelovanjem. Rezultat našega dela bo posodobitev učnih načrtov na področju informacijske tehnologije. V prvi fazi bomo s pomočjo dodatnega izobraževanja razvili digitalne in trajnostne kompetence pedagoškega kadra, v drugi fazi pa izboljšali zaposljivost in okoljsko zavest vključenih študentov.

V trenutni fazi projekta smo pripravili osnovno strukturo za vsebine študijskega gradiva ter osnutke posameznih poglavij in praktičnih vaj. V študijska gradiva bo vključenih tudi nekaj primerov iz realnega okolja. Glavni poudarek študijskega gradiva bo uporaba orodja Oracle Analytics Cloud, ki je na voljo v okviru Oracle Cloud Infrastructure. Oblačna storitev je v omejenem obsegu prosto dostopna študentom. S pomočjo pripravljenih študijskih gradiv bodo študenti pridobili dodatna znanja na področju podatkovne analitike ter tako še povečali svoje zaposlitvene priložnosti.

ZAHVALA

Prispevek je nastal ob podpori Evropske komisije z nepovratnimi sredstvi v okviru ErasmusPlus projekta 2022-1-SK01-KA220-HED-000089149 Including EVERYone in GREEN Data Analysis (EverGreen). Vsebina tega prispevka ne odraža nujno stališča ali mnenja Evropske komisije. Za izražena mnenja odgovarjajo samo avtorji in se zato ta ne morejo šteti za uradno stališče Evropske komisije.

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Izvedba začetnega tečaja programiranja v okolju MS Teams

Conducting an introductory programming course in the MS Teams environment

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POVZETEK

V članku sem predstavil načrt za izvedbo začetnega tečaja programiranja v okolju MS Teams, s poudarkom na učinkoviti in interaktivni izkušnji v obliki dela na daljavo. Tematika, ki jo obravnavam, je učinkovito poučevanje programiranja v sodobnem okolju, ki vključuje tudi oddaljeno učenje. Glavni cilj tečaja je omogočiti udeležencem, da pridobijo osnovna znanja programiranja in razvijajo svoje veščine skozi praktične vaje in sodelovalno delo. Ugotovil sem, da je bil tečaj izpeljan na časovno in prostorsko učinkovit način, fizični stik z učenci pa ni bil bistvenega pomena in v tem delu niso bili prikrajšani.

KLJUČNE BESEDE

oddaljen tečaj, okolje MS Teams, učinkovito in interaktivno poučevanje, Visual Studio, začetni tečaj programiranja

ABSTRACT

In the article, I presented a plan for implementing an introductory programming course in the MS Teams environment, with an emphasis on an efficient and interactive remote learning experience. The theme I addressed is the effective teaching of programming in a modern setting, which also includes remote learning. The main goal of the course is to provide participants with basic programming knowledge and to develop their skills through practical exercises and collaborative work. I found that the course was conducted in a time and space efficient manner, and physical contact with the pupils was not essential and they were not deprived in this aspect.

KEYWORDS

effective and interactive teaching, introductory programming course, MS Teams environment, remote course, Visual Studio

1 UVOD

V šolskem letu 2022/2023 sem prejel nadpovprečno število prijav na popolnoma prosto izbirno vsebino Začetni tečaj programiranja. Na tečaj so se prijavili dijaki 1. in še nekaj 2. letnikov, in sicer različnih poklicnih smeri: elektrotehniki, računalniški tehniki, mehatroniki in dijaki iz strokovne gimnazije. Prijavljeni dijaki so prihajali iz 9 različnih oddelkov. Po analizi prijav sem se posvetoval z ravnateljem Srednje tehniške šole, kako izpeljati krožek za toliko različnih oddelkov. V preteklih letih sem največkrat izobraževanje izvedel takoj po

pouku, večinoma 9. in 10. šolsko uro, ko so se učilnice sprostile. Letos pa je bila šola zelo polna. Nekateri dijaki so imeli na urniku še 9. šolsko uro. Nekateri so pouk zaključevali že 7. šolsko uro. Nekateri imajo popoldan že druge dejavnosti (glasbo, šport in podobno), zato je pravočasen prihod domov za njih pomemben. Ravnatelj je predlagal, naj krožek izpeljem preko platforme MS Teams, podobno kot smo v času korone izpeljali pouk na daljavo.

2 PRED ZAČETKOM TEČAJA

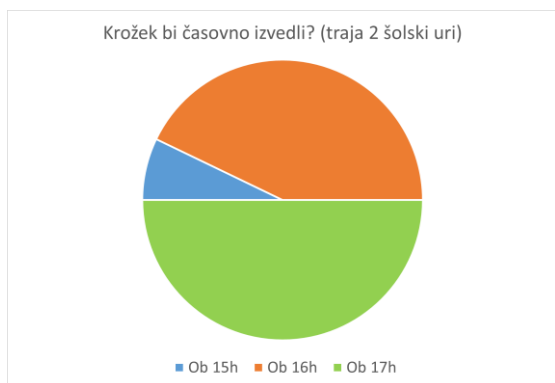
Ker so dijaki že imeli šolske spletne in Microsoft račune (spletna domena sckr.si) in so se spoznali z delom v platformi MS Teams že pri rednem pouku informatike, delo v okolju MS Teams ni predstavljalo oviro [2]. Tam sem takoj ustvaril ekipo z imenom Začetni tečaj programiranja in dodal vse prijavljene dijake. Skupno število dodanih dijakov je bilo 44. Vse prijave niso bile resne in vsi niso uspešno opravili tečaja. Prva aktivnost, ki sem jo ustvaril v ekipi, je bila anketa pred začetkom tečaja. V anketi je bilo potrebno odgovoriti na dve vprašanji. Cilj ankete je bil, da preverim, v kakšni obliki si dijaki želijo izpeljati tečaj programiranja, na daljavo ali v šoli. Rezultati so bili sledeči.



Slika 1: Prvo obvezno vprašanje

Iz Slike 1 je razvidno, da si dobra polovica dijakov želi imeti krožek v popoldanskem času na daljavo preko video konference. Slaba polovica dijakov pa meni, da je stik v učilnici za njih še vedno bolj pomemben in da se tako lažje in več naučijo.

Kdor je na prvo vprašanje odgovoril z izbiro "Preko okolja MS Teams", se je odprlo naslednje vprašanje.

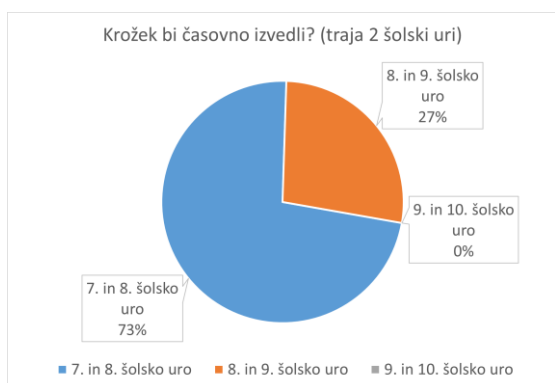


Slika 2: Drugo možno vprašanje

Iz Slike 2 je razvidno, da od 56 % dijakov, ki so odgovorili "Preko okolja MS Teams", jih je 6 odgovorilo, da bi začeli z video konferencami ob 16. uri in končali ob 17.30, 7 jih je odgovorilo, da bi začeli ob 17. uri in končali ob 18.30 in samo eden dijak je odgovoril, da bi začel ob 15. uri.

Iz odgovorov sklepam, da dijaki prihajajo domov po 15. uri in dejansko točno ob tej uri še ne morejo začeti s tečajem. Sicer pa jim je odgovarjalo, da s tečajem začnemo čim prej, ker se veliko dijakov udeležuje tudi drugih dejavnosti, ki pa se začnejo po 18. uri.

Če so v prvem vprašanju odgovorili "V računalniški učilnici", pa se je odprlo naslednje vprašanje (Slika 3).



Slika 3: Drugo možno vprašanje

Od dijakov, ki so na prvo vprašanje odgovorilo "V računalniški učilnici" (44 %), jih je 8 odgovorilo, da bi imeli tečaj "7. in 8. šolsko uro", 3 so odgovorili, da bi lahko imeli tečaj "8. in 9. šolsko uro", nihče pa si ni želelo imeti tečaja "9. in 10. šolsko uro".

Iz odgovorov sklepamo, da bi dijaki v šoli začeli s tečajem takoj po zaključku rednega pouka in bi radi na tečaj čakali čim manj časa, zato prevlada odgovor s pričetkom 7. šolsko uro.

Po zaključeni anketi sem dijake preko MS Teams objave obvestil o dogovoru z ravnateljem in samem načrtu poteka krožka. Dijaki so se na objavo odzvali pozitivno.

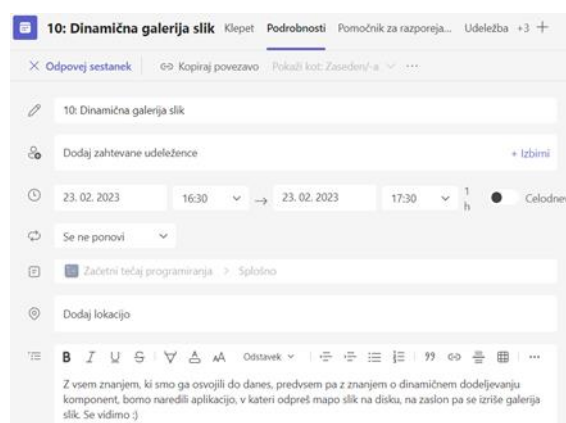
3 POTEK IN IZVEDBA TEČAJA

Tečaj je potekal tedensko s pričetkom v sredo, 30. 11. 2022, in zaključkom v četrtek, 23. 2. 2023 [1]. Izvedenih je bilo 10 delavnic. Časovni potek prikazuje dnevnik v Tabeli 1. Potek tečaja so dvakrat prekinile počitnice. Dijakom sem ponudil, da bi lahko tečaj potekal tudi v času počitnic, saj delamo od doma, a si dijaki tega niso želeli. Tudi meni je ustrezalo, da so počitnice namenjene počitku.

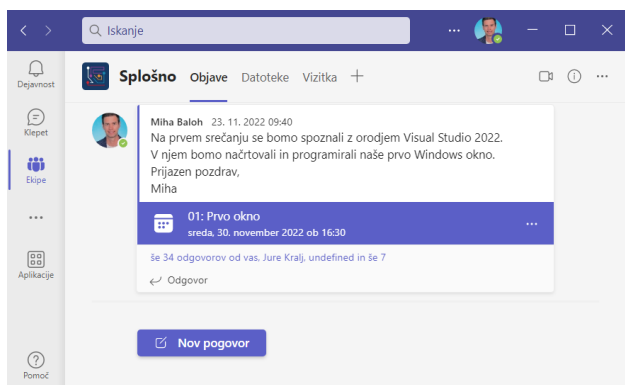
Tabela 1: Dnevnik začetnega tečaja programiranja

1. srečanje (2 h)	sreda, 30. 11. 2022	Prvo okno
2. srečanje (2 h)	četrtek, 8. 12. 2022	Osnovni gradniki
3. srečanje (2 h)	četrtek, 15. 12. 2022	Preprosto računalno
4. srečanje (2 h)	petek, 23. 12. 2022	Igra labirint
POČITNICE		
5. srečanje (2 h)	četrtek, 5. 1. 2023	Kviz
6. srečanje (2 h)	četrtek, 12. 1. 2023	Štoparica
7. srečanje (2 h)	četrtek, 19. 1. 2023	Različna sporočilna okna
8. srečanje (2 h)	četrtek, 2. 2. 2023	Križci in krožci
POČITNICE		
9. srečanje (2 h)	četrtek, 16. 2. 2023	Dinamično dodeljevanje komponent
10. srečanje (2 h)	četrtek, 23. 2. 2023	Galerija slik

Delo v okolju MS Teams je potekalo tako, da sem vedno en teden vnaprej napovedal dogodek s krajšim opisom in ga vnesel v koledar (Slika 4). Dijakom se je dogodek pojavil na osebнем koledarju in jih obveščal o pričetku dogodka (Slika 5).

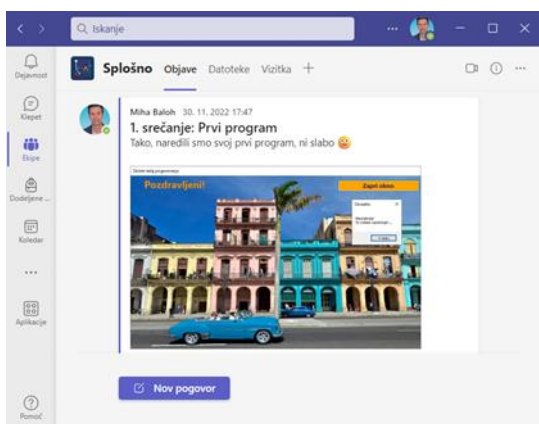


Slika 4: Objava dogodka v koledar in kanal Splošno



Slika 5: Obvestilo o dogodku v kanalu Splošno

Ob določeni uri in datumu se je dogodka začel. MS Teams je na to opozoril tudi dijake. Po srečanju pa sem vedno tudi objavil zaslonsko sliko aplikacije in kratek opis opravljenega dela (Slika 6).



Slika 6: Objava po zaključku video konference

4 SNEMANJE VIDEO KONFERENCE

Video konference sem tudi snemal. Saj so tako lahko dijaki zamudniki ali manjkajoči dijaki imeli še tri tedne časa, da si ogledajo posnetek in nadoknadijo zamujeno. Po treh tednih pa se video posnetek žal izbriše, razen če ga preneseš in shraniš na varno mesto. Tako določa MS politika uporabe [3]. Dijaki so si s posnetki pomagali na različne načine. Nekateri so tako lahko lažje nadomestili manjkajoče ure. Nekateri dijaki so povedali, da ko VK poteka v živo, stvari samo spremljajo in poslušajo. Po VK pa sami poskusijo samostojno ustvariti predstavljeno aplikacijo. Če jim to ne uspe, si lahko pogledajo posnetek za nazaj in ravno ta del jim je bil najbolj všeč.

5 DELJENJE ZASLONSKE SLIKE

Vsako video konferenco sem izpeljal tako, da sem delil celotno sliko mojega namizja in dijaki so lahko natančno spremljali moje delo. Za začetek sem vedno v orodju za razvoj programske opreme odprl nov prazen projekt in začel graditi aplikacijo od začetka. Tako so dijaki lahko opazovali, kako sestavim grafični del aplikacije in kasneje tudi, kako napišem kodo. Kodo sem

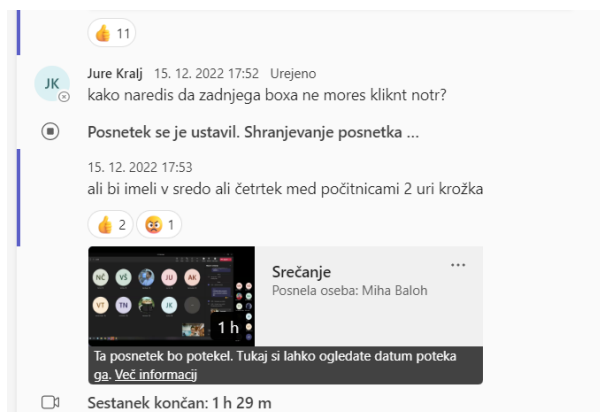
pisal počasi, da bi jo dijaki lahko sproti prepisovali in da sem zraven bolj podrobno razložil posamezne vrstice kode. Dijaki so bili začetniki programiranja in prav veliko kode še niso napisali, zato so potrebovali več razlage.

Motivacij za učenje ni manjkalo, saj so na tečaju sodelovali večinoma zainteresirani dijaki in so si tega znanja zelo želeli. Le redki so se na tečaj prijavili izključno zaradi pridobitve potrdila o opravljeni popolnoma prosti izbirni vsebini.

Ko se je nekemu dijaku stvar popolnoma zataknila in ni vedel, kako nadaljevati s programiranjem, sva to rešila tako, da je najprej delil svojo zaslonsko sliko. Jaz sem tako najbolj učinkovito izvedel, kaj je konkretno problem ali kaj ne deluje. Z deljenem slike sem veliko lažje pomagal in usmerjal z navodili do rešitve. Ostali dijaki pa se pri tem niso dolgočasili, saj so to dogajanje opazovali in se tudi sami iz te situacije nekaj naučili. Nekateri so v istem trenutku imeli enake težave in so kasneje povedali, da jim je bilo to v veliko pomoč.

6 KLEPET MED VIDEO KONFERENCO

Veliko rajše kot prekinjanje profesorja med predstavitvijo oz. zastavljanje vprašanj preko mikrofona so dijaki v veliki večini izbrali možnost klepeta. Vse probleme in vprašanja, ki so jih imeli, so večinoma zapisali v klepet. Jaz sem imel vklopljena obvestila za klepet, ki so se mi instantno prikazala. Če je bilo možno, sem takoj prekinil svojo predstavitev in preko mikrofona in slike poskušal odgovoriti na njihova vprašanja. Na Sliki 7 je primer enega izmed pogovorov. Po zaključku video konference pa se v pogovor zapiše povezava do shranjenega posnetka, ki ga je možno kasneje tudi odpreti in si ga ogledati. V klepet se zapiše tudi trajanje video konference.



Slika 7: Klepet med video konferenco

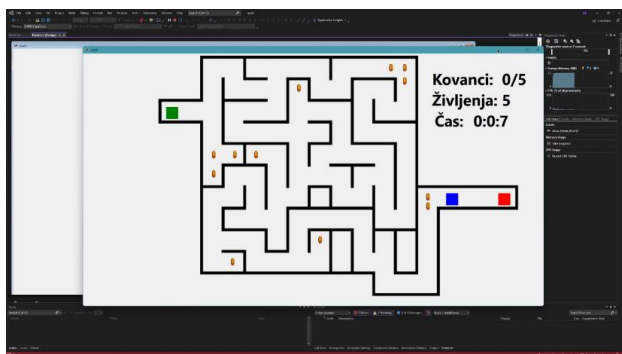
7 IZVEDBA S POMOČJO VIDEO POSNETKA

Dve temi začetnega tečaja programiranja pa nisem izvedel na način preko video konference. Uporabil sem vnaprej posnet video, ki sem ga objavil v glavnem kanalu ekipe. Več podrobnosti je v nadaljevanju.

7.1 Video s kratkimi nasveti

Eno izmed tem sem izvedel tako, da sem vnaprej pripravil in objavil posnetek s kratkimi nasveti in primeri uporabe. Dijaki so

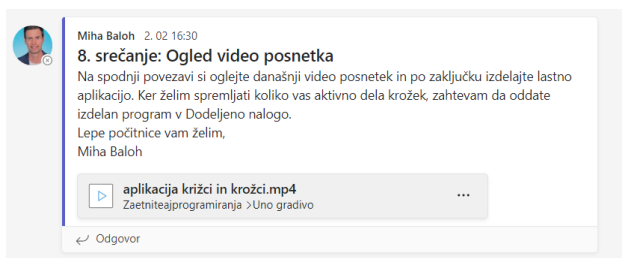
s pomočjo videa izdelali lastno igro. Trike, spoznane v predstavitvenem videu, so dijaki uporabili na svoj način in izdelali igro po lastni meri. Še posebej lepo igro Labirinta, prikazano na sliki 8, je izdelal eden izmed dijakov.



Slika 8: Igra Labirint, izdelana samostojno in po lastni meri dijaka

7.2 Video posnetek celotne aplikacije

Temo Križci in krožci sem izvedel tako, da sem vnaprej pripravil video posnetek s celotnim potekom izdelave aplikacije. Posnetek je bil dolg 26 minut. Aplikacijo sem sprogramiral v hitrejšem ritmu, saj so si dijaki lahko sami poljubno zaustavili in predvajali posnetek po potrebi. Ker sem želel spremljati, koliko jih aktivno sodeluje, sem zahteval, da oddajo izdelan program v dodeljeno nalogo. Dodeljena naloga je rubrika ekipe, ki omogoča oddajo nalog. V tem koraku smo imeli nekaj težav, ker nisem vedel, da MS Teams ne dovoli oddati izvršljivih »exe« datotek. Potem so se dijaki znašli kar sami in mi pošiljali povezave do deljenih map preko klepeta ali e-pošte. Iz Slike 9 je razvidno, kako so dijaki na dan krožka prejeli navodila. Čas za oddajo dodeljene naloge je bil dva tedna.



Slika 9: Objava navodil

8 POROČILO O UDELEŽBI

Po vsaki video konferenci MS Teams pripravi razpredelnico v obliki CSV, ki jo lahko prenesemo na svojo napravo in pregledamo, kdo in koliko časa je sodeloval v VK. Vidimo tudi, če je kdo predčasno zapustil VK. Ker so dijaki na koncu prejeli Potrdilo o udeležbi v obsegu 20 šolskih ur, sem te razpredelnice shranjeval in jih natančno pregledal. V samem začetku tečaja je bilo razloženo, da je obvezna 80 % prisotnost za pridobitev potrdila. Tako sem tekom tečaja beležil tudi glavno razpredelnico, v kateri sem vodil prisotnost za posameznega

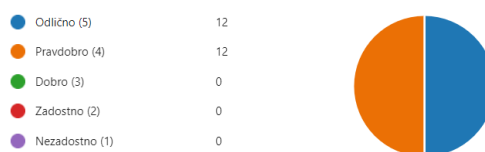
dijaka za vse tedne. Od skupno vključenih 44 dijakov, jih je začetni tečaj programiranja uspešno opravilo 31 dijakov. Kar je največje številko številko, odkar izvajam ta tečaj.

9 PO ZAKLJUČKU TEČAJA

Po zaključku tečaja sem pridobil mnenje in oceno dijakov o kvaliteti izvedbe začetnega tečaj programiranja. To sem pridobil s kratko spletno anketo, ki so jo dijaki rešili s pomočjo svojih telefonov. V anketi je sodelovalo 24 dijakov. Zastavljenih je bilo 8 vprašanj.

9.1 vprašanje: Kako bi ocenili delavnico?

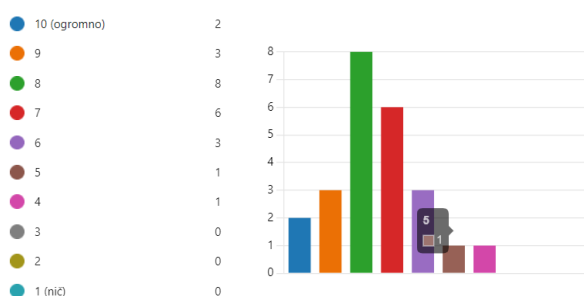
S tečajem programiranja so bili dijaki zelo zadovoljni, saj so za splošno oceno vsi označili visoke ocene odlično (5) in prav dobro (4). Povprečna ocena odgovora je bila natančno 4,5.



Slika 10: Rezultati 1. vprašanja

9.2 vprašanje: Ali si se na delavnici naučil kaj novega?

Na to vprašanje so dijaki odgovorili številčno, pri čemer je pomenila številka 10, da so se naučili ogromno in številka 1, da se niso nič naučili. 6 dijakov je odgovorilo z oceno 7/10, 8 dijakov z oceno 8/10 in potem še skupno 5 dijakov z oceno 9/10 ali 10/10. Bili so tudi 4 dijaki, ki so odgovorili z oceno nižjo od 7. Če iz vseh ocen izračunamo (Slika 11) povprečno oceno, koliko so po njihovem mnenju pridobili novega in uporabnega znanja, dobimo povprečno oceno 7,5/10.



Slika 11: Rezultati 2. vprašanja

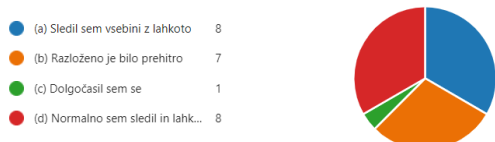
9.3 vprašanje: Opiši, kaj si se naučil?

Na to vprašanje so dijaki odgovorili s kratkimi opisnimi odgovori, iz katerih lahko povzamem, da so se naučili programskega jezika C#, uporabljati Visual Studio, izdelati preproste vizualne programe, izdelati grafične vmesnike in oblikovati okna, izdelati preprosto igro, "programersko

razmišljati" in kako programi delujejo. Lahko sem ponosen, da so v tako kratkem tečaju osvojili toliko znanja.

9.4 vprašanje: Kako je potekala delavnica?

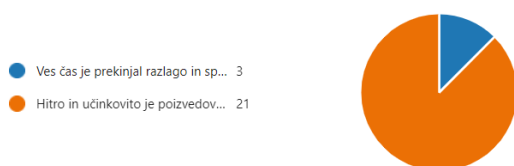
Na to vprašanje so odgovorili z izbiro enega od možnih odgovorov (Slika 12). Dve tretjini dijakov meni, da je predstavljeni vsebini sledila z lahkoto oz. brez večjih težav, med konferenco pa so lahko tudi zastavili vprašanja (modra in rdeča kosa tortnega grafa). Ena tretjina dijakov pa meni, da je bila snov razložena prehitro (oranžen kos) in eden izmed njih pravi, da se je dolgočasil, verjetno zato, ker ni uspel slediti.



Slika 12: Rezultati 4. vprašanja

9.5 vprašanje: Kako pogosto je predavatelj želel izvedeti povratno informacijo?

Iz slike 13 je razvidno, da velika večina dijakov meni (87,5 %), da sem hitro in učinkovito poizvedoval, ali dijaki uspešno sledijo tečaju in ali rabijo kakšno dodatno pomoč. Kar pomeni, da je bil moj ritem programiranja primeren in da sem imel zadostno število premorov.



Slika 13: Rezultati 5. vprašanja

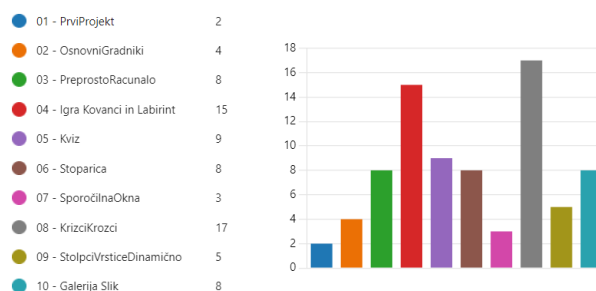
9.6 vprašanje: Kaj ti je bilo na delavnici najbolj všeč?

Na to vprašanje so odgovorili s prostimi opisnimi odgovori, iz katerih lahko povzamem, da kaj je bilo dijakom na tečaju najbolj všeč: na splošno vse, izdelane aplikacije, izdelovanje iger, ogled video konference za nazaj, učenje programiranja, učinkoviti prenos znanja, kar ni delovalo, je učitelj z veseljem pomagal, da je bila snov enostavno razložena in da lahko sedaj sami nadaljujejo s programiranjem.

9.7 vprašanje: Označi aplikacije, ki so ti bile všeč?

Na to vprašanje so odgovorili z »označi več možnosti«, ki so vidne na sliki 14. Iz rezultatov je razvidno, da sta jim bili od vseh aplikacij najbolj všeč igri Labirint in Križci krožci. Med splošnimi aplikacijami, ki niso bile igre, pa so jim bile najbolj všeč aplikacija Kviz, Računalo, Štoparica in Galerija slik. Če pogledamo preostale aplikacije (Prvi projekt, Osnovni gradniki, Sporočilna okna, Dinamični stolpci in vrstice), so bile dejansko namenjene predvsem temu, da so pridobili novo znanje ali

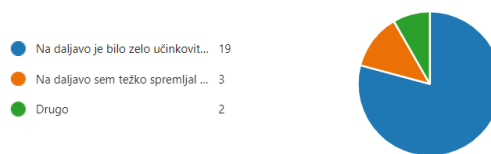
spoznali novo grafično komponento, ki jo bodo kasneje uporabili.



Slika 14: Rezultati 7. vprašanja

9.8 vprašanje: Bi se izvedbe krožka na daljavo še udeležil?

Zadnje vprašanje je potrdilo, da je bila odločitev glede izvedbe tečaja na daljavo dobra in da je dijakom po pridobljeni izkušnji tudi ustrezala. Na odgovor »Na daljavo je bilo zelo učinkovito in udobno spremljati tečaj« je odgovorilo kar 79 % anketirancev (Slika 15).



Slika 15: Rezultati 8. vprašanja

10 ZAKLJUČEK

Z izvedbo začetnega tečaja programiranja imam že dolgoletne izkušnje, a ga na daljavo nisem izvedel še nikoli pred tem. Izvedba v okolju MS Teams, z uporabo video konference in v naprej pripravljenih posnetkov, se je izkazala za prostorsko in časovno učinkovito metodo izpeljave. Sicer sem pogrešal izvedbo v živo, saj po lastnih izkušnjah vem, da tako lahko dobim veliko več povratnih informacij od dijakov, in to med samo izvedbo tečaja. Sicer pa večina dijakov meni, da kontakta v živo ni pogrešala. Z anketno raziskavo je bilo ugotovljeno, da zaradi dela na daljavo in ne v šoli, dijaki v tem pogledu niso bili prikrajšani. Ne glede na vse, je bila to odlična izkušnja, ki je osvežila znanje izvajanja pouka na daljavo, tako za dijaka kot za učitelja.

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Naj bodo jezikovni priročniki zares priročni

Make language handbooks really handy

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POVZETEK

Sodobna informacijska tehnologija omogoča rabo raznih oblik in metod dela ter omogoča učitelju pripravo inovativnega gradiva za doseganje številnih ciljev, zapisanih v učnem načrtu. Učenje s pomočjo sodobne tehnologije učence in učenke večinoma motivira in tako omogoča hitrejšo in kakovostnejšo doseganje učnih ciljev. Ko IKT povežemo še s sodelovalnim in problemskim učenjem, učenci razvijajo tudi druge pomembne kompetence 21. stoletja.

V prispevku je predstavljena obravnava nekaterih jezikovnih vsebin pri pouku slovenščine, s poudarkom na razvijanju sposobnosti uporabe spletnih jezikovnih portalov oz. v ožjem smislu spletnih jezikovnih priročnikov. Po frontalni obravnavi jezikovnih vsebin o stalnih besednih zvezah oz. frazemih in procesnem učenju o pomenu in rabi jezikovnih priročnikov, so bili učenci premišljeno razdeljeni v heterogene skupine. V skupinah so reševali problemsko strukturirane naloge, pri čemer so morali pridobljeno teoretično znanje uporabiti na novih praktičnih primerih. Navodila so jih vodila h kritični uporabi spletnih jezikovnih priročnikov in ob tem vplivala na razvijanje novih spretnosti. Učenci so bili bolj suvereni pri uporabi portala Franček, ki je bil ustvarjen z namenom, da slovenski jezik inovativno približa mladim. Pri uporabi Slovarja slovenskega knjižnega jezika, Slovenskega pravopisa v spletni obliki so imeli več težav, ki pa so jih premostili s sodelovalnim učenjem in ob usmeritvi učitelja. Izkazalo se je, da so izbrane didaktične metode ustrezale zastavljenim učnim, saj so učenci postali samozavestnejši in samostojnejši pri delu s spletnimi jezikovnimi priročniki.

KLJUČNE BESEDE

Spletni jezikovni priročniki, Fran, Franček, kompetence 21. stoletja, digitalna pismenost

ABSTRACT

Modern information technology enables the use of various forms and methods of work and allows the teacher to prepare innovative material to achieve the many goals outlined in the curriculum. Learning through modern technology generally motivates pupils and enables them to reach educational goals more swiftly and with higher quality. When ICT (Information and Communication Technology) is combined with collaborative and problem-based learning, pupils also develop other crucial 21st-century skills.

The article presents the discussion of some language content in Slovenian language lessons, with an emphasis on developing the ability to use online language portals or specifically, web language handbooks. After the frontal treatment of language content about idioms as well as the process of learning about the meaning and use of language handbooks, students were thoughtfully divided into heterogeneous groups. In groups, they solved problem-structured tasks, where they had to apply the acquired theoretical knowledge to new practical examples. The instructions led them to make critical use of online language handbooks and at the same time influenced the development of new skills. Pupils exhibited greater confidence in utilizing the Franček portal, which was designed to creatively introduce the Slovenian language to the youth. While encountering more challenges in using the online version of the 'Dictionary of the Slovenian Standard Language' and the 'Slovene Orthography Dictionary,' they managed to overcome these difficulties through collaborative learning and under the guidance of the teacher. It became evident that the chosen didactic methods aligned with the established learning objectives, as pupils became more self-assured and independent when working with web language handbooks.

KEYWORDS

Online language handbooks, Fran, Franček, 21st-century skills, digital literacy

1 UVOD

Učitelji 21. stoletja smo postavljeni pred izziv, kako v svoje učilnice vpeljati čim več inovativnih pedagoških pristopov, preko katerih bi ustvarili učne priložnosti, ki postavljajo učenca kot aktivnega udeleženca v središče učnega procesa. V učenca usmerjen pouk namreč omogoča njegovo sodelovanje pri načrtovanju sebi lastnih ciljev, skupnem postavljanju kriterijev, izbiri učne poti in s tem spodbuja prevzemanje odgovornosti za lastno znanje [1].

Inovativne metode dela naj bi bile usmerjene k spodbujanju razvoja ključnih kompetenc, ki so bile s strani Evropskega parlamenta in Sveta Evropske unije leta 2006 opredeljene in sprejete v priporočilu o ključnih kompetencah za vseživljenjsko učenje. Kompetence so v tem dokumentu opredeljene kot » /.../ kombinacija znanja, spretnosti in odnosov /.../«, ki ustrezajo okoliščinam. Ključne kompetence so tiste, »ki jih vsi ljudje potrebujejo za osebno izpopolnitev in razvoj, dejavno državljanstvo, socialno vključenost in zaposljivost.« Referenčni okvir določa osem ključnih kompetenc, ki se štejejo za enako

pomembne, našete pa so v naslednjem vrstnem redu: sporazumevanje v materinem jeziku, sporazumevanje v tujih jezikih, matematična kompetenca ter osnovne kompetence v znanosti in tehnologiji, digitalna pismenost, učenje učenja, socialne in državljanske kompetence, samoiniciativnost in podjetnost ter kulturna zavest in izražanje [2].

Ob obravnavi stalnih besednih zvez oz. frazemov in jezikovnih priročnikov pri pouku slovenščine v 7. razredu se je porajala dilema, kako učence čim bolj učinkovito opolnomočiti, da bodo znali sami najti razlago za njim nove oz. nerazumljive besede oz. besedne zveze, poiskati pravopisno rešitev, preveriti in odpraviti svoje pravopisne napake in nenazadnje preveriti tudi sklanjanje t. i. kritičnih samostalnikov. Ob zavedanju, da je mogoče znanje in spretnosti najlažje usvojiti ob problemskem in izkustvenem učenju, je nastalo nekaj didaktičnih metod, ob katerih so učenci razvijali istočasno več omenjenih kompetenc (sporazumevanje v maternem jeziku, digitalna pismenost, učenje učenja, socialna in državljanska kompetenca). Pri pripravi omenjenih metod se je izhajalo iz učnega načrta. V skladu s standardi znanja naj bi namreč sedmošolec znal razložiti frazeme iz besedila in jih smiselno uporabiti v novih okoliščinah in besedilih ter znal uporabljati slovarske priročnike v knjižni in elektronski obliki. V zadnjih dveh razredih OŠ je še posebej priporočljivo, da si pri jezikovnem pouku učenci pomagajo z različnimi jezikovnimi svetovalnicami ter s pravopisnimi priročniki v knjižni in elektronski obliki [3].

V nadaljevanju prispevka bo natančneje predstavljena obravnava stalnih besednih zvez in slovarskih ter pravopisnih priročnikov v okviru obravnave jezikovnih vsebin pri pouku slovenskega jezika. Natančneje bodo prikazane dejavnosti, ki so učence spodbudile k sodelovalnemu delu, reševanju problemov, raziskovanju in obenem k aktivni rabi spletnih jezikovnih portalov.

2 OBRAVNAVA JEZIKOVNIH VSEBIN

2.1 Stalne besedne zveze oz. frazemi

V zadnjem obdobju zaznavamo upad bralne pismenosti, kar so pokazali tudi izsledki mednarodne raziskave bralne pismenosti PIRLS 2021[4]. Ker so učenci v povprečju manj naklonjeni branju, je osiromašen njihov besedni zaklad, kar pomeni tudi porast nerazumevanja besednih zvez v prenesenem pomenu (frazemov). Posledično že nekaj let iskanje razlage besed, raziskovanje večpomenk ipd. na jezikovnih portalih Fran in Franček nadgrajujemo z iskanjem razlag stalnih besednih zvez. Učenci so tako vajeni, da za vse nerazumljivo besedišče znajo poiskati razlago.

Učencem je teorija o stalnih besednih zvezah najprej predstavljena frontalno, ob številnih primerih. Z risanjem dobrednih pomenov frazemov uzaveščajo, da so njihovi pomeni nenapovedljivi in se jih lahko le naučimo skozi čim več besedilnih izkušenj. Učencem nato ob PPT-projekciji spletnega portala Fran demonstriramo, kje v SSKJ se nahajajo frazemi in njihove razlage. Pokažemo jim tudi, kako hitreje in lažje najdemo večino nestavčnih frazemov – na Frančku, jezikovnem portalu za učence in dijake. Na Frančku slovarske vsebine niso prikazane po slovarjih, ampak glede na informacije o posameznih besedah: pomen, sinonimija, pregibanje, izvor, frazeologija, narečja,

zgodovina, etimologija. Portal tako preko odgovorov na vprašanja združuje vsebine različnih slovarjev, prikazane na poenostavljen način, a z jasno navedbo vira, s čimer učence postopno uvaja na ustrezno razumevanje kompleksnejših priročnikov [5].

Nato posamezni učenci na računalniku v učilnici poiščejo razlago številnih frazemov, ki jih nihče od sošolcev ni znal pojasniti. Nagovorjeni so tudi, da nekaj pomenov stalnih besednih zvez poiščejo doma.

Naslednji dve šolski uri sledi delo v heterogeno oblikovanih skupinah z uporabo IKT (tablični računalnik oz. mobilni telefon). Posamezna skupina prejme problemsko zasnovane naloge, primer:

1. Poišči naslednje frazeme v Frančku in jih razloži.

- *biti bolj počasne pameti*
- *ne priplavati po juhi*
- *pretakati krokodilje solze*

Si razlagal pogovore ali rekla? Utemelji.

2. Frazeme iz prve naloge uporabi v smiselnih povedih.

3. a) Kaj pomenijo spodnji pogovori? Poišči jih v SSKJ.

- *Boljši je vrabec v roki kot golob na strehi.*
- *Več glav več ve.*
- *Po toči zvoniti je prepozno.*

b) Spomni se (ali poišči) še nekaj pogovorov, ki vsebujejo besede za živali, hrano, dele telesa ali naravne pojave.

4. a) Razlagam dopiši ustrezen frazem. Išči v Frančku pod geslom ROKA.

- biti pošten, brez krivde
- biti zelo zaposlen
- ujeti, aretirati koga

b) Izpiši še vsaj 5 frazemov, ki vsebujejo besedo ROKA.

c) Pripravi se, da boš 3 frazeme s pantomimo prikazal sošolcem.

Da se učenci uspešno prebijajo skozi zastavljane naloge, morajo pokazati osnovno znanje slovaropisja (npr. da so slovarska gesla zapisana v imenovalniku ednine; kje iskati frazeme v SSKJ), razvite morajo imeti digitalne kompetence za uspešno rabo spletnih jezikovnih portalov, pokazati morajo najvišjo taksonomsko stopnjo znanja in frazeme uporabiti v novi situaciji, zmožni morajo biti sodelovalnega učenja, ob prikazu s pantomimo pa izražajo tudi zmožnost umetniškega izražanja. Poleg naštetega skupinsko delo in rokovanje z IKT-orodji učence visoko motivira. Učenci kaj hitro dobijo povratno informacijo o svojem napredku pri učenju spretnosti uporabe jezikovnega portala, prevzemajo odgovornost za učenje in ob pomoči sošolcev zapolnjujejo vrzeli v znanju. Najpomembnejše pa je, vsi učenci aktivno vključeni v učni proces.

Slika 1: Učenci v trojicah raziskujejo frazeme s pomočjo spletnih portalov Fran in Franček



2.2 Jezikovni priročniki

V uvodu učnega sklopa o jezikovnih pripomočkih učenci v učilnici slovenščine in v šolski knjižnici dobijo vpogled v knjižne izdaje Slovarja slovenskega knjižnega jezika, Slovenskega pravopisa, različnih slovníc (šolskih in znanstvenih) in slovarjev (npr. etimološki ali slovar tujk).

Ob pregledovanju slovarjev sledi procesno učenje, ko ob pomoči učitelja ugotovijo, da nam jezikovni priročniki pomagajo, da naš jezik čim bolj ustreza okoliščinam, v katerih ga uporabljamo, in namenu, ki ga imamo z njim (znamo prav izgovoriti, naglasiti, zapisati, poznamo pomen besed ...). V nadaljevanju se natančneje posvetimo slovarskima člankoma v SSKJ in Slovenskem pravopisu – njuni zgradbi, specifičnim oznakam ipd. V fazi utrjevanja učenci številna gesla iščejo na računalniku v učilnici; sošolci njihovo raziskovanje in učenje spremljajo na PPT-projekciji. Ob skupinski diskusiji analizirajo članke, iščejo število pomenov, frazeološko in terminološko gnezdo, pravopisno pravilne in napačne besede. Nekaj nalog za utrjevanje rešijo tudi v domačem okolju.

Ker je snov 7. razreda tudi sklanjanje samostalnikov, pri katerih se pojavljajo posebnosti, se učenci spoznajo tudi z avtomatsko lektorico Amebis Besano. Ugotovijo, da jim orodje omogoča pregibanje pregibnih besednih vrst in avtomatski jezikovni pregled njihovih besedil.

Urjenje v uporabi jezikovnih priročnikov se nadaljuje v naslednjih dveh šolskih urah. Učenci so ponovno razdeljeni v premišljene heterogene skupine. Vsaka izmed njih prejme tablični računalnik in problemsko zastavljene naloge:

1. Uporaba SSKJ

V SSKJ² poišči besedo OKNO.

- Izpiši geslo ali iztočnico.
- Katerega spola je beseda? Kje lahko to razbereš?
- Koliko pomenov ima beseda?
- Izpiši en primer rabe besede pri prvem pomenu besede.
- V kateri stroki uporabljajo izraz *bazikalno* okno?
- Iz frazeološkega gnezda izpiši en frazem.
- Frazem, ki si ga izpisal v nalogi e, uporabi v smiselni povedi.

2. Uporaba Slovenskega pravopisa

a) V Slovenskem pravopisu poišči kraj Polhov Gradec. Naslednji povedi ustrezno dopolni in ju v celoti zapiši v zvezek.

- *Prebivalci Polhovega Gradca se imenujejo _____, prebivalke pa _____.*

- *Še nikoli nisem bil _____ Polhovem Gradcu.*

b) Poišči besedo *jaka/Jaka* in odgovori oz. ustrezno izpiši.

- Kaj pomeni beseda *jaka* (z malo začetnico)?

- Izpiši svojilni pridevnik, ki ga tvorimo iz osebnega imena *Jaka*, in je jezikovno pravilen.

- Izpiši svojilni pridevnik, ki ni pravilen in ga ne smemo uporabljati.

3. Uporaba Amebis Besane

Na spletni strani Amebis Besana preveri:

a) kako je slovnično pravilno zapisana naslednja poved in jo izpiši:

Medtem, ko me ni bilo doma me je obiskal božiček.

b) in izpiši, kako se pregiba samostalnik *kost* v dvojini, dajalnik.

Delo s spletnimi jezikovnimi priročniki v učilnici pokaže, da marsikateri učenec na spletu ne bi znal samostojno najti e-SSKJ in e-Pravopisa. Prav tako so redki učenci, ki si med frontalno razlago in demonstracijo zapomnijo, kje najti Amebis Besano in kje na omenjeni spletni strani lahko besedila pravopisno preverijo in prepričajo o pregibanju pregibnih besednih vrst. Delo s spletnimi jezikovnimi priročniki, ki so namenjeni tako znanstvenemu kot šolskemu raziskovanju jezikovnega sistema, se za osnovnošolce pričakovano izkaže za precej zahtevno. Vendar premišljeno strukturirane naloge in heterogeno oblikovane skupine učencev omogočajo, da učenci s skupnimi močmi uspešno rešijo zastavljene probleme ob minimalnem usmerjanju učitelja in tako dosežejo zastavljen cilj – razvijajo spretnosti.

3 ZAKLJUČEK

Kot narekuje učni načrt, je ključnega pomena, ne le da učenec ve, čemu so namenjeni jezikovni priročniki, temveč da jih zna uporabljati. Dandanes so spletni jezikovni priročniki namreč dobesedno »pri roki« (4. pomen v SSKJ: *lahko, hitro dostopen*) oz. na dosegu roke, naloga pedagogov in odraslih je le, da usmerjamo in spodbujamo njihovo rabo. V okviru ključnih kompetenc 21. stoletja bi lahko govorili o kombinaciji znanja (pomen jezikovnih priročnikov) in spretnosti (učinkovita uporaba). Pedagogi pa uporabo znanja pojmujejo kot eno višjih taksonomskih stopenj v procesu učenja.

Predstavljene inovativne metode učenja od učitelja nedvomno zahtevajo ogromno priprave, še posebej ko želi vsaki skupini pripraviti različne izzive. V času izpeljave problemsko zastavljenega skupinskega dela pa je razbremenjen in celo nagrajen z aktivnimi in motiviranimi učenci, ki jim uporaba IKT pri pouku predstavlja poseben izziv. Vsi udeleženi želijo končati z nalogami, večkrat ponavljajo procese iskanja in se učijo iz napak.

Systematično učenje rabe spletnih jezikovnih priročnikov se je izkazala kot učinkovita metoda za uvajanje učencev v delo s spletnimi slovarji in spletnimi slovničnimi priročniki. Učenci so ugotovili, da je jezik živ sistem, ki se nenehno spreminja in da

niti učitelj slovenščine o jeziku ne ve vsega. Odkar zanjo uporabljati spletne priročnike, so v učilnici vsakodnevno v uporabi. Izgubili so strah in sram, ko besede/besedne zveze ne znajo razložiti, in kar tekmujejo, kdo bo raziskal pomen določenega izraza. V oddelkih so nastali tudi oddelčni slovarski snopiči, kamor zapisujejo nove besede in besedne zveze, na katere naletijo med branjem raznovrstnih besedil. Lahko bi zaključili, da niso le razvili sposobnosti raziskovanja jezikovnih priročnikov, temveč so to aktivnost celo vzljubili.

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Premor pred odgovorom: vzpodbujanje usvarjalnosti pri poučevanju Interneta stvari

Enhancing Creativity with Pause, Ponder, and Open New Avenues Technique: for teaching Internet of things

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POVZETEK

PPO - Premor Pred Odgovorom, oziroma razmisli, preden spregovoriš (v nadaljevanju PPO) je enostavna intuitivna metoda za spodbujanje ustvarjalnosti in divergentnega razmišljanja.

Metodo PPO sva Samo Božič in Ivan Škrlec uporabila in razvijala v času izvajanja praktičnega izobraževanja študentov s področja IoT (Interneta stvari). Pri izvajanju praktičnega izobraževanja se je izkazalo, da je ustvarjalnost pri izvajanju konkretnega projekta odvisna od tega, ali smo študente na to pripravili že prej, med predavanji. Metoda je zasnovana na Kahnemanovem sistemu 1 in 2, in podobni pristopi pa se že uporabljajo v številnih tehnoloških organizacijah pri treningih in kognitivnih analizah.

Metodo PPO izvajamo tako, da ne odreagiramo takoj, temveč pri odgovorih vsilimo čas za premislek, spodbudimo tišino in omogočimo kreativni dialog. S tem pa spodbujamo nevrološke povezave v Broca-Wernickejevem področju možganov. Metoda je praktična in učinkovita, še posebej pa je primerna v strokovnih šolah, saj spodbuja uporabno ustvarjalnost in s tem pripomore k dodatnemu razvoju sposobnosti študentov.

V nadaljevanju sta podana dva konkretna primera uporabe PPO med predavanji.

KLJUČNE BESEDE

Internet stvari in poučevanje, Kahnemanov sistem, vzpodbujanje ustvarjalnosti

ABSTRACT

The PPO technique, short for "Pause Before Answering," is a straightforward yet potent approach designed to spark creativity and foster divergent thinking. Also referred to as "think before you speak," this method offers an intuitive way to ignite innovative thoughts and encourage more profound insights.

Originating from collaborative efforts between students, Ivan Škrlec and myself, the PPO technique was born out of the practical teaching of IoT (Internet of Things). Our experiences highlighted the need to instill creativity in students from an early stage, directly within the framework of lectures. Drawing inspiration from Kahneman's System 1 and 2, and

building upon similar strategies employed in various technological organizations, cognitive analysis, and training, the PPO method seeks to enhance cognitive processes.

Our implementation of the PPO method is elegantly simple yet impactful. Instead of rushing to respond immediately, we advocate for a moment of pause, allowing for contemplation and creating a space for silence to cultivate creative discourse. This deliberate pause not only triggers heightened neurological connections within the Broca-Wernicke area of the brain but also nurtures an environment where original ideas can flourish.

Practical and proven, the PPO technique has shown its efficacy. Its utility is particularly pronounced within vocational schools, where it not only stimulates valuable creativity but also empowers students to hone their skill sets.

To illustrate its application, we provide two concrete examples of how the PPO technique has been seamlessly integrated into our lecture settings, seamlessly enhancing the learning experience and encouraging students' unique contributions.

KEYWORDS

Internet of things, Kahneman system 1 and 2, enhancing creativity

1 UVOD

Spremembe, ki smo jim priča, nas postavljajo pred izziv, kako poučevati informatiko, Internet stvari. Kompetence, ki jih prenašamo na naslednje generacije, morajo preko inovativne uporabe tehnologije zagotavljati konkurenčnost in s tem našo blaginjo. Kreativnost je ena ključnih kompetenc za zagotavljanje globalne konkurenčnosti.

Metodo PPO smo razvili, ko smo kot prvi v Sloveniji pred desetletjem začeli poučevati Internet stvari v okolju višješolskega laboratorija na VSŠ Telekomunikacije, z reševanjem praktičnih izzivov. Metoda PPO je enostavna in intuitivna metoda spodbujanja ustvarjalnosti, ki jo z malo vaje uporablja vsak inštruktor ali predavatelj. Gradnike in programsko opremo študenti sestavijo v internet naprav, stvari, ki jih v nek koristen sistem povezujejo telekomunikacije.

Teoretična osnova za metodo PPO je povzeta po knjigi »Thinking slow and fast« nobelovca Kahnemana [12]. Prevod te klasike »Razmišljanje, hitro in počasno« je prejel na Slovenskem knjižnem sejmu nagrado za najboljšo poslovno knjigo po izboru Gospodarske zbornice Slovenije in Združenja Manager za leto 2016. Daniel Kahneman po desetletjih raziskav razdeli razmišljanje na dva osnovna načina, sistema. Naše odločitve izvirajo iz prepletanja teh dveh načinov, sistemov mišljenja, tako

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pri vsakodnevnem običajnem odločanju kot pri dolgoročnem načrtovanju strategij.

Naše odzive, ki so hitri in avtomatični, brez napora in brez zavestne kontrole, Kahneman poimenuje sistem razmišljanja 1.

Nasproti temu Kahneman postavi razmišljanje, ko zavestno usmerjamo pozornost na določeno temo in se poglobimo v snov. Ta način razmišljanja poimenuje sistem 2; je počasnejši, bolj premišljen in bolj logičen.

PPO metoda prestavi sistem razmišljanja 1 v sistem 2. Njen cilj je, da že v predavalnici in pozneje med praktičnim in projektnim poučevanjem v laboratorijih spodbudimo poglobljeno razmišljanje z namenom inoviranja.

2 PREGLED LITERATURE

V svoji knjigi Razmišljanje, hitro in počasno Daniel Kahneman loči sistem 1: takojšen, spontan odgovor, od sistema 2: počasnega in mentalno napornega razmisleka. Misлити – zdeti se še ni razmišljati oz. poglobiti se, kot bi rekli po domače.

Srž večine uveljavljenih metod ustvarjalnega razmišljanja je ločitev generacije izmišljanja in »fantaziranja« idej od selekcije in izbire ene, najboljše [14] Viharjenje možganov ali možganska nevihta (brainstorming) [8] uporablja sistem 1 za generacijo različnih, tudi nepovezanih, divergentnih idej. Sledi spraševanje, iskanje itd. in končno sklep, izbira in akcijski načrt. Slednje pa je domena sistema 2.

Prav zaradi miselnega ukvarjanja z neko tematiko prakticiranje sistema 2 omogoča globlje razumevanje materije. Dokazano omogoča več ohranjanja znanja [1]. Možganske povezave v Broca-Wernickejevem področju se namreč krepijo in povezave na abstraktnih nivojih integrirajo [24],[2]

V praksi pa so se že uveljavile tehnike, ki krepijo ustvarjalnost direktno s sistemom 2 in ki so nam služile kot osnova za PPO. Tako se na primer v organizacijah uporablja VPA (Verbal Protocol Analysis) oz. protokol besedne analize [15]. Po končani nalogi, rešenem izzivu ali zaključku se udeležence zaprosi, da se ustavijo, premislijo in ubesedijo utrinke in uvide. Pri kognitivnih raziskavah se podobna tehnika – TAP (Think Aloud Protocol) oz. protokol mišljenja na glas – uporablja za posredno opazovanje in analize miselnih procesov [7]. Na tečajih in treningih, ki vsebujejo veliko vaj, pa se včasih podobna tehnika poimenuje s tujko de-roling oz. verbalni pregled vlog (roles), ki jih je v vaji uporabljal udeleženec [10]. Ker je posameznik prisiljen premisliti notranje dogajanje in zunanjo dinamiko, s tem krepí sistem 2. Ta namerna prekinitev in avtomatizmov z refleksijo prekine navade. Novi pogledi in morda novi načini reševanja problemov pa spodbujajo ustvarjalnost.

Pomen kritične refleksije, samoopazovanja svojih miselnih procesov, kot ključ za napredek našega razumevanja in spreminjanje sveta, v svojem vplivnem delu Logika znanstvenega odkritja poudarja Karl Popper [20]. Vklon sistema 2 je morda prvi korak k temu napredku. Tudi Yuval Harari v knjigi »21 lekcij za 21. stoletje« [11] izpostavlja, da je poleg kritičnega in sistemskega razmišljanja prav ustvarjalno mišljenje največkrat našeta spretnost, ki bo zanimiva v 21. stoletju, in opisana tehnika PPO te spretnosti razvija.

3 REZULTATI

3.1 Uporaba PPO v laboratoriju

Praktični pouk Interneta stvari je potekal od 2014 do pandemije covida. Udeležence samo spodbujali, da najdejo praktične probleme in koristne rešitve zanje. Refleksijo oz. Kahnemanov

sistem 2 smo spodbudili s tem, da smo uporabili metodo »Vprašaj 3, preden vprašate mene« (ask 3 before me, tudi ask 3b4 me). Ta tehnika verbalnega protokola izhaja iz 3B (Brain, Books, Buddies) oz. vprašaj možgane, knjige oz. literaturo in kolege [19]. V delovnem okolju se je poenostavila v to, da kadar nekemu nekaj ne gre, se mu zatakne ali delo ne steče, se posameznik posvetuje najprej s kolegi, šele potem vpraša strokovnjaka ali nadrejenega.

Na Newyorški politehniko (NYU, New York University), kjer sem poučeval, je kolega profesor imel medvedka kar na stolu pred pisarno. Pravil mi je, da se je študentom ob ubesedenju – verbalizaciji problema pogosto že utrnula rešitev in konzultacije niso bile potrebne. »Povej medvedku« (Tell it to your Teddy bear) [18] je tudi tehnika eksternalizacije, besednega opisovanja notranjega dogajanja [23] oz. prisilni vklop prej omenjenega sistema 2.

Na začetku prakse v prvem letu je bilo nekaj dvomov, tudi odpora. Študenti so pričakovali pasivno podajanje snovi in sledenje navodilom. Toda ob doslednem uveljavljanju navodil udeležencem tudi ni preostalo drugega kot sodelovanje in postalo je zabavno.

3.2 Uporaba PPO v predavalnici

Po prvem letu smo prenesli izkušnje iz vaj v predavanja. Kahnemanov sistem 2 smo med predavanji uporabljali s tehniko ločevanja vprašanj od odgovorov. Torej postavimo vprašanje za diskusijo ali izziv za premislek. Takoj zavrnemo vse odgovore, ki so izstreljeni kot iz topa. Spodbujamo premislek, na primer tako, da uporabimo pregovore, npr. »Prvo speci, potem pa reci« itd. Doseči moramo, da namesto sprovočanega odziva na stimulus ne odgovorimo nekaj na prvo žogo, da ne odreagiramo, temveč spodbudimo tišino, premor in razmislek.

3.2.1 Prvi primer PPO: kapital in tehnologija

Pri predmetu »Ekonomika podjetja«, kjer je Internet stvari predstavljen iz uporabnega, tržnega vidika, smo naredili eksperiment. Po nobelovcu Tobinu je 80 % ekonomije produktivnost. Ker zaposleni dela 8 ur dnevno in ker je fiziološko omejen, je ves napredek skozi zgodovino le v tehnologiji, ki zaobjema tudi načine dela in mišljenja.

Anatole Kaletsky je pred časom izjavil, da delavec zapravi, kar dobi, lastnik kapitala pa dobi, kar ne zapravi, ali pa dobi, kar zapravi [13]. Kaj je bolj prav, če sploh kaj?

Kapitalist pač dobi, kar delavec zapravi – jasno! Toda kaj pa je donos na kapital, na tehnologijo, na proizvodnjo? Kaj pa je vlaganje in zakaj je kapital pregovorno »plaha ptica«? V večini primerov je diskusija pripeljala do vprašanja, kaj pa je zaslužek lastnikov podjetij oz. kapitala, in seveda do želenega zaključka, da je »varčnost« najboljša posameznikova naložba. Le tako lahko nekdo pobegne »podganji tekmi« hedonističnega »treadmilla« oz. tekočih stopnic: ustvarjanja umetnih in vedno večjih želja, včasih celo potreb [9]. Diskusija odpre nove poglede na to, kaj tehnologija je in kaj ustvarjamo s tem ko povezujemo naprave v internet.

3.2.3 Drugi primer PPO: podatkovna analiza

Če na primer študent položi na banko 1000 evrov in banka posodi denar naprej z obvezno rezervo, koliko denarja »je« oz. ljudje »mislijo«, da je v ekonomskem sistemu? Namreč posameznik ima ta denar na banki, banka pa ga tudi ima! Očitno se zdi, da ga »je« vsaj 2000, a banka denar posodi naprej. Neskončno tega denarja ne more biti, koliko pa ga je? Študenti uganjujejo in argumentirajo. Sledijo Excelove razpredelnice in šele na nato aritmetična – Gaussova rešitev in po geometrijski rešitvi s podobnimi trikotniki še intuitivna razlaga. Zakaj je rezultat te

osnovne enačbe financ vedno enak? Kaj pove Zenov paradoks o limitah, kaj so eksponencialni fenomeni in kaj je Eulerjevo število oz. osnova naravnih algoritmov? Diskusija pripelje do razmisleka o vlaganju, donosnosti tehnologije in pomena investicij v časa in denarja v nove ponudbe.

3.3 Zakaj uporabiti metodo PPO?

3.3.1 PPO omogoča izogibanje »obrambi« v komunikaciji

Poenostavljeno je vsaka izzvana komunikacija ali reakcija ali pa kreacija [3]! Ali odreagiramo ali pa kreiramo, ali se odzovemo na slišano ali pa se miselno oddaljimo in odgovorimo z drugega stališča, gledišča ali zornega kota oziroma okvira. To presneti sogovornike in pogosto vodi na »tangentno«, v nepričakovano smer, ali odpre nove poglede na komunicirano.

Ob reakcijah se sogovornik pogosto postavi v bran svojih stališč, še posebno če ima občutek, da je njegova samopodoba, status, položaj ali predstava o samem sebi pod vprašajem. Pogovor se nato razvije v napad ali v obrambo in vodi v iskanje argumentov na osebni ravni (ad homini). Ne glede kdo prevlada ali kdo se potegne nazaj, diskusije ni in redko kdo spremeni stališče, se pa kopicijo zamere [22]. S kreacijo, nadgrajevanjem, se konfliktom lahko izognemo in omogočimo dialog. Manj preprirov pomeni tudi več sodelovanja in ustvarjalnih uspehov v timskem delu.

3.3.2 PPO spodbuja prispevke introvertiranih posameznikov in posameznic

Na tehnične strokovne šole se pogosto vpišejo študenti in študentke, ki so praktično naravnani. Značilnost nekaterih od teh posameznikov pa je introvertiranost. Ti ljudje nabirajo energijo, ko so stran od družbe in zato niso vidni, glasni ali vsiljivi. Introvertni posamezniki potrebujejo predvsem čas, da sodelujejo. Susan Cain v svoji knjigi *Tihi : moč introvertnih ljudi v svetu*, ki ne zna molčati [5] poudarja, da prav ti posamezniki in posameznice pogosto blestijo v vlogah, ki zahtevajo globoko osredotočenost, raziskovanje in ustvarjalnost. Metoda PPO pa jim daje tako prostor in čas za njihov prispevek.

4 ZAKLJUČEK

V Metoda PPO s spodbujanjem časovne distance in ločevanjem med izzivom in odgovorom spodbuja razmislek in nove poglede na izzive. Kreativnega razmišljanja se moramo navaditi [4] in s prekinjanjem rutinskih odzivov vzpostavljamo pogoje za razvoj ustvarjalnosti.

PPO je zasnovana na študijah nobelovca Kahnemana in njegovi delitvi razmišljanja v hitro, površno intuicijo – sistem 1 in načrtno, poglobljeno razmišljanje – sistem 2. PPO prehod iz sistema 1 v 2 oz. v razmišljanje izven okvirov v laboratoriju dosežemo z eksternalizacijo miselnih procesov, v predavalnici pa z izzivanjem dialogov.

Intuitivno to že pogosto počnemo v našem vsakdanu. Oglejmo si primere. Nekdanja direktorica banke, sicer nekadilka, mi je potarnala, da na sestankih s prepovedjo kajenja ni mogla več prižgati cigarete, da bi si »kupila čas«. Čas, potreben za razmislek, poglobitev v povedano in predvsem čas, ki odpre prostor novim uvidom, idejam in rešitvam. Čas za nekaj novega, konstruktivnega.

Predavatelji velikokrat intuitivno spodbujamo razmislek pri slušateljih z uporabo premorov. Z odpiranjem časa, v katerem imajo slušatelji možnost ponotranjiti slišane

informacije, omogočimo, da se na nezavedni ravni le-te povežejo z že obstoječimi informacijami in skozi premislek v sintezo novih uvidov. Spet drugi predavatelji pa uporabljamo »Sokratsko« metodo spraševanj za spodbujanje kritičnega mišljenja.

Premori imajo potencial, da spodbudijo miselne procese. Način razmišljanja lahko prav s tišino in izzivi dvignemo na Kahnemanov sistem 2, na raven poglobljenega premisleka.

Dokazano metoda PPO oz. »ločevanja vprašanj od odgovorov« tudi olajša uvide v lastne miselne procese in s tem tudi izboljšuje znanje o sebi « [16], [21].

Na višjih strokovnih šolah so projekti povezani s praktično in koristno tehnologijo, ki jo stroka uporablja. Študenti, praktiki, lahko na svojem konkretnem področju z ustvarjalnostjo prispevajo največ. Namreč bolj ko so stvari abstraktne, odmaknjene od stvarnosti, več učenja je potrebno, dlje traja in manj je oprijemljivega [6]. Posledično »ustvarjalnost« pri visokih abstrakcijah ni tako enostavna ali hitra, kot je pri konkretnih, praktično naravnanih vsebinah [17].

Če želimo v Sloveniji ohraniti življenjski standard in tekmovati s hitro rastočim vzhodom in prenaseljenim jugom, bomo pač morali še okrepiti Krpanovo »znajdenje«, ribničansko »svetovljanstvo« in »iznajdljivost« desetega brata. V času bombardiranja oglasnih sporočil, polresnic, socialnih medijev ... pa sta ustvarjalnost in kritični razmislek nujno potrebna za razvoj in prosperiteto tako posameznika kot družbe.

In metoda PPO, ki je enostavna za uporabo, praktična in teoretsko podkrepljena, je eno izmed orodij, ki tudi lahko prispeva k doseganju teh ciljev.

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Spoznavanje jezikovnih priročnikov v e-obliki s pomočjo spletnega orodja Google Forms in igre soba pobega*

Getting to Know Language Manuals in e-form Using Google Forms and Escape Room Games

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POVZETEK

Knjižnica je prostor, kjer ljudje navadno iščemo knjige za branje v prostem času, iščemo in brskamo pa tudi za podatki, ki jih potrebujemo v vsakodnevnem življenju. Toda knjižnica je dobila konkurenco med spletnimi viri, zato smo se morali temu prilagoditi tudi šolski knjižničarji, saj lahko na spletu in v šolski knjižnici najdemo različne slovarje (Slovar slovenskega knjižnega jezika, jezikovne slovarje, etimološki slovar ipd.) ter druge zanimive podatke.

V prispevku bo predstavljen primer dobre prakse učne ure v 8. razredu osnovne šole, kjer v okviru knjižnično informacijskih znanj izvajamo učne ure, namenjene spoznavanju jezikovnih priročnikov v fizični in spletni obliki. Ker pa se učenci raje učijo skozi igro, smo vse skupaj povezali z igro »soba pobega«, ki je izdelana v spletnem orodju Google Forms.

KLJUČNE BESEDE

jezikovni priročniki, spletni portal Fran, Google Forms

ABSTRACT

A library is a place where people usually look for books to read in their free time, but also search and browse for information that we need in our daily lives. However, the library faced competition from online resources, so school librarians also had to adapt to this, as we can find various dictionaries online and in the school library (Dictionary of the Slovenian Literary Language, language dictionaries, etymological dictionary, etc.) and other interesting information.

The article will present an example of good lesson practice in the 8th grade of primary school, where we conduct lessons aimed at getting to know language manuals in physical and online form within the framework of library information

*Article Title Footnote needs to be captured as Title Note

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skills. However, since students prefer to learn through play, we connected everything with the "escape room" game, which was created using the Google forms web tool.

KEYWORDS

language manuals, web portal Fran, Google Forms

1 UVOD

V članku bom predstavila, kako lahko referenčno gradivo učencem predstavimo s pomočjo različnih spletnih orodij. Spletna orodja se v zadnjem času razvijajo s svetlobno hitrostjo in ponujajo najrazličnejše možnosti za uporabo, zato mora biti knjižničar v koraku s časom z njimi dodobra seznanjen.

2 JEDRO

Kot knjižničarka na osnovni šoli se z učenci posameznega oddelka srečujem nekajkrat letno (najmanj štiri krat), zato se mi zdi še toliko bolj pomembno, da v tistih urah, ko učenci posameznega oddelka skupaj obišejo šolsko knjižnico, pripravim take ure, ki bodo učence motivirale za pridobivanje novih znanj, hkrati pa bodo tudi zabavne, saj si učenci tako bolj zapomnijo nova znanja. Obenem pa naj bi bila knjižnica prostor, ki jih bo vabil in poučeval vse do odrasle dobe in kamor bodo (upam da) radi zahajali tekom celega življenja.

V poplavi informacij, ki nas dnevno obkrožajo z vseh strani, je pomembno, da učence čimbolj pripravimo, da bodo znali poiskati prave informacije, tiste, ki jih potrebujejo. Informacijsko opismenjevanje se v osnovni šoli začne že na samem začetku osnovnošolskega izobraževanja. Učenci obiskujejo šolsko knjižnico v okviru pouka večkrat mesečno, v knjigah iščejo podatke ter so do pridobljenih podatkov tudi kritični. Vse to poskušamo razvijati vse do konca osnovne šole, saj so to veščine, ki jim bodo koristile tudi v odrasli dobi. Tako v prvih razredih osnovne šole brskamo bolj po knjižnih virih, kasneje, ko učenci že bolj spoznavajo tudi delo na računalniku, pa uporabljamo tudi spletne vire in skušamo učence pripraviti na kritično vrednotenje le-teh.

Učenci 5. razreda spoznajo spletni portal Franček, malo starejši učenci pa že portal Fran.

3 OSMOŠOLCI IN REFERENČNO GRADIVO V KNJIŽNI IN E-OBLIKI

Med operativnimi cilji knjižnično-informacijskih znanj za 8. razred najdemo med drugimi tudi naslednje cilje:

- učenec najde definicijo besede, pravilno pisavo in izgovorjavo besede, etimologijo besede,
- učenec spozna in loči različne vrste slovarjev,
- učenec zna uporabiti različne slovarje za določen namen. [2]

Jezikovni priročniki so Slovar slovenskega knjižnega jezika, Slovenski pravopis, različni jezikovni slovarji (tudi slikovni) in podobno. Spadajo med referenčno gradivo, to gradivo pa je navadno v knjižnicah shranjeno na posebnem mestu in ima UDK številko 0. To gradivo ni namenjeno izposoji na dom, temveč je namenjeno temu, da učenci v čitalnici knjižnice gradivo prelistajo in tam poiščejo informacije, ki jih potrebujejo. Čitalniški način dela je namenjen predvsem učencem zadnje triade. Gre pa predvsem za predpripravo na srednjo šolo, kjer je tak način učenja še bolj pogost kot v osnovni šoli.

Učenci se v 8. razredu pri pouku slovenščine učijo o jezikovnih priročnikih. V ta namen učenci večkrat med letom obišejo knjižnico, kjer se s temi priročniki v okviru ur knjižnično-informacijskih znanj tudi boljše spoznajo. Učenci ob prvem obisku knjižnico spoznajo jezikovne priročnike v fizični obliki. Med pogovorom z učenci ugotovimo, da priročnikov v fizični pozna malo učencev, niti jih nimajo doma. Učenci povedo, da nima smisla imeti teh knjig doma, ko pa je vse to dostopno na spletu.

Učenci se v tej uri razdelijo v skupine, vsaka izmed skupin pa spozna drug jezikovni priročnik. Učenci brskajo po priročnikih, spoznajo njegovo zgradbo in sami s pomočjo učnega lista iščejo gesla, razvozlavajo krajšave in podobno. Trudim se, da so gesla, ki jih iščejo, zabavna, da se iz njih tudi nekaj naučijo. Učenci spoznavajo priročnike tako v fizični kot tudi spletni obliki ter primerjajo uporabo obeh različic.

Učenci v evalvaciji ure povedo, da je na spletu iskanje podatkov lažje pa tudi spletni slovarji so bolj posodobljeni in v njih najdemo že kakšne novejšje, sodobnejše besede, ki jih v starejših verzijah jezikovnih priročnikov v fizični obliki ni.

V naslednjem obisku knjižnice povežemo jezikovne priročnike z domačim branjem. Osmošolci za domače branje berejo pesmi iz zbirke Skrivnosti pesnika Nika Grafenauerja. Pesmi so dostopne na Wikiviru, kjer jih učenci tudi preberejo. Učenci nato v pesmih iščejo fraze. Pri tem si pomagajo s spletnim frazeološkim slovarjem, dostopnim na povezavi: <https://fran.si/192/janez-keber-frazeoloski-slovar-slovenskega-jezika>.

Učimo se uporabljati jezikovne priročnike

Poveži.

FRANČEK SLOVAR SLOVENSKEGA KNJIŽNEGA JEZIKA

ETIMOLOŠKI SLOVAR

PORTAL FRANČEK

SLOVENSKI PRAVOPIS

SLOVAR TUJK

V njem je o besedi zapisano, iz katerega jezika izhaja in kako se glasi v nekaterih tujih jezikih.

Obsega pravila o pravilnem zapicovanju besed, rabi velikih in malih črk, rabi loči, deljenju besed, pisanju skupaj in narazen pisanju prevzetih besed.

Obsega vse pomembne oblikovne in vsebinske podatke o besedah slovenskega besedišča. V njem so zbrane tudi nekujne besede, vse besede, ki jih dovolj pogosto uporabljamo.

V njem najdemo prevzete besede iz tujih jezikov, zapisane po so po abecednem vrstnem redu in razložene.

Jezikovna svetovalnica za vse mlajše in starejše učence ter vse učitelje slovenščine.

V Etimološkem slovarju poišči izvor besede ringlo. Beseda je prevzeta prek avstrijsko nemške besede _____ iz francoske _____ kar je poimenovano po francoski kraljici (francosko _____ pomeni _____).

V Etimološkem slovarju poišči besedo tolovaj. Zapiši, iz katerega jezika izhaja. _____ Kaj pomeni tolovaj. _____

V Etimološkem slovarju poišči besedo čokolada in zapiši, iz katerega jezika je beseda prevzeta? _____

Katera beseda ni domačega izvora? obramba, igriščo, servis. _____

Kako so urejene besede v slovarjih? _____

Slika 1: UL Učimo se uporabljati jezikovne priročnike

KIZ 8. razred: Slovarji

Niko Grafenauer: SKRIVNOSTI

Pri delu boste uporabljali frazeološki slovar, ki je dostopen na spletni strani fran.si ter **SSKJ**, ki je dostopen v šolski knjižnici.

1. V pesmi poišči frazem in ga razloži. Pomagaj si s frazeološkim slovarjem.

2. Izpiši 3 frazeme z različnim pomenom za besedo strah.

3. Za katere verze vešja frazem naganjati komu strah v kosti? Razloži pomen tega frazema.

4. Pojasi razliko med frazeološkim slovarjem in Slovarjem slovenskega knjižnega jezika.

Slika 2: UL Niko Grafenauer, Skrivnosti (spoznajmo frazeološki slovar)

Za zaključek leta pa pripravim ponovitev snovi, ki so jo učenci spoznali skozi šolsko leto, in sicer z igro soba pobega. Soba pobega se v šolske namene uporablja že nekaj časa in predstavlja zabaven način dela z učenci. Soba pobega je družabna igra, v kateri mora skupina učencev v določenem času rešiti vse zastavljene uganke in se tako rešiti iz zaprtega prostora, v našem primeru iz knjižnice. S sobo pobega lahko predvsem ponovimo že usvojeno snov, ni pa primerna za usvajanje nove snovi.

Za pripravo sobe pobega sem uporabila spletno orodje Google forms. Orodje Google forms je orodje za ustvarjanje spletnih obrazcev, anket, kvizov, vabil in podobnega. Je popolnoma brezplačen ter preprost za uporabo. V samem

orodju lahko izbiraš med različnimi vrstami vprašanj, lahko spreminjaš barvo ali pisavo, dodajaš slike in podobno.

Učenci se v tej uri sprehodijo skozi vse jezikovne priročnike, ki so jih spoznavali skozi vse šolsko leto.

Učenci v skupinah na štirih računalnikih tekmujejo drug proti drugemu, kdo bo uspel prvi razvozlati geslo, ki odklepa knjižnico, in se rešiti.

Soba pobega je zasnovana tako, da učenci odgovarjajo na vprašanja. Pravilen odgovor na prvo vprašanje jih vodi do drugega vprašanja in tako vse do zadnjega vprašanja, ki da rešitev za pobeg.

Ob zaključku ure sledi refleksija ure. Učencem je po večini tak način dela všeč, saj gre tako za tekmovalnost, uporabljajo pa lahko tudi splet in računalnik, ki je današnjim generacijam definitivno zelo blizu.

knjižničarja, da pozna vsebine, da dobro timsko sodeluje s predmetnim učiteljem. Poznati pa mora tudi spletna orodja, v tem primeru spletno orodje Google forms.

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Slika 3: Soba pobega o orodju Google Forms

4 ZAKLJUČEK

Spletni portali za spoznavanje jezikovnih in drugih priročnikov ter različna Google orodja predstavljajo odličen način, kako popestriti pouk knjižne ali knjižnične vzgoje. Igra soba pobega ponuja možnosti za sodoben način poučevanja, ki je lahko zasnovan in izpeljan na mnogo različnih načinov in z različnimi vsebinami. Seveda pa mora biti knjižničar fleksibilen in pripravljen na dolgotrajen proces izdelave take igre, saj mora biti zelo natančen pri pripravi vprašanj, da dobi ustrezne odgovore, upoštevati mora cilje knjižnično informacijskih znanj in cilje predmeta, s katerim se povezuje (v našem primeru je to slovenščina), kar zahteva od

Tekmovanje Bober za učence od 2. do 5. razreda v Sloveniji

Bebras Competition for students from grade 2 to 5 in Slovenia

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POVZETEK

Bober je mednarodno tekmovanje iz računalniškega mišljenja, ki v Sloveniji poteka že od leta 2011 in je namenjeno učencem osnovnih in srednjih šol. Učenci od drugega do petega razreda osnovne šole naloge rešujejo na papir, njihove rezultate pa učitelji podajo v obliki končnega seštevka točk. Iz tega razloga organizatorji nimamo vpogleda v to, kako uspešni so učenci pri posameznih nalogah. Prav tako nimamo povratnih informacij, ki bi osvetljevale druge pomembne vidike izvedbe tekmovanja, kot npr. ali je učencem tekmovanje všeč, ali oz. kako potekajo priprave na tekmovanje in katere naloge so učencem zanimive. V ta namen smo izvedli raziskavo med učitelji-mentorji tekmovanja Bober v Sloveniji, da bi dobili vpogled v navedene vidike. V prispevku predstavljamo rezultate omenjene raziskave in kvalitativno analizo faktorjev, ki prispevajo h kompleksnosti pri identificiranih težjih nalogah. Analiza vključuje dolžino besedila nalog, kompleksnost uporabljenega jezika, računalniško ozadje in večine računalniškega mišljenja, ki jih je potrebno uporabiti za pravilno rešitev naloge. Rezultati so pokazali, da imajo učenci težave pri razumevanju daljših besedil, dolgih in med seboj povezanih pravil, interpretaciji nepoznanih simbolov ter hkratni uporabi več različnih veščin računalniškega mišljenja pri reševanju problemov. Ugotovili smo, da se jim zdijo najbolj zanimive naloge, ki vključujejo elemente iger in da jim je tekmovanje Bober všeč. Rezultati raziskave bodo v pomoč sestavljalvcem nalog v prihodnjih letih in učiteljem-mentorjev, ki bodo dobili vpogled v vidike, ki jih morajo podpreti v okviru računalniškega izobraževanja.

KLJUČNE BESEDE

Tekmovanje Bober, računalniško mišljenje, nižji razredi osnovne šole, težavnost nalog.

ABSTRACT

Bebras is an international computational thinking competition that has been held in Slovenia since 2011. It is aimed at primary and secondary school students. Pupils from grades 2 to 5 of primary school solve tasks on paper and their results are reported by their teachers in the form of a final score. In this way, we have no insight into how well pupils do on each task. We also have no feedback that sheds light on other important aspects of the competition, such as whether the students like the competition, whether or how the preparation for the competition is organised and which tasks the students find interesting. To this end, we conducted a survey among the teacher-mentors of the Bebras competition in Slovenia to gain insight into these aspects. In this paper we present the results of the survey and also present a qualitative analysis of the factors that contribute to the complexity of the more difficult tasks identified. The analysis includes the length of the task text, the complexity of the language used, the computer science background and the computational thinking skills that need to be applied to solve the task correctly. The results show that students have difficulty understanding long texts, understanding long and connected rules, interpreting ambiguous symbols and applying several different computational thinking skills simultaneously to solve problems. We found that they were most interested in tasks that contained game elements and that they liked the Bebras competition. The results of the survey will help task designers in the coming years and teacher mentors to gain insight into the aspects they need to support in computer science teaching.

KEYWORDS

Bebras competition, computational thinking, lower primary school, task difficulty.

1 UVOD

V Sloveniji se tekmovanje iz računalniškega mišljenja Bober, ki je del mednarodne iniciative Bebras, uspešno odvija že od leta 2011. Tekmovanje je namenjeno učencem osnovnih in srednjih šol ter je razdeljeno v tri kategorije: Bobrček (2. – 5. razred), Mladi Bober (6. – 9. razred) ter Izkušeni Bober (srednja šola). Vsako leto mednarodna skupnost ustvarjalcev nalog pod okriljem iniciative Bebras pripravi nabor nalog, posamezne države pa iz njega naredijo specifičen izbor, ki ga uporabijo za izvedbo tekmovanja v svoji državi. Način izvedbe si lahko

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države prilagodijo glede na svoje specifične zahteve in okoliščine. Organizatorji tekmovanja Bober v Sloveniji so se od samega začetka odločili, da učenci v najmlajši kategoriji naloge rešujejo na papir, starejši pa s pomočjo računalnika. S tem so želeli ustvariti enakost pogojev, saj se stopnja obvladovanja uporabe računalnika v tej starostni skupini pomembno razlikuje med učenci. Reševanje na papir omogoča tudi več svobode pri podajanju odgovorov in posledično raznolikosti nalog, kar je priročno pri sestavljanju nalog za to starostno skupino. Reševanje na računalnik je omejeno na izbiro med predlaganimi odgovori, medtem ko lahko učenci, ki rešujejo na papir npr. prikažejo pot, ki jo opisuje algoritem, ali pa v skladu s postavljenimi pravili pobarvajo sliko. Kljub bolj raznolikim možnostim reševanja pa se problem pojavi pri pridobivanju povratne informacije. Reševanje na računalniku omogoča pridobivanje podrobne statistike, saj je ocenjevanje avtomatično, podatki pa se shranijo v sistem. Rešitve na papirju učitelji ocenjujejo ročno in za posameznega učenca podajo zgolj končni seštevek točk. Na ta način organizatorji ne dobijo vpogleda v to, kako uspešno so učenci reševali posamezne naloge. Posledično je nemogoče ugotoviti, katere naloge so učencem predstavljale izziv in so jih reševali slabše, katere so se jim zdele zanimive in katere so se izkazale za enostavne.

V tem prispevku bomo predstavili izsledke raziskave, ki smo jo izvedli med učitelji mentorji tekmovanja Bober, s katero smo želeli nasloviti izpostavljen problem. V okviru raziskave nas je zanimalo njihovo mnenje o tem, katere naloge so se učencem zdele najbolj zanimive, katere so jim predstavljale izziv in ali jim je bilo tekmovanje všeč. Zbrane podatke smo uporabili pri analizi faktorjev, za katere smo menili, da lahko vplivajo na težavnost nalog. Pri tem smo upoštevali dolžino besedila naloge, stopnjo kompleksnosti uporabljenega jezika v besedilu in komponente računalniškega mišljenja, ki jih je potrebno uporabiti za pravilno rešitev naloge.

Izsledki raziskave so nam omogočili vpogled v uspešnost reševanja posamezne naloge in ugotavljanje vzrokov, zakaj je neka naloga za učence težka. Menimo, da je raziskava pomembna z vidika nadaljnje organizacije tekmovanja, saj osvetljuje razloge za slabe rezultate reševanja posameznih nalog, predvsem pa daje vpogled v vidike računalniškega mišljenja, ki so za učence težavni. Rezultati so pomembni za organizatorje tekmovanja, saj bodo lahko na ta način bolj informirano izbirali naloge v prihodnje, prav tako pa za učitelje mentorje, ki bodo izvedeli, katere vidike morajo v okviru podajanja računalniških znanj najbolj podpreti.

2 PREGLED LITERATURE

Računalniško mišljenje je kognitivni proces, ki vključuje logično sklepanje, kritično razmišljanje ter uporabo računalniških konceptov [2]. Predstavlja edinstven in učinkovit pristop k reševanju problemov, saj posamezniku omogoča, da preoblikuje kompleksne, zapletene in delno opredeljene probleme v obliko, ki jo je mogoče učinkovito obdelovati z računalnikom. Na ta način vzpodbuja globlje razumevanje in širši pogled na digitalne tehnologije ter izboljša sposobnost analize in razsojanja o naravnih, družbenih in umetnih sistemih in procesih [3].

Računalniško mišljenje zajema različne komponente, ki so jih skušali identificirati različni avtorji. V tem članku uporabljamo za analizo nalog model opisan v [1], saj menimo, da zajema

bistvene komponente, ki jih povzemajo tudi druge pomembne taksonomije iz tega področja. Model razdeli računalniško mišljenje na naslednje komponente: 1) algoritmično razmišljanje, 2) dekompozicija, 3) posploševanje (prepoznavanje vzorcev), 4) abstrahiranje in 5) vrednotenje. Algoritmično razmišljanje, kot je opredeljeno v tem modelu, zajema kognitivne sposobnosti za pristop k reševanju problemov z oblikovanjem natančnih in sistematičnih korakov. Vključuje sposobnost razmišljanja v smislu logičnih zaporedij in pravil ter se osredotoča zlasti na oblikovanje in izvajanje algoritmov. Dekompozicija je kognitivna sposobnost prepoznavanja sestavnih delov sistema ali problema in dojemanja le-tega kot zbirke medsebojno povezanih, neodvisnih sestavnih delov. Razdelitev zapletenih sistemov na manjše obvladljive enote omogoča globlje razumevanje in posledično reševanje problemov. Posploševanje (prepoznavanje vzorcev) se nanaša na proces prepoznavanja ponavljajočih podobnosti in povezav. To omogoča reševanje problemov, ki so konceptualno podobni prejšnjim izkušnjam. Vključuje prepoznavanje podobnosti in razlik med sedanjimi in preteklimi problemi ter prilagajanje algoritmov za reševanje širšega nabora podobnih problemskih situacij. Abstrahiranje predstavlja sposobnost poenostavljanja zapletenih problemov oz. sistemov z odstranjevanjem nepotrebnih podrobnosti in predstavljanje informacij v bolj obvladljivi obliki. S tem se ohranijo ključni elementi problema, ta postane bolj preprost in ga lažje naslovimo. Vrednotenje je postopek ocenjevanja kakovosti in ustreznosti rešitve na podlagi relevantnih kriterijev. Ti kriteriji so odvisni od značilnosti in konteksta problema. Vrednotenje vključuje upoštevanje lastnosti, kot so pravilnost, učinkovitost, uporabnost in uporabniška izkušnja. Zahteva sprejemanje kompromisov in posvečanje pozornosti podrobnostim.

Menimo, da z uporabo tega modela zagotavljamo zanesljiv teoretični okvir za analizo nalog na tekmovanju Bober, ki nam bo omogočila celovito razumevanje načel računalniškega mišljenja v praksi.

3 REZULTATI

3.1 Mnenja učiteljev o tekmovanju Bober za učence od 2. do 5. razreda OŠ

3.1.1 Vzorec

Vzorec v raziskavi vključuje 71 učiteljev-mentorjev, ki so sodelovali na tekmovanju Bober v Sloveniji v šolskem letu 2022/23. Ti mentorji so bili izbrani med vsemi aktivnimi učitelji-mentorji v Sloveniji prek javnega povabila k sodelovanju k reševanju ankete v spletnem sistemu Ika. Vzorec zajema različne skupine učiteljev: 36 (51 %) je razrednih učiteljev, 29 (41 %) je učiteljev računalništva in 10 (14 %) poučuje druge predmete (fizika, matematika, tehnologija) ali pa delujejo kot računalničarji in organizatorji informacijskih dejavnosti (ROID). Med vključenimi učitelji jih je 36 mentoriralo učence 2. razreda, 35 jih je mentoriralo 3. razrede, 50 jih je mentoriralo 4. razrede in 51 učiteljev je bilo mentorjev 5. razredom. Na tem mestu bi želeli pojasniti, da je lahko nek učitelj mentor v več razredih hkrati. Med vsemi učitelji na razredni stopnji, ki jih je bilo 36 (100 %) je bilo 22 (61 %) takih, ki so mentorirali učence ene razredne stopnje, 14 (39 %) pa jih je mentoriralo v več razrednih

stopnjah. Med 29 (100 %) vključenimi učitelji računalništva pa je bil zgolj eden (3 %) tak, ki je mentoriral na eni razredni stopnji, medtem ko je preostalih 28 (97 %) mentoriralo na več razrednih stopnjah.

3.1.2 Ocena zadovoljstva učencev s tekmovanjem

V okviru ankete smo pridobili vpogled v stališča učiteljev glede tega, ali je bilo učencem tekmovanje Bober všeč. To smo preverjali s stopnjo strinjanja s trditvijo »Učencem je bilo tekmovanje všeč.«, pri čemer so učitelji izbirali med tremi možnostmi: »se strinjam«, »se ne strinjam« in »nimam mnenja«.

Od 65 (100 %) veljavnih odgovorov se jih je 62 (95 %) strinjalo s trditvijo, da je bilo učencem tekmovanje všeč. Dva učitelja (3 %) se s trditvijo nista strinjala, en učitelj (1 %) pa ni izrazil mnenja. Rezultati kažejo na visoko raven soglasja med učitelji, ko gre za ocenjevanje všečnosti tekmovanja za učence. Ti podatki potrjujejo našo hipotezo, da je sodelovanje na tekmovanju Bober za učence pozitivna in prijetna izkušnja. Čeprav je število učiteljev, ki niso delili mnenja večine relativno majhno, pa ti rezultati kažejo na pomembnost razmisleka o morebitnih področjih za izboljšavo.

3.1.3 Analiza priprav na tekmovanje Bober: metode, vsebine in organizacijski vidiki

Eden od ciljev ankete je bil ugotavljanje, ali so učitelji-mentorji izvedli priprave na tekmovanje Bober in, če so jih, na kakšen način so potekale. Od vseh 65 (100 %) veljavnih odgovorov je 59 (91 %) učiteljev odgovorilo, da so priprave izvedli, medtem ko 6 (9 %) učiteljev priprav ni izvedlo. Vprašanje o načinu izvedbe je bilo odprtega tipa. Odgovore smo razvrstili v tri sklope: 1) organizacijski vidik, 2) vsebinski okvir in 3) uporabljene metode poučevanja ter didaktične strategije pri izvedbi priprav.

Z organizacijskega vidika so učitelji večinoma priprave izvedli v okviru šole. V višjih razredih so jih izvajali pri neobveznem izbirnem predmetu računalništvo, računalniškem krožku in dodatnem pouku. V nižjih razredih pa so jih izvedli v okviru obšolskih dejavnosti. Nekaj učiteljev je poročalo, da so priprave organizirali tako, da so učencem dali naloge, ki so jih morali opraviti doma.

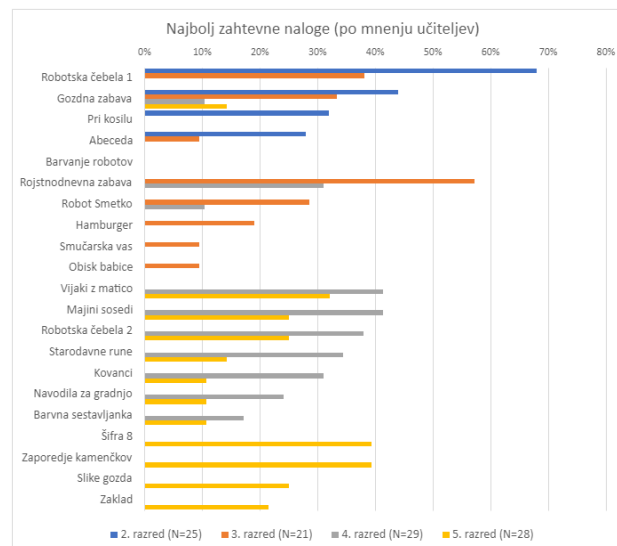
Kar zadeva vsebinski vidik priprav na tekmovanje Bober, so učitelji večinoma odgovarjali, da so uporabili naloge iz prejšnjih izvedb tekmovanja Bober. Poudarili so prednost tega, da so naloge prosto na voljo. Vendar je pa zgolj en učitelj omenil, da je pri pripravah uporabljal knjižico z nalogami in rešitvami, ki so opremljene z razlago in dodatnimi pojasnili.

Z vidika uporabljenih učnih metod in didaktičnih strategij so učitelji priprave organizirali tako, da so učenci delali samostojno, hkrati pa so bili ves čas dosegljivi za podajanje razlag in pojasnil, ko je bilo to potrebno. Pri zahtevnejših nalogah so uporabili frontalno učno obliko, v okviru katere so nalogo skupaj z učenci rešili na tablo. V tem procesu so spodbujali razpravo o možnih pristopih k reševanju ter vrednotenju uporabljenih rešitev.

3.1.4 Najbolj zahtevne naloge (po mnenju učiteljev)

Učitelji so v anketi dobili seznam nalog iz tekmovanja za razrede, ki so jih mentorirali. Med temi so morali označiti tiste, ki so bile za učence najtežje in so posledično pri njih dosegali najnižje število točk. Učitelji-mentorji v teh razredih so odgovorili, da sta v 2. razredu to bili nalogi »Robotska čebela« in »Gozdna

zabava«, v 3. razredu »Rojstnodnevna zabava« in »Robotska čebela«, v 4. razredu »Majini sosedi« in »Vijaki z matico«, v 5. razredu pa »Šifra 8« in »Zaporedje kamenčkov«. Slika 1 prikazuje podrobnejše podatke analize težavnosti nalog. Iz nje je razvidno, kako se ocenjena težavnosti v višjih razredih zmanjšuje.



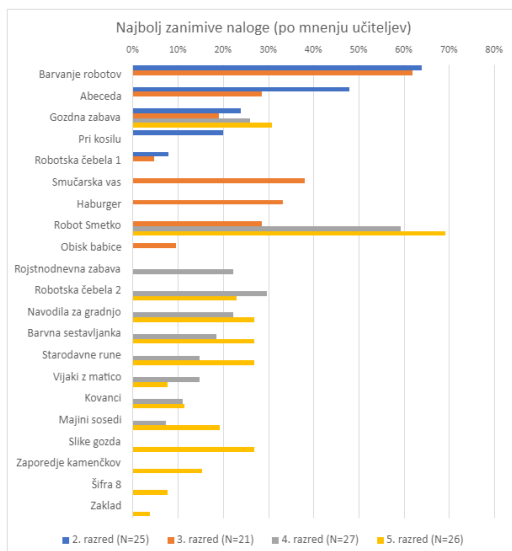
Slika 1: Mnenje učiteljev o zahtevnosti nalog na tekmovanju Bober 2022 od 2. do 5. razreda

Učitelji so navajali različne potencialne vzroke za višjo težavnost nekaterih nalog. V 2. razredu so izpostavljali, da učenci niso vajeni takšnega tipa nalog. Pri nalogi »Robotska čebela« so navajali, da je način spreminjanja smeri čebele drugačen, kot so ga vajeni iz matematike. Pri nalogi je bilo obračanje relativno glede na trenutno pozicijo, medtem ko pri matematiki uporabljajo absolutne premike. Predvsem jih je to motilo v primerih, ko se je morala čebela obrniti in nato premakniti naprej. Zmotno so mislili, da puščica za premika označuje dve akciji: obrat in premik, medtem ko je dejansko označevala zgolj obrat, premik v trenutni smeri pa je določala naslednja puščica. Pri nalogi »Gozdna zabava« pa so opazili, da učenci ne znajo brati tabel ter upoštevati omejitev. Vsaka žival na zabavi je lahko namreč pojedla največ tri jedi, teh pa ni bilo mogoče deliti.

V 3. razredu so učitelji opazili, da otroci nimajo ustrezno razvitih sposobnosti bralnega razumevanja in posledično težko iz besedila povzamejo ključne zahteve naloge. Pri nalogi »Rojstnodnevna zabava« so imeli težave pri upoštevanju vrstnega reda opravil, kar pa je ključno za pravilno rešitev. Prav tako so izpostavili, da je bila to zadnja naloga na tekmovanju in da je do takrat mnogo učencem že popustila koncentracija. Učitelji so navajali, da so imeli težave z bralnim razumevanjem tudi učenci 4. razreda. Ugotavljali so, da je v tej starostni skupini še vedno precej učencev, ki berejo počasi in da so bila zato besedila nekaterih nalog predolga. Eden od učiteljev je zapisal, da se učenci pri veliki količini besedila ustrašijo in ga v celoti izpustijo. Težave z branjem besedil so opazili tudi učitelji-mentorji učencev v 5. razredu. Večkrat se je namreč zgodilo, da učenci niso prebrali navodil, ampak so iz slike skušali uganiti kaj od njih zahteva naloga. V primeru, da niso takoj našli ustrezne strategije za reševanje naloge, pa so hitro odnehali.

3.1.5 Najbolj zanimive naloge (po mnenju učiteljev)

Podobno kot v zgornjem primeru, smo učitelje prosili, da označijo naloge, za katere menijo, da so bile učencem najbolj zanimive. Slika 2 prikazuje njihove odgovore. Opazimo lahko relativno velik razkorak med prvo in drugo najbolj zanimivo nalogo v posameznem razredu.



Slika 2: Mnenje učiteljev o zanimivosti nalog na tekmovanju Bober 2022 od 2. do 5. razreda

Analiza nalog, ki so jih učitelji iz svojih opažanj ocenili kot najbolj zanimive za učence pokaže, da gre za enostavnejše naloge. Npr. naloga »Barvanje robotov« od učencev zahteva, da pobarvajo različne dele robota. Pri tem morajo upoštevati preprosto pravilo, da je izbran del robota (npr. kapa) pobarvan z barvo, ki je nima noben drug od podanih treh robotov. Pri nalogi ni veliko besedila in je zastavljena kot uganka. Naloga »Abeceda« je od učencev zahtevala, da iz kombinacije dveh simbolov ugotovijo črko. Možne kombinacije so bile shranjene v tabeli, cilj pa je bil na ta način ugotoviti besedo. Iz priložene slike je bilo mogoče brez branja besedila sklepati, kaj naloga od nas zahteva. Pri nalogi »Smučarska vas« je bilo potrebno z upoštevanjem enostavnih izjav, ki so bile prikazane s simboli ugotoviti, v kateri hiški stanuje vsak od treh mladih bobrov. Pri nalogi »Robot Smetko« so morali učenci narisati pot robota, ki vedno pobere najbližjo smet in na ta način pospravi sobo. V 4. razredu je bila naloga »Robotska čebela« podobna, vendar težja od tiste v 2. oz. 3. razredu, saj je vključevala večjo mrežo, po kateri se je robot premikal in dodaten ukaz. Vendar je bila kljub temu za učence razumljiva in zanimiva. Podobno se je zgodilo pri nalogi »Gozdna zabava«, ki je bila za učence 2. razreda težka, učencem 5. razreda pa je bila zanimiva.

3.2 Analiza izbranih nalog na tekmovanju Bober v letu 2022

3.2.1 Robotska čebela

Pri nalogi »Robotska čebela« je potrebno najti ustrežno kombinacijo ukazov, ki čebelo na 3x3 mreži pripelje od njene začetne pozicije do rumenega panja. Čebelo lahko usmerjamo s pomočjo treh ukazov: »naravnost«, »desno« in »levo«. Ta naloga

je bila del nabora nalog za tekmovanje v 2. in 3. razredu. Običajno so v 2. razredu učitelji na glas prebrali besedilo naloge.

ROBOTSKA ČEBELA

ROBOTSKA ČEBELA POZNA UKAZE:

NARAVNOST	ČEBELA GRE ENO POLJE NAPREJ.
DESNO	ČEBELA SE NA MESTU OBRNE V DESNO.
LEVO	ČEBELA SE NA MESTU OBRNE V LEVO.



V GOZDU SO TRIJE PANJI, A LE RUMEN (R) PANJ JE DOM NAŠE ČEBELE.

KATERO ZAPOREDJE UKAZOV BO ČEBELO PRIPELJALO DO RUMENEGA PANJA? OBKROŽI.



Slika 3: Naloga »Robotska čebela«

Veščina računalniškega mišljenja, ki je potrebna za rešitev te naloge je algoritmično razmišljanje. Računalniško ozadje naloge pa je sledenje nizu ukazov. Naloga je relativno kratka, saj obsega okvirno zgolj 50 besed. Delovanje ukazov je ponazorjeno z grafičnimi simboli in kratkimi besedilnimi opisi. Menimo, da so učenci slabše reševali nalogo, ker so narobe interpretirali grafična simbola za obrat v desno oz. levo. Učitelji so navajali, da so bile rešitve usklajene z napačnim razumevanjem, da simbol pomeni premik naprej, obrat in še en premik v tej smeri. Iz tega je razvidno, da se učenci zelo zanašajo na grafično ponazoritev in ne na besedilo. Posledično pa je potrebno veliko pozornosti nameniti oblikovanju teh elementov.

3.2.2 Rojstnodnevna zabava

Pri nalogi »Rojstnodnevna zabava« je potrebno ustrezno razvrstiti opravila za organizacijo rojstnega dne. Opravila so predstavljena v tabeli, pri čemer je za vsako opisano, katera druga opravila morajo biti zaključena, preden je mogoče to opravilo izvesti. Učenec lahko izbira med štirimi ponujenimi odgovori in si tudi na ta način olajša reševanje.

ROJSTNODNEVNA ZABAVA

Bober si je za lažjo organizacijo zabave izdelal seznam opravil. Ugotovil je, da lahko nekatera opravila izvede le, če najprej opravi določena druga (spodnja tabela). Tako mora na primer bober pred izbiro lokacije najprej preveriti, koliko ljudi se bo zabave udeležilo.

OPRAVILO	Opravila, ki jih je potrebno opraviti prej
Preveri, koliko ljudi se bo udeležilo zabave.	10
Kupi prigrizke.	10
10 Določi datum.	NIČ
Oцени stroške.	10
Izberi lokacijo.	

Obkroži črko pred zaporedjem, ki prikazuje vrstni red, v katerem bo bober izvedel opravila.



Slika 4: Naloga "Rojstnodnevna zabava"

Veščine računalniškega mišljenja, ki so potrebne za rešitev te naloge so: algoritmično razmišljanje, posploševanje in

abstrahiranje. Računalniško ozadje je razvrščanje procesov. Besedilo naloge je relativno kratko, saj obsega 79 besed in vsebuje primer interpretacije ene vrstice v tabeli. Menimo, da težavnost naloge izhaja iz branja podatkov v tabeli, s čemer otroci v tej starostni skupini še nimajo veliko izkušenj. Še posebej, če niso pozorni na besedilo v glavi tabele, ki pojasnjuje pomen prikazanih simbolov.

3.2.3 Vijaki z matico

Naloga "Vijaki z matico" zahteva, da v skladu s pravili določimo zaporedje matic in vijakov na tekočem traku, ki omogoča uspešen zaključek procesa, pri tem pa upoštevamo posebni situaciji, ki prekineta postopek.

VIJAKI Z MATICO

Branko dela v tovarni na proizvodni liniji vijakov z matico.

Njegovo delo je naslednje:

- Branko stoji na koncu dolgega tekočega traku, na katerem je vrsta matic in vijakov.
- Branko vzame vsak element (ali matico ali vijak) s tekočega traku.
- Če s traku vzame matico, jo postavi v vedro, ki ga ima na tleh.
- Če s traku vzame vijak, pobere eno matico iz vedra, privije matico na vijak ter tako sestavljen del odloži v veliko škatlo.



Vendar pa gredo pri delu lahko stvari tudi narobe, in sicer v dveh primerih:

- Branko s traku vzame vijak, v vedru pa ni nobene matice.
- Na tekočem traku ni več matic in vijakov, v vedru pa so ostale še matice.

Katero zaporedje matic in vijakov , če jih obdelujemo z leve proti desni, **ne bo** povzročilo, da gredo stvari narobe?



Slika 5: Naloga "Vijaki z matico"

Veščini računalniškega mišljenja, ki sta potrebni za pravilno rešitev te naloge sta: algoritmčno razmišljanje in abstrahiranje. Računalniško ozadje je koncept potisnega avtomata, tj. avtomata, ki uporablja sklad. Besedilo naloge je relativno dolgo, saj obsega 135 besed, kar pridoda k težavnosti. Pri reševanju naloge je potrebno upoštevati štiri pravila in dve izredni situaciji, ki povzročita napako, kar je za učence lahko kompleksno.

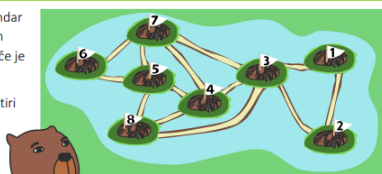
3.2.4 Majini sosedi

Naloga "Majini sosedi" zahteva, da ugotovimo, kje živijo bobri, pri čemer moramo upoštevati pravila, opredeljena v nalogi.

MAJINI SOSEDI

Bober želi obiskati prijateljico Majo, vendar ne ve, kje živi. Na srečo ima zemljevid in nekaj podatkov. Dva bobra sta soseda, če je med njunima bobriščema zgrajena pot.

- Maja, Zoja in Pavla imajo vsaka po štiri sosede.
- Zoja in Pavla sta sosedi z Niko.
- Nika nima drugih sosedov.



V katerem bobrišču živi Maja?

- 1 2 3 4 5 6 7 8 Ni mogoče določiti

Slika 6: Naloga "Majini sosedi"

Veščine računalniškega razmišljanja, ki jih moramo uporabiti za pravilno rešitev naloge so: abstrahiranje, logično sklepanje in dekompozicija. Računalniško ozadje so lastnosti grafa. Besedilo je relativno kratko, saj obsega 53 besed. Menimo, da lahko poleg kombiniranja treh veščin računalniškega mišljenja prispeva h

kompleksnosti naloge tudi zadnje pravilo, saj se navezuje na prejšnje.

4 ZAKLJUČEK

V članku smo predstavili izsledke raziskave med učitelji-mentorji slovenskega tekmovanja Bober v letu 2022 za učence od 2. do 5. razreda osnovne šole. Cilj raziskave je bilo ugotoviti kakšno je njihovo mnenje o tem, katere naloge so bile najzahtevnejše in katere najbolj zanimive za učence. Prav tako nas je zanimalo ali je bilo po njihovem mnenju učencem tekmovanje všeč, ter ali so organizirali priprave na tekmovanje, kakšne vsebine so obravnavali v okviru priprav in katere učne metode, oblike ter strategije so pri tem uporabili. Pri analizi nalog, ki so jih mentorji izpostavili kot težke smo ugotovili, da je pomembno, da je opis naloge jasn in nedvoumen ter da se pri predstavitvi kombinira besedilni in vizualni opis. Rezultati analize so pokazali, da imajo učenci nižjih razredov težave pri branju podatkov iz tabel. Menimo, da ti učenci še nimajo dovolj izkušnje s takšnim načinom podajanja podatkov, zato bi bilo smiselno pri pripravah na tekmovanje temu učnemu cilju posvetiti posebno pozornost. Poleg tega smo ugotovili, da imajo učenci težave pri bralnem razumevanju. To postane še posebej očitno pri nalogah, ki vsebujejo daljša in bolj kompleksna navodila. Te težave niso omejene zgolj na dolžino celotne naloge, saj se pojavijo tudi takrat, ko so posamezna pravila bolj zapletena in obsežna. Priporočilo, ki izhaja iz te ugotovitve je, da naj bodo opisi nalog jasni in razumljivi, pravila pa kratka in specifična, brez nepotrebnega nanašanja na druga pravila. Zelo pomembno je tudi, da so uporabljeni vizualni simboli nedvoumni. To je razvidno iz naloge »Robotska čebela«, pri kateri se je izkazalo, da so nekateri učenci napačno interpretirali ukaz za obračanje v levo oz. desno. V takih situacijah, zlasti če gre za naloge v nižjih razredih, priporočamo uporabo primera, ki vizualno ponazori delovanje ukazov. Iz analize rezultatov ni mogoče zaključiti, katera večšina računalniškega razmišljanja povzroča učencem v tej starostni skupini največ težav. Vendar pa pri zahtevnejših nalogah v višjih razredih opazimo, da je za pravilno rešitev potrebno združiti več različnih veščin. Menimo, da kombiniranje različnih veščin prispeva k težavnosti nalog.

Ugotovili smo, da so najbolj zanimive naloge tiste, ki vključujejo elemente igre, na primer uganke ali barvanje. Učenci pri reševanju takšnih nalog uživajo. Še posebej je to pomembno v nižjih razredih, saj želimo, da je zanje učenje zabavno in hkrati poučno. Na ta način bomo lahko pridobili več otrok k sodelovanju na tekmovanje Bober. To je ob dejstvu, da v Sloveniji nimamo obveznega predmeta, v okviru katerega bi se poučevale računalniške vsebine, izjemnega pomena, saj na ta način otroci lahko pridejo v stik s temi vsebinami.

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Starostnikom prijazna informacijsko-komunikacijska rešitev

Age-friendly information and communication solution

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POVZETEK

Študentski projekt z naslovom Multiplikativni učinki novih načinov zdravstvene samopomoči starostnikov, je bil izveden z namenom združevanja različnih vidikov zdravstvene samopomoči, kot možnosti, da starostniki z vodeno aktivnostjo bistveno vplivajo na izboljšanje svojih psihofizičnih sposobnosti in identifikaciji informacijsko komunikacijske rešitve prilagojene starostnikom.

S pomočjo predavanj, ki jih je podal dr. Nikolay Grishin in raziskave, izvedene na vzorcu udeležencev Šole zdravja, je bila izdelana učinkovita in starostnikom prijazna informacijska rešitev, za izobraževanje za potrebe zdravstvene samopomoči starostnikov na daljavo. Informacijska rešitev bo v pomoč tistim starostnikom, ki se ne morejo udeležiti skupinskih delavnic. Informacijska rešitev je pripravljena tudi z namenom motiviranja starostnikov, k spreminjanju svojih življenjskih in zdravstvenih navad v smeri aktivnosti, ki bi jim čim dlje omogočale aktivno in samostojno življenje.

KLJUČNE BESEDE

Starostniki, Šola zdravja, vadba, informacijsko-komunikacijska rešitev

ABSTRACT

The student project entitled Multiplier effects of new ways of medical self-help of the elderly was carried out with the purpose of combining various aspects of medical self-help and improving psychophysical activity of the individual and finding an information and communication solution tailored to the elderly.

With the help of lectures conducted by Dr. Grishin and the research carried out on a sample of participants of the Health School of Health created an effective IT solution for distance health self-help education. The IT solution would help those individuals who cannot attend group workshops and motivate those who have not yet taken a step towards improving their life and health habits.

KEYWORDS

Elderly, Health school, exercise, information and communication solution

1 UVOD

Letos je potekal študentski projekt z naslovom Multiplikativni učinki novih načinov zdravstvene samopomoči starostnikov. Na projektu je sodelovalo osem študentov iz različnih fakultet, dva pedagoška mentorja iz Fakultete za organizacijske vede, Univerze v Mariboru in partner Šola zdravja iz negospodarstva.

V projektu smo izvedli raziskavo na starostnikih, ki so člani Šole zdravja. S pomočjo analize njihovih odgovorov smo razvili informacijsko-komunikacijsko rešitev primerno za uporabo glede na njihove zmožnosti uporabe računalnika. V nadaljevanju smo podali predloge za nadgradnjo spletne strani, ki bi v prihodnje starostnikom omogočila lahko in učinkovito iskanje želenih informacij.

2 TEORETIČA IZHODIŠČA

Ob vse hitrejšem staranju prebivalstva raziskovalci veliko pozornosti namenijo človeški aktivnosti starostnikov (Lentzas and Vrakas, 2020). Starostniki se velikokrat spopadajo z različnimi boleznimi, katere skušajo omiliti z vnosom različnih zdravil kar zavira gibljivost (Factor et al., 2019).

Zmanjšana gibalna sposobnost privede do zmanjšane kakovosti življenja, kar nenazadnje vpliva na povečano obremenitev družine in okolja (Wen Xiangtian and Wenyi, 2022). Lavinger in drugi (2020) ugotavljajo, da so vadbe v parku, ki jih izvajajo starostniki lahko učinkovita rešitev za ohranjanje in izboljšanje dobrega počutja in telesnih funkcij.

Razvite so številne metode telovadb, ki večinskemu delu populacije, omogočajo aktivno preživljanje časa. Pri starostnikih sta intuitivna interakcija in vadbena rutina ključni za ohranjanje gibljivosti (Fernandez et al., 2018). Schwenk in drugi (2019)

ugotavljajo, da programi funkcionalne vadbe uspešno pripomorejo k zmanjšanju padcev.

Zaporedni dnevi poležavanja doma na dolgi rok povzročajo prekomerno telesno nedejavnost (Aung et al., 2020). Levinger in drugi (2018) poudarjajo, da ima gibanje na prostem blagodejen vpliv na telesno in duševno zdravje ljudi.

3 METODE DELA

Glede na problematiko starostnikov smo na Fakulteti za organizacijske vede že dlje časa razvijali zamisel o ustanovitvi kakovostne spletne strani, ki bo starostnikom omogočala učinkovite nasvete glede samopomoči in ohranjanju aktivnega življenja. V Sloveniji je več kot dvesto petdeset skupin društva Šole zdravja, ki vsako jutro aktivno telovadi v zelenju in naravi (Društvo Šola zdravja, 2021).

Telovadba se izvaja v vseh letnih časih in tako omogoča aktivno življenje starostnika ne glede na zunanje vplive. Vaje so primerne vsem ne glede na starost vendar v njih največkrat zasledimo starostnike. Vsak si lahko na dan privoščiti produktivnih trideset minut v katerih si razgiba vsak del telesa. Delo je bilo izvedeno na daljavo, saj je tako bil zagotovljen čas za uspešno usklajevanje projektnega dela in prostega časa. Projekt je na študente imel pozitiven vpliv, saj smo s pomočjo njega razvili kompetenco timskega dela.

4 OD ZASNOVE DO IZVEDBE

Predavanja dr. Alekseja Grishina so nam poleg predstavitev spoznanj z medicinskega vidika, omogočila razumeti, zakaj je gibanje pomemben del samooskrbe vsakega človeškega organizma, še posebej organizma starostnika. Dr. Grishin poudarja, da je socialna interakcija starostnika ključnega pomena za fizično in mentalno zdravje, saj skozi druženje in igro pride do afizičnih in socialnih aktivnosti, kar pa je željeni cilj.

S pomočjo praktičnih primerov, ki jih je demonstriral dr. Grishin smo dojemali pomen aktivnega gibanja, ki v bistvu telo razbremenjuje. Ena od metod dr. Grishina je metoda samopomoči 23+5, ki predstavlja 23 različnih vaj in 5 ključnih točk na telesu, ki jih je treba razbremeniti oziroma zaktivirati.

Dr. Grishin trdi, da morajo starostniki na vadbah odpraviti čustveno napetost, ki posledično zmanjšuje odprtost telesa in s tem negativno vpliva na vse procese, ki potekajo v telesu. Eden od razlogov, zakaj vadbe potekajo v naravi, je pridobivanje energije in miru, ki ga ponuja narava. Dr. Grishin je opozoril, da je človek del sveta in, da lahko z dobrimi vadbenimi praksami v naravi pozitivno vplivamo na podzavest večine starostnikov.

V sklopu projekta so se tudi študentje udeležili jutranje vadbe v Šoli zdravja. Študentje trdijo, da se pozitivnega vzdušja in zadovoljstva ob prvem stiku članov Šole zdravja s študenti ne da opisati z besedami. Kraj, kjer udeleženci vsakodnevno telovadijo so nadvse vabljivi. Narava in parki, kar dišijo po

svežini in zelenju in so stran od mestne naglice, hrupa in urbanih pritiskov.

Število članov v posamičnih vadbenih skupinah je različno, vendar smo opazili, da vadbo obiskujejo večinoma ženske. Vodja na vadbi prikazuje pravilno izvedbo vaj, članice pa mu sledijo. Med vajami je zastopana disciplina, saj potekajo v tišini, kjer sta ključna predanost in posvečena aktivnost. Skupaj z ostalimi člani društva so tudi študentje izvajali vaje in kasneje ugotavljali, da je vadba vplivala na njihovo celotno počutje tekom dneva.

Ob izvajanju vaj so študentje opazovali vadeče starostnike in ugotavljali, da nekateri člani vaje izvajajo težje kot drugi, vendar jim ne primanjkuje upornosti in energije za izvedbo vaj. Študentje ugotavljajo, da nekateri starostniki veliko vaj ne izvajajo ali pa jih ne izvajajo pravilno, saj so delno gibalno omejeni, vendar to ne spremeni dejstva, da se trudijo in želijo iz vadbe potegniti samo najboljše.

Študentje trdijo, da so udeleženci Šole Zdravja z veseljem privolili v intervju in suvereno odgovarjali na vprašanja. Vsak od študentov je imel nalogo anketirati dva člana skupine, s skupno sedemnajstimi vprašanji iz vnaprej sestavljenega vprašalnika. Intervju je bil sestavljen sistematično, z namenom pridobivanja informacij o njihovem zdravstvenem stanju, zadovoljstvu z delovanjem Šole zdravja, razlogih za njihovo članstvo in vprašanj, ki so jim bila v pomoč za pripravo in razvoj informacijsko komunikacijskega sistema, primerne za starostnike.

V okviru projekta Šola zdravja so študentje uspešno razvili in implementirali inovativno informacijsko - komunikacijsko rešitev, ki je bila zasnovana z mislijo na potrebe in izzive, s katerimi se srečujejo starostniki. Glavni cilj projekta je bil zagotoviti prilagojeno in enostavno dostopno rešitev za izvajanje vadbe na daljavo, z namenom starostnikom omogočiti aktivno in zdravo življenje.

V ta namen so študentje ustvarili spletno učilnico (slika 3.1) za razvoj so uporabili WordPress. Ta inovativna rešitev predstavlja enega od ključnih dosežkov projekta Šola zdravja in je namenjena izboljšanju življenjskega sloga starostnikov. Spletna učilnica omogoča enostaven dostop do vadbenih programov, navodil in vsebin za izboljšanje telesne kondicije.



Slika 3.1 Primer spletne učilnice

Poudarek je bil na uporabniški izkušnji, ker mnogi starostniki nimajo znanj za uporabo informacijske tehnologije. S starostnikom prijazno informacijsko - komunikacijsko rešitvijo so študentje starostnikom iz Šole zdravja, olajšali učenje in omogočiti postopno pridobivanje veščin za uporabo spletne učilnice.

Zgoraj omenjeno bistveno prispeva k razvoju kompetenc starostnikov in jim omogoča neodvisnost pri uporabi sodobne informacijske tehnologije. Omenjena informacijsko-komunikacijska rešitev ima velik potencial za izboljšanje kakovosti življenja starostnikov, saj spodbuja aktivno, samostojno življenje in hkrati omogoča ohranjanje stika s sodobno tehnologijo.

4 ZAKLJUČEK

Starostniki so lastniki velike količine znanja in izkušenj iz različnih strokovnih področij. Znanje, ki ga imajo je potrebno skrbno negovati in ohranjati. Glede na to, da se število starostnikov iz leta v leto povečuje, jim je potrebno za njihovo čim daljšo življenjsko samostojnost ponuditi metode in tehnologijo ki bi omogočila ohranjanje in posodabljanje njihovega intelektualnega kapitala.

Študentje trdijo, da je gospodarski in zdravstveni sistem preobremenjen, zato mora vsak posameznik čim dlje ostati samostojen. Vključevanje starostnikov v Šolo zdravja je ena izmed učinkovitih rešitev, ki uspešno pripomorejo k ohranjanju zdravja in dobrih medčloveških odnosov.

Kakovostna spletna stran, bo tudi gibalno oviranim starostnikom omogočila dostop do video posnetkov, ki uspešno pripomorejo k ohranjanju zdravega duha v zdravem telesu. Ker so starostniki manj veščini uporabe spleta študentje predlagajo dodatno nadgraditev trenutne informacijske-komunikacijske rešitve z virtualno osebo, ki bo ponudila pomoč pri iskanju vsebin.

V raziskavi so zasledili tudi, da pojma osamljenosti pri starejših ne smemo zanemariti, zato predlagajo ustanovitev klepetalnice, kjer bodo starostniki z izmenjavo izkušenj in znanja glede samopomoči ohranjali človeške stike.

ZAHVALA

Zahvaljujemo se sofinancerjem _____, ki so nam omogočili delo na projektu ter pedagoškima mentorjema dr. Goranu Vukoviču in dr. Urošu Rajkoviču za vse naporitve in pomoč pri izdelavi informacijsko-komunikacijske rešitve.

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Zagotavljanje znanja za zdravstveno samopomoč starostnikov

Providing Knowledge for Health Self-Care for Older People

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POVZETEK

V samem procesu staranja se naše telo spreminja. Zato je v tem obdobju redna vadba ključnega pomena. Telo z leti postane manj zmogljivo in fleksibilno. Zelo je pomembno, da v svoje dnevne navade vključimo telovadbo že zelo zgodaj ter kasneje to navado ohranjamo. V sklopu projekta smo se udeležili telovadbe v društvu Šole zdravja in opravili intervjuje z udeleženci v različnih skupinah po Sloveniji. Ugotovili smo, da se starejši največkrat spopadajo s težavami povezanimi z sklepi, hrbtenico in ščitnico. Udeleženci Šole zdravja se pri izvajanju vaj nekoliko prikrajšani saj z leti se vzdržljivost in moč nekoliko zmanjšata. Poleg aktivne udeležbe v Šoli zdravja se udeleženci poslužujejo tudi drugih oblik samopomoči kot so hoja, plavanje, uporaba različnih dodatkov in drugo. Razlogi za priključitev k jutranji telovadbi so različni od starosti, bolezní do smrti zakonskega partnerja. Pozitivni premiki, ki jih zaznavajo ob rednih vadbah so boljše počutje, gibčnost, fleksibilnost ter odprava obstoječih težav. Navajajo da so medčloveški odnosi ključni v teh letih in da se v društvu pogovarjajo o različnih tematikah. Ugotovili smo tudi, da so intervjuvanci manj veščí uporabe informacijsko-komunikacijske tehnologije pri čemer smo se potrudili ustvariti spletno stran primerno njihovim potrebam.

KLJUČNE BESEDE

Šola zdravja, Starejši, 3. Telovadba

ABSTRACT

*Article Title Footnote needs to be captured as Title Note

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In the aging process itself, our body changes. Therefore, during this period, regular exercise is even more crucial. The body becomes less powerful and flexible over the years. It is very important to include exercise in your daily habits at a very early age and maintain this habit later. As part of the project, we attended gymnastics at the Health Schools Association and interviewed participants in various groups around Slovenia. We have found that older people most often struggle with problems related to joints, spine and thyroid gland. Participants of the Health School are somewhat disadvantaged when performing exercises, because over the years, endurance and strength decrease slightly. In addition to active participation in the Health School, participants also use other forms of self-help such as walking, swimming, using various accessories and more. The reasons for joining a morning exercise vary from age, illness to death of a spouse. The positive shifts they perceive during regular workouts are better well-being, flexibility, flexibility and elimination of existing problems. They state that human relationships are crucial in these years and that the association talks about various topics. We also found that the interviewees are less skilled at using information and communication technology, and we tried to create a website appropriate to their needs.

KEYWORDS

Health school, Seniors, 3. Gym

1 UVOD

Redna telesna aktivnost in konstantno gibanje pripomoreta k posameznikovem boljšem počutju na večih področjih. S pomočjo gibanja ohranjamo naše telo zmogljivo ter zdravo. Hkrati pa tudi lahko vplivamo na naše počutje. Vsakdanje gibanje lahko vpliva tako na naše fizične sposobnosti, kot tudi na naše psihično stanje.

Iz vidika fizičnih sposobnosti nam redna telovadba in telesna aktivnost pomagata pri boljši kondicijski formi ter dobri gibljivosti. Z gibljivostjo lahko preprečimo nastajanje novih

poškodb v telesu ali pa morebitne oziroma že obstoječe poškodbe omilimo in odstranimo.

Dobra kondicijska zmogljivost in zdravo telo posledično vpliva tudi na naše psihično počutje. Z rednim gibanjem naše telo ohranjamo v vrhunskem stanju, kar pa posledično vpliva na našo samozavest in zadovoljstvo v svojem telesu.

V sklopu projekta Šole zdravja smo želeli ugotoviti kako starejši člani z rednim obiskom jutranjih telovadb Šole zdravja omilijo obolenja.

Šola zdravja starejšim članom pomaga pri razumevanju določenih gibov, ki lahko vplivajo na različne predele telesa in jih usmerja kako lahko na različne načine ohranjajo svoje telo zdravo ter aktivno.

V okviru naše raziskave smo želeli ugotoviti s katerimi zdravstvenimi težavami se srečujejo starejši, katere nepravilnosti se pojavljajo pri izvajanju vaj v Šoli zdravja in kako te v nadaljevanju odpravijo, kaj člani poleg šole zdravja še uporabljajo za samopomoč, kateri so razlogi za priključitev društvu šole zdravja, kakšne pozitivne premike zaznavajo člani Šole zdravja ob rednih vadbah, kakšno vlogo vodijo medčloveški odnosi v samem društvu in kakšen vpliv ima na njihovo aktivnost informacijsko – komunikacijska tehnologija.

Analizo naše raziskave smo izvedli s pomočjo pridobljenih odgovorov, na podlagi izvedenih intervjujev. Udeležili smo se nekaj jutranjih telovadb, kjer smo se s člani Šole zdravja pogovorili o zdravstvenem stanju, telovadbi in drugem. Namen naše raziskovalne naloge je ozaveščati o pomenu gibanja vseh generacij s poudarkom na starejših.

2 TEORETIČNE OSNOVE

Družba je postala vse bolj dolgoživa, rodnost pa se je zmanjšala. Vse več je starejših in potrebno je sistem in okolje prilagoditi njihovim potrebam (UMAR, 2017). Starejši so velika zakladnica znanja in imajo tako svoje prednosti kot slabosti. V organizacijah je potrebno delovna mesta ergonomsko prilagoditi starejšim, da lahko efikasno opravljajo delovne naloge. Ergonomsko prilagoditev pa ni potrebna le v podjetjih temveč tudi zunaj njega.

Starejši se morajo zavedati, da njihova produktivnost z leti upada in, da njihov organizem potrebuje spremembe (Šet, 2015). Veliko pozornost je v starosti potrebno posvetiti prelomnim dogodkom, ki nas obdajajo. Različne življenjske okoliščine nas pripeljejo do razmišljanja ali je starost zares takšna kakor na prvi pogled deluje. Staranje prinaša veliko odprtih vprašanj na življenjskem področju, katera so ključna za obvladovanje vse večjega števila starejših prebivalcev (Štandeker, 2021).

Glede na zgodovino se je odnos do starejših veliko spremenil. Civilizacija se mora zavedati staranja in vzpostaviti učinkovit odnos do le tega (Štandeker, 2023). Življenje v penziju se

ne sme ustaviti, ravno nasprotno. Telo je potrebno še posebej v letih razgibavati, saj tako lahko podaljšamo našo gibljivost. Ena izmed učinkovitih rešitev za razgibanje je prav Šola zdravja katero je ustanovil Nikolay Grishin, dr. med. (Šola Zdravja, 2021).

3 RAZISKAVA

V raziskavi smo zajeli odgovore devetih intervjuvancev, ki so del Šole zdravja v različnih skupinah po Sloveniji. Odgovarjali so ustno na sedemnajst zastavljenih vprašanj s področja medčloveških odnosov, bolezni, telovadb in številnih drugih področij.

Na podlagi analize manjšega odstotka udeležencev Šole zdravja smo prišli do zaključkov, s katerimi najpogostejšimi zdravstvenimi težavami se srečujejo starejši. Med najpogostejšimi zdravstvenimi težavami so bolečine v hrbtu, osteoporoza, bolečine v sklepih, visok krvni tlak, želodčne težave in težave s ščitnico. Bolečine v hrbtu in sklepih pomembno vplivajo na funkcionalnost posameznika in kakovost življenja. Osteoporoza je bolezen, pri kateri pride do izgube kostne gostote in povečanega tveganja za zlome kosti, težave z ravnotežjem in gibanjem.

Najpogostejše težave, s katerimi se udeleženci srečujejo pri izvajanju vaj, sta pomanjkanje moči in premajhna vzdržljivost. Posamezniki so izpostavili nekatere vaje, ki jih izvajajo zelo dobro ali pa jim predstavljajo težave zaradi zdravstvenih razlogov. Najpogostejše problematične vaje so tiste, ki zahtevajo moč, vaje, povezane z nogami, pri katerih običajno čutijo bolečino ali pomanjkanje vzdržljivosti. Pomanjkanje moči in ravnotežja sta dva glavna vzroka, zaradi katerih udeleženci težko izvajajo vaje.

Poleg Šole zdravja se udeleženci poslužujejo tudi drugih oblik pomoči. Največkrat so omenili hojo kot glavni vir samopomoči. Zasledili smo, da se nekateri udeleženci poleg Šole zdravja udeležujejo dodatne telovadbe ali joge. Nekateri izmed udeležencev se poslužujejo tudi zdravnih rastlin, plavajo ter koristijo dodatke k prehrani in vitamine.

Razlogi za priključitev v društvo Šole zdravja so različni. Pri nekaterih je odločilen dogodek bil vstop v penzijo in predvsem starost. Drugi so navajali tudi selitev družinskega člana in smrt zakonskega partnerja. Zdravstveno stanje se razlikuje od člana do člana. Nekateri navajajo, da so imeli zdravstvene težave drugi pa ne. Ključno, kar poudarjajo vsi udeleženci pa je, da so s telovadbo zadovoljni in, da so bolj gibčni ter polni energije. Udeleženci navajajo, da jutranja telovadba vpliva na celotno počutje tekom dneva. Starostniki menijo, da je potrebno več pozornosti posvetiti pojmu osamljenosti ter psihološkem in socialnem stanju človeka.

Ko govorimo o izboljšanju njihovih medčloveških odnosov, lahko opazimo, da večina udeležencev v Šoli zdravja opaža pozitivno spremembo s sklepanjem novih poznanstev, izmenjavo izkušenj, s čimer si širijo obzorja ob druženju izven dejavnosti Šole zdravja. Tisti, ki razlike ne opazijo, to

pojasnjujejo s tem, da so že pred udeležbo na vajah imeli in negovali medosebne odnose, pri tem pa so se izogibali konfliktom.

Uporaba spletnih vsebin je prisotna pri približno polovici anketiranih. Tisti, ki ga ne uporabljajo in tudi v prihodnje ne bi uporabljali bolj inovativnih spletnih vsebin, navajajo, da nimajo dovolj znanja za uporabo računalnika ali pa se ga izogibajo. Kot slabosti navajajo posledično zmanjšanje stika z ljudmi in naravo. Prednosti se kažejo v samostojnosti posameznika pri vadbi.

4 DISKUSIJA

Udeleženci Šole zdravja so pogosto starejši ljudje, kar se odraža po običajnih starostnih težavah, kot so težave s kostmi in s tem omejena gibljivost in sposobnost gibanja. Pri odpravljanju tovrstnih zdravstvenih težav pomagajo vaje, ki so zastopane v dejavnostih Šole zdravja. Te vaje zajemajo usmerjene vadbe, ki pripomorejo k krepitvi hrbtnih mišic, raztezanju in izboljšanju telesne države.

Nepravilno dihanje pri izvajanju vaj ne daje učinkovitih rezultatov, zato je treba posvetiti pozornost posameznikom in se posvetiti izboljšanju njihove aktivne udeležbe. Pomembno je omeniti, da lahko pri nepravilni izvedbi pride celo do negativnih učinkov. Potrebno je udeležence opozoriti, da je bolje izvesti manj pravih poskusov v seriji vaj kot več poskusov, ki niso izvedeni po pravilih. Vsako vajo se je treba lotiti temeljito, da bi od nje lahko pričakovali efikasno končno rešitev.

Nekateri ne opazijo nepravilnosti pri izvajanju vaj, tisti, ki pa jih opazijo pa se o njih dodatno podučijo z viri objavljenimi na spletni strani Šole zdravja. Večina udeležencev se poleg aktivne udeležbe v Šoli zdravja poslužuje tudi daljših pohodov, vadbe kot je joga, plavanja ter uživanje prehranskih dopolnil in vitaminov.

Medosebni odnosi v skupini so zelo pomembni in udeležencem na nek način predstavljajo podporo in motivacijo. Poleg interakcije med aktivnostmi v Šoli zdravja so posamezniki medsebojne stike ohranjali tudi izven teh aktivnosti. Z organizacijo skupnih aktivnosti poleg Šole zdravja, kot so sprehodi, odhodi na kavo, izleti, jim pomaga nenehno razvijati socialni segment njihovega življenja, kar precej pripomore k njihovemu splošnemu zadovoljstvu. Zmanjša se občutek osamljenosti, povečuje se zadovoljstvo in izpolnjenost, volja in trud za lasten napredek.

Starejši ljudje velikokrat bivajo stran od svojih najbližjih družinskih članov, kar lahko nenazadnje negativno vpliva tudi na osamljenost. Osamljenost se velikokrat pojavi tudi ob izgubi življenjskega sopotnika, ki je bil desna roka v celem odnosu. Pomen osamljenosti velikokrat zanemarjamo vendar v praksi ni ravno tako nedolžen pojav, saj lahko terja pojav različnih bolezni.

5 ZAKLJUČEK

Motivi za vključitev v Šolo zdravja so izboljšanje zdravja, pa tudi pomanjkanje druženja in želja po izboljšanju družbenega življenja oziroma laična odločitev posameznika, da se vključi v aktivnosti. Vaje pomagajo izboljšati mobilnost in prožnost ter lajšajo bolečine, ki so pogoste pri tej starostni skupini. Ugotovili smo da udeleženci občutijo pozitivne spremembe na področju svoje fleksibilnosti in se zato počutijo bolj srečne in zadovoljne.

Poleg fizične aktivnosti gre tudi za krepitev mentalnih sposobnosti. Z navezovanjem stikov, spoznavanjem in druženjem se povečuje občutek sprejetosti in sproščenosti. Njihove jutranje aktivnosti v Šoli zdravja pozitivno vplivajo na njihovo vsakodnevno delovanje in počutje čez dan, dobijo energijo, ki jo potrebujejo za aktivnost skozi ves dan.

Ugotavljamo, da sta druženje in učinkovito preživljanje prostega časa pomembna motiva udeležencev za vključitev v Šolo zdravja. Negativno psihično stanje človeka lahko povzroči izgubo volje do dela na sebi, lahko povzroči anksioznost, depresijo, kognitivne težave. Udeleženci po vadbi izmenjujejo informacije o vsakdanjih dogodkih, izkušnjah, povečujejo interakcijo in odpravljajo občutek osamljenosti in ne pripadnosti.

Starejša generacija je manj večča dela z računalnikom zato smo poskušali razviti spletno stran, ki bo enostavna za uporabo. Na spletni strani bodo naloženi različni članki, znanstveni prispevki, videi pravilne izvedbe vaj, klepetalnica in še veliko koristnih vsebin. Intervjuvanci sicer vztrajajo na ohranjanju osebnega stika v naravi vendar je vzpostavitev informacijsko-komunikacijske rešitve ključna za tiste, kateri so zaradi fizičnih zmožnosti delno ali v celoti prikrajšani.

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Krepitev digitalne suverenosti nevladnih organizacij s podpornim okoljem za uporabo odprtokodne programske opreme – Na-prostem.si

Strengthening the digital sovereignty of NGOs through a supportive environment for the use of open source software - Na-prostem.si

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POVZETEK

Digitalna suverenost predstavlja pomemben vidik digitalne preobrazbe nevladnega sektorja. Suverenost organizacij in posameznikov v digitalnem okolju pomeni samostojno in informirano odločanje o uporabi strojne in programske opreme ter spletnih storitev. Rezultati raziskave o uporabi in potrebah v povezavi z odprtokodnimi programi kažejo, da se nevladne organizacije (NVO) zavedajo prednosti odprtokodne programske opreme pri zagotavljanju digitalne suverenosti, vendar pa jo pri svojem delu uporabljajo v manjši meri. Prispevek predstavlja digitalno storitev www.na-prostem.si, ki deluje kot podporno okolje za informiranje, neformalno usposabljanje in pomoč pri uporabi preverjenih odprtokodnih in prosto dostopnih programov ter storitev. Hkrati prispeva k digitalni vključenosti NVO in prostovoljskih organizacij ter njihovih uporabnikov v družbo z donacijami obnovljene računalniške opreme, kjer je nameščen Linux operacijski sistem. Podporno okolje Na-prostem.si je bilo prepoznano kot pozitiven premik za leto 2022 v Sloveniji pri izvajanju zavez Berlinske deklaracije o digitalni družbi in digitalni vladi, ki temelji na vrednotah.

KLJUČNE BESEDE

Digitalna suverenost, nevladne organizacije, odprtokodna programska oprema, podporno okolje

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ABSTRACT

Digital sovereignty is an important aspect of the digital transformation of the NGO sector. Sovereignty for organisations and individuals in the digital environment means making autonomous and informed decisions about the use of hardware, software and online services. The results of the survey on the use and needs related to open source software show that non-governmental organisations (NGOs) are aware of the benefits of open source software in ensuring digital sovereignty, but use it to a lesser extent in their work. This paper presents the digital service www.na-prostem.si, which acts as a supportive environment for information, informal training and assistance in the use of proven open source and freely available software and services. At the same time, it contributes to the digital inclusion of NGOs and voluntary organisations and their users in society by donating refurbished computer equipment running the Linux operating system. The Na-prostem.si support environment has been recognised as a positive development for 2022 in Slovenia in implementing the commitments of the Berlin Declaration on a Digital Society and a Digital Government based on Values.

KEYWORDS

Digital sovereignty, NGOs, open source software, enabling environment

1 UVOD

NVO[1] so eden izmed ključnih gradnikov civilne družbe, ki pomembno prispevajo k družbenem razvoju, porastu družbene blaginje, kakovosti življenja, družbeni povezanosti in solidarnosti ter uresničevanju načel pluralnosti in demokracije[2]. V Sloveniji je registriranih 27.470 NVO, od

tega 23.322 društev, 3.893 (zasebnih) zavodov in 255 ustanov, ki zaposlujejo nekaj več kot 12.000 ljudi[3] in povezujejo večino izmed 226.000 prostovoljcev[4]. Največ NVO deluje na področju športa, kulture, sociale, izobraževanja, varstva okolja ter zaščite, reševanja in pomoči.

Podobno kot ostali sektorji družbe, se tudi NVO odzivajo na organizacijske, procesne in komunikacijske spremembe, ki jih prinašajo digitalne tehnologije. Digitalizacija nevladnega sektorja v ožjem pomenu naslavlja uporabo digitalnih tehnologij pri delovanju, poslovanju in zagovorništvu NVO. Širša posledica digitalizacije je digitalna preobrazba organizacij, ki poleg tehnoloških prinaša tudi procesne, komunikacijske in kulturne spremembe. Pomemben vidik digitalne preobrazbe NVO sektorja je zagotavljanje njegove digitalne suverenosti[5], ki pomeni njihovo zmožnost, da se zaščitijo pred digitalnim nadzorom državnih akterjev, da zavarujejo svoje podatke pred poslovnimi modeli podatkovnega kapitalizma ter da se samostojno in informirano odločajo o uporabi strojne in programske opreme ter spletnih storitev[6].

Pomembni uporabniški prednosti preverjene odprtokodne (prosto dostopne) programske opreme za digitalizacijo NVO sta dostopnost in prilagodljivost, ki izhajata iz proste uporabe licence brez licenčnine za neomejeno legalnih kopij. Da je nek računalniški program prosto programje, mora uporabniku zagotavljati naslednje pravice oz. svoboščine: pravico, da program prosto uporablja za kakršen koli namen; pravico, da prosto preuči, kako program deluje - za ta namen mora biti na voljo izvorna koda; pravico, da program prosto prilagodi svojim željam in potrebam – tudi za ta namen mora biti na voljo izvorna koda; ter pravico, da program in svoje spremembe na njem prosto širi naprej[6].

Naštete svoboščine odprtokodne programske opreme omogočajo NVO-jem preprečevanje t.i. »priklenitve na prodajalca« (ang. vendor lock-in) programske in strojne opreme ter digitalnih storitev. V primeru priklenitve na prodajalca gre za porabo zasebnih in javnih sredstev za digitalne produkte, od katerih javnost nima praktično nič. Boljšo alternativo predstavlja poraba sredstev NVO za odprtokodno in prosto dostopno programsko opremo in storitve, ki omogočajo ponovno rabo in (re-)investicije v skupno dobro[7]. Na takšen način NVO zmanjšujejo lastno odvisnost od programov in storitev tehnoloških korporacij[8].

2 POTREBE IN ODNOS DO ZAGOTAVLJANJA DIGITALNE SUVERENOSTI NEVLADNEGA SEKTORJA

Raziskava[9] o uporabi in potrebah NVO v povezavi z odprtokodnimi programi, ki je bila izvedena v okviru projekta Na-prostem.si, je pokazala precejšen delež strinjanja respondentov s trditvami, da odprtokodni programi in storitve »omogočajo neodvisnosti uporabnika

od tehnoloških korporacij in monopolov« (72 %) in so »razviti na pravičnih, etičnih in trajnostnih načelih« (65,6 %), »spodbujevalec sodelovanja posameznikov in skupnosti pri razvoju programov in storitev« (64 %) ter »varni z vidika zaščite podatkov in zasebnosti« (52 %).

Kljub relativno visoki stopnji zavedanja o prednostih odprtokodne programske opreme pri zagotavljanju digitalne suverenosti pa je njihova uporaba med NVO dokaj skromna. Podatki raziskave med anketiranimi NVO kažejo, da jih:

- 23,8 % uporablja pisarniški paket LibreOffice,
- 21,4 % program za urejanje grafike GIMP,
- 20,6 % videokonferenčno storitev Jitsi Meet,
- 18,2 % Linux operacijski sistem,
- 15,9% e-poštni program Mozilla Thunderbird,
- 11,9 % oblračno storitev za skupno urejanje dokumentov Nextcloud in
- 2,4 % video platformo PeerTube.

Precej večji delež NVO uporablja spletni brskalnik Mozilla Firefox (50,8 %) in program Wordpress za izdelavo spletnih strani (48,4%).

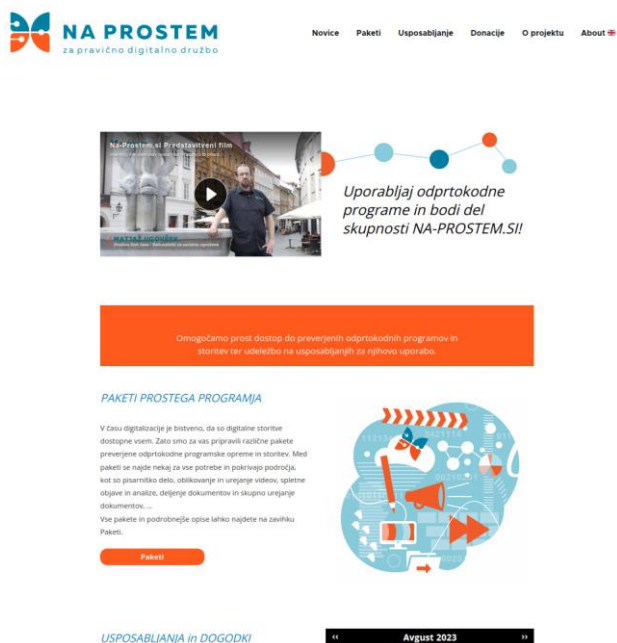
Na vprašanje o posameznih pogojih, ki bi prepričali anketirane NVO, da bi začele uporabljati odprtokodni program oz. storitev, sta bila najpogostejša odgovora »enostavnost uporabe in zanesljivo delovanje« (94,4 %) in »pokrivanje delovnih potreb« (91,3 %). Kot tretji najpogostejši pogoj so respondenti navedli »enake ali boljše funkcionalnosti od zaprtokodnih (plačljivih) programov« (88,1 %). Naslednja po pomembnosti sledita pogoja, ki se nanašata na zagotavljanje digitalne suverenosti kot sta »zagotavljajo zasebnost in ne sledijo uporabnikom« (86,5 %) in »ustrezne informacije in vsebine o odprtokodnih programih/storitvah« (82,5 %).

Predstavljeni rezultati raziskave o uporabi in potrebah NVO v povezavi z odprtokodnimi programi kažejo na njihov pragmatični odnos do programske opreme. Programska oprema mora v prvi vrsti izpolniti pričakovanja NVO glede uporabnosti oz. t.i. »funkcionalne pogoje«. V povezi s tem so respondenti kot pomembne pogoje za začetek uporabe odprtokodnega programa oz. storitve navedli tudi t.i. »podporna pogoja« kot sta »urejen servis in podpora pri prehodu na odprtokodne programe/storitve« (80,2 %) in »hitra in učinkovita pomoč uporabnikom« (79,4 %).

3 PODPORNİ SPLETNI SERVIS NA-PROSTEM.SI

Prispevek lahko vsebuje slike in tabele. V delu besedila prispevka, kjer opisujete sliko oz. tabelo, je potrebno navesti sklic nanjo. Rezultati raziskave so predstavljali koristno

vodilo razvijalcem spletne podporne storitve za uporabo odprtokodne programske opreme med NVO. Spletni servis Na-prostem.si (Slika 1) sestavljajo gradniki preverjenih odprtokodnih in prosto dostopnih programov in spletnih storitev. Pri združevanju različnih odprtokodnih storitev v enotno spletno platformo so si razvijalci pomagali z nasveti in izkušnjami slovenske odprtokodne skupnosti.



Slika 1: Vstopna stran digitalne storitve www.na-prostem.si

V nadaljevanju predstavljamo posamezne odprtokodne storitve in programe ter njihove uporabniške možnosti, ki sestavljajo spletni servis Na-prostem.si:

- Drupal je program za postavitve spletne strani. Namenjen je uporabnikom, ki se ukvarjajo s spletnimi vsebinami. Njegove prednosti so modularnost, prilagodljive teme, redne posodobitve, sledenje varnostnim standardom in široka izbira dodatkov. Spletni servis Na-prostem uporablja Drupal za objavljane vsebin kot so novice s področja odprtokodnih programov[10], primerjalnik alternativ odprtokodnih in zaprtokodnih programov[11] ter opisi priljubljene in preverjene odprtokodne programske opreme in storitev[12].

- Nextcloud je spletna aplikacija, ki je namenjena hranjenju datotek na strežniku in sinhronizaciji z lokalnim odjemalcem. Nextcloud je uporaben za upravljanje datotek, slik, anket, poslovnega in/ali zasebnega koledarja ter stikov, ki jih je mogoče sinhronizirati s telefonom. Dostop do datotek je urejen preko skupin ali samo na ravni uporabnika. Aplikacija zagotavlja zasebnost s tem, da administrator nima dostopa do vsebine uporabnika brez njegovega izrecnega dovoljenja.

- Peertube je prosto dostopni pretočni servis za video vsebine po zgledu Youtube. Uporabniku omogoča shranjevanje in objavljane video vsebin. Peertube prilagaja prikaz video vsebin na prijazen način glede na pretočno zmogljivost internetne povezave gledalca. Spletni servis Na-prostem.si uporablja storitev Peertube za objavljane video vodičev za uporabo odprtokodne programske opreme in storitev, video predstavitev projekta in video posnetke dogodkov[13].

- Discourse Forum je pogosto uporabljen ter stilsko in vsebinsko dovršen spletni razpravni forum. Omogoča enostavno namestitvev na strežnik in preprosto komunikacijo med uporabniki. Storitvev je zelo dodelana s strani razvijalcev, zaradi priljubljenosti omogoča izbiro med različnimi vizualnimi prikazi in vsebinskih dodatkih. Forum Na-prostem.si je namenjen pomoči uporabnikom in pogovoru o odprtokodni programski opremi[14].

- MediaWiki (wikipedija) je prosto dostopna aplikacija za urejanje spletne enciklopedije. Wikipedija vsebuje različne razširitve, s katerimi lahko prilagajamo tako izgled kot dodajamo funkcionalnosti. Ima široko razvejano skupnost razvijalcev in uporabnikov po celem svetu. Wikipedija Na-prostem.si[15] na poljuden in razumljiv način razlaga teme in pojme is področja odprtokodne in prostodostopne računalniške opreme.

- Storitvev za enotno prijavo (SSO) je namenjena uporabnikom spletne storitve Na-prostem.si, da nemoteno in varno dostopajo do različnih odprtokodnih aplikacij, ki jih potrebujejo za svoje delo v NVO ter urejajo vsebine na spletnem servisu.

- Sledilnik zahtevkov za pomoč uporabnikom (Request tracker) omogoča podajanje in evidentiranje zahtevka uporabnika za podporo ali pomoč pri uporabi odprtokodne programske opreme ali storitve. Sledilnik omogoča iskanje poljubno izbranih izrazov in izvajanje skript za avtomatizacijo pri vodenju in preglednosti podanih zahtevkov.

4 DONACIJE OBNOVLJENE RAČUNALNIŠKE OPREME Z LINUX OPERACIJSKIM SISTEMOM

V okviru projekta in podpornega okolja Na-prostem.si je v sodelovanju z Društvom Duh časa vzpostavljen tudi sistem donacij obnovljene računalniške opreme z nameščeno Linux distribucijo KDE Neon[16]. Cilj projektnih donacij je podariti 50 računalnikov NVO in 150 računalnikov njihovim posameznim uporabnikom. Prejemnikom donacij so na voljo tudi brezplačna usposabljanja za osnovno uporabo prejetega računalnika.

5 NEFORMALNA USPOSABLJANJA ZA UPORABO PREVERJENIH ODPRTOKODNIH PROGRAMOV IN STORITEV

Koncept usposabljanja za uporabo odprtokodne programske opreme predstavlja ključno komponento pri uvajanju novih tehnoloških orodij v sodobno družbo. Skoraj tri četrtine (74,4 %) respondentov v raziskavi o porabi in potrebah NVO v povezavi z odprtokodnimi programi, je kot pomemben pogoj za uporabo odprtokodnega programa/storitve navedlo brezplačna usposabljanja za njihovo uporabo. V okviru podpornega okolja Na-prostem.si je bilo razvito interaktivno neformalno izobraževanje, ki temelji na izkušnjah preteklih izvajanj organizacij, kot so Rampa, Kersnikova, Duh Časa, INePA, Beletrina, Ljudmila in drugih.

Na usposabljanjih[17] se uporabljajo različne metode, med katerimi izstopajo pristopi »naredi sam« (DIY), »naredimo skupaj« (DITO) in »poskusi znova« (fail better). Vsak mentor, ki vodi usposabljanje, prejme temeljito usposabljanje za mentorje, kjer se nauči, kako učinkovito izvajati usposabljanje, vključiti omenjene metode, spremljati udeležence in prilagajati potek usposabljanja glede na njihove potrebe.

Celoten proces usposabljanja je razdeljen na tri dele, pri čemer sta prvi in tretji del enaka pri vseh usposabljanjih, medtem ko se drugi del prilagaja glede na specifično odprtokodno programsko opremo, ki je predmet izobraževanja. Razvoj usposabljanj je privedel do vzpostavitve različnih scenarijev, ki določajo potek usposabljanja za posamezno programsko opremo. Vsak scenarij je prilagojen specifičnim značilnostim programske opreme kar omogoča udeležencem, da sistematično napredujejo skozi različne faze usposabljanja.

Pomemben del usposabljanja predstavlja tudi naloga za udeležence, ki vključuje majhen, a ključen izziv. Ta izziv spodbuja udeležence k raziskovanju (DIY), sodelovanju (DITO) ter k soočanju z možnostjo neuspeha (fail better), kar se hitro spremeni v uspeh. Takšen pristop spodbuja udeležencev k praktičnemu preizkušanju in učenju z lastnimi izkušnjami. Rezultat je najvišja oblika učenja in pomnjenja, saj se udeleženci učijo z uporabo pristopa »učenje z uporabo« (learning by doing).

Z interaktivnim neformalnim izobraževanjem, prilagajanjem metod in scenarijev ter spodbujanjem aktivnega sodelovanja udeležencev se doseže optimalno učenje in razumevanje, kar vodi k uspešni in trajnostni uporabi odprtokodne programske opreme v modernem digitalnem okolju.

Neformalna usposabljanja v okviru podpornega okolja Na-prostem.si potekajo za naslednje pakete preverjene odprtokodne programske opreme in storitev[18]:

- uvod v odprtokodno programsko opremo in storitve,
- osnovna raba računalnika,
- spletne strani in analitika (Wordpress, Drupal, Plausible Analytics, Matomo),

- pisarna za pripravo dokumentov (LibreOffice Writer, LibreOffice Calc in LibreOffice Impress), oblikovanje slik (Gimp, Krita, Inkscape, Darktable),
- urejanje videa (Kdenlive, Pitivi, Open Shot),
- oblačne storitve (Nextcloud, Jitsi Meet za spletne konference in Etherpad za skupno urejanje dokumentov),
- komunikacija prek e-pošte in novičnikov Mailtrain, Matrix in Thunderbird),
- odprtokodni operacijski sistemi (Linux Mint in KDE Neon),
- objavljanje na spletu (Open Broadcaster Software, Peer Tube, Calibre-Web in Scribus) in
- tehnično risanje (FreeCAD, KiCAD n PrusaSlicer).

Cilje je izvesti skupno 102 usposabljanj za NVO in njihove uporabnike po celotni Sloveniji.



Slika 2: Usposabljanje za osnovno uporabo računalnika za članice Društva upokoencev Rakitna

6 IZKUŠNJE Z IZVAJANJEM NEFORMALNIH USPOSABLJANJ

Mentorji se na usposabljanjih v okviru projekta srečujejo z različni skupinami udeležencev, njihovo predznanje se ne razlikuje zgolj med skupinami, ampak tudi med posamezniki v samih skupinah. Izrednega pomena je, da se mentorji zavedajo različnih nivojev znanja in potreb posamezne skupine, ter usposabljanje prilagodijo tako, da udeleženci na usposabljanjih pridobijo večšine, ki jim bodo koristile tako pri delu kot v vsakdanjem življenju. V praksi se je izkazalo, da se morajo mentorji na usposabljanja dobro pripraviti ne zgolj s pedagoškega, ampak tudi tehničnega vidika, saj prostori, v katerih potekajo usposabljanja, niso vedno opremljeni z dovolj velikim številom vtičnic, pogosto manjka projektor, internetna povezava pa je pogosto slaba.

Pred vsakim usposabljanjem udeleženci na svoje računalnike - če teh nimajo, jih dobijo v okviru projekta, naložijo tisto prosto programsko opremo, za katero se bodo usposabljali. Med starejšo populacijo, ki se je udeležila usposabljanj, se je izkazalo, da je potrebno več časa nameniti učenju osnovne uporabe računalnika. V skupinah z ustreznim predznanjem, se več časa posveti praktičnim nalogam, da se pridobljeno znanje čim bolj utrdi. Pomembno je tudi, da udeleženci po zaključku usposabljanja niso prepuščeni sami sebi, saj jim je na spletnem servisu Na-prostem.si, vedno na voljo tako pomoč mentorjev kot širše skupnosti. Pomemben del usposabljanja je zato prikaz delovanja omenjenega servisa in vseh njegovih storitev, vključno s podporo. Dosedanje izkušnje so pozitivne, udeleženci pa so izrazili veliko zanimanja za nadaljnja izobraževanja.

7 ZAKLJUČEK

Ob pomanjkanju tovrstnih usposabljanj in projektov ne pričaja zgolj veliko zanimanje med nevladniki, ampak tudi drugo poročilo Evropske komisije o napredku izvajanja zavez Berlinske deklaracije o digitalni družbi in digitalni vladi. Glede na skupne vrednote, ki jih izpostavlja tudi projekt Na-prostem.si: Prosto programje za digitalno vključenost NVO in uporabnikov je Evropska komisija za leto 2022 v Sloveniji pripoznala projekt kot pozitiven premik na področju spodbujanja temeljnih pravic in demokratičnih vrednot na digitalnem področju.

Vse naštetu daje pozitiven signal, da bomo zgodbo Na-prostem.si pisali še naprej. Kljub temu, da se projekt s koncem leta 2023 izteka, projektna ekipa že gleda v leto 2024, ko bo projekt prerasel v pravno-formalno NVO, ki bo delovala kot skupnost uporabnikov, zagovornikov, strokovnjakov ter programerjev prostega programja in storitev. Z ustanovitvijo zadruga ciljamo na doseganje dolgoročnih učinkov projekta ter na povečano rabo prostih programov in storitev v Sloveniji.

ZAHVALA

Zahvaljujemo se koordinatorici projekta Na-prostem.si Maši Malovrh (Beletrina, Zavod za založniško dejavnost) za uredniški pregled prispevka.

Projekt Na-prostem.si je financiran s strani Ministrstva za javno upravo v okviru javnega razpisa za digitalno preobrazbo nevladnih in prostovoljskih organizacij ter povečanje vključenosti njihovih uporabnikov v informacijsko družbo 2021-2023. Vsebinska članka je izključno odgovornost avtorjev in ne predstavlja stališč Ministrstva za javno upravo.

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Analiza ravni digitalnih kompetenc učiteljev po evropskem okviru digitalnih kompetenc izobraževalcev DigCompEdu

Analysis of teachers' digital competence levels according to the DigCompEdu European Framework of Digital Competences for Educators

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POVZETEK

V prispevku obravnavamo digitalne kompetence učiteljev. Izhajali smo iz dokumenta »Evropski okvir digitalnih kompetenc izobraževalcev: DigCompEdu (angl.: European Framework for the Digital Competence of Educators: DigCompEdu.) V naši raziskavi smo uporabili dobesedne formulacije: področij kompetenc učiteljev, vsebin opisov posameznih področij in opisov ravni kompetenc. Opravili smo spletno anketiranje. Anketne vprašalnike smo maja 2023 poslali vodstvom 26 šol v Gorenjski regiji in jih prosili, naj tam zaposlene povabijo k sodelovanju v spletni anketi. Po enem mesecu smo prejeli 57 v celoti rešenih vprašalnikov. Rezultati kažejo, da je raven kompetenc učiteljev pod našimi pričakovanji, saj v povprečju ne dosega nivoja »strokovnjak«

KLJUČNE BESEDE

Učitelji, digitalne kompetence, Evropski okvir digitalnih kompetenc izobraževalcev.

ABSTRACT

In this paper, we look at the digital competences of teachers. The research is based on the document "European Framework for the Digital Competence of Educators: DigCompEdu" (DigCompEdu). In our research we have used the literal formulations: domains of teachers' competences, content descriptions of the domains and descriptions of the levels of competences. We conducted an online survey. In May 2023, we sent the questionnaires to the management of 26 schools in the Gorenjska region and asked them to invite their staff to participate in the online survey. After one month, we received 57 fully completed questionnaires. The results show that the level of teachers' competences is below our expectations, as on average it does not reach the level of "expert".

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KEYWORDS

Teachers, digital competences, European Framework for the Digital Competence of Educators: DigCompEdu.

1 UVOD

Uporaba računalnika v izobraževanju ima že zelo dolgo zgodovino. Živ dokaz za to je konferenca »Vzgoja in izobraževanje v informacijski družbi,« ki poteka letos že 26. leto zapored. Skozi vsa ta leta se je razvijala strojna oprema, programska oprema in tudi metodološki pristopi uporabe računalnikov v izobraževanju.

V naši raziskavi smo želeli ugotoviti, kakšna je današnja raven digitalnih kompetenc učiteljev. Vzporedno z razvojem strojne in programske opreme so se namreč morale razvijati tudi digitalne kompetence učiteljev. Ena izmed študij, ki je preučevala uporabo računalniške opreme pri poučevanju učiteljev in kompetence učiteljev se je odvijala v letih od 2015-2018 na Švedskem [1]. Rezultati študije so pokazali, da je poleg pomanjkanja časa za uporabo računalniške opreme in slabe platforme v učilnicah, ravno digitalna usposobljenost učiteljev tisti izziv, s katerim se bodo najbolj ukvarjali v prihodnjih letih.

Pomembnost uporabe digitalne tehnologije pri pouku se iz leta v leto povečuje, saj omogoča hitrejši, predvsem pa drugačen pristop do novega znanja. V Nemčiji so tako med novembrom 2021 in februarjem 2022 s pomočjo raziskave, ki je zajela 145 učiteljev prišli do zaključka, da je diferenciacija in opolnomočenje učencev pozitivno povezano z učiteljevo uporabo tehnologije za izboljšanje kakovosti pouka [2]. Do podobnih zaključkov so prišli tudi v študiji, ki je bila izvedena v Švici med junijem in septembrom 2020 in je zajela 2011 učiteljev [3]. Rezultati so namreč pokazali, da so mnenja učiteljev o njihovih digitalnih kompetencah pozitivno povezana z njihovo uporabo tehnologije pri poučevanju.

V Sloveniji je Zavod RS za šolstvo v času pred koncem zaprtja šol v obdobju covida-19 izvedel raziskavo, katere izsledki so objavljeni v spletni monografiji z naslovom Analiza izobraževanja na daljavo v času prvega vala epidemije covida-19 v Sloveniji [4]. Rezultati raziskave so pokazali, da imajo učitelji strokovnih šol v Sloveniji v primerjavi z gimnazijskimi učitelji večje težave na področju zagotavljanja podporne tehnologije, nimajo ustreznega prostora za delo, niso večji

različnih digitalnih orodij in ne morejo doseči na daljavo nekaterih učencev.

2 EVROPSKI OKVIR DIGITALNIH KOMPETENC IZOBRAŽEVALCEV DIGCOMPEDU

V našem prispevku smo kot teoretični okvir raziskave uporabili Evropski okvir digitalnih kompetenc izobraževalcev: DigCompEdu [5].

Da smo kot izhodišče v množici različnih pristopov k preučevanju kompetenc uporabili ravno ta dokument, seveda obstajajo utemeljeni razlogi. Dokument »Evropski okvir digitalnih kompetenc izobraževalcev: DigCompEdu« je relativno nov, saj je bil objavljen leta 2018. Vsaj na ravni držav Evropske unije trenutno velja za sprejet in splošno veljaven. V primeru, da bomo našo raziskavo še razširili, bodo možne tudi mednarodne primerjave. Cilj okvirja DigCompEdu je prikaz in opis digitalnih kompetenc, specifičnih za izobraževalce. Predlaganih je 22 osnovnih kompetenc, ki so razporejene v 6 področij. Okvir vključuje tudi model napredovanja, s pomočjo katerega lahko izobraževalci ocenijo in razvijejo svoje digitalne kompetence. Opisuje šest različnih ravni razvoja, skozi katere izobraževalec običajno pridobi digitalno kompetenco, in tako izobraževalcu pomaga prepoznati trenutno raven njegove kompetence ter določiti in izbrati korake, potrebne za njeno izboljšanje.

3 PODROČJA KOMPETENC UČITELJEV

Evropski okvir digitalnih kompetenc izobraževalcev DigCompEdu kompetence učiteljev razvršča v 6 področij (Evropski okvir digitalnih kompetenc izobraževalcev: DigCompEdu, 2018):

1. poklicno delovanje;
2. digitalni viri;
3. poučevanje in učenje;
4. vrednotenje (evalvacije);
5. opolnomočenje učencev;
6. vodenje in podpora učencem pri pridobivanju digitalnih kompetenc.

Znotraj 6 področij Evropski okvir digitalnih kompetenc izobraževalcev DigCompEdu je predlaganih 22 vsebin osnovnih kompetenc, ki so znotraj področij razporejene takole (Evropski okvir digitalnih kompetenc izobraževalcev: DigCompEdu, 2018):

POKLICNO DELOVANJE - Organizacijsko komuniciranje (Raba digitalnih virov za komuniciranje z učenci, starši, idr.); Strokovno sodelovanje (Raba digitalnih tehnologij za sodelovanje z drugimi izobraževalci); Reflektivna praksa, (kritična presoja ter aktiven razvoj lastne digitalne pedagoške prakse); Stalno strokovno spopolnjevanje (Raba digitalnih virov in sredstev za stalen strokovni razvoj).

DIGITALNI VIRI - Izbiranje (Prepoznavanje, vrednotenje in izbiranje digitalnih virov za poučevanje in učenje.); Izdelovanje in poustvarjanje (Poustvarjanje in nadgrajevanje obstoječih virov z odprtimi dovoljenji ter drugimi viri, kjer je to dovoljeno. Izdelava ali soustvarjanje novih); Upravljanje, zaščita, deljenje (Organizacija digitalnih vsebin ter zagotavljanje dostopa).

POUČEVANJE IN UČENJE - Poučevanje (Načrtovanje in vpeljava digitalnih naprav in virov v proces poučevanja); Vodenje (Raba digitalnih tehnologij in storitev za izboljšanje komunikacije z učenci); Sodelovalno učenje (Raba digitalnih tehnologij za spodbujanje in izboljšanje sodelovanja med učenci.); Samouravnnavnje učenja (Raba digitalnih tehnologij za podporo samouravnnavanja učenja).

VREDNOTENJE (EVALVACIJE) - Strategije vrednotenja (Raba digitalnih tehnologij za vrednotenje); Analiza dokazov (Ustvarjanje, izbira ter kritična analiza in razlaga digitalnih dokazov o učenčevih dejavnostih, uspešnosti ter napredku); Povratne informacije in načrtovanje (Raba digitalnih tehnologij za ciljno usmerjene in pravočasne povratne informacije učencem).

OPOLNOMOČENJE UČENCEV - Dostopnost in vključenost (Zagotavljanje dostopa do učnih virov in dejavnosti vsem učencem); Diferenciacija in personalizacija (Raba digitalnih tehnologij za naslavljanje različnih učnih potreb učencev); Aktivno vključevanje učencev (Raba digitalnih tehnologij za spodbujanje aktivnega in ustvarjalnega sodelovanja učencev).

VODENJE IN PODPORA UČENCEM PRI PRIDOBIVANJU DIGITALNIH KOMPETENC - Informacijska in medijska pismenost (Vključevanje učnih dejavnosti, nalog ter različne vrste vrednotenij, ki od učencev zahtevajo, da izkažejo potrebo po informacijah); Komuniciranje in sodelovanje (Vključevanje učnih dejavnosti, nalog ter vrednotenja, ki od učencev zahtevajo učinkovito in odgovorno rabo digitalnih tehnologij za Izdelovanje vsebin); Izdelovanje digitalnih vsebin (Vključevanje učnih dejavnosti, nalog in vrednotenja, ki od učencev zahtevajo, da se izrazijo prek digitalnih sredstev); Odgovorna raba (Zagotavljanje ukrepov za dobro počutje učencev v fizičnem, psihičnem in družbenem smislu); Reševanje problemov (Vključevanje učnih dejavnosti, nalog ter vrednotenja, ki od učencev zahtevajo, da prepoznajo in rešijo tehnične težave ali tehnološko znanje ustvarjalno uporabijo v novih situacijah.).

4 OPISI RAVNI KOMPETENC

Evropski okvir digitalnih kompetenc izobraževalcev DigCompEdu vključuje tudi model napredovanja, s pomočjo katerega lahko izobraževalci ocenijo in razvijejo svoje digitalne kompetence. Opisuje šest različnih ravni razvoja, ki so prikazane v tabeli 1. Poimernovanja ravni so prikazana v tabeli 2 [5].

Tabela 1: Ravni kompetenc po Evropskem okviru digitalnih kompetenc izobraževalcev DigCompEdu [5].

RAVEN	SAMOOCENA
1	SEM ZAČETNIK: Zavedam se potenciala digitalnih tehnologij za izboljšanje pedagoške in poklicne prakse, vendar imam z digitalnimi tehnologijami zelo malo stika ter jih uporabljajo predvsem za pripravo učnih ur, administracijo ali organizacijsko komuniciranje. Pri razširitvi uporabe ter prenosu svojih obstoječih digitalnih kompetenc na pedagoško področje potrebujejo vodenje.
2	SEM RAZISKOVALEC: Digitalne tehnologije sem začel uporabljati na določenih področjih

3	SEM VKLJUČEVALEC: Na ravni vključevanja preizkušam digitalne tehnologije v različnih okoljih in za različne namene ter jih vključujejo v številne od svojih praks.
4	SEM STROKOVNJAK: Na ravni strokovnosti uporabljam nabor digitalnih tehnologij samozavestno, ustvarjalno in kritično. Digitalne tehnologije za določene situacije izbiram namensko ter poskušam razumeti prednosti in pomanjkljivosti različnih digitalnih strategij
5	SEM VODITELJ: Na ravni vodenja pri rabi digitalnih tehnologij sledim doslednemu ter celovitemu pristopu za izboljšanje pedagoških in poklicnih praks.
6	SEM POBUDNIK: Na ravni pobudništva se sprašujem o ustreznosti sodobnih digitalnih in pedagoških praks. Zanimajo me omejitve ali pomanjkljivosti teh praks ter sledim ciljem nadaljnjih inovacij.

Tabela 2: Poimenovanje ravni kompetenc po Evropskem okviru digitalnih kompetenc izobraževalcev DigCompEdu (Evropski okvir digitalnih kompetenc izobraževalcev: DigCompEdu, 2018).

ODGOVOR	OZNAKA RAVNI	IME RAVNI
1	A1	ZAČETNIK
2	A2	RAZISKOVALEC
3	B1	VKLJUČEVALEC
4	B2	STROKOVNJAK
5	C1	VODITELJ
6	C2	POBUDNIK

5 NAMEN RAZISKAVE

Z raziskavo, smo želeli ugotoviti, kakšna je raven digitalnih kompetenc učiteljev.

6 OPIS VZORCA

Maja 2023 je bilo vabilo k sodelovanju po elektronski pošti poslano na naslove 26 izobraževalnih ustanov na področju Gorenjske regije. Vodstva šol smo prosili, prosili, naj tam zaposlene povabijo k sodelovanju v spletni anketi. Vabilo je bilo poslano na elektronske naslove, ki so uradno objavljeni kot elektronski naslovi šol: solagorje@osgorje.si; os-bled@guest.arnes.si; info@os-antonjansse.si; o-atlr.kr@guest.arnes.si; os-tone.cufar@guest.arnes.si; dekanat@fzab.si; info@gimjes.si; info@poldestrazisar.si; o-16decmojstr.kr@guest.arnes.si; osjvkg.tajnistvo@siol.net; info@o-lesce.kr.edus.si; os-bohinj@guest.arnes.si; tajnistvo-os.trzic@guest.arnes.si; tajnistvo@os-naklo.si; tajnistvo@osjpcenter.si; info@ossklm.si; uprava@os-zelezniki.si; ravnatelj.osziri@krajnik.si; info@os-ivantavcar.si; tajnistvo@osdj-cerklje.si; gimnazija.kranj@gimkr.si;

info@gimnazija-skofjaloka.si; info@egss.si; info@scsl.si; info@vgs-bled.si

V roku enega meseca smo prejeli 57 pravilno in v celoti vrnjenih vprašalnikov, 15 je bilo moških in 42 žensk. Povprečna starost je bila 48 let, najmlajši anketiranec je imel 28 let, najstarejši 68 let.

7 INSTRUMENT

Raziskavo smo izvedli z spletne ankete v okolju IKA. Kot teoretični okvir raziskave in s tem tudi vprašalnika (področja kompetenc učiteljev, vsebine opisov posameznih področij kompetenc in opisi ravni kompetenc) smo uporabili dobredne formulacije iz slovenskega dokumenta: Evropski okvir digitalnih kompetenc izobraževalcev: DigCompEdu. Izdajatelj: Zavod Republike Slovenije za šolstvo, Ljubljana, 2018, ki je prevod Angleškega izvornika: European Framework for the Digital Competence of Educators: DigCompEdu, avtorica: Christine Redecker, urednik: Yves Punie, Joint Research Centre, European Commission, JRC Science Hub <https://ec.europa.eu/jrc/>, © European Union, 2017.

8 REZULTATI RAZISKAVE

V tabeli 3 prikazujemo aritmetične sredine in standardne odklone za vseh 22 vsebin kompetenc.

Tabela 3: Aritmetične sredine in standardni odkloni za 22 vsebin kompetenc po Evropskem okviru digitalnih kompetenc izobraževalcev DigCompEdu (n=57).

PODROČJE/VSEBINA KOMPETENCE	MEAN	STD. DEV
POKLICNO DELOVANJE		
1. Organizacijsko komuniciranje	3,58	1,034
2. Strokovno sodelovanje	3,42	1,164
3. Reflektivna praksa,	3,30	1,309
4. Stalno strokovno	3,28	1,236
DIGITALNI VIRI		
1. Izbiranje	3,35	1,142
2. Izdelovanje in poustvarjanje (3,09	1,286
3. Upravljanje, zaščita, deljenje	3,09	1,299
POUČEVANJE IN UČENJE		
1. Poučevanje	3,21	1,250
2. Vodenje	3,30	1,180
3. Sodelovalno učenje	3,05	1,141

4. Samouravnavnje učenja	3,00	1,165
VREDNOTENJE (EVALVACIJE)		
1. Strategije vrednotenja	2,77	1,350
2. Analiza dokazov	2,77	1,254
3. Povratne informacije in načrtovanje	2,95	1,260
OPOLNOMOČENJE UČENCEV		
1. Dostopnost in vključenost	3,23	1,180
2. Diferenciacija in personalizacija	2,96	1,068
3. Aktivno vključevanje učencev	3,19	1,172
VODENJE IN PODPORA UČENCEM PRI PRIDOBIVANJU DIGITALNIH KOMPETENC		
1. Informacijska in medijska pismenost	3,07	1,348
2. Komuniciranje in sodelovanje	3,05	1,260
3. Izdelovanje digitalnih vsebin	2,89	1,398
4. Odgovorna raba	3,09	1,184
5. Reševanje problemov	2,82	1,054

9 ZAKLJUČEK

Naša raziskava ima omejitve v velikosti vzorca. Raziskava je bila zastavljena tako, da bi bil vzorec reprezentativen in tudi dovolj velik. K sodelovanju smo namreč povabili kar 26 različnih šol. To glede na število šol predstavlja približno eno tretjino vseh šol v Gorenjski regiji. Vzorec ni bil izbran naključno, pač pa z vplivanjem. Pri izbiri vzorca šol smo bili pozorni na to, da smo vabili različne vrste šol: osnovne šole, poklicne šole, srednje strokovne šole, gimnazije, višje šole in eno fakulteto. Šole so bile locirane v večjih mestih in na podeželju. Da bi bila zagotovljena anonimnost anketirancev, nismo spraševali po vrsti šole, niti ne po lokaciji šole. Na koncu smo prejeli samo 57 popolnih odgovorov.

Ne glede na to lahko iz naše raziskave izluščimo nekatere zaključke: Raziskava je pokazala, da so digitalne kompetence učiteljev na ravni „vključevanja.“ Ta raven je nižja od ravni »strokovnjak.« Menimo, da je taka raven skrb zbujajoča.

Anketiranci ne sodijo v populacijo, ki jih teorija šteje za »starejše osebe«. Povprečna starost anketirancev je bila 48 let, kar pomeni, da anketirance v povprečju čaka še vsaj 15 let delovne dobe. Statistična analiza je pokazala, da je pri večini vsebin kompetenc raven kompetenc pri do 8 % anketirancev še vedno na nivoju »začetnik«. Tak delež najnižje ravni kompetenc se nam zdi velik.

Analiza odgovorov je nadalje pokazala, da na nobenem področju kompetenc ni več kot 5% anketirancev na ravni »pobudnik«. Najvišjo raven kompetenc smo ugotovili za področje „poklicno delovanje.“ Pri nobenih od vsebin tega področja ni začetnikov več kot 8%. Kljub temu povprečna raven kompetenc niti na tem področju ni dosegla ni dosegla ravni „strokovnjak“

Za primer si vzemimo področje kompetenc »poklicno delovanje«, vsebino kompetence »Organizacijsko komuniciranje« (Raba digitalnih virov za komuniciranje z učenci, starši, idr.) Frekvence odgovorov prikazuje tabela 4.

Tabela 4: Aritmetične sredine in standardni odkloni za 22 vsebin kompetenc po Evropskem okviru digitalnih kompetenc izobraževalcev DigCompEdu

	<i>frekvenca</i>	<i>Delež (%)</i>
<i>ZAČETNIK</i>	2	3,5
<i>RAZISKOVALEC</i>	5	8,8
<i>VKLJUČEVALEC</i>	18	31,6
<i>STROKOVNJAK</i>	24	42,1
<i>VODITELJ</i>	6	10,5
<i>POBUDNIK</i>	2	3,5
<i>SKUPAJ</i>	57	100,0

Raven kompetence »Organizacijsko komuniciranje« (ki sodi v področje „poklicno delovanje.“ je glede na ostale vsebine kompetenc ocenjena zelo visoko, celo najbolje od vseh kompetenc (aritmetična sredina odgovorov je 3,58). Vrednost aritmetične sredine je nižja od 4, kar pomeni nižja od ravni strokovnjak. Kljub temu med 57 anketiranci kar 25 dosega nižjo raven od ravni »strokovnjak«

Najnižjo raven kompetenc smo ugotovili za področje „vrednotenje, konkretno za kompetenci“

- Strategije vrednotenja (Raba digitalnih tehnologij za vrednotenje).

- Analiza dokazov (Ustvarjanje, izbira ter kritična analiza in razlaga digitalnih dokazov o učenčevih dejavnostih, uspešnosti ter napredku)

Pri obeh kompetencah je aritmetična sredina 2,77.

Pri vsebinah »Strategije vrednotenja« je 17,5% anketirancev na ravni »začetnikov«, pri kompetenci »analiza dokazov« pa je na ravni začetnika 14,0% anketirancev.

Zelo nizko raven kompetenc učiteljev smo prepoznali tudi na področju »vodenje in podpora učencem pri pridobivanju digitalnih kompetenc«.

Zlasti nizka raven je pri vsebinah kompetenc:

- Izdelovanje digitalnih vsebin (Vključevanje učnih dejavnosti, nalog in vrednotenja, ki od učencev zahtevajo, da se izrazijo prek digitalnih sredstev) 9 od 57 vprašanih je pri pripravi digitalnih vsebin na ravni začetnika. Frekvence in deleži odgovorov v tabeli 5.

- Reševanje problemov (Vključevanje učnih dejavnosti, nalog ter vrednotenja, ki od učencev zahtevajo, da prepoznajo in rešijo tehnične težave ali tehnološko znanje ustvarjalno uporabijo v novih situacijah.) Samo 11 od 57 vprašanih je ocenilo, da bi na ravni strokovnjaka ali bolje znalo rešiti tehnične težave učencev. Frekvence in deleži odgovorov v tabeli 5 IN6.

Tabela 5: Frekvence in deleži odgovorov na vprašanje o kompetenci »Izdelovanje digitalnih vsebin« (n=57)

	frekvenca	Delež (%)
ZAČETNIK	9	15,8
RAZISKOVALEC	15	26,3
VKLJUČEVALEC	18	31,6
STROKOVNJAK	7	12,3
VODITELJ	4	7,0
POBUDNIK	4	7,0
SKUPAJ	57	100,0

Tabela 6: Frekvence in deleži odgovorov na vprašanje o kompetenci »Reševanje problemov« (n=57)

	frekvenca	Delež (%)
ZAČETNIK	3	5,3
RAZISKOVALEC	21	36,8
VKLJUČEVALEC	22	38,6
STROKOVNJAK	6	10,5
VODITELJ	4	7,0
POBUDNIK	1	1,8
SKUPAJ	57	100,0

Ocenjujemo, da smo z našo raziskavo kljub majhnosti vzorca prepoznali problem. Ugotovljena raven digitalnih kompetenc učiteljev je daleč pod pričakovanji. Tudi, če je vzorec še tako majhen, ugotovljene digitalne kompetence učiteljev ne bi smele biti na ravni, ki je nižja od ravni »strokovnjak«.

ZAHVALA

Projekt sofinancirata Republika Slovenija, Ministrstvo za visoko šolstvo, znanost in inovacije, in Evropska unija – NextGenerationEU. Projekt se izvaja skladno z načrtom v okviru razvojnega področja Pametna, trajnostna in vključujoča rast,

komponente Krepitev kompetenc, zlasti digitalnih in tistih, ki jih zahtevajo novi poklici in zeleni prehod (C3 K5), za ukrep investicija F. Izvajanje pilotnih projektov, katerih rezultati bodo podlaga za pripravo izhodišč za reformo visokega šolstva za zelen in odporen prehod v družbo 5.0: projekt Pilotni projekti za prenavo visokega šolstva za zelen in odporen prehod.

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Umetna inteligenca v izobraževanju

Artificial Intelligence in Education

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POVZETEK

Namen šol v sodobni družbi se v tem desetletju radikalno spreminja na eni strani zaradi hitrega razvoja digitalnih tehnologij in umetne inteligence, po drugi strani pa tudi zaradi vse večjega pritiska s strani naprednih oblikovalcev politik, vodstev šol, raziskovalcev, učiteljev in tudi učencev, ki so v razvojnih projektih v preteklih letih učinkovito razvili nove celovite pristope poučevanja in učenja, velikokrat tudi skupaj s kolegi iz Evrope in širše. V članku so tako predstavljeni nekateri vidiki umestitve umetne inteligence v izobraževanju, prihajajočih tehnologij, vloga učitelja in učenca. Predstavljen je tudi projekt Umetna inteligenca za učitelje ter aktualne smernice in priporočila povezana z uporabo umetne inteligence v izobraževanju.

KLJUČNE BESEDE

umetna inteligenca, izobraževanje, usposabljanje učiteljev

ABSTRACT

The purpose of schools in modern society is changing radically in this decade, on the one hand, due to the rapid development of digital technologies and artificial intelligence, and on the other hand, due to increasing pressure from progressive policymakers, school leaders, researchers, teachers and also students who participated in development projects over the past years and effectively developed new comprehensive approaches to teaching and learning, often together with colleagues from Europe and beyond. The article thus presents some aspects of artificial intelligence and upcoming technologies, the role of the teacher and the student. The Artificial Intelligence for Teachers project and current guidelines and recommendations for using artificial intelligence in education are also presented.

KEYWORDS

Artificial intelligence, education, teacher training

1 UVOD

Smo v dobi že 4. vala razvoja umetne inteligence, v katerem med drugih novo nastajajoče e-storitve in aplikacije s pomočjo pametnih naprav zbirajo, procesirajo in uporabljajo ogromno podatkov o uporabnikih (ljudje, internet stvari), njihovih potrebah, navadah, prava tako pa tudi o dosedanjih dognanjih človeštva ipd. Pri tem se je treba vprašati, ali se in kako zaradi tega spreminja vloga šole, učitelja in učenca. Smo pa tudi v desetletju, v katerem želijo napredni oblikovalci politik, vodstva šol, raziskovalci, pa tudi učitelji in tudi že učenci sami na sistemski ravni trajno prispevati k nujnim spremembam, ki so jih nakazali in tudi preizkusili uspešni razvojni projekti zadnjih let v Sloveniji, predvsem pa tudi evropski projektih. Naloga sodobne šole je tako, da navdušuje in učencem pomaga prepoznati njihovo edinstvenost, da bi lahko v polnosti razvili svoje potencialne. Spodbujati mora kritično razmišljanje in ustvarjalnost ter opolnomočiti učence, da razvijajo spretnosti in zmožnosti, ki jih potrebujejo v življenju [17]. Ključno vprašanje za sodobno šolo torej je, kako prepoznati spretnosti in zmožnosti, ki jih bodo naši otroci potrebovali v življenju. Hkrati pa se postavlja vprašanje, kako v koncept sodobne šole umestiti neprestan razvoj digitalne tehnologije (še posebej umetne inteligence), socialnih kompetenc naših otrok in kako s naprednimi metodami in načini poučevanja vzpodbuditi in zagotoviti holističen razvoj naših otrok na vseh področjih (od znanja, odnosov, digitalnih kompetenc in temeljnih znanj računalništva in informatike do zmožnosti njihovega samouravnavanja ipd.). Izpostavljen je pomen izgradnje znanja znotraj nekega konteksta, s posebnim poudarkom na socialnih odnosih med učečimi se. Psihološki procesi, ki se razvijajo v posamezniku ter družbeno-situacijski vidiki, ki vplivajo na učenje, so razumljeni kot reflektivno in enakovredno povezani [6]. Nova paradigma razume učenje in kognicijo kot interaktivno dejavnost med posameznikom in situacijo, za znanje pa pravi, da je "umeščeno, proizvod dejavnosti, konteksta in

kulture, v kateri se razvija in v kateri je uporabljeno" [4]. Učenje se razume kot "participacija" oziroma "družbeno pogajanje". V tem kontekstu učitelj pripravlja učna okolja, kjer:

- se spodbuja konstruktivno, samoregulacijsko učenje,
- je učenje senzibilno na kontekst,
- je učenje sodelovalno, usmerjeno na učenca.

Učenje ni več pasivno, ampak aktivno, socialno okrepljen proces izgradnje znanja. Znanje se ne more prenesti na učenca, temveč ga mora sam zgraditi oziroma si ga ustvariti v procesu učenja. Sodobno izobraževanje tako temelji na inovativnih metodah in pristopih poučevanja, med katerimi je treba izpostaviti ([10]):

- sodelovalno delo,
- problemsko pouk,
- personalizacijo učenja,
- problemsko učenje z avtentičnimi nalogami (ang. problem based learning),
- raziskovalni pouk s poudarkom na razvoju kritičnega mišljenja ipd.

Aktivnosti sodobnega izobraževanja so usmerjene na učenca, njihov cilj pa je, da vsi učenci dosežejo predpisano raven znanja in kompetence (čim višje taksonomske ravni zastavljenih ciljev). Tovrstno učenje pa se ne odvija le v šolskih prostorih, temveč se dotika tudi naših interesov in izkušenj. Pri tem je pomembno aktivno sodelovanje tudi zunanjih deležnikov v vseh fazah učenja. Vloga učitelja je pri ključna, saj se mora povezovati tako s sodelavci na šoli preko medpredmetnih aktivnosti, iskati izzive, s katerim se ukvarjajo deležniki v lokalnem in širšem prostoru. Učitelji so tisti, ki skupaj z zunanjimi deležniki učence usmerja in jim svetuje ter jim predstavi orodja in jim pokaže, kaj je ozaveščenost.

2 VLOGA UČITELJA

Da je v procesu dviga kvalitete poučevanja in učenja učencev prav učitelj v sodelovanju z zunanjimi izvajalci najpomembnejši dejavnik, je sprejeto dejstvo, ki je podkrepljeno s številnimi raziskavami [27], zato v tem valu umetne inteligence le-ta ne zmore zamenjati učitelja pri pripravi, izvedbi in evalvaciji celovitega procesa poučevanja in učenja.

Bandura v svoji učni teoriji dokazuje, da sta kvaliteta poučevanja ter strokovna usposobljenost učitelja dva ključna poudarka na področju dviga kvalitete celotne šole [2]. V tem duhu o kvaliteti šole razmišlja tudi Ernest Boyer: "Ko govorimo o izboljšanju šole v bistvu govorimo o dvigu učinkovitosti učiteljev. To je edina pot za dvig kvalitete šole in s tem šolskega sistema..." [3]. Rivkin, Hanushek in Kain so ugotovili, da bi lahko sodelovanje skupine dobrih učiteljev močno pripomoglo k zapolnitvi obstoječih vrzeli v dosežkih različnih skupin učencev. Če je učitelj

neučinkovit, bodo tudi učenci, deležni njegovega procesa poučevanja, slabše napredovali, ne glede na kognitivne razlike med njimi [10].

Tudi Wright, Horn in Sanders se strinjajo, da je prav učitelj najpomembnejši dejavnik, ki vpliva na uspešnost učenja učencev [27]. John Hattie v sklopu svoje obširne metaanalize podkrepi ta spoznanja in gre še korak naprej. Ugotovil je, da je močna kolektivna učinkovitost učiteljev (collective efficacy) eden pomembnejših dejavnikov, ki vpliva na dosežke učencev [9]. Do enakih spoznanj je prišla tudi Jenni Donohoo, ki prav tako izpostavlja kolektivno učinkovitost učiteljev kot enega najpomembnejših dejavnikov kvalitete poučevanja učitelja [7]. Skupaj s Stefani Arzonetti Hite postavi model »A Model for Leading Collective Teacher Efficacy«, kjer izpostavita neposredno korelacijo med dosežki učencev in kolektivno učinkovitostjo učiteljev [1].

Kvaliteta učiteljevega dela v razredu je pogojena tako z znanjem in izkušnjami, ki jih bodoči učitelji dobijo v času študija, kot permanentnim usposabljanjem na delovnem mestu [23]. Hkrati mednarodne raziskave kažejo, da so metode in pristopi, ki jih učitelji uporabljajo v razredu, bolj kot od njihove izobrazbe odvisne od okolja in kulture poučevanja, v kateri so zrasli. Le redki učitelji prerastejo način poučevanja, v katerem so bili sami poučevani [22].

Učitelj, rutiniran strokovnjak, ki se izobražuje znotraj znanih okvirjev se mora spremeniti v inovativnega vseživljenjsko se učečega strokovnjaka, ki išče navdih, znanje in podporo. Razvoj trdne poklicne identitete je prvi korak k uspešnemu sodelovanju v relevantnih strokovnih mrežah, kjer učitelj dobi nove ideje in skupaj z drugimi išče odgovore na nove izzive, ki jih je zmožen prevesti v lokalni kontekst. Inovativni učitelj je:

- kompetenten in strasten profesionalc, ki v sodelovanju z drugimi išče najboljše rešitve za poučevanje svojih učencev;
- ima pozitiven odnos do raziskovanja in vseživljenjskega učenja;
- namerno in s ciljem sodeluje v različnih strokovnih skupnostih, ter se z dragocenimi vpogledi vrača v svojo učilnico;
- je povezan z razvojem družbe, še posebej digitalno transformacijo in hkrati ceni kulturno raznolikost
- vse več odgovornosti in lastništva izobraževanja prenaša tudi na učence same.

V poročilu The Digital Transformation of Education: Connecting Schools, Empowering Learners [20] UNESCO prepoznava učitelje kot pomembne

dejavnike digitalne transformacije, seveda ob predpostavki, da s posodobitvijo in prenovo profesionalnega razvoja učiteljev zagotovimo, da bodo le-ti zmožni izkoristiti tehnologijo v podporo izobraževalnemu procesu. Poudarek torej ni na tehnologiji in povezanosti - ta je le pogoj, ki skupaj z kompetentnim učiteljem v procesu digitalne transformacije pouka učencem omogoča sodelovanje v učnih priložnostih, torej izvajanje tistih dejavnosti, ki omogočajo vključujoč in učinkovit proces učenja.

3 VLOGA DIGITALNE TEHNOLOGIJE IN AI V IZOBRAŽEVANJU

Richard E. Mayer je učenje s tehnologijo opisal kot "učne situacije, v katerih izkušnjo poučevanja ustvarjamo s pomočjo fizičnih naprav, kot sta računalnik in internet" [12]. Hkrati je opozoril na bistveno razliko med dvema pristopoma k učenju s tehnologijo:

- v tehnologijo usmerjeno učenje razume kot aktivnost, katere cilj je uporabiti tehnologijo pri poučevanju in je tehnologija tista, ki zagotavlja dostop do poučevanja;
- v učenca usmerjen pristop učenja s tehnologijo pa je tisti, ki pomaga pri učenju, katerega cilj je torej prilagoditi tehnologijo za spodbujanje učenja.

Hattie [14] je v svojem seznamu 150 vplivov na učne dosežke, ki ga je sestavil na osnovi raziskave več kot 800 metaanaliz razvrstil tudi nekatere vplive, ki so povezani z uvajanjem tehnologije. Sam dostop do tehnologije torej še ne pomeni, da bo učenje samo tudi učinkovitejše, čeprav nekateri dokazujejo, da uporaba tehnologije, ki jo učenci uporabljajo v vsakdanjem življenju, pri pouku poveča njihovo motivacijo in občutek vključenosti [8].

Vpliv tehnologije na učinkovitost učenja je odvisen tudi od načina njene uporabe. Pri tem obstajajo različni modeli, s katerimi lahko učitelji preverijo smiselnost in učinkovitost uporabe tehnologije. Smiselno je izpostaviti vsaj dva in sicer odločitveni model podjetja Microsoft: »Uporabiti tehnologijo pri pouku ali ne« [16] in pa štiristopenjski SAMR model (substitution, augmentation, modification, redefinition) [18].

3.1 AI v izobraževanju

Lahko rečemo, da je digitalno tehnologijo treba uporabljati smiselno in mora biti v podporo učitelju pri njegove delu v razredu na učenca usmerjenega pristopa poučevanja. Če izmed celotnega nabora digitalne tehnologije izpostavimo umetno inteligenco, veljajo prav vsi poudarki uporabe in

zgoraj naštetih izobraževalnih pristopov tudi za umetno inteligenco.

Obstaja niz delitev in razvrstitev tehnologij povezanih z umetno inteligenco, odvisno od področja. V izobraževanju je s področja umetne inteligence tehnološko gledano smiselno izpostaviti tri tehnološka področja in sicer:

- govorne tehnologije (sinteza glasbe, razpoznavnik govora, razhrščevalnik govorca, razvrščevalnik starosti govorca, razpoznavna živalskih glasov, razpoznavna glasbe ter sinteza govora);
- obdelave besedil (razpoznavna imen, razvrščevalnik besedilnih vrst, prevajalnik, semantična analiza, upravljalnik dialoga, slovnično lektoriranje ter analizo sentimenta);
- strojni vid (zaznava oseb, zaznava obrazov, razvrščevalnik barve kože, razvrščevalnik čustvenih stanj, razvrščevalnik starosti osebe, razvrščevalnik objektov ter zaznava objektov).

Seveda bi lahko dodali k temu še več pomembnih področij kot so analitični sistemi, senzorske tehnologije ipd., vendar za področje izobraževanja (didaktika poučevanja) niso ključnega pomena.

Za boljše razumevanje različnih vidikov uporabe umetne inteligence v izobraževanju, vključno s tem, kako se poučuje o njej, kako se uporablja za izboljšanje izobraževalnega procesa in kako se pripravljajo posamezniki za kariere, ki vključujejo uporabo AI pa bi bilo smiselno uporabiti naslednje delite:

- poučevanje o umetni inteligenci
- poučevanje z umetno inteligenco
- poučevanje za umetno inteligenco.

Poučevanje o umetni inteligenci je ključno za digitalno transformacijo in digitalno pismenost naših učencev. Pod tem terminom podrazumevamo razumevanje osnovnih konceptov umetne inteligence, njenih aplikacij in etičnih vprašanj, povezanih z njo. Pouk o umetni inteligenci omogoča, da posamezniki razvijejo ozaveščenost o tej tehnologiji in njeno vlogo v družbi. Hkrati spodbuja razmišljanje o etičnih vidikih uporabe umetne inteligence ter spodbuja kritično razmišljanje o njenih vplivih na delovna mesta, družbo in gospodarstvo. O osnovnih terminih in konceptih s področja umetne inteligence bi bilo smiselno pripraviti izobraževalni program za učitelje, ki bi bili zmožno predstaviti to področje učencem glede na njihovo starostno obdobje.

Poučevanje z uporabo umetne inteligence je nekako tisto področje, o katerem je največ govora tudi v tem članku. Poučevanje z uporabo AI učiteljem omogoča

podpreti njihove inovativne metode poučevanja z digitalno tehnologijo. S takšnim pristopom je možno pri učenci dosegati višje taksonomske ravni njihovega znanja oziroma zastavljenih ciljev. S tem se spreminja vloga učitelja, ki postaja usmerjevalec in tutor ter ne več le transmittor znanja.

Poučevanje za umetno inteligenco pa pomeni pripravo posameznikov za kariere in delovna mesta, povezana z razvojem, implementacijo in vzdrževanjem umetne inteligence. To vključuje učenje programiranja, obvladovanje podatkovnih znanj, razumevanje algoritmov in strojnega učenja ter sposobnost kritičnega razmišljanja o uporabi AI v različnih panogah. Poučevanje za umetno inteligenco je ključno za izoblikovanje delovne sile, ki bo znala izkoristiti prednosti in izzive, ki jih prinaša ta tehnologija v prihodnosti. Nekako to področje najbolj nagovarja srednješolski prostor.

Umetna inteligenca kot del digitalne tehnologije torej ima ključno vlogo pri podpori učiteljev pri različnih metodah in oblikah dela v razredu, kot so sodelovalno delo, problemski pouk, individualizacija in personalizacija, problemsko učenje z avtentičnimi nalogami ter raziskovalni pouk s poudarkom na razvoju kritičnega mišljenja.

V prvi vrsti je vsekakor treba izpostaviti personalizacijo izobraževanja. S pomočjo analize podatkov o učečih se in modelov ter algoritmov strojnega učenja (kot del AI) lahko učitelji bolje razumejo potrebe vsakega posameznega učenca. Takšen vpogled jim omogoča personalizacijo oziroma kreiranje učne poti, glede na specifične potrebe, želje in sposobnosti vsakega učenca. S tem se doseže boljša učna izkušnja in poveča motivacija za učenje. To brez podpore AI ni možno, saj ima učitelj povprečno v razredu 25 učencev in tega enostavno ne zmora. AI namreč lahko pomaga učiteljem pri ustvarjanju interaktivnih personaliziranih učnih poti (s prilagajanjem nalog, ipd). Virtualni pomočniki in tutorji, ki temeljijo na UI, lahko nudijo takojšnjo pomoč učencem pri reševanju težjih nalog ali vprašanjih. Prav tako omogočajo avtomatizirano ocenjevanje, kar razbremeni učitelje in jim omogoča, da se osredotočijo na bolj individualno mentorstvo in spodbujanje kritičnega razmišljanja.

Sodelovalno delo je prav tako eden izmed inovativnih pristopov poučevanja. AI lahko pomaga učiteljem pri oblikovanju učnih skupin z raznolikimi spretnostmi in interesi ter spodbuja sodelovalno delo med učenci. Nekatere raziskave izpostavljajo pozitivne vidike sodelovalnega dela podprtega s sodobno digitalno tehnologijo (AI), ki vzpodbuja sodelovanje in interakcijo med člani skupine na temelju igrifikacije. Prav tako je na tem mestu

smiselno izpostaviti virtualne učitelje/avatarje, ki omogočajo učencem, da sodelujejo v realnem času v skupini, ki premore eksperta z določenega področja in lahko z njih diskutira ter sprejema odločitve.

Problemski pouk predstavlja kombinacijo različnih metod in pristopov poučevanja. Vsekakor je reševanje avtentičnih nalog in problemov smiselno izvajati v skupinah, kjer ima vsak posamezen učenec določeno vlogo/mesto. S pomočjo prilagojenih aplikacij podprtih z AI je močno prilagodi naloge in izzive glede na stopnjo sposobnosti učencev, s čimer se zagotovi, da so izzivi ustrezni za vsakega posameznika oziroma skupino. Učitelj lahko s pomočjo analiz spremlja napredek posameznika in skupine, ter jim nudi usmerjene nasvete in povratne informacije za izboljšanje reševanja težav.

Vloga UI v sodobni šoli ni omejena le na učence in učitelje. Pomaga tudi pri upravljanju šolskih sistemov in načrtovanju izobraževalnih politik. Z analizo obsežnih podatkov lahko UI pomaga identificirati vzorce v uspešnosti šolskih programov in predlaga izboljšave.

3.2 Uigrani učitelj - projekt Umetna inteligenca za učitelje (AI4T)

Cilj projekta AI4T, Umetna inteligenca za in z učitelji (*angl. Artificial intelligence – for and by teachers; 2021 – 2024, Erasmus+; www.ai4t.eu*), je razvoj celovitega programa usposabljanja učiteljev in drugih strokovnih delavcev, njegova poskusna izvedba ter na podlagi pridobljenih rezultatov priprava smernic za različne deležnike. Ciljna skupina so predvsem učitelji angleščine, matematike in tudi nekateri ravnatelji na srednjih šolah, ki poučujejo dijake v starostnem obdobju od 15 do 17 let. Od januarja do junija 2023 se je v vseh partnerskih državah (Slovenija, Francija, Italija, Irska, Luksemburga) udeležilo usposabljanj 1.004 učiteljev iz 315 šol. Na podlagi celovite evalvacije se oblikujejo priporočila za različne ključne deležnike, od ravnateljev do snovalcev politik.

Izmed rezultatov je v prosti uporabi spletni priročnik v vseh petih jezikih projekta, ki zajema šest področij, kmalu pa bo na voljo spletni tečaj. V Luksemburgu bo 18. in 19. januarja 2024 zaključna konferenca projekta, po koncu projekta pa bodo vsem na voljo tudi ostali rezultati projekta, vključno s programi in gradivi izvedenih usposabljanj, kar bo lahko prispevalo k opolnomočenju drugih učiteljev kot ozaveščene uporabnike virov umetne inteligence (UI).

V Sloveniji imamo v projektu AI4T aktivno vlogo sodelavci Službe za digitalizacijo izobraževanja Ministrstva za vzgojo in izobraževanje, Pedagoškega inštituta in Fakultete za naravoslovje in tehnologije Univerze v Mariboru. V projektu sodeluje 17 partnerjev – ministrstev, univerz, raziskovalnih ustanov ter izvajalcev usposabljanj iz Francije, Italije, Irske, Luksemburga in Slovenije. Konzorcij je nastal z namenom povezovanja, da izobraževalne institucije, učitelji in ravnatelji srednjih šol razblinijo predsodke, razvijajo kompetence in spodbudijo učinkovito in smiselno uporabo UI.

4 ZAKLJUČEK

Učenje in poučevanje prihodnosti je mogoče realizirati le, če učitelji skupaj z drugimi strokovnjaki sledijo na eni strani tehnološkemu razvoju, po drugi strani pa dejanskim potrebam mladih pri enakopravni vključitvi v družbo in tudi na trg delovne sile ne le v Sloveniji ampak tudi drugje. Sodobna družba zahteva spremembo procesa poučevanja in učenja, v katerem učenci ozaveščeno aktivno in enakopravno prispevajo tudi lastništvu izobraževanja oz. lastne učne poti. Pri tem je učiteljem in drugim na voljo že veliko primerov iz prakse (dobre in manj dobre) in e-skupnosti, v katerih lahko diskutirajo o izzivih, ki se pojavljajo z novimi tehnologijami in tudi novimi pričakovanju mladih generacij. Uporabljajo tudi smernice, priporočila, ki jih oblikujejo strokovnjaki na lokalni, regionalni, nacionalni, evropski in širši ravni, kot npr. Nadgrajen okvir digitalnih kompetenc za evropskega državljana [25], Nacionalni program spodbujanja razvoja in uporabe umetne inteligence [24], vidiki izobraževanja prihodnosti (ang. Smart Education, [5]), Umetna inteligenca za otroke [26] ter navsezadnje tudi transparentnost umetne inteligence ter algoritmčne pravice in zaščita otrok (ang. Algorithmic Rights and Protections for Children [15]).

Za konec si postavimo vprašanja, ki bosta zagotovo povezani z novimi prihajajočimi valovi umetne inteligence in digitalne tehnologije, kar bo pomembno za razumevanje in nadaljnji razvoj človeka samega in posledično tudi njegove izobraževalne procese:

- Ali je človek res tako superioren, kot se ima, glede na to, kako mu umetna inteligenca nastavlja ogledalo. Na primer, ChatGPT odgovarja precej podobno (in celo brez sovražnega govora) kot človek, tj. od celovitih in pravih odgovorov do nepravilnih in blefiranj ter tudi redko enako odgovori na isto vprašanje, podobno kot ljudje zaradi stalnega intelektualnega razvoja?

- Kje so stranpoti ljudi (vojne, uničevanje, kraje, namerno zavajanje, čustveno izsiljevanje), ali lahko umetna inteligenca prispeva k nadaljnjem u razvoju človekovih možganov in koliko nas je morda UI že "podjarmila"?

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Postopek izdelave elektronske prijavnice s pomočjo Microsoftove aplikacije Forms

Creating an electronic application form using the Microsoft Forms application

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POVZETEK

Na šolskem centru Kranj se kot koordinator projekta Erasmus+ mobilnosti, na področju poklicnega izobraževanja in usposabljanja, vsako leto srečujem z izzivom učinkovite priprave in izpeljave razpisa, s katerim bom omogočila opravljanje praktičnega usposabljanja na delovnem mestu v tujini za dijake in usposabljanja ali poučevanja v tujini za strokovne delavce, zaposlene na Šolskem centru Kranj. Z željo biti v koraku s časom sem zaradi dela od doma in vse večjega zanimanja za projekt mobilnosti ustvarila elektronsko prijavnico s pomočjo Microsoft Oblaka 365, natančneje aplikacijo Forms. V prispevku opišem postopek izdelave samega obrazca, s katerim sem si kasneje olajšala tudi obdelava podatkov. Za pripravo obrazca imam že pripravljene kriterije, ki sem jih določila s pomočjo ravnateljev in dijaške skupnosti. Kriterij predvidi, da lahko posamezen kandidat doseže največ 100 točk, ki ga uvrstijo na določeno mesto za odobritev ali zavrnitev opravljanja praktičnega usposabljanja v tujini. Po zaključku razpisa prenesem prijavnice kandidatov v Excel datoteki, ki jo s pomočjo spajanja dokumentov prenesem v Word datoteko, da je pripravljena za ogled in nadaljnjo obdelavo.

KLJUČNE BESEDE

Elektronska prijavnica, Oblak 365, Erasmus+, mobilnosti, Forms, Excel

ABSTRACT

At Šolski center Kranj, where I work as the coordinator of the Erasmus+ mobility project for vocational education and training, I am faced every year with the challenge of effectively preparing and conducting an Erasmus call, which will enable practical training abroad for students and training or teaching abroad for School Center Kranj employees. With the desire to keep in step with the times, when working from home and with the increasing interest in the mobility project, I created an electronic application form with the help of Microsoft Cloud 365, more precisely the Forms application. In the paper, I describe the process of creating the form itself, which later made all the data processing easier. I have already prepared the criteria for the preparation of the form, which I determined with the help of the principals and the students. The criterion stipulates that an individual candidate can achieve a maximum of 100 points, which places him in a certain position for approval or rejection of practical training abroad. After the call has ended, I download the candidates' application forms in an Excel file, which I transfer to a Word file by merging the documents so that it is ready for viewing and further processing.

KEYWORDS

Electronic application, Cloud 365, Erasmus+, mobility, Forms, Excel

1 UVOD

Na šolskem centru Kranj že vrsto let, vse od akcijskega programa Leonardo da Vinci, postopoma povečujemo število zaposlenih in dijakov, ki jim omogočimo opravljanje prakse v tujini. S pridobitvijo Listine kakovosti v letu 2018 in Akreditacije Erasmus+ v letu 2020 smo se zavezali h kakovostni izvedbi mobilnosti in sprotne merjenju kratkoročnih in dolgoročnih učinkov na delovanje celotnega šolskega centra. Zaposleni in dijaki se na mobilnost prijavijo v času internega razpisa, ki ga izpeljemo v drugi polovici šolskega leta, za naslednje šolsko leto. Kot koordinator projekta mobilnosti zberem več dokumentov, ki jih nato skupaj z izbrano komisijo pregledam in razvrstim po ustreznosti. Žal niso vsi prijavljeni kandidati tudi izbrani, kar postavi postopek izbire in pregleda posameznih oddanih dokumentov v še večji pritisk, da je le ta izvedena objektivno. Da je bila potrebna prevetritev načina prijave sta bila ključna dva dejavnika: delo na daljavo in želja po poenostavitvi pregleda podatkov. Ustvarila sem enostavno obliko oblačne prijavnice, ki mi je pri delu na projektu mobilnosti precej olajšala delo. Elektronska prijavnica pa je skladna tudi z okolju prijazno prakso Zeleni Erasmus+, saj je popolnoma brezpapirna in ima manjši ogljični odtis.

Erasmus+ je program, ki omogoča izmenjavo dobrih praks na območju celotne Evrope, za njegovo izvajanje v Sloveniji skrbi Center Republike Slovenije za mobilnost in evropske programe izobraževanja in usposabljanja (CMEPIUS). Program v okviru ključnega ukrepa 1 (KA1) omogoča posameznikom mobilnost v tujini. Te so namenjene osebnemu in strokovnemu razvoju vključenih posameznikov [1]. Naš projekt mobilnosti v poklicnem in strokovnem izobraževanju, ki je del ključnega ukrepa Erasmus+ KA1, smo po pridobitvi Listine kakovosti v letu 2018 poimenovali Nadgradimo znanje z izkušnjami. Z imenom želimo povedati, da omogočamo dijakom in strokovnemu osebju nadgrajevanje na poklicnem in strokovnem področju. Praktično usposabljanje v tujini omogoča dijakom pridobivanje kompetenc na strokovnem področju in osebnem, kot na primer na področju komunikacije v tujem jeziku, načrtovanja in organizacije, ter na področju vseživljenjskega učenja. Enako omogočamo tudi zaposlenim na šolskem centru, da izpopolnijo svoje znanje v tujini v obliki senčenja na delovnem mestu ali s poučevanjem v tujem jeziku.

Na Šolskem centru Kranj imamo okoli 2200 dijakov in 150 pedagoških delavcev. S posodobljenim programom v letu 2020 smo pridobili tudi novo Akreditacijo Erasmus+, ki nam omogoča kvalitetnejše izvajanje mobilnosti v večjem številu. V šolskem letu 2021/2022 smo na projektu izkušnjo dela v tujini omogočili kar 59 dijakom, v preteklem šolskem letu 2022/2023 pa 42 dijakom. Razpis in izbirni postopek sem v letih od prve mobilnosti do danes izpopolnila, da poteka po ustaljeni časovnici.

2 POSTOPEK RAZPISA IN IZBORA

Pred objavo razpisa na spletni strani Šolskega centra se sestane najprej vodstvo, ki določi komisijo in potrdi časovnico, predlagano z moje strani, kot koordinatorja projekta. Po objavi razpisa imajo dijaki mesec dni časa, da oddajo vse potrebne dokumente. Dijaki izpolnijo vprašalnik, pridobijo mnenje razrednika, napišejo motivacijsko pismo in izdelajo življenjepis v tujem jeziku. Vse našeto poteka v elektronski obliki. Za pomoč pri izdelavi življenjepisa jim je omogočena delavnica Europass CV, ki jo vodi koordinatorica za Europass s Centra RS za poklicno izobraževanje (CPI).

Posamezni dijak lahko, glede na oddano, doseže 100 točk, ki so razdeljene na sedem ključnih kriterijev prikazanih v Tabela 1.

V kolikor sta dva dijaka na meji z enakim številom točk, lahko dodatne točke pridobita na podlagi individualnega razgovora.

Tabela 1: Obrazec za točkovanje dijakov

Kriterij	Opredelitev	Št. točk
Splošni učni uspeh za zadnje zaključeno šolsko leto	Odličen uspeh	15
	Prav dober	10
Znanje tujega jezika	Dober uspeh	5
	Odlično ali prav dobro	10
	Dobro	5
Motivacijsko pismo in življenjepis	Odlično in izvirno izdelano	10
	Povprečno izdelano	5
Sodelovanje pri promociji šole	Tri ali več dogodkov	20
	Dva dogodka	10
	En dogodek	5
Vključevanje v obšolske dejavnosti (število dejavnosti na teden)	Tri ali več	20
	Dve dejavnosti	10
	Ena dejavnost	5
Mnenje razrednika	Vestnost pri izpolnjevanju obveznosti	5
	Motiviranost za pridobivanje znanj, ustvarjalnost, razgledanost	5
	Odnos do sošolcev in zaposlenih	5
	Komunikativnost in sodelovanje pri pouku	5

Vpisi v eAsistenta	Vpis pohvale	+10
	Vzgojni ukrep	-5
	Neopravičena ura	-1

Razpis je za zaposlene objavljen istočasno, vendar pa imajo zaposleni na voljo več časa za oddajo, saj se na razpis prijavi občutno manj kandidatov, ki so v večini na projektu že sodelovali in ga dobro poznajo. Kot obvezno prilogo priložijo le motivacijsko pismo, kjer jasno opredelijo osebne in strokovne cilje in zapišejo kako bodo izkušnjo mobilnosti posredovali naprej, ter svoj življenjepis v angleškem jeziku.

3 ELEKTRONSKA PRIJAVNICA

3.1 Microsoft Forms aplikacija

Aplikacija Microsoft Forms je na voljo vsem uporabnikom Microsoftovega oblaka 365 in je del paketa, ki ga izobraževalne ustanove lahko pridobijo preko zavoda Arnes. Z aplikacijo lahko ustvarimo ankete in kvize, ki jih rešujejo povabljeni v katerem koli spletnem brskalniku ali na mobilni napravi. Ko rezultate oddajo uporabimo vgrajeno analitiko odgovorov in izvozimo rezultate v Excel za dodatno analizo in razvrščanje [2].

Pred začetkom oblikovanja elektronskih dokumentov se mi je zdelo ključno, da je dokument smiselno razdelan. Elektronska prijavnica mora imeti vse podatke, ki jih za potrebe prijave potrebujem, hkrati pa kandidata ne smemo preobremeniti, saj se lahko zaradi kompleksnosti prijavnice tudi premisli in odstopi.

Podatki, ki jih nujno potrebujemo so: ime in priimek, razred, razrednik, izobraževalni program, ter kontaktni podatki (elektronski naslov in številka mobilnega telefona). Dodatno pa so ravno tako ključni za točkovanje kandidata: učni uspeh, ocena pri predmetu angleškega jezika, sodelovanje pri promociji in dejavnosti izven pouka. Mnenje razrednika pridobim ločeno, zato je bilo ključno, da dijak v prijavnici zapiše ime in priimek razrednika.

Ko imamo razdelane bistvene kriterije se odločim za obliko Forms dokumenta.

3.2 Oblikovanje elektronske prijavnice

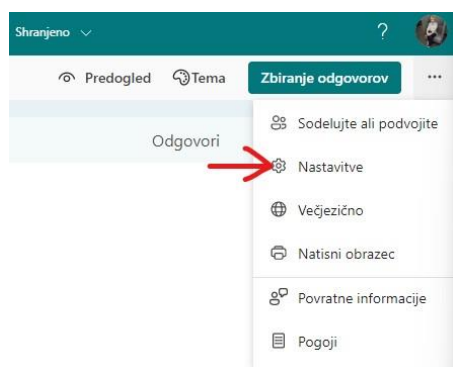
Takoj ob kliku na logotip aplikacije nas le ta vpraša po obliki samega vprašalnika. Ustvarimo lahko nov kviz ali nov obrazec. Ker bomo odgovore kandidatov točkovali glede na vsebino oddanega, bi se lahko odločili za kviz, kjer točke vnaprej tudi nastavimo, vendar pa so pri kvizu možnosti bolj namenjene šolskemu ocenjevanju, kot pri obrazcu, zato se raje odločimo za obrazec, ki ga bomo ob koncu izvozili, kot Excel datoteko.

3.2.1 Nastavitve obrazca

Ob kliku na Nov obrazec se nam pokaže osnovna oblika ankete. Obrazec poimenujem, poigram se lahko s temo in dodam tudi slike, ki se navezujejo na projekt ali šolo. Možnosti za oblikovanje samega izgleda obrazca je več.

Nekaj ključnih nastavitvev lahko nastavimo že pred dodajanjem vprašanj ali pa se k njim vrnemo ob koncu oblikovanja. V kotu aplikacije so skrivajo tri pike, ko kliknemo na ikono se odpre spustni seznam v katerem izberem nastavitve, prikazano na Slika 1. V nastavitvah določim kdo lahko odgovarja na vprašanja v

obrazcu. Ker imajo dijaki dodeljen šolski elektronski naslov izberemo možnost: Le ljudje v moji organizaciji. Na ta način se izognem morebitnemu vdoru nepovabljenim osebam. Omogočim lahko le en odgovor tako, da obkljukam možnost: En odgovor na osebo. Ker je čas za oddajo prijavnice točno določen s časovnico, v nastavitvah določim začetni in končni čas možnosti oddaje odgovorov. Prijavnico lahko ustvarim vnaprej, ker pa smo nastavili začetni čas je nihče pred tem rokom ne bo mogel niti odpreti. Prav tako bo prijavnica nedostopna po končanem datumu. S to možnostjo izključim vse, ki niso pravočasno oddali svojih odgovorov.



Slika 1: S spustnega seznama izberemo nastavitve

Nastavitve nam ponujajo prilagoditev zahvalnega sporočila kamor lahko zapišem datum, ko bom kandidate obvestila o rezultatih razpisa in se jim zahvalila za sodelovanje.

3.2.2 Obvestilo o obdelavi osebnih podatkov

S posodobitvijo zakona o varovanju osebnih podatkov je postalo ključno, da so posamezniki, ki delijo kakšne koli osebne podatke obveščeni o njihovem hranjenju in obdelavi. Da se izognem kasnejšemu morebitnemu zapletu zaradi obdelave podatkov kandidate še pred začetkom reševanja ankete opozorim na obdelavo in hranjenje vseh odgovorov, ter o morebitni objavi podatkov na javnem mestu. V obliki besedila s pojasnilom pod naslovom obrazca.

3.3 MOŽNOSTI OBLIK VPRAŠANJ

Obrazcu dodajam vprašanja tako, da kliknemo na znak: +Dodajte novo. Ob kliku se nam ponudi več možnosti, kot so:

1. Izbira (anketiranec imam možnost le izbrati med ponujenim)
2. Besedilo (tip odprtega vprašanja, kjer anketiranec lahko poda kratek ali daljši odgovor)
3. Ocena (anketiranec lahko oceni izkušnjo)
4. Datum (zaprt tip vprašanja, kjer lahko anketiranec odgovori z datumom)
5. Razvrstitev (anketiranec ponujene odgovore razvrsti v določen vrstni red, tako, da jih s klikom miške prenese višje ali nižje na lestvici)
6. Likert (likertova lestvica omogoča zbiranje kvantitativnih podatkov o stališčih, prepričanjih in mnenjih ljudi ipd. [3])
7. Želite naložiti datoteko? (izbrana možnost omogoča nalaganje datotek)

8. Odsek (vprašalnik lahko razdelimo na več delov v kolikor imamo več sklopov)

3.3.1 Besedilo

Ob začetku prijavnice od kandidatov želim pridobiti osnovne podatke: ime, priimek, razred, izobraževalni program in kontaktne podatke. Smiselna izbira vrste vprašanja za te podatke je možnost: Besedilo. Pri tej možnosti mora anketiranec vtipkati odgovor v okvir pod vprašanjem, kot je prikazano na Slika 2. V kolikor pričakujemo daljši odgovor nam vprašanje ponudi možnost: Dolg odgovor, kar omogoči vnos do 4000 znakov. To možnost uporabim na primer pri vprašanju o sodelovanju na šoli, kot je prikazano na Slika 2. Anketiranec lahko navede vse svoje obšolske dejavnosti oziroma načine sodelovanja pri promociji šole.

Slika 2: Primer besedilnega vprašanja s kratkim in dolgim odgovorom.

3.3.2 Ocena

Za podatke, kjer pridobivam številko, kot je na primer ocena zaključnega uspeha ob koncu šolskega leta ali ocena pri predmetu tujega jezika uporabim možnost vprašanja: Ocena. Pri tej možnosti določimo najvišjo raven ocene in način prikaza. Kot je razvidno na Slika 3 izbiramo med številko ali obliko zvezde. Ker gre za oceno, ki je v redovalnici dijaka zapisana s številko je smiselna izbira le te. Zvezdo bi lahko izbrali pri anketi, ko sprašujemo o zadovoljstvu izkušnje.

Slika 3: Primer vrste vprašanja – ocena

3.3.3 Nalaganje datoteke

Zelo pomembni pri prijavnici so priloženi dokumenti. Ker ne želim da so dokumenti oddani ločeno od same prijavnice nam obrazec ponuja možnost: Želite naložiti datoteko?, ki se nam odpre po kliku na škarjice ob koncu ikon. Tretja na spustnem seznamu je možnost nalaganja datotek. Aplikacija nas najprej opozori, da bomo ustvarili novo mapo na svojem oblaku OneDrive, kjer se bodo oddane datoteke hranile. Število, vrsto in velikost datoteke lahko nastavimo pri samem vprašanju **Error! Reference source not found..** Na oddajo primerne datoteke opozorim s podvprašanjem, kjer anketirancu dodatno pojasnim kaj točno oddaja na tem mestu. Izbiram lahko med oblikami, kot so Word, Excel, PPT, PDF, Slika, Videoposnetek in Zvok. Ker želim, da kandidat naloži svoj življenjepis izberem format PDF in/ali Word. Datoteke, ki jih kandidat naloži se avtomatsko

shranijo v mapo ustvarjeno na oblaku z elektronskim naslovom kandidata v imenu datoteke. Na ta način imam v mapi takojšen pregled oddanih dokumentov.

3.3.4 Odsek

Zadnja ikona na spustnem seznamu je odsek. Z dodanim odsekom lahko obrazec razdelim na več delov. Vprašanja tako na primer razdelimo na:

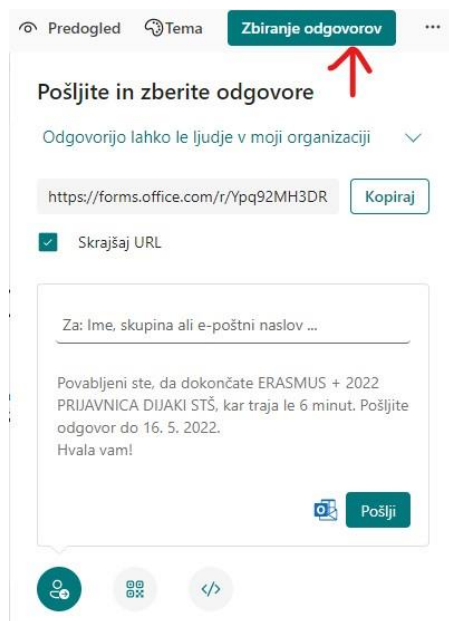
- prvo stran, kjer se nahajajo ključni osebni podatki
- drugo stran, kjer imamo vprašalnik o ocenah in sodelovanju pri pouku ter izven njega
- tretjo stran pa namenimo oddaji dokumentov in morebitni dodatni možnosti, kjer anketiravec poda svojo pobudo, mnenje ali vprašanje

V kolikor bi pripravili enostavnejšo obliko vprašalnika to možnost izpustimo in izdelamo obrazec brez odsekov.

3.4 ZBIRANJE ODGOVOROV

Vprašalnik s prijavnico je izdelan, pripravljen na objavo v besedilu razpisa.

V zgornjem desnem kotu obrazca je poleg teme obarvan gumb, kjer piše: Zbiranje odgovorov, kot vidimo na Slika 4. Po kliku na gumb se odpre pasica z desne strani, kjer izberem možnost posredovanja ankete. Ena izmed ponujenih možnosti je URL naslov ankete, ki ga skrajšamo z obkljukanjem na možnost: Skrajšaj URL. Naslov preprosto kopiramo in dodamo v besedilo razpisa ali objavimo na spletnih straneh, kjer bo razpis objavljen.



Slika 4: Zbiranje odgovorov.

Na dnu Slika 4 vidim tri okrogle ikone, ki nam ponujajo možnost delitve obrazca. Prva možnost ponuja vnos elektronskega naslova, kjer izbranec dobi vabilo v svoj elektronski poštni predal. To možnost bi izbrali, če bi želeli posredovati svojo anketo sodelavcu v pregled. Druga okrogla ikona nam generira QR kodo s katero dostopamo do ankete, tretja možnost pa nam ponudi da vdelamo kodo v našo spletno stran [4].

3.5 OBDELAVA PODATKOV

Tekom odprtega razpisa lahko spremljam oddane odgovore tako, da odprem ustvarjen obrazec in vidim število oddanih odgovorov. Ob zaključku razpisa, določenem ob začetku, v nastavitvah, se anketa zapre. Aplikacija ima že vgrajeno analitiko odgovorov in nam zbere podatke v Excel datoteko in izračuna povprečen čas reševanja ankete.

Za nadaljnjo obdelavo podatkov jih bomo najprej izvozili v Excel datoteko. To naredimo preprosto s klikom na možnost: Odpri v Excelu. Datoteka je na prvi pogled nepregledna, saj je oblikovanje pri tabeli generično. Z malo spretnosti oblikujem izgled tabele, da je uporabniku prijaznejša. Izberemo med možnostmi preloma besedila in nastavitve širine posameznih celic tabele. Tabela lahko naprej, s pomočjo spajanja dokumentov, uvozimo tudi v Word datoteko, v kolikor nam je delo v Wordu lažje.

Sama sem uporabila čarovnika za spajanje in podatke uvozila v Wordov dokument. Tako sem za posameznega kandidata ustvarila posamezen dokument, ki je bil nato tudi ocenjen, glede na podane znane kriterije.

4 ZAKLJUČEK

V elektronsko prijavnico je vključenih več let izpolnjevanja oblike prijavnice, saj od kandidatov ne želimo podatkov, ki jih ne potrebujemo, kljub temu, pa so zaradi vse večjega števila prijavljenih dijakov kriteriji, po katerih dijake ocenjujemo, vse bolj strogo določeni. Tako je izredno pomembno, da dobimo čim več podatkov o dijakovi udeležbi pri pouku, ter izven njega, saj to kaže na njegovo pripadnost šoli in voljo do dodatnih izzivov, kar je za mobilnost v tujini ključno. Elektronska prijavnica je bila sestavljena, v duhu Zelenega Erasmusa, saj podpira brezpapirno poslovanje in je trajnostno naravnano. Arhiv prijavnice je hranjen na oblaku in na ta način dostopen z vsake elektronske naprave, ki je povezana s spletom. Iz oblaka je omogočena obdelava podatkov tako na delovnem mestu, kot pri delu na daljavo, ne da bi s seboj nosili težke vložne mape z vsemi podatki.

Prispevek je namenjen vsem, ki si želijo poenostaviti delo s prijavnico in potrebujejo idejo, kako se dela lotiti oziroma katero aplikacijo uporabiti.

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Izpeljava delavnic za dvig digitalnih kompetenc v osnovni šoli Idrija

Conducting workshops to improve digital competence in primary school Idrija

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POVZETEK

Osnovna šola Idrija je v zadnjih letih sodelovala v dveh večjih projektih, s pomočjo katerih je izboljšala digitalne kompetence učiteljev in učencev ter vzporedno nadgradila IKT opremo na šoli. Ta dva projekta sta bila Inovativna pedagogika 1:1 in Dvig digitalne kompetentnosti. V obeh projektih so učitelji pri učencih izboljšali skupno izbrana področja iz okvira digitalnih kompetenc za državljane DigiComp 2.1. Izpeljane so bile številne delavnice za učitelje, kjer so različni učitelji razredne in predmetne stopnje prikazali primere dobrih praks uporabe digitalnih orodij pri pouku. Vsak učitelj je moral izpeljati na letni ravni vsaj 4 ure pouka z uporabo digitalnih kompetenc, s čimer smo poskusili razvijati digitalne kompetence učencev skozi celotno vertikalno devetletko. Napredek pri učencih predmetne stopnje in njihovih učiteljih smo evalvirali z orodjem Selfie. V prispevku boste dobili nove ideje, kako izdelati uporabne anketne vprašalnike, kvize za preverjanje in ocenjevanje znanja, stripe, virtualno sobo pobega, uporabiti 3D očala pri ogledu poučnih 360° fotografij in posnetkov, uporabiti aplikacijo za pouk na prostem, izdelati video vodiče in zmontirati kratke posnetke.

KLJUČNE BESEDE

digitalne kompetence, delavnice za učitelje, digitalna vertikala, kompetence DigiComp 2.1, orodje Selfie

ABSTRACT

In recent years Primary school Idrija participated in two major projects, with the help of which it improved the digital competences of teachers and students and simultaneously upgraded the school's ICT equipment. These two projects were Inovativna pedagogika 1:1 and Dvig digitalnih kompetentnosti. In both projects, teachers together selected areas from the the Digital Competence Framework for Citizens DigiComp 2.1, to improve the knowledge of students. A number of workshops for teachers were held, where teachers of different subjects and teaching levels demonstrated examples of good practices of the use of digital tools in lessons. Every teacher had to conduct at least 4 hours of lessons using digital competences on an annual basis, with which we tried to develop the digital competences of students throughout the entire primary school. We evaluated the progress of older students age between 10 and 13 and their teachers using the Selfie tool. In this article, you will get new ideas how to create useful survey questionnaires, quizzes for checking and evaluating knowledge, comics, a virtual escape room, use of 3D glasses when viewing interactive 360° photos

and videos, using an app for outdoor lessons, create video guides and edit short clips.

KEYWORDS

digital competences, teacher workshops, digital vertical, DigiComp 2.1 competences, Selfie tool

1 UVOD

Na osnovni šoli Idrija se zavedamo, da trenutni učni načrt ne zagotavlja ustreznega sistematičnega digitalnega opismenjevanja otrok skozi celotno devetletko. Zato si že več let izmenjujemo izkušnje z ostalimi šolami znotraj različnih projektov. V projektu Inovativna pedagogika 1:1 je šola sodelovala od leta 2018 do 2022 kot partnerska šola in pridobila kar nekaj dragocenih izkušenj. Ker smo po koncu projekta čutili potrebo po vzpostavitvi vertikale digitalnih kompetenc na celotni šoli, smo se vključili v projekt Dvig digitalnih kompetenc, ki ga uspešno zaključujemo z letošnjim šolskim letom.

Poleg sodelovanja z drugimi šolami nam je še bolj pomembno povezovanje učiteljev in izmenjava izkušenj s smiselno uporabo IKT-ja na šoli. Vsi učitelji so bili seznanjeni s področji digitalnih kompetenc za državljane DigiComp 2.1. V skupnem dogovoru smo se odločili, da bomo pri učencih po celotni vertikali razvijali sklope digitalnih kompetenc kot so digitalna pismenost, komuniciranje in sodelovanje, izdelovanje digitalnih vsebin in varnost. Ravni doseganja kompetenc pa bomo prilagodili starostni skupini otrok [1].

Hvaležni smo, da imamo kot velika šola z dvema zaposlenima računalničarjema prednost, saj nam le to omogoča lažjo pomoč učiteljem na različnih področjih. V letu 2022 smo pridobili novo računalniško učilnico, ki omogoča da vsak učenec dela s svojim računalnikom. Prav tako nam je sodelovanje v različnih projektih omogočilo nakup tabličnih in prenosnih računalnikov za dve mobilni učilnici. Zavedamo se, da je bolj kot na opremi potrebno delati na uporabnem znanju učiteljev, ki ga lahko prenesejo na učence. Zato je razširjen projektini tim učiteljev različnih predmetni področji pripravil skupno 10 delavnic, kjer se je vsak učitelj moral udeležiti najmanj dveh delavnic tekom leta. Hkrati je moral vsak učitelj pri svojem predmetu smiselno uporabiti pridobljeno znanje pri najmanj 4 urah pouka, kjer so učenci aktivno uporabljali IKT tehnologijo. V nadaljevanju bodo na kratko predstavljene aplikacije iz izpeljanih delavnic za učitelje in njihov namen, ki učitelju omogočajo boljšo izpeljavo pouka.

2 DELAVNICE ZA UČITELJE

Čeprav si informacijsko komunikacijska tehnologija nezadržno utira pot v pore vsakdanjega življenja, se šolski prostor temu pohodu nekoliko upira. Kar se zdi prav. Poudarjanje nujnosti osmišljene uporabe IKT pri pouku, ki je ciljna in osredotočena na učenca, je namreč ključno. Vse prehitro se lahko tehnologija pri pouku spremeni v poceni zabavljaštvo, navidezno lažje, bolj zabavno, a površinsko učenje in manj zahtevno poučevanje [2].

Zato predlagamo kritično presojo pred smiselno uporabo pri pouku kot nadgradnjo ali izboljšavo obstoječih ur. Vsaka izmed delavnic je potekala 4 šolske ure, pri čemer je učitelj prikazal primere izdelkov iz pouka, nato pa učitelje podučil kako uporabljati aplikacijo. Delavnice smo razdelili po zahtevnosti, tako da so učitelji z različnim predznanjem lahko izbirali med različnimi delavnicami.

2.1 Napredna uporaba prosojnic

Večina učencev šole se nauči izdelovati elektronske prosojnice proti koncu razredne stopnje. V delavnici iz napredne uporabe prosojnic v programu Powerpoint so učitelji spoznali še nekaj dodatnih naprednih trikov, kot so izdelava fotoalbuma z glasbeno podlago v ozadju. Izdelek je s strani učiteljev velikokrat uporabljen, ko želijo da se samodejno predvajajo slike šolskih dogodkov v jedilnici ali hodniku šole. Učitelji so prav tako spoznali kako se prilagodi matrico diapozitiva v unikatno ozadje prosojnic in izdelava s prosojnicami kviz, ki ti z internimi hiperpovezavami na ponujene odgovore avtomatsko sporoči, ali je izbran odgovor pravi ali ne.

2.2 Izdelava kviza v Kahootu

Le kdo ne pozna tega enostavnega in zabavnega orodja, ki omogoča da pri učencih preverite njihovo znanje v obliki kviza z več možnimi odgovori. Učitelj poda učencem PIN kodo, s katero dostopajo preko aplikacije na tablici ali strani www.kahoot.it iz računalnika. Kviz lahko učenci rešujejo tako v živo kot tudi na daljavo v obliki domače naloge. Učenci nabirajo točke in ves čas lahko spremljajo na katerem mestu so. Zelo jim je všeč tudi glasbena podlaga in izbira emotikona, ki se med kvizom pojavi poleg njihovega imena. Učitelji uporabljajo to orodje predvsem za preverjanje znanja ali uvodno motivacijo v vseh starostnih obdobjih šolanja.

2.3 Interaktivna vsebina H5P

Z naprednim vtičnikom H5P lahko uporabniki ustvarijo, delijo in uporabljajo interaktivne vsebine, ki imajo mnogo elementov igrifikacije in vizualizacije študijskega procesa. Vsebine so pripravljene na podlagi HTML5, zato je zagotovljena podpora delovanja na različnih vrstah (mobilnih) naprav. Vtičnik je zgrajen na podlagi odprtokodne tehnologije (licenca MIT), tako da je tudi uporaba in sodelovanje v spletni skupnosti z ostalimi uporabniki brezplačna. Uporaba orodij je zelo intuitivna in podprta z nazornim grafičnim vmesnikom, zato poglobljeno računalniško oz. programersko znanje ni potrebno [3].

Učitelji z vtičnikom v svoji spletni učilnici ali spletni strani največkrat izdelujejo kvize, interaktivne video posnetke, interaktivne prosojnice ali spominske karte. V času pouka na daljavo so učitelji velikokrat uporabljali to orodje, sedaj pa se ga poslužujejo v primeru utrjevanja snovi ali bolj raznolike razlage.

2.4 Google Forms

Številni učitelji so že kdaj izdelali spletno anketo za učence, sodelavce ali pa starše s pomočjo orodja Google forms. Zato smo se med vsemi anketnimi orodji odločili prav za tega. V dveh različnih delavnicah so učitelji spoznali kako se izdelava s tem orodjem enostaven kviz in bolj napredno virtualno sobo pobega. Orodje namreč poleg navadnih anketnih vprašanj ponuja sestavo vprašanj, ki se jih lahko točkuje, prav tako pa lahko iz enega vprašanja glede na izbran ali vpisan odgovor skočite na poljuben razdelek in s tem izdelate zanimivo sobo pobega. Vsak razdelek lahko predstavite kot novo sobo, ki vam sporoči ali ste pravilno razvozlati uganko na predhodnem razdelku. V primeru, da vam je to uspelo, dobite novo vprašanje, v primeru napačnega odgovora pa se morate vrniti nazaj na prejšnji razdelek z vprašanjem in ponovno odgovoriti na vprašanje. Vsa vprašanja je dobro opremiti z zanimivo tematsko zgodbo, ki ima rdečo nit in vas skozi vprašanja vodi do konca kviza. Soba pobega lahko učitelj uporabi, da popestri preverjanje znanja ali da učenci bolje utrdijo osvojeno znanje.

2.5 Uporaba 3D kartonastih očal

Ker šola nima zadostnih sredstev za uporabo aktivnih 3D očal z integriranim zaslonom, smo se odločili za uporabo cenovno bolj dostopnih 3D kartonastih očal. Ker je Google ukinitel zelo poučno aplikacijo Expeditions, učitelji naravoslovnih predmetov sedaj največkrat uporabljajo podobno brezplačno aplikacijo Expeditionspro. Učenci pri tem vstavijo svoje mobilne telefone v kartonasta očala in se povežejo preko istega brezžičnega omrežja z učiteljevo tablico, na kateri le ta upravlja potek prikazovanja 360° fotografij ali pa video posnetkov. Pri tem ima učitelj vpogled kam na sliki gledajo učenci, ko imajo nadeta 3D očala. Če učenci svojega telefona ne smejo ali pa nočejo imeti, je ogled slik možen tudi preko aplikacije na šolskih tablicah. Očala so na šoli največkrat v uporabi pri pouku geografije, biologije, zgodovine ali astronomije, saj lahko učitelj bolj nazorno razložimo določeno snov na tak način. Aplikacija zaradi nekaterih varnostnih omejitev ne deluje pravilno preko Eduroam omrežja, zato je potrebno pred njeno uporabo vzpostaviti dodatno dostopno točko, ki ni vezana na to omrežje.

2.6 Snemanje video vodičev

V času pouka na daljavo so za učence postale izjemno zanimive video razlage, ki jih sedaj lahko uporabljamo za dopolnitev pouka. Učitelji so v malo bolj zahtevni delavnici spoznali brezplačni del orodja ActivePresenter, s pomočjo katerega lahko posnamete na Windows ali iOS napravah vašo razlago zaslona ali pa sebe. Orodje ima prednost pred nekaterimi podobnimi orodji za zajem ekrana, da lahko v njem hkrati tudi montirate video posnetek. Njegova slabost je, da so nekatere funkcije plačljive. Učitelji so se z brezplačnimi funkcijami naučili kako izrezati posamezne dele razlage, dodati naslovno in odjavno špico, slikovno grafiko, podnapise, približati posnetek na posamezen del ekrana in samemu posnetku dodati ambientalno glasbo. Vse skupaj so na koncu delavnice izvozili iz programa na računalnik v obliki mp4 formata. Svoje video posnetke so nekoč učitelji nalagali na Youtube video platformo, a sedaj predvsem na Arnes video portal, ki vam omogoča brezplačno nalaganje poljubno dolgih video posnetkov, brez motečih reklam med samim predvajanjem.

2.7 Izdelava stripov

Če želimo biti pri risanju stripa čim bolj kreativni, potem se bomo lotili le tega ročno ali vsako sliko posebej narisali v izbranem grafičnem programu. Če pa želimo z njim sporočiti le neko zgodbo je uporaba namenskih aplikacij bolj enostavna. Učitelji tujih jezikov dobro vedo, kako pomembno je, da lahko zgodbo povemo v enostavni a vseeno zabavni obliki. Še nekaj časa nazaj so zato uporabljali orodje Pixton, ki vam s številnimi liki omogoča, da hitro izdelate posamezne figure z ustrežno obrazno mimiko in kretnjami ter jim dodate ustrezen napis v oblaku namenjenemu za govor. Na žalost ima orodje sedaj samo 14-dnevno brezplačno preizkusno obdobje, zato lahko uporabite kako drugo brezplačno alternativo kot je Canva. V osnovi brezplačno spletno orodje vam omogoča, da spremenite posamezne pred pripravljene predloge za stripe na hiter in enostaven način. V ospredju izdelave stripa pride predvsem zgodba in ne toliko kreativnost pri risanju, zato boste učitelji likovne vzgoje morali poiskati kak drug način izdelave stripa.

2.8 Osnove video montaže

Pri široki izbiri orodij za montažo video posnetkov smo se ozirali za enostavnim orodjem, s pomočjo katerega se lahko učitelji ali učenci začetniki v kratkem času naučijo video montaže. Zaradi tega razloga smo izbrali učencem dobro poznano orodje CapCut, saj nekateri že sami preko njega objavljajo zmontirane posnetke na svoja socialna omrežja. Orodje lahko uporabljate kot spletno različico za urejanje slik ali video posnetkov, okrnjeno mobilno različico na mobilnih napravah iOS in Android ali pa polno namizno različico na platformi Windows. Za potrebe delavnice smo izbrali slednjo verzijo programa. Učitelji so se naučili kako dodati naslovno in odjavno špico, ustrezno porezati posnetek, mu dodati slikovne efekte, neopazne prehode, uporabiti brezplačno ponujeno glasbeno podlago in vse skupaj shraniti v ustrezno obliko za nalaganje posnetka na Arnes video portal.

2.9 Aplikacija za raziskovanje okolice šole

Pri izbiri aplikacije TeachOut za raziskovanje lokalnega okolja, smo se oprli na Zavod za turizem Idrija. Naravoslovna igra na prostem (ali preprosto TeachOut) je poučna igra, zasnovana za rabo na sistemih Android in iOS. Aplikacija je razvita kot orodje za izboljšanje poučevanja, ki skupaj s sistemom CMS omogoča učiteljem, da izdelajo in objavijo zunanje igrice o znanosti, ki jih bodo njihovi učenci igrali na pametnih telefonih, pri tem pa se na ekskurzijah učili in zabavali. [4]

Aplikacijo za potrebe pouka uporabljajo tako učiteljice razrednega kot predmetnega pouka, pri čemer se na šolske tablice predhodno prenese igra, da lahko le to uporabljamo brez mobilnih podatkov izven šolskih prostorov.

3 REZULTATI

Pri začetni evalvaciji projekta Dvig digitalnih kompetentnosti maja 2022 in končni evalvaciji projekta ob junija 2023 smo vsakič uporabili isti anketni vprašalnik narejen v orodju Selfie. To je orodje, zasnovano za pomoč šolam pri vključevanju digitalnih tehnologij v procese poučevanja, učenja in preverjanja znanja. Orodje anonimno zbira stališča učencev (v našem primeru zadnje triade), učiteljev in predstavnikov vodstva šole glede uporabe tehnologije na njihovih šolah. V tem postopku se

uprabljajo kratke trditve in vprašanja ter preprosta lestvica odgovorov od 1 do 5. Za vprašanja in izjave je potrebnih približno 20 minut [5].

Ko primerjamo rezultate obeh vprašalnikov opazimo, da so pri večini vprašanj tako učitelji kot tudi učenci izbrali boljše ocene ob končnem reševanju ankete v primerjavi s prvim poskusom pred enim letom. Po mnenju učiteljev in vodstva so najboljša področja šole infrastruktura in oprema (4,6) in možnost profesionalnega razvoja učitelja (4,2). Najslabše rezultate učitelji dosegajo na področju implementaciji pridobljenih digitalnih znanj v razredu (3,4) in spremembi klasičnega načina ocenjevanja (3,0).

Učenci so kot najboljša področja ocenili infrastrukturo in opremo (4,0) ter podporo in vire, ki jim jih omogočajo učitelji s pomočjo digitalnih orodij (3,8). Po drugi strani si učenci želijo več sodelovanja in mreženja s pomočjo digitalnih tehnologij (3,2) in modernejšie načine ocenjevanja (3,1). Zanimiva je tudi končna primerjava znanja digitalnih kompetenc učencev. Učitelji in vodstvo šole meni z oceno 4,3 da je znanje učencev zelo dobro, medtem ko so učenci z oceno 3,4 do sebe bolj kritični.

4 ZAKLJUČEK

Rezultati ankete Selfie kažejo, da je šola na področju digitalnega razvoja naredila korak naprej. Učitelji so od pandemije Covid 19 naredili velik napredek pri osvojenih znanjih na področju digitalnih kompetenc, le te pa bo potrebno v večji meri v razredu smiselno uporabiti. Prav zaradi razkoraka ocene digitalnih kompetenc med učenci in učitelji menimo, da bo v prihodnje potrebno nadaljevati s sistematičnim izobraževanjem učiteljev, jim nuditi podporo pri pedagoškem procesu in jih ustrezno pohvaliti oziroma nagraditi ob njihovem napredku. Potrebno jih bo spodbujati, da ta znanja smiselno uporabijo v razredu, se med sabo povezujejo in s tem vzpostavijo vertikalo digitalnih znanj pri učencih skozi celotno devetletko.

ZAHVALA

Kot šola se zahvaljujemo vsem učiteljem, ki so pripravljene deliti svoje ideje z drugimi. Predvsem pa gre zahvala ravnateljici Ivici Vončina za vso podporo pri izpeljavi različnih projektov ter javnih razpisov v sodelovanju z Arnesom, s katerim smo pridobili kar nekaj opreme in izpeljali brezplačne tečaje na šoli. Zahvala gre tudi g. Radovanu Kranjcu, ki na Zavodu za šolstvo svetuje vsem šolam kako dvigniti raven digitalnih kompetenc. Velika zahvala gre tudi vsem društvom in podjetjem kot so Duh časa, Kolektor, Rotary klub Idrija in Zavarovalnica Sava, ki so v preteklih letih donirala materialna ali pa finančna sredstva za posodobitev in razširitev IKT opreme na šoli.

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PREDSTAVITEV RAVNIKARJEVEGA IN TAVČARJEVEGA LETA Z UPORABO SPLETNIH ORODIJ

THE YEAR OF THE RAVNIKAR AND TAVČAR WITH THE USE OF ICT

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POVZETEK

V članku Predstavitev Ravnikarjevega in Tavčarjevega leta z uporabo spletnih orodij bom predstavila, kako so učenci in učenke ovrednotili in predstavili leto pisatelja Ivana Tavčarja in arhitekta Edvarda Ravnikarja ter kako so se lotili tega leta, ki ga je predlagalo Ministrstvo za kulturo Republike Slovenije. Namen izbranih slovenskih umetnikov in ustvarjalcev je, da bolj natančno orišemo njihovo delo, ustvarjanje ter vpliv, ki ga imajo na današnji čas. Z učenci smo se odločili, da bodo predstavitev lahko v obliki Power Pointa, video posnetkov, narejenih s pomočjo aplikacije Filmora, ali pa bodo izbranega avtorja predstavili na klasičen način v obliki govornega nastopa. Pri tem so medpredmetno sodelovali (izbirna predmeta Filmska vzgoja in Multimedija). Na ta način so poglobili svoje znanje tako o Tavčarju in Ravnikarju kot tudi nadgradili znanje informacijsko-komunikacijske tehnologije. Učenje je bilo tudi sodelovalno, saj so delali v skupinah.

KLJUČNE BESEDE

Edvard Ravnikar, Ivan Tavčar, arhitekt, realizem, modernizem, Power Point, Filmora

ABSTRACT

In the article entitled Ravnikar's and Tavčar's year using information and communication technology, I will present how the students evaluated and presented the year of the writer Ivan Tavčar and the architect Edvard Ravnikar and how they tackled this year, which was proposed by the Ministry of Culture of the Republic of Slovenia. The purpose of the selected Slovenian artists and creators is to more accurately present their work, creation and the influence they have on today. Together with the students, we decided that the presentations could be in the form of Power Point, movies made with the help of the Filmora application, or the selected author would be presented in a classic way in the form of a speech. In doing so, they collaborated cross-curricularly (elective courses Film Education and Multimedia). In this way, they deepened their knowledge of both Tavčar and Ravnikar, as well as upgraded their knowledge of information and communication technology. Learning was also collaborative, as they worked in groups.

KEYWORDS

Edvard Ravnikar, Ivan Tavčar, architect, realism, modernism, Power Point, Filmora

1 UVOD

V članku bom predstavila, kako so učenci in učenke osmih razredov s pomočjo IKT predstavili Tavčarjevo in Ravnikarjevo delo. Letošnje leto je namreč Ministrstvo za kulturo Republike Slovenije razglasilo za leto Tavčarja in Ravnikarja, saj obeležujemo 100- oziroma 30-letnico njune smrti. Tavčarja poznamo kot enega najpomembnejših slovenskih pisateljev realizma, Ravnikar pa je znan kot začetnik modernizma v slovenski arhitekturi.

Tavčar je tudi vključen v Učni načrt za slovenščino za 8. razred, saj v tem razredu obravnavamo realizma kot literarnozgodovinsko obdobje.[1]

Primerna in zanimiva se mi je zdelo ideja, da obletnico obeh znanih in ustvarjalnih Slovencev vključim v učni proces. Učenci so se razdelili v skupine in se dogovorili, na kakšen način se bodo lotili raziskovanja. Pri tem so medpredmetno sodelovali (Filmska vzgoja, Multimedija). Z rezultati dela smo bili zadovoljni, učenci so na svež način predstavili ustvarjalno pot pisatelja in arhitekta, tudi z uporabo spletne aplikacije Filmora. Delo so v razredu tudi predstavili.

2 OBDOBJE REALIZMA

Realizem je literarno obdobje, ki se je začelo v Franciji okrog 1830, na Slovenskem pa se je razmahnilo šele v drugi polovici 19. stoletja in je trajalo do začetka 20. stoletja. Beseda realizem izhaja iz latinskega pojma realis, kar pomeni stvaren.

Realizem pomeni dvoje: obdobje ali pa književno metodo. Realizem kot književna metoda se pojavlja v vseh književnostih od antike do danes. Stvarnost prikazuje tako, kot v resnici je ali pa bi lahko bila po zakonu verjetnosti. Realizem kot obdobje se je v posameznih književnostih razvil ob različnem času in v različnih političnih in kulturnih razmerah, zato ni bil čisto enotno književno obdobje.

Realizem se je do 1848 razmahnil v Angliji, Rusiji in deloma Nemčiji. Prvo obliko je predstavljal romantični realizem, ob njem pa so se pojavili še zametki psihološkega in socialnega realizma. V Franciji velja Balzac za začetnika realizma z delom Človeška komedija. Prvi primer psihološkega realizma je Stendhalovo delo Rdeče in črno. V Rusiji je prehod iz romantike v realizem izvedel Nikolaj V. Gogolj z deli Plašč, Mrtve duše, Revizor. Najpomembnejša pisca ruskega realizma sta Dostojevski in Tolstoj. Po letu 1848 se je pojavil objektivni realizem. Socialni realizem je v angleški književnosti uveljavil Dickens z delom Oliver Twist. [2]

Glavna predstavnika realizma na Slovenskem sta Janko Kersnik (Kmetske slike, Jara gospoda) in Ivan Tavčar (Cvetje v jeseni, Med gorami, Visoška kronika.). Poleg njiju pa še Anton Aškerc, Simon Gregorčič, Fran Levstik in Josip Jurčič.

2.1 IVAN TAVČAR

Ivan Tavčar (1851–1923) je bil pisatelj, odvetnik, politik, poslanec in župan (Slika 1). Aktiven je bil tako na umetniškem kot na političnem področju.

Šolanje je začel leta 1858 v Poljanah. Izobraževanje je nadaljeval na normalki v Ljubljani, končal jo je leta 1863. Nato se je leta 1863 vpisal na gimnazijo v Ljubljani. Književnost ga je navdušila že v dijaških letih in tudi sam se je kmalu preizkusil v pisanju. Po koncu gimnazije leta 1871 se je vpisal na pravo na Dunaju in začel objavljati v raznih revijah (mariborska Zora, Stritarjev Zvon, Ljubljanski zvon, Slovan). Leta 1875 je postal odvetniški pripravnik v Ljubljani. Tu je leta 1884 odprl lastno odvetniško pisarno. V letih od 1886 do 1902 je predsednikoval Dramatičnemu društvu. Politično kariero je začel v kranjskem deželnem zboru, kjer je bil skupaj s političnim somišljenikom Ivanom Hribarjem. V letih 1901 do 1907 je bil državnozborski poslanec, med letoma 1911 in 1921 je bil tudi ljubljanski župan.

Kot besedni umetnik je začel s pesnenjem, nadaljeval pa s prozo. Pisateljstvo je začel z ljubezensko prozo, nadaljeval pa s realističnimi črticami v zbirki Med gorami (Slika 2). V tem ciklu je 12 črtic: Holekova Nežika, Gričarjev Blaže, Tržačan, Moj sin, Kako se mi ženimo, Kalan, Kobiljekar, Grogov Matijče, Posavčeva češnja, Šarevčeva sliva, Kočarjev gospod, Miha Kovarjev. Piše v prvi osebi ednine, vendar ne gre za osebno izpoved, ampak je predstavljena usoda ljudstva. Govori o revščini, krutosti in brezobzirnosti ljudi. [3]

Pri pouku književnosti smo obravnavali Tržačana iz zbirke zgodb Med gorami in zgodovinski roman Visoška kronika (Slika 3).

Roman je najdaljša prozna oblika. Ima številna poglavja, dogajanje je zapleteno in po navadi zajema daljše časovno obdobje. V njem nastopa množica književnih oseb, značaj osrednje pa se razvija v samem dogajanju romana. V romanu odsevajo medčloveški odnosi in družbene razsežnosti časa ter kraja dogajanja. Glede na snov poznamo pustolovske, ljubezenske, znanstvenofantastične, kriminalne, biografske, psihološke, vojne romane. Pri Visoški kroniki, ki je zgodovinski roman, Tavčar mojstrsko opiše dogajanje v 16. stoletju, čarovniški proces, kamor vključi še ljubezensko zgodbo med Agato in Jurijem ter Izidorjem.

V učnem načrtu za slovenščino za osnovno šolo so navedeni standardi znanja za jezik in književnost. Med cilji za književnost v osmem razredu osnovne šole je predvideno, da učenec prepozna dogajanje, motiv, temo, književni čas in kraj ter pripovedovalca določenega besedila. K operativnim ciljem pa uvrščamo zmožnost razumevanja dogajanja, razumevanje književne perspektive, interpretativno branje in govorno nastopanje. Poleg tega še učenci navajajo bistvene značilnosti litararnozgodovinskih obdobij in smeri ter izbrane predstavnike in njihova dela. Slovenske avtorje tudi razvrščajo v literarnozgodovinska obdobja in smeri ter predstavljajo njihovo vlogo v razvoju slovenskega jezika in književnosti.

Pri Tavčarju so se učenci večinoma odločali za predstavitev v obliki Power Pointa. Njegovo življenje in ustvarjanje so predstavili kot govorni nastop.



Slika 1: Ivan Tavčar

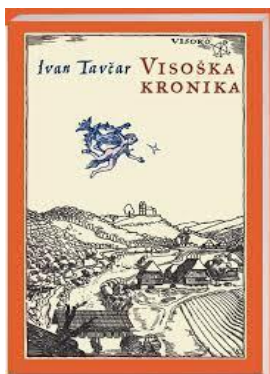


Slika 2: Med gorami

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Slika 3: Visoška kronika

3. OBDOBJE MODERNIZMA V ARHITEKTURI

Moderna arhitektura je obdobje v arhitekturi, v katero uvrščamo stavbe 20. stoletja s podobnimi značilnostmi. Najpogosteje so oblike poenostavljene in število ornamentov je zmanjšano. Arhitekti so začeli preoblikovati stare oblike in jih prilagajati potrebam sodobne družbe. Po drugi svetovni vojni in v evropskih državah že pred njo je ta slog postal dominanten, predvsem se je uveljavil v javnih stavbah, pri tovarnah in večjih kompleksih. Izraz moderna arhitektura se v pisnih virih pojavi že leta 1902, in sicer v naslovu knjige Otta Wagnerja.

Nekateri zgodovinarji začetek modernizma v arhitekturi opisujejo kot posledico družbenih in političnih revolucij v 19. stoletju, drugi večji pomen pripisujejo razvoju tehnike in tehnologije. Razpoložljivost novih gradbenih materialov kot so jeklo, železo, železobetone in steklo z začetkom industrijske revolucije je omogočila nastanek novih gradbenih tehnik. V Franciji je bil predstavnik tega obdobja tudi Le Corbusier. Pokazati je hotel svoje navdušenje nad čistimi geometrijskimi oblikami strojev. Hotel je, da se njegove hiše toliko razlikujejo od običajnih, da bi ustvarile nov način gradnje. [4]

3.1 EDVARD RAVNIKAR



Arhitekt Edvard Ravnikar (1907–1993), predstavnik modernistične arhitekture na Slovenskem, je s študijem arhitekture začel na Dunaju in ga nadaljeval v Ljubljani pri arhitektu Jožetu Plečniku (Slika 4). Njegov najozži sodelavec je bil še dve leti po diplomu. Zanimanje za tedanja umetnost ga je vodilo v Pariz, v atelje arhitekta Le Corbusiera. V Parizu je ostal nekaj mesecev, do vojne.

»Čeprav se je Ravnikar v formalnem pogledu oddaljil od Plečnikove arhitekture, je ostal najbolj občutljiv in izviren prenašalec njegovega izročila. Ravnikar je med Plečnikovo šolo in Le Corbusierovim ateljejem odkril presenetljive podobnosti,

podobno kot je njegova lastna arhitektura svojevrsna sinteza tradicije in moderosti,« so zapisali v objavi za javnost Ministrstva za kulturo RS. [5]

3.1.1 UREDITEV TRGA REPUBLIKE IN NOVE GORICE

Za najpomembnejše Ravnikarjevo delo v Ljubljani velja urbanistično in arhitekturno celostno zasnovani kompleks Trga revolucije, ki je bil zasnovan leta 1960. Ta poleg ploščadi obsega različno visoke ter različno oblikovane stavbe: tristrani stolpnici TR2 in TR3, blagovnico Maximarket in Cankarjev dom (Slika 5,6).

Trg republike je največja ploščad in trg v Ljubljani. Dolga leta je bilo na njem javno parkirišče, po prenovi, zaključeni leta 2014, pa je trg spet vzpostavljen kot glavni mestni in državni trg. Med letoma 1962 in 1982 je bila opravljena večja arhitekturna pozidava ožjega območja trga in okolice, ki jo je opravila skupina arhitektov pod vodstvom arhitekta Edvarda Ravnikarja. Leta 1963 so začeli graditi parkirno hišo, oktobra 1964 je bila gradnja začasno prekinjena zaradi pomanjkanja denarja. Leta 1965 je bil zgrajen prizidek h Gimnaziji Jožeta Plečnika, leta 1971 blagovnica Maximarket in stolpnica Nove Ljubljanske banke s prizidkom in ploščadjo. Leta 1975 je bilo urejeno območje nekdanjega »nunskega vrta« in postavljen spomenik revoluciji. Leta 1976 je bila dograjena še stolpnica TR3 s prizidkom. Cankarjev dom so začeli graditi leta 1979 in ga končali 1981 (Slika 7). [6]

Prav tako pomembno Ravnikarjevo delo je urbanistični načrt za Novo Gorico (Slika 8). Zasnovan je kot mreža. Graditi so jo začeli leta 1947, vendar urbanističnega načrta nikoli niso izvedli v celoti. V Ravnikarjevem opusu najdemo tudi Moderno galerijo, Fakulteto za gradbeništvo ali geodezijo, stanovanjski kompleks Ferantov vrt in objekte v Kranju.



Slika 4: Edvard Ravnikar



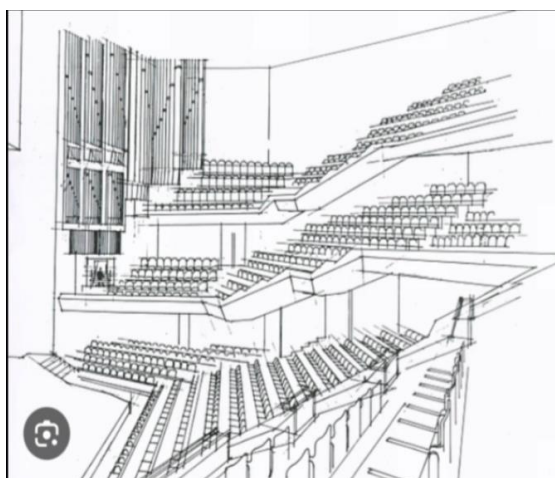
Slika 5: TR2 in TR3



Slika 6: Cankarjev dom

Edvard Ravnikar je dobil več pomembnih nagrad, Prešernovo 1961 in 1978 (za življenjsko delo), Župančičevo 1965, Plečnikovo nagrado 1975 in 1987 (jubilejno), jugoslovanski nagradi Borbe in Avnoja (1982) in dunajsko Herderjevo

nagrado (1988). Postal je dopisni član Jugoslovanske akademije v Zagrebu (JAZU, 1963), Slovenske akademije znanosti in umetnosti (SAZU: dopisni član 1969, redni 1979), 1985 je dobil naslov zaslužnega profesorja ljubljanske univerze. [7]



Slika 7: Skica Gallusove dvorane



Slika 8: Skica trga v Novi Gorici

4 UPORABA SPLETNE APLIKACIJE FILMORA IN IZDELAVA POSNETKA



Wondershare Filmora

Slika 9: Logotip Filmora

Skupina učenk, ki so vpisne tudi na izbirni predmet Multimedija, se je odločila za uporabo spletne aplikacije Filmora, ki vključuje zvok, sliko in še glasbeno podlago v ozadju (Slika 9). Spletno aplikacijo so si prenesle na računalnik. Za določeno časovno obdobje je aplikacija brezplačna, v nadaljevanju pa je plačljiva. S prepletom oz. montažo vseh treh elementov so pripravile zelo zanimiv posnetek o delu Edvarda Ravnikarja. Z učenci smo si ga ogledali v razredu in na zaključni prireditvi.

Filmora je video urejevalnik za začetnike. Učenke pred tem videoposnetkov na tak način še niso urejevale in jim je

predstavljal kar velik izziv. Ponuja prednastavljene predloge in samodejno sinhronizacijo utripov za izdelavo videa v nekaj korakih. Filmora ima tudi zeleni zaslon, ključni okvir ter številne funkcije in učinke, ki so enostavni za uporabo. [8]

Učenke so najprej izbrale gradivo o življenju in delu arhitekta in urbanista. Nato je ena od njih to gradivo prebrala in se pri tem snemala. Tako je nastala avdio podlaga za posnetek. Izbrale so tudi glasbo, ki se na nekaj mestih pojavi kot dodatno avdio gradivo. Odločile so se tudi, da bodo prikazale načrte za stavbe in nekaj fotografij zgradb, ki jih je Ravnikar projektiral. Vse skupaj so nato smiselno povezale v kratek video. Filmora omogoča preprosto urejanje videa in podpira široko paleto formatov datotek, vključno z Apple ProRes, MPEG-2, MPEG-4, AVCHD in izvornimi formati fotoaparatorov, kot sta Canon in Sony RAW.

5 ZAKLJUČEK

Letos obeležujemo 30. obletnico smrti arhitekta Edvarda Ravnikarja (1907 – 1993) in 100. obletnico smrti pisatelja Ivana Tavčarja (1851 – 1923). Zaradi tega je Vlada Republike Slovenije na pobudo Ministrstva za kulturo leto 2023 razglasila za leto arhitekta Edvarda Ravnikarja in pisatelja Ivana Tavčarja. Odločila sem se, da bodo delo in življenje obeh ustvarjalcev učenci dodatno predstavili.

Pri pouku slovenščine smo se z učenci odločili, da predstavimo življenje in delo slovenskega pisatelja, predstavnika realizma Ivana Tavčarja ali pa arhitekta Edvarda Ravnikarja. Predlagala sem, naj se dela lotijo tako, da naredijo Power Point predstavitev, govorni nastop ali katero drugo možnost, ki vključuje uporabo IKT. Skupina učenk se je odločila za uporabo aplikacije Filmora in nam tako v besedi, glasbi in siki predstavila delo Edvarda Ravnikarja. Dekleta so pri tem medpredmetno sodelovala (izbirni predmet Multimedija).

Učenci in učenke so se dogovarjali glede vsebine predstavitev dveh avtorjev in s tem izvajali sodelovalno učenje. Z uporabo informacijsko-komunikacijske tehnologije so pripravili zanimive predstavitve. Izstopala je predstavitev s Filmoro, kjer so uporabljali novo spletno aplikacijo, računalnik in lastno znanje. S tem so razvijali svoje digitalne kompetence in bili aktivno vključeni v šolski proces. Tak način predstavitve avtorja in njegovega dela bomo naslednje šolsko leto vključili v učni proces.

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Analiza jezikovnih napak pri prevajanju iz slovenščine v nemščino s pomočjo strojnih prevajalnih programov

Analysis of language errors in translations from Slovenian to German using machine translation programs

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POVZETEK

V raziskavi smo preučevali vpliv uporabe spletnih orodij za strojno prevajanje na produkcijo pisnih besedil v nemščini. 13 udeležencev raziskave je prevedlo dve besedili iz prvega oz. učnega jezika (slovenščina) v nemščino. Pri analizi smo se osredotočali na kolokacije, spol samostalnikov in ustrezajoči zaimki ter a uporabo člena. Za kodiranje napak smo uporabili digitalna orodja Translog II (keystroke-logging) in MAXQDA. Rezultati so pokazali, da so udeleženci slovenske kolokacije velikokrat prevedli dobesedno ali prevzeli slovenske sintaktične strukture v nemški prevod. Napake pri spolu, ujemanju zaimkov s spolom samostalnikov in pri ustrezni uporabi členov so prav tako bile posledice vpliva prvega jezika. Uporaba strojnih prevajalskih programov je zmanjšala število tovrstnih napak, je pa istočasno zmanjšala tudi raznolikost prevodov, kar je privedlo do sintaktično zelo podobnih ciljnih besedil. Raziskava omogoča boljše razumevanje zapletenega odnosa med učečimi (študenti nemščine) in spletnimi strojnimi prevajalnimi orodji in poudarja pomen ciljno usmerjenega tujejezikovnega pouka in premišljene uporabe orodij za strojno prevajanje pri pisanju v tujem jeziku.

KLJUČNE BESEDE

Strojno prevajanje, učenje jezika, Nemščina kot tuji jezik, pisanje besedil/pisna besedila, strategije poučevanja in učenja

ABSTRACT

This study examines the influence of machine translation (MT) tools on the production of written texts in the German language. Two texts from the first language, Slovenian, were translated into German by 13 participants. The analysis focused on collocations, gender and agreement, and article usage. Translog II (keystroke-logging) and MAXQDA were used for error coding. Results revealed that participants sometimes translated collocations

literally or transferred syntactic structures from Slovenian to German. Errors in gender, agreement, and pronoun usage were also influenced by the first language. The use of MT tools reduced errors but limited the diversity of translations, producing syntactically similar outputs. The study contributes to a better understanding of the complex relationship between language learners and MT tools. It highlights the significance of targeted language instruction and conscious use of MT tools in foreign language writing.

KEYWORDS

Machine translation, language learning, German as a foreign language, written text production, teaching and learning strategies

1 UVOD

Pri učenju tujih jezikov se spletna orodja za strojno prevajanje uporablja že vrsto let, a do pred letom ali dvema so bili takšni prevodi nenatančni z velikim številom napak, zaradi česa niso bili ravno uporabni in jim učitelji, ki so takšne prevode zlahka prepoznali, niso namenjali posebne pozornosti.

V preteklih letih je uvedba nevronskega strojnega prevajanja drastično izboljšala sposobnosti programov strojnega prevajanja in s tem tudi povečalo atraktivnost in uporabnost pri učenju tujih jezikov – predvsem pri učečih. Zaradi tega skokovitega kvalitativnega preskoka tako nastalih besedil se upravičeno poraja skrb, da bi to izboljšanje spletnega strojnega prevajanja lahko negativno vplivalo na učenje tujih jezikov.

Ali je ta skrb upravičena ali ne, se bo pokazalo v prihodnosti, nedvomno pa moramo že zdaj preveriti, kakšen vpliv ima uporaba strojnega prevajanja na učenje tujih jezikov. Ta tehnološki izziv, ki bo nedvomno spremenil učenje in poučevanje tujih jezikov, je večplasten in prepleten, odnose in odvisnosti posameznih elementov pa še zdaleč nismo v celoti zaznali in razumeli.

Prvi majhen korak na poti k razumevanju sprememb, ki se trenutno dogajajo na področju učenja in poučevanja tujega jezika, je, da poskusimo razumeti, kaj pomeni uporaba spletnega orodja za strojno prevajanje oz. kakšne so razlike v besedilih, kadar se pri prevajanju določenega besedila uporablja strojno prevajanje ali pa se prevaja brez te pomoči.

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2 IZHODIŠČA RAZISKAVE

2.1 Pregled literature

Stein je že leta 2009 pisal o strojnem prevajanju, njegovem razvoju in tudi zgodovini [1]. Za prispevek posebej zanimiv je njegov pogled na pomen strojnega prevajanja v tistem času:

»Die Idee der formalen Manipulation von Sprachen geht auf die philosophischen Traditionen von Geheim- und Universalsprachen, wie sie Ramon Llull oder Gottfried Wilhelm Leibniz begründet haben, zurück. Bis heute ist die Maschinelle Übersetzung (MÜ) Königsdisziplin der Sprachverarbeitung geblieben: Die Fortschritte seit den ersten praktischen Versuchen sind auf den ersten Blick nur bescheiden. Dabei haben sich im Verlauf der Jahrzehnte zahlreiche unterschiedliche Ansätze zur MÜ gebildet.« [1]

Njegov pregled razvoja je zanimiv – posebej iz stališča današnjega uporabnika strojnega prevajanja –, saj so ga takrat oklicali za »kraljevo disciplino« digitalne obdelave jezika, mu pa pravilno pripisali le malo napredka pri razvoju ... Danes pa ta »kraljeva disciplina« dosega neslutene dosežke in izredno hitri nadaljnji razvoj.

Zaradi podvrženosti strojnih prevajalnikov napakam, tako vsebinskim kot strukturnim, in manjše ali celo neobstoječe digitalizacije šol in pouka, se strojni prevajalniki v prvi dekadi novega tisočletja niso oz. so se le izjemoma uveljavili pri pouku tujega jezika. Danes je zadeva drugačna: Učeči se poslužujejo spletnega strojnega prevajanja na vseh možnih področjih učenja, zato tudi učitelji tujih jezikov ne smejo »spregledati« te novosti, temveč jo morajo spoznati, se na tem področju izobraževati in ga smiselno vključiti v moderno poučevanje tujega jezika. Učitelj in sam pouk tujega jezika sta zelo aktualni temi, a v tem prispevku niso predmet raziskave, prispevek se prav tako ne bo ukvarjal z natančno opredelitvijo ali definicijo spletnega strojnega prevajanja – vse to je deziderat za bližnjo prihodnost. V nadaljevanju bo obravnavan le vzorec učečih (študenti germanistike) in njihova uporaba spletnih strojnih prevajalnikov.

Dejstvo, da spletni strojni prevajalniki niso vedno učinkoviti pripomočki pri učenju tujega jezika, je Briggs predstavil leta 2018, ko je v raziskavi o sposobnosti korejskih študentov pri dodelavi strojno prevedenih besedil v angleščini ugotovil, da ti niso prepoznali očitnih jezikovnih napak in da tudi niso bili sposobni ustrezno urediti strojno prevedena besedila z očitnimi napakami tako, da bi te opazne napake odpravili [2].

Danes je strojno prevajanje na neprimerno višjem nivoju in kot uporabno in učinkovito orodje vstopa v proces učenja, ne pa tudi v proces poučevanja tujega jezika. Nedvomno lahko ima strojno prevajanje pozitiven vpliv na učenje tujega jezika: Različne raziskave so pokazale, da se npr. s pomočjo strojnega prevajanja lahko zmanjša število napak na področjih besedišča in slovnice [3, 4, 5, 6], in da se kakovost besedila v celoti izboljša, če so učeči pri pisanju besedila lahko uporabljali spletne strojne prevajalnike [7, 8].

2.2 Raziskovalna metodologija

Zaradi obsežnosti področja učenja tujega jezika (v raziskavi je bil fokus na nemškem jeziku) in velikem številu aktualnih vidikov, ki jih moramo pri raziskovanju pouka tujega jezika upoštevati, je raziskava omejena na spretnost pisanja besedil oz. ožje na prevajanje besedil iz prvega ali učnega jezika v tuji jezik nemščina. Raziskali smo tri lingvistične pojave, ki pri pisanju besedil in tudi pri prevajanju velikokrat povzročajo odstopanja, ki se pokažejo bodisi kot dejanske napake ali kot različne jezikovne rešitve. Zanimale so nas stalne besedne zveze oz. kolokacije, opredelitev spola pri samostalniki in ustrezna uporaba zaimkov ter uporaba ustreznih členov.

Kolokacije oz. stalne besedne zveze (na tem področju obstaja po besedah Hausmanna [9] neke vrste »terminološka vojna«, zato sta v prispevku oba pojma uporabljena kot sinonima), so pomembni del jezika, a istočasno predstavljajo problematično področje pri učenju in uporabi tujega jezika. Zato sta bili za poskus izbrani dve izhodiščni besedili, ki so vsebovali nekaj slovenskih kolokacij, ki jih je nekoliko težje prenesti oz. prevesti v nemščino. Predvidevali smo (hipoteza 1), da bodo udeleženci poskusne skupine, ki so pri prevajanju uporabljali spletni strojni prevajalnik, uporabili dobesedni prevod slovenskih kolokacij pri manj kolokacijah (posebej zato, ker imajo v različnih jezikih različne idiosinkratične značilnosti) kot udeleženci kontrolne skupine (brez uporabe spletnega strojnega prevajalnika).

Spol samostalnikov in skladnost zaimkov je bilo drugo področje raziskovanja: Spol in skladnost zaimkov znotraj jezika (slovenščina ali nemščina) večinoma ni problematična. Problem nastane pri prevajanju, če se spol samostalnika v obeh jezikih ne ujema, npr. sonce je v slovenščini srednjega spola, v nemščini pa ženskega. Posledično se dogaja, da učeči v nadaljevanju uporabe te besede uporabijo napačen osebni zaimek, npr. *es* namesto *sie* za samostalnik *die Sonne*. Iz tega je izhajala hipoteza 2: Udeleženci poskusne skupine (z uporabo spletnih strojnih prevajalnikov) bodo imeli manj napak pri uporabi ustreznih zaimkov (glede na spol samostalnika).

Za slovenske učeče uporaba člena v nemščini predstavlja velik problem, saj ga slovenščina ne uporablja na enak način kot nemščina. Ker nemščina pozna tudi možnost uporabe samostalnikov brez člena, imamo pri uporabi členov v nemščini kar nekaj pasti: Ali ga uporabljamo s členom ali brez njega, člen za kateri spol (in število) je pravilen, ali moramo uporabiti določni ali nedoločni člen itd.? Hipoteza 3 tako predpostavlja, da bodo udeleženci poskusne skupine (z uporabo spletnega strojnega prevajalnika) naredili manj napak pri rabi členov kot kontrolna skupina.

Na podlagi ugotovitev pri navedenih hipotezah, bomo odgovorili na naslednja raziskovalna vprašanja: (1) Katere napake oz. predloge prevodov lahko opredelimo kot posledico vpliva prvega/učnega jezika? (2) Kakšna je vloga podobnosti in razlik med jezikoma? (3) Kaj lahko opredelimo kot posledico strojnega prevajanja?

2.3 Raziskovalni inštrumenti

Poskusa se je udeležilo 13 študentov germanistike, od tega 8 magistrskih in 5 dodiplomskih, 11 je bilo Slovencev, dva pa Ne-Slovenca (makedonski in hrvaški državljani – to smo upoštevali pri interpretaciji rezultatov raziskave). Vsi udeleženci so prevedli isti dve besedili in so za to imeli na razpolago 60 minut časa (le en udeleženec je izjavil, da je imel premalo časa). V poskusni

skupini (uporaba spletnega strojnega prevajalnika dovoljena) je bilo 7 udeležencev, v kontrolni skupini (brez spletnega strojnega prevajalnika) pa 6.

Poskusna skupina je lahko uporabila spletna strojna prevajalnika *DeepL* in/ali *Google translate* (izbrana sta bila na podlagi dostopnosti in kompatibilnosti s programom Translog II). Vsi udeleženci so opravili prevod istočasno na računalnikih v računalniški učilnici z nameščenim računalniškim programom Translog II (uporaben in učinkovit program za opazovanje prevajalskih praks posameznih udeležencev), ki je bil uporabljen pri analizi končnih izdelkov. S pomočjo tega programa je bila uporabljena metoda *Keystroke-Logging*, ki omogoča podrobno analizo celotnega procesa prevajanja vsakega posameznika. Prednost te metode pred intervjuji in slikovnim zajemom je, da je vsaka sprememba besedila sledljiva in trajno zabeležena [10]. Poleg tega smo primerjali prevode med sabo: Primerjali smo prevode 13 izbranih kolokacij, vse napake pri spolu in ustreznih zaimkih, uporabo členov in še nekatere druge posebnosti. Pri primerjanju ciljnih besedil smo uporabili program MAXQDA (Version Plus 2022) za računalniško podprto kvalitativno analizo podatkov in besedil, saj lahko s tem programom kodiramo besedila.

3 REZULTATI

Poskusna skupina je lahko uporabljala spletne strojne prevajalnike po želji, izkazalo se je, da so jih nekateri uporabljali veliko – dva udeleženca sta celotni besedili prevedla s spletnimi strojnimi prevajalniki –, drugi le izjemoma. Ta problem je bil naslovljen tako, da smo pri kodiranju delov besedil dodali kode »z spletnim strojnim prevajalnikom« in »brez spletnega strojnega prevajalnika«.

V nadaljevanju so predstavljeni rezultati za področje kolokacij, spol in ustrezni zaimki in uporaba členov.

3.1 Kolokacije

V izhodiščnih besedilih smo identificirali 13 kolokacij ali fraz, ki bi po naših pričakovanjih udeležencem lahko povzročali težave, spletni strojni prevajalniki pa bi jih morali pravilno prenesti oz. prevesti v ciljni jezik (nemščino). Izpostavili bomo le nekatere zanimive ugotovitve:

Ugotovili smo, da so za slovensko kolokacijo »lepo označena (pot)« vsi člani poskusne skupine uporabili ustrezna prevoda »gut ausgeschildert« (5x) ali »gut markiert« (2x), medtem ko so 3 člani kontrolne skupine naredila dobesedni prevod: »schön markiert« (druga polovica te skupine je zapisala ustrezen prevod »gut markiert«).

Drugo besedilo, del horoskopa, je vseboval napotek, da »pospraviš nepotrebno prtljago« (mišljeno je vse nepotrebno, kar te teži). Večina članov poskusne skupine (6 od 7) si je pomagala s spletnim prevajalnikom in zapisala »sich von unnötigem Ballast zu befreien«, kar je tudi najprimernejši prevod. En član v tem primeru ni uporabil spletnega prevajalnika, saj noben od spletnih prevajalnikov ne poda dobesednega prevoda »das unnötige Gepäck aufzuräumen«, ki iz linvističnega stališča v danem kontekstu ni ustrezen. Veliko bolj pester je bil prevod pri kontrolni skupini: Le v enem primeru je bil prevod popolnoma ustrezen (»unnötigen Ballast loszuwerden«), dvakrat je bil zapisan dobesedni prevod, enkrat je bil uporabljen drug izraz (»dass du es löst«) in enkrat pravilna kolokacija z napačno

besedo in pravopisno napako (»den nicht *gewollten *Ballast aufräumen«).

»... zimi pomahamo v slovo« je na prvi pogled zelo enostavna izjava, ki pa je zaradi raznovrstnih prevodov posebej zanimiv. Spletna strojna prevajalnika enotno ponudita prevod »dem Winter Lebewohl zu sagen«, kar so 3 člani poskusne skupine tudi uporabili. 4 člani so od tega prevoda odstopali: Beseda »Lebewohl« je v nemški kolokaciji enkrat bila nadomeščena z besedo »Tschüss« (slov. »adijo«) in enkrat z »auf Wiedersehen«, oba izraza uporabljamo za slovo, prvo se uporablja pri tikanju, drugo pa pri vikanju. Dva člana očitno nista uporabila spletnega prevajalnika in sta se osredotočala na besedo »pomahati«, saj sta uporabila »winken«. Enkrat pravilno »dem Winter zum Abschied zu winken« in enkrat s slovničnima napakama »*den Winter *für Abschied zu winken«.

Kakšen je torej vpliv spletnih strojnih prevajalnikov? Na podlagi ugotovitev (analiza vseh 13 kolokacij in njihovih prevodov) ugotavljamo, da so prevodi kolokacij pri uporabi spletnih strojnih prevajalnikov jezikovno bolj pravilni, ni pa tako velike raznolikosti prevodov, kot je to vidno pri prevajanju brez pomoči spletnih strojnih prevajalnikov. Rezultat uporabe spletnih strojnih prevajalnikov so sintaktično zelo podobna ciljna besedila.

3.2 Spol in ustrezni zaimki

Po pričakovanju je na področju spola samostalnikov in uporaba ustreznih zaimkov prišlo do številnih napak. Pri poskusni skupini smo – pričakovano – zaznali manj napak pri sami uporabi spola, saj je to nekaj, česar so strojni prevajalniki večji. So pa člani poskusne skupine naredili tudi nekaj napak pri izbiri ustreznih zaimkov, npr. »... der Frühling ... Mit *ihr ...«, ali »... das Wiedererwachen der Natur, *die ...«. Zelo podobno, vendar malce več primerov nepravilne rabe osebnih zaimkov smo zaznali pri kontrolni skupini, npr. »Der Weg ... es ...«, »... die *Erwachung der Natur, *dass ...«, ali »... einen Blick auf *wunderschönen Safranfeld werfen«.

Kontrolni prevod obeh besedil je pokazal, da je spletni strojni prevajalnik pravilno podal vse člene in pripadajoče zaimke, kar pomeni, da so udeleženci na tem področju delali napake, ki niso posledica uporabe prevajalnika, temveč neuporabe le-teh pri poskusni skupini in nezmožnost uporabe le-teh pri kontrolni skupini. Ker napake pri uporabi osebnih zaimkov niso nepravilna določitev spola samostalnika, na katerega se osebni zaimki nanašajo, lahko govorimo le o površnosti udeležencev pri pripravi oz. pregledovanju prevodov.

Na področju uporabe pravilnega spola in ustreznih oblik v različnih sklonih ter pri uporabi pravilnih osebnih zaimkov v tej zvezi lahko zaključimo, da so spletni strojni prevajalniki dobri pripomočki, ki zmanjšujejo število napak.

3.3 Uporaba členov

Za učeče s prvim jezikom slovenščina je, glede na naše dolgoletne izkušnje, področje nemških členov zelo kritično. Prav to se je tudi pokazalo v analizi prevodov. Strojno generirani kontrolni prevodi (kar smo naredili še preden so udeleženci opravili svoje delo) na področju členov in njihove uporabe niso naredili nobene napake, zato moramo vse tovrstne napake članov

poskusne skupine pripisati temu, da niso uporabili ali pa so spremenili predlog strojnega prevajalnika. Je pa opazna razlika pri številu tovrstnih napak: Člani kontrolne skupine so naredili bistveno več in zelo različnih napak pri pripravi prevodov. Tako so 3 člani poskusne skupine (od 7) naredili 11 tovrstnih napak, pri čemer je šlo v 7 od 11 primerih za manjkajoč člen, v ostalih primerih so člene uporabili na različne neustrezne načine, npr. »... **im** guten Wetter ...«, »... in **einen** schönen Wetter ...«. Pri kontrolni skupini smo zasledili 19 napak pri uporabi členov, od tega je 10 krat manjkal člen, enkrat je bil dodan člen tam, kjer ga ne potrebujemo, in enkrat je bil napisan določni člen namesto potrebnega svojilnega zaimka (»dass wir **den** Abschied vom Winter nehmen«. Pri ostalih 7 napakah je razvidno, da udeleženci ne obvladajo uporabe končnic pri atributivni rabi členov in pridevnikov. Vzrok za te napake torej ni spletni strojni prevajalnik, temveč znanje oz. manjkajoče ali prešibko znanje udeležencev.

Iz navedenega izhaja, da bi spletni strojni prevajalniki lahko odpravili številne tovrstne napake, če bi jih udeleženci ustrezno vključevali v prevajanje oz. pisanje besedil.

4 ZAKLJUČEK

Na začetku raziskave smo postavili tri hipoteze, za katere bomo v nadaljevanju preverili ali jih lahko potrdimo, ali jih moramo ovreči.

Prva hipoteza je bila, da bodo člani poskusne skupine ob možnosti uporabe spletnih strojnih prevajalnikov uporabili manj krat dobredni prevod slovenskih kolokacij kot člani kontrolne skupine, ki niso uporabljali spletnih strojnih prevajalnikov. Besedila, pri katerih so bili uporabljeni spletni strojni prevajalniki so v veliki meri vsebovala bistveno manj napak pri prevajanju kolokacij, kot pri tistih, ki so manj ali pa sploh niso uporabljali prevajalnikov. Na podlagi predstavljenih ugotovitev lahko prvo hipotezo potrdimo.

Druga hipoteza je predpostavila, da bodo člani poskusne skupine, ki so lahko uporabljali spletne strojne prevajalnike, naredili manj napak pri spolu samostalnikov in ustrezni rabi osebnih zaimkov za te samostalnike. Hipotezo na podlagi ugotovitev ne moremo v celoti potrditi, saj so tudi člani poskusne skupine naredili številne napake na tem področju, ki jih sicer pripisujemo temu, da so pri teh primerih ali spreminjali predloge prevajalnika ali pa jih sploh niso uporabili, razlika v številu napak te vrste in podobnost napak pri obeh skupinah pa ne omogočajo enoznačnega odgovora.

Tretja hipoteza, da bodo člani poskusne skupine naredili manj napak pri členih, lahko potrdimo. Napake te vrste so naredili vsi člani kontrolne skupine, a le 3 od 7 članov poskusne skupine. Omenjeni trije člani poskusne skupine so bili tisti, ki so strojno prevajanje uporabljali le občasno. Kot vir opaženih napak lahko identificiramo prvi oz. učni jezik udeležencev.

Oblikovali smo tudi tri raziskovalna vprašanja, na katere bomo odgovorili v nadaljevanju.

Glede vpliva prvega oz. učnega jezika na prevode lahko rečemo, da je vpliv prvega/učnega jezika zelo opazen, manj kot so udeleženci uporabljali spletne strojne prevajalnike, bolj so prenašali slovenska pravila in načine izražanja v nemško besedilo. Kadar so uporabljali spletne strojne prevajalnike, je vpliv prvega/učnega jezika bil bistveno manjši.

Na vprašanje, kakšna je vloga podobnosti in razlik obeh jezikov pri prevajanju, lahko zaključimo, da smo pričakovali, da se predvsem razlike na vseh treh področjih manifestirajo/pokažejo kot napake v nemškem besedilu. Tudi v tej majhni raziskavi velja splošno pravilo, da pozitivnega transferja med jeziki le težko identificiramo, opazimo pa vsak negativni transfer, t. i. interferenco, torej napake in neobičajne načine izražanja, kar se je posebej izrazito pokazalo pri kolokacijah.

Kaj pa lahko opredelimo kot posledico uporabe spletnega strojnega prevajalnika? Kot smo že pri analizi izpostavljali, je pri uporabi spletnih strojnih prevajalnikov opazno manj napak pri izbiri pravih kolokacij, pri določanju spola samostalnikov in ustrezni rabi osebnih zaimkov za te samostalnike. Posebej uspešno so se zmanjšale napake pri členih v nemščini, seveda le, če so udeleženci uporabljali prevajalnike. Ne smemo pa spregledati, da je uporaba spletnega strojnega prevajalnika zmanjšala raznolikost prevodov, kar pa je nekoliko manj zaželen učinek.

Opozoriti moramo na nekaj pomanjkljivosti spletnih strojnih prevajalnikov, ki so se pokazale v raziskavi: Če pogledamo kontrolne prevode iz slovenščine v nemščino, opazimo, da prevodi niso vedno najbolj primerni, predvsem pri prenesenih pomenih in pri geografskih imenih imajo strojni prevajalniki še veliko težav (kar velja tudi za izrazito strokovna besedila!), zato mora uporabnik teh pripomočkov nastali prevod zelo natančno pregledati in po potrebi tudi popraviti ali spremeniti, da bo tudi nemško besedilo izrazilo to, kar je bilo izraženo s slovenskim besedilom. Umetniška svoboda, v kolikor je dovoljena, je prav tako nekaj, kar strojni prevajalniki še ne obvladajo na ustrezni ravni, posledica so sintaktično in vsebinsko podobna besedila, kjer se zlahka izgubi čar kreativno napisanega besedila, ki te resnično pritegne. Izhodiščni besedili bralca nagovarjajo oz. vabijo k aktivnostim, nemški strojni prevodi tega ne prenesejo v celoti, vsebujejo tudi vsebinske napake, ki niso opazne, če ne primerjaš obe besedili. Kot zanimivost naj omenimo še, da je eden od uporabljenih spletnih strojnih prevajalnikov imel izrazite težave pri vikanju v nemščini: Večinoma je pravilno uporabljal vikanje, na enem mestu je namesto tega uporabil tikanje, kar bralcu takoj pade v oči, ko pride do tega mesta v besedilu.

Kaj pa vse navedene ugotovitve pomenijo za učenje tujega jezika nemščine v slovenskih šolah? Spletni strojni prevajalniki so uporabni pri prevajanju besedil in s tem tudi pri pisanju besedil, a pomembno je, da učeče – ne glede na starost – čim prej in čim bolje naučimo pravilnega ravnanja s spletnimi strojnimi prevajalniki in jih senzibiliziramo za nenehno preverjanje ciljnega besedila na ustreznost povedanega oz. napisanega. To seveda pomeni, da tudi učitelji morajo oz. moramo obvladati pravilno in učinkovito uporabo spletnih strojnih prevajalnikov – a to je že tema druge raziskave ...

ZAHVALA

Zahvaljujemo se udeležencem raziskave, da so bili pripravljeni sodelovati in so tako omogočili to raziskavo.

Prispevek je nastal v okviru raziskovalne skupine *Slovenska identiteta in kulturna zavest v jezikovno in etnično stičnih prostorih v preteklosti in sedanjosti* (P6-0372) na Filozofski fakulteti Univerze v Mariboru.

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Sodelovalno ustvarjanje tabelske slike Miro

Collaboratively creating a Miro table

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POVZETEK

Digitalne veščine so ključne za uspešno delovanje v sodobni družbi. Mnoga delovna mesta in tudi družbeni sistem, v katerem živimo, zahtevajo razumevanje in uporabo digitalnih orodij, zato je uporaba digitalizacije pri pouku postala že kar stalnica. Ker se svet zaradi tehnološkega napredka hitro spreminja, bodo učenci, dijaki, študenti boljše pripravljene na prihodnost, če bodo razvili kompetence, ki jih digitalizacija omogoča. Članek opisuje enega od možnih pristopov k poučevanju, ki lahko pomaga povečati angažiranost učencev, dijakov, študentov in morebitnih drugih vključenih ter olajšati razumevanje kompleksnih konceptov pri obravnavanju snovi. Miro je digitalno sodelovalno središče, ki predstavlja orodje za sodelovalno delo in vizualno upravljanje projektov na spletu. Delovni ekipo omogoča skupno ustvarjanje, deljenje idej in informacij na virtualnem platnu, obogatenem s predlogami in drugimi funkcijami za ustvarjanje interaktivnih in vizualnih desk.

Ključne besede

Digitalizacija, digitalno orodje, Miro, projekt, tabelska slika, ustvarjalnost, učenje, veščine

ABSTRACT

Digital skills are essential for successful functioning in modern society. Many jobs, as well as the social system in which we live, require the understanding and use of digital tools, which is why the use of digitization in lessons has already become a regular feature. As the world is rapidly changing due to technological progress, students will be better prepared for the future if they develop the competencies made possible by digitization. The article describes one possible approach to teaching that can help increase the engagement of pupils, students and any other involved and facilitate the understanding of complex concepts. Miro is a digital collaboration center that presents a tool for collaborative work and visual project management online. It allows the work team to co-create, share ideas and information on a virtual canvas enriched with templates and other features for creating interactive and visual whiteboards.

Keywords

Creativity, digitization, digital tool, learning, Miro, project, skills, spreadsheet

1. UVOD

Digitalizacija pri pouku prinaša številne prednosti in priložnosti tako za učitelje kot za učence. Razlogov, zakaj naj bi pedagoški delavci stremeli k uporabi digitalnih orodij in tehnologije pri pouku, je vedno več. S pomočjo digitalizacije, ki omogoča različne načine komunikacije – z besedilom, zvokom, videoposnetkom, slikami, lahko učenje prilagodimo različnim učnim stilom. Digitalna orodja omogočajo pestrost pouka in sodelovalno učenje. Učitelj z njimi lažje organizira projektno delo, diskusije, viharjenje možganov. Splet omogoča hitro iskanje informacij, ne glede na temo, obenem pa ob tem urimo svoje kritično razmišljanje in se učimo o verodostojnosti pridobljenih virov. Vizualni elementi, različne grafike in videoposnetki pomagajo pri lažjem razumevanju kompleksnih nalog in vsebin, lažje tudi prilagodimo učno snov posameznim skupinam ali celo posamezniku, veliko lahko prihranimo tudi na času. Z uporabo interaktivnih vaj in drugih inovativnih metod, ki jih vključujemo v poučevanje, pa naredimo učenje zanimivejše in privlačnejše.

Informacijsko komunikacijska tehnologija (v nadaljevanju IKT) že pomembno vpliva na izvedbo pedagoških procesov in učnega okolja, posledično pa tudi na pridobivanje znanja pri učencih. Kot ugotavljajo tudi strokovnjaki Univerze v Ljubljani v svoji študiji, morajo današnji pedagogi poleg digitalnih kompetenc imeti tudi didaktične kompetence, ki vključujejo IKT [4]. Šele ustrezna didaktična uporaba IKT omogoča kvalitetno izvedbo pouka, za katero pa je v celoti odgovoren učitelj. Poznavanje pristopov za ustrezno uporabo orodij, ki jih vključuje v svoj delovni proces, je ključno za uspešno delo, je pa ob množičnem naboru spletnih orodij in storitev vsak dan težje slediti tovrstnemu napredku.

2. TABELSKA SLIKA

Orodja za pisanje po zaslonu ali kot jih poznamo pod imenom »Whiteboards« so v šolski prostor aktivno vstopila v času epidemije COVID-19. Gre za novodobno orodje simulacije pisanja po tabli, saj se ustvarjena tabelska slika prenese v digitalno okolje. OneNote, Miro, Microsoft Whiteboard so primeri, ki smo jih in jih še večinoma uporabljamo na Šolskem centru Kranj, drugod, kot navaja Univerza v Ljubljani v svoji raziskavi [1], so aktualni tudi Jamboard Google, uporaba Whiteboarda v Zoomu, Whiteboard chat, tabelske slike v Moodlu.

2.1 Značilnosti orodij za pisanje po beli tabli

Univerza v Ljubljani je v raziskavi poudarila nekatere skupne značilnosti omenjenih orodij [1]. Na osnovi lastnih izkušenj, uporabe nekaterih in spoznanj so podane slednje:

- Interaktivno sodelovanje: več uporabnikov lahko istočasno sodeluje na isti tabli ali dokumentu, kar omogoča realno

časovno sodelovanje in komunikacijo med uporabniki. Obenem je omogočena možnost, da učitelj sam določi, koga od učencev, dijakov, študentov bo vključil v delo, kar pomeni, da v nekaterih orodjih lahko lastniki dokumentov dodeljujejo različne stopnje dovoljenj za urejanje, ogled in sodelovanje.

- Shranjevanje in sinhronizacija: običajno se dokumenti in tabele shranjujejo v oblak, kar pa omogoča enostaven dostop in sinhronizacijo med različnimi napravami. Nekatera orodja imajo celo možnost shranjevanja zgodovine in posledično sledenja spremembam (kdo je naredil kaj). Končni izdelek lahko učitelj deli z učenci, dijaki, študenti ali obratno.
- Dopolnjevanje – tabelsko sliko lahko ustvarjamo tekom pouka, predavanj, vaj ali projektnega dela. Možna je naknadna ali ponovna priključitev k ustvarjanju in smo tako neodvisni od časa in prostora.
- Raznolikost in urejanje vsebin – orodja omogočajo ustvarjanje različnih vizualnih struktur - tabel, grafov, slik, vsebin, njihovo označevanje in poudarjanje. Uporabniki lahko enostavno dodajajo, premikajo, spreminjajo velikost in urejajo različne vizualne elemente na tabli, lahko prosto rišejo ali pišejo. Nekatera orodja ponujajo predstavljene predloge za različne vrste projektov – brainstorming, planiranje ...
- Velikost table – običajno neomejena velikost prostora za ustvarjanje (v obliki neskončne table, zvezka) z možnostjo dodajanja novih drsnic.



Slika 1 : Viharjenje možganov (vir: lasten)

O Miro-jevih funkcijskih zmogljivostih piše tudi Zarqoon Amin. Najbolj osnovne so neskončnost platna, vsestranske predloge, interaktivni elementi, pametno risanje, vgrajen klepet, časovnik, skupna raba zaslona, povezovanje z drugimi napravami [5]. Primer vsestranske predloge predstavljata slika 2 in slika 3.

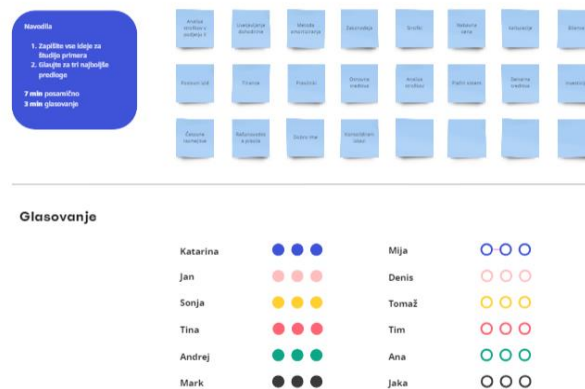
2.2 Aplikacija Miro

Digitalna tabla Miro je orodje za skupinsko sodelovalno delo in interaktivno upravljanje nalog (projektov, sestankov). Ekipam, ki z njim delajo, omogoča ustvarjanje, sodelovanje in deljenje idej ter informacij v obliki prispevkov na virtualnem platnu. Aplikacija Miro izpolnjuje vse zgoraj navedene karakteristike, s poudarkom na zelo širokem naboru vsebin, ki jih lahko dodajamo, o tem pišejo tudi pri TechAcute [3]. Navajajo tudi, da Miro nudi sedem različnih vrst primerov uporabe, vsaka pa vodi do 40 ali več inovativnih predlog. V primeru, da je predlog premalo, so na voljo tudi plačljive. Sicer je aplikacija za učitelje brezplačna, potrebna je le registracija učitelja. Študenti tablo lahko uporabljajo kot aktivni ali neaktivni uporabniki. V prvem primeru se morajo v aplikacijo prijaviti, saj jim prijava omogoča ustvarjanje vsebine, v drugem primeru prijava v aplikacijo ni potrebna, vendar je vsebina le na vpogled.

2.2.1 Uporaba tabelske slike Miro

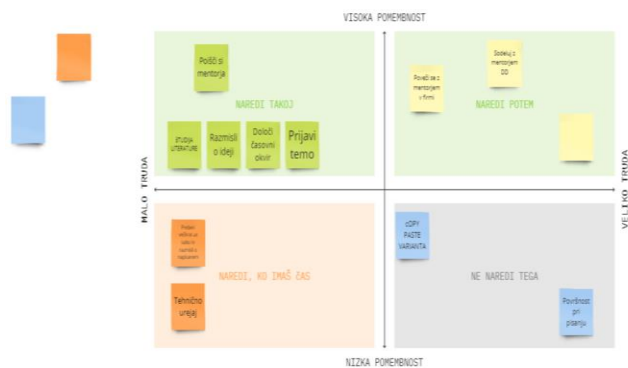
Tabelska slika Miro na videz resnično deluje kot neskončna tabla. O tem piše tudi vodja trženja pri Miro-ju Natalie Nedre in poudarja, da Miro omogoča shranjevanje vsega na neskončnem platnu, ta pa ponuja helikopterski pogled na celotni projekt. Vsak član ekipe z dostopom lahko kadarkoli odpre tablo in preveri trenutno stanje katere koli datoteke, ne da bi mu bilo potrebno iskati po mapah, preklapljati pri prijavi ali se premikati med zavihki. Hkrati avtorica prispevka poudarja, da ima Miro vedno večji nabor dodatkov za sodelovanje in vizualizacijo [2]. Eden od orodij, ki je zelo primeren za izvedbo brainstorminga, so samolepilni lističi. Primer je prikazan na sliki 1. Na Medpodjetniškem izobraževalnem centru ŠC Kranj smo razmišljali o temi novega Erasmus + projekta.

Izbor predloga ideje



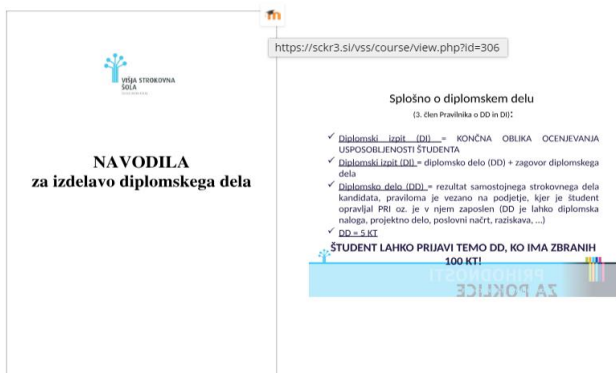
Slika 2: Glasovanje (vir: lasten)

Na sliki 2 je predstavljen primer glasovanja. Skupina, ki je glasovala za najboljšo idejo, je s krogci, ki so posamezniku pripadali, na samolepilnem lističu označila najboljšo ideje. Ideja z največ pikami je najboljša. V primeru, da ima več idej isto število pripadajočih glasovalnih krogcev, se glasovanje ponovi, vendar v ožjem krogu idej. Glasovanje in druge naloge lahko časovno omejimo s pomočjo odštevalnika časa.



Slika 3 : Seznam opravil (vir: lasten)

Na sliki 3 je predstavljena predloga seznama opravil, ki jo določata trud in pomembnost naloge. Prednastavljene vrednosti na vseh predlogah seveda lahko poljubno spreminjamo, prav tako tudi barve in oblike samolepilnih lističev in glasovalnih likov, ki jih skupina lepi na posamezno okno.



Slika 4: Ravnanje z dokumenti (vir: ŠC Kranj)

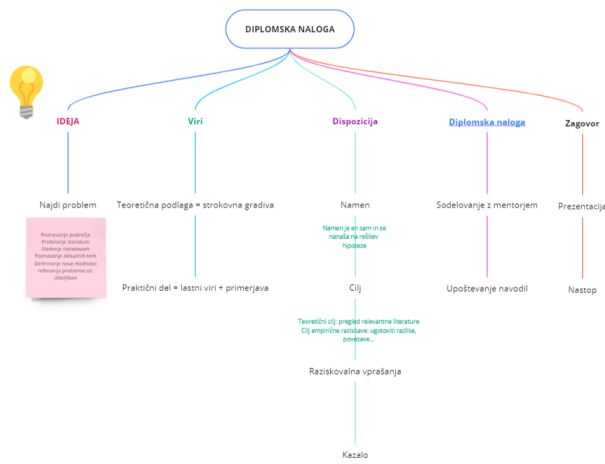
Slika 4 predstavlja ravnanje z dokumenti. Vsi udeleženci skupine, ki imajo pravice do urejanja, namreč lahko na tabli delijo projektne datoteke, jih komentirajo, uporabljajo emoji ... Vsi dokumenti so berljivi (pdf, word, excel, powerpoint ...). Ko se nanje postavimo z miško, jih lahko v celoti prelistamo, premikamo, označujemo ... Če je potrebno, dokumentu lahko prilepimo tudi povezavo do uradne spletne strani, kjer se nahaja, kar je iz slike tudi razvidno.

Ustvarjamo lahko direktno na platnu, lahko pa platno razdelimo na delovne plošče (framei), s pomočjo katerih lahko ločimo posamezne teme, dokumente, analize ...

Vsaka delovna plošča ima enak nabor ustvarjalnih orodij. Znotraj ekipe tako lahko vsi, ki v skupini delajo, uporabljajo razpoložljiva orodja za izražanje svojih idej in mnenja. Lahko se sprehajamo po celotni tabli ali pa po posamezni delovni plošči. Če uporabimo možnost @omembe nekoga na naloženi sliki ali dokumentu, Miro takoj pošlje obvestilo omenjenemu. Tako lahko sodelujoči takoj vidijo komentar, komunikacija in odziv sta posledično hitrejša, projekt pa zato hitreje napreduje. Pri skupnem ustvarjanju tabele slike lahko delu posameznika sledimo na tri načine:

- sledimo kazalcu oz. puščici, kjer se posameznik premika;
- zapisujemo komentarje;
- družno dopolnjujemo vsebino v dokumentu;
- vklopimo video klepet.

V primeru, ko ne uporabljamo predlog, je zelo priročna funkcija v Miro-ju tudi pametno risanje, ki nam omogoča poljubno ustvarjanje različnih miselnih vzorcev, slik, tabel, grafikonov. Slika 5 prikazuje primer miselnega vzorca, ki je bil del ene delovne plošče, namenjene izdelavi diplomske naloge. Poleg miselnega vzorca si študenti na tej delovni plošči lahko ogledajo in si prenesejo naložene dokumente, s pomočjo predloge za razvijanje ideje pa skupaj z mentorjem poiščejo končen naslov.



Slika 5: Miselni vzorec (vir: lasten)

2.2.2 Učne koristi tabelske slike

Tabelske slike omogočajo bolj jasno in strukturirano organizacijo podatkov. Pri delu s študenti smo ugotavljali, da je v primeru, če je tabelska slika dobro zasnovana, iz nje lahko hitro in enostavno razbrati informacije, opaziti vzorce, trende ali pa relacije med podatki. Tudi zato se lahko lažje razume kompleksne koncepte. Prednost je tudi ta, da kar na enem mestu lahko preverimo razlike in podobnosti med različnimi vrednostmi in naredimo hitro analizo. Kadar razpolagamo z veliko količino podatkov, nam tabelske slike omogočajo večjo preglednost, obenem pa lahko s podatki manipuliramo, jih razvrščamo in jih analiziramo, s čimer spodbujamo aktivno razmišljanje in sodelovalno učenje. Učeči se z njihovo pomočjo učijo ocenjevati podatke, preverjati njihovo verodostojnost in jih interpretirati, kar pa spodbuja razvoj kritičnega mišljenja.

3. ZAKLJUČEK

Digitalizacija ne sme nadomestiti klasičnih učnih metod. Če želimo doseči najboljše rezultate pri poučevanju in učenju, jih mora le dopolnjevati in prilagajati. Omogočati mora izboljšanje učnih pristopov ter prilagajanje učenja sodobnim potrebam in trendom. Tabelska slika Miro in njej podobna orodja so se v praksi izkazala kot dobra orodja za učenje, saj vizualno podprejo učne cilje. Miro je uporaben za različne scenarije - timsko delo, projektno delo, design thinking ... Izboljšuje sodelovalno delo in omogoča bolj vizualno in interaktivno upravljanje idej in

projektov. Informacijsko komunikacijska tehnologija spreminja proces izobraževanja tako s prostorskega kot časovnega vidika, obenem pa vpliva tudi na organizacijo učenja. Vlogo učitelja je močno spremenila, saj učitelj mora, če želi uresničevati svoje poslanstvo, skladno z njenim razvojem, slediti napredku, ob tem pa predvsem samoiniciativno iskati, se učiti uporabljati in preizkušati nova orodja za učinkovito uporabo pri pouku in jih kritično vrednotiti.

4. VIRI IN LITERATURA

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sBiblos - novost v naši šolski knjižnici

sBiblos - novelty in our school library

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POVZETEK

Besedilo opisuje ter predstavlja šolsko knjižnico gimnazije ter novost – storitev izposoje e-knjig prek aplikacije sBiblos, kar je kot pilotni projekt omogočilo pristojno ministrstvo. Prikazane in predstavljene so podrobnosti vpeljave novosti v šolsko knjižnico, izvedba pouka za dijake, sama izposoja e-knjig ter statistični podatki o izposoji e-knjig.

KLJUČNE BESEDE

Šolske knjižnice, e-branje, sBiblos, motivacija, IKT

ABSTRACT

The article describes and introduces secondary school library and the new e-book lending service through the sBiblos application, which was made possible by the ministry responsible for education as a pilot project. The details of the introduction of the innovation in the school library, the implementation of the lessons for students, the e-book lending itself and the statistics on e-book lending are presented and discussed.

KEYWORDS

School libraries, e-reading, sBiblos, motivation, ICT

1 UVOD

Šolske knjižnice v Sloveniji so pomemben del vzgojno-izobraževalnega sistema ter vsakega zavoda oziroma šole. Svojim uporabnikom nudijo dostop do različnih tiskanih in elektronskih virov (knjige, referenčna gradiva, serijske publikacije) in drugih informacijskih materialov, ki jim pomagajo pri učenju, raziskovanju in razvijanju bralnih navad.

Šolsko knjižnico določa 68. člen Zakona o organizaciji in financiranju vzgoje in izobraževanja [1], v katerem piše, da ima šola knjižnico, v kateri se zbira, strokovno obdeluje, hrani, predstavlja in izposoja knjižnično gradivo ter opravlja informacijsko-dokumentacijsko delo kot sestavino vzgojno-izobraževalnega dela v šoli.

Torej je šolska knjižnica sestavni del vzgojno-izobraževalnega dela v šoli in je namenjena vzgojno-izobraževalnemu procesu ter potrebam učencev in delavcev šole, zato je pomembno, da se vključuje v delo na šoli (Medved, 2020, str. 4). S svojimi nalogami, dejavnostmi, aktivnostmi in gradivom pospešuje ter razvija kulturne navade, krepi veselje do branja pri učencih ter nudi mnogo možnosti za pridobivanje izkušenj ter novega znanja. Šolska knjižnica je torej »fizični in

digitalni prostor za učenje v šoli, v katerem so branje, poizvedovanje, raziskovanje, razmišljanje, domišljija in ustvarjalnost bistveni za pot učencev od informacij do znanja ter za njihovo osebno, družbeno in kulturno rast«[2]. V naslednjem poglavju bo predstavljena naša šolska knjižnica.

2 ŠOLSKA KNJIŽNICA SREDNJA VZGOJITELJSKA ŠOLA, GIMNAZIJA IN UMETNIŠKA GIMNAZIJA LJUBLJANA

Šolska knjižnica na gimnaziji ni več samo prostor, v katerem so shranjene knjige in se te izposojajo v strogi tišini. "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]. Šolska knjižnica na Srednji vzgojiteljski šoli, gimnaziji in umetniški gimnaziji Ljubljana (dalje SVŠGUGL) se nahaja na dveh lokacijah, tako kot tudi sama šola. Večina gradiva se nahaja v matični stavbi na naslovu Kardeljeva ploščad 28 A (Slika 1), manjši del gradiva, ki je namenjen izključno programu predšolska vzgoja na naslovu Kardeljeva ploščad 16.



Slika 1: Pogled na police v naši šolski knjižnici

Poleg omenjenih dveh lokacij knjižnice, imamo tudi bralni kotiček, to je prostor nad plesnimi dvoranami, ki je namenjen počitku in neformalnemu druženju. V tem prostoru imajo dijaki na razpolago gradivo, ki je prosto dostopno in ga lahko uporabljajo kadarkoli. Tudi v času njihovih popoldanskih treningov. Posebnost bralnega kotička je v tem, da dijaki

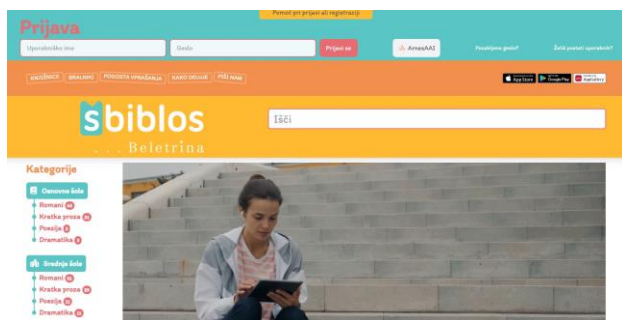
soustvarjajo prostor in soustvarjajo ponudbo gradiva. Ta prostor je kot neke vrste knjigobeznica, uporabniki prinesejo svoje gradivo in lahko vzamejo gradivo, ki so ga prinesli predhodniki.

Vsaka šolska knjižnica ima knjižnično gradivo, kar predstavlja zbirko gradiv, ki se redno dopolnjuje, ureja in hkrati tudi izloča. Knjižnično gradivo [4] so publikacije in dokumenti v knjižnični zbirki, ki jim je knjižnica dodala knjižnično informacijo: UDK-vrstilec za opredelitev vsebine, s katerim je predmet obravnave lahko opredeljen tudi s krajevno, časovno in metodološko oznako, in signaturo za oznako lokacije publikacije v knjižnični zbirki ter inventarno številko kot lastninsko oznako [5]. Knjižnično gradivo je tudi neknjižno gradivo – to so posebne brste gradiva, ki za uporabo potrebujejo določene naprave. Med neknjižno gradivo sodijo kasete, cd in dvd plošče in razni predmeti ter drugo. Z leti in z razvojem sodobne tehnologije ter e-poti pa so knjižnično gradivo postale tudi e-knjige. V Sloveniji je nekaj ponudnikov le-teh, a za potrebe knjižnične izposoje se je razvil Biblos. Za potrebe šolskih knjižnic pa se je v lanskem letu razvila platforma sBiblos. Več o tem v naslednjem poglavju.

3 KAJ JE SBIBLOS

Ministrstvo za izobraževanje znanost in šport (sedaj Ministrstvo za vzgojo in izobraževanje) je v sodelovanju z več strokovnimi službami in zavodi (Zavod RS za šolstvo, IZUM ...) omogočilo brezplačen dostop do e-knjig (prek aplikacije sBiblos) učencem 3. vzgojno izobraževalnega obdobja osnovnih šol, srednješolcem ter otrokom in mladostnikom s posebnimi potrebami.

Ker gre za enoletni pilotni projekt, so si na pristojnem ministrstvu želeli, da bi se vse šolske knjižnice vključile ter pričele z uporabo platforme sBiblos (<https://www.sbiblos.si>) in svojim uporabnikom ponudile brezplačen dostop do e-knjig (Slika 2). MVI po zaključku projekta napoveduje evalvacijo, ki bo prikazala rezultate ter usmeritve za nadaljnji razvoj ter uporabo platforme sBiblos v šolskih knjižnicah.



Slika 2: Zaslonska slika vstopne strani sBiblos

4 STATISTIČNI PREGLED IZPOSOJE SBIBLOS

Na SVŠGUGL smo se hitro odločili in uredili vse formalnosti, da smo lahko pristopili k projektu in našim dijakom ponudili možnost brezplačnih e-knjig. Kot šolska knjižničarka sem poskrbela za vse formalnosti ter za predstavitev projekta vodstvu, pri čemer sem izpostavila pomen projekta za naše

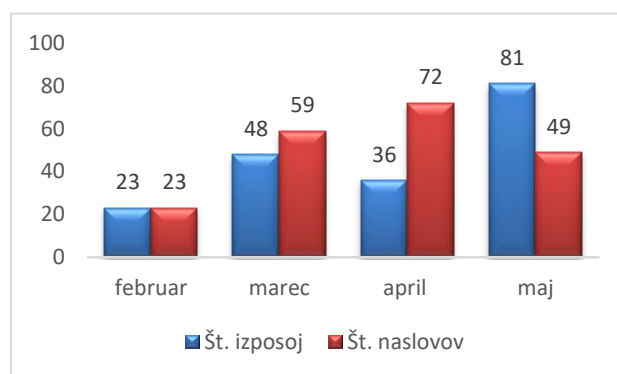
dijake. Prav tako sem izvedla reklamo med sodelavci in dijaki. Ugotavljam, da je zelo pomembno, da naše dijake seznanimo in jim omogočimo uporabo e-knjig.

V naši šolski knjižnici smo dijakom v okviru organiziranih aktivnosti predstavili sBiblos ter jim po korakih razložili prednosti [6].

Na kratko bom predstavilo eno izmed ur pouka knjižnično-informacijskega znanja (KIZ), ki sem ga letos izvajala prvič na to temo.

Z dijaki drugega letnika smo preizkusili uporabo platforme sBiblos. Predstavila sem jim platformo, načine iskanja, navigacijo ter navodila za uporabo, ki so objavljena na spletni strani sBiblos. Dijaki so si na svoje mobilne naprave namestili aplikacijo ter uporabljali tudi aplikacijo mCOBISS ali Mojo knjižnico. Uporabo aplikacije mCOBISS smo že prejšnje ure KIZ že uporabljali in se je naučili uporabljati. Dijaki so začeli z izposajo e-knjig v sistemu sBiblos, kar je bilo razvidno v statistiki izposoje COBISS3 (Grafikon 1).

Kot že omenjeno, je po navodilih Ministrstva za vzgojo in izobraževanje, IZUM vsem šolskim knjižnicam sBiblos vključil v COBISS3 ter v lokalne baze dodal ustrezne bibliografske zapise e-knjig. Tako je imela vsaka šolska knjižnica pripravljeno zalogo ter nabor naslovov e-knjig.



Grafikon 1: Prikaz statistike izposoje

Na grafikonu so vidni statistični prikazi števila izposoj (posamezni uporabniki oziroma dijaki naše šole) ter število naslovov, ki so se v določenem mesecu izposojali. Gre za mesece od februarja do maja 2023. Kot je razvidno iz grafikona, je izposoja počasi naraščala iz meseca v mesec.

E-knjige so dostopne vsak čas dneva, ne glede na odprtost knjižnice. Tako so nekateri dijaki ugotovili, da so si pozabili izposoditi tikano knjigo v knjižnici ali pa so bili že vsi izvodi določenega naslova izposojeni, zato so si lahko pomagali s platformo sBiblos ter na ta način prišli do gradiva (še posebno se je to pokazalo pri obveznem domačem branju, ko vsi dijaki morajo prebrati izbrane naslove).

Dijake sem tudi na kratko anketirala o sami platformi, uporabnosti ter rokovanju in pridobila koristne informacije, ki so bile del poročanja na zaključni konferenci ob koncu šolskega leta.

Ravno tako sem se odločila ter s pridobljenimi podatki pripravila dopis z evalvacijo in opisom ter predlogi za pristojno ministrstvo.

5 ZAKLJUČEK

V prispevku je bila predstavljena novost preteklega šolskega leta, ki jo je za vse šolske knjižnice v Sloveniji uvedlo Ministrstvo za vzgojo in izobraževanje. Vpeljava in ideja o platformi sBiblos za šolske knjižnice je nastala in se izkazala za nujno med posebnimi šolskimi leti, ki jih je v preteklosti zaznamovala pandemija COVID-19.

Dijakom se je platforma zdela uporabna in pregledna, vendar so bili razočarani nad izborom e-knjig. Ugotovili so, da niso našli ustrezne literature za svoje domače branje. O tem bom pripravila tudi obvestilo za pristojno ministrstvo, morda bodo pri evalvaciji upoštevali primernost že ponujenega gradiva ter razmislili o širši ponudbi.

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Poučevanje in učenje s pomočjo IKT pri pouku športne vzgoje

Teaching and learning with ICT in P. E. classes

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POVZETEK

V današnjem času nas informacijsko-komunikacijska tehnologija (IKT) spremlja na vsakem koraku. Je zaščitni znak sodobne družbe in človeku danes vsekakor omogoča prijaznejše življenje, ter mu olajša marsikateri napor. Razvoj interneta in IKT spreminjata proces učenja in poučevanja tudi v srednji šoli. Učitelji pri poučevanju vse pogosteje uporabljajo IKT, dijaki pa pri učenju. Sodobna tehnologija dopolnjuje in nadgrajuje izobraževanje. Učitelj lahko pouk s pomočjo IKT naredi zanimivejši in kvalitetnejši, hkrati pa pripravi dijake k sodelovanju in tako tudi dodatno motivira. V prispevku je predstavljena uporaba IKT (programa CoachNow), ki služi kot pomoč in popestritev pri poučevanju nekaterih športnih vsebin pri predmetu športna vzgoja.

KLJUČNE BESEDE

IKT, športna vzgoja, video analiza

ABSTRACT

Nowadays, information and communication (ICT) is present wherever we go. It is a trademark of the modern society and it certainly helps a person to have a nicer life and makes many efforts easier. The development of the Internet and ICT is changing the process of learning and teaching in secondary schools as well. Teachers are increasingly using ICT for teaching, as much as the students are for learning. Modern technology enhances and upgrades education. With the help of ICT, the teacher can make lessons more interesting and of higher quality, and the same time, we can also encourage students to participate, which provides more motivation. The paper presents the implementation of CoachNow which serves as an aid and a tool in order to enrich some sports content in physical education.

KEYWORDS

ICT, Physical Education, video analysis

1. UVOD

Šolska športna vzgoja je nenehen proces bogatenja znanja, razvijanja sposobnosti in lastnosti ter pomembno sredstvo za oblikovanje osebnosti in odnosov med posamezniki. Z redno in

kakovostno športno vadbo prispevamo k skladnemu biopsihosocialnemu razvoju mladega človeka, sprostitvi, nevtralizaciji negativnih učinkov večurnega sedenja in drugih nezdravih navad. Ob sprotni skrbi za zdrav razvoj ga vzgajamo in učimo, kako bo v vseh obdobjih življenja bogatil svoj prosti čas s športnimi vsebinami. Z zdravim življenjskim slogom bo tako lahko skrbel za dobro počutje, zdravje, vitalnost in življenjski optimizem [1].

Svetovna zdravstvena organizacija (WHO) zadnja leta opozarja na alarmantno stanje, saj so kar štirje od petih mladostnikov med 11. in 17. letom starosti premalo telesno aktivni in preveč na telefonih. Zaradi nezadostne aktivnosti je ogroženo zdravje otrok, kot tudi razvoj njihovih možganov in družbenih veščin, opozarja WHO. Otroci bi se morali gibati najmanj uro na dan, neaktivnost pa je pogostejša med dekleti. Tudi v Sloveniji je slika podobna; v letu 2016 je bilo telesno nedejavnih 80 odstotkov mladostnikov, kar je 0,1-odstotne točke manj kot leta 2001. Športna vzgoja je v primerjavi z drugimi učnimi predmeti res nekaj posebnega. Gibanje je uporabljeno kot medij za pridobivanje znanja. Učenec, ki ima sicer težave na področju pridobivanja akademskega znanja, je lahko zelo uspešen na področju športne vzgoje. Vendar pa športna vzgoja ne pomeni le gibanja samega po sebi, zabave in sprostitve, ampak je to predmet, pri katerem zasledujemo gibalne in vzgojne cilje ter cilje razvoja temeljnih gibalnih sposobnosti. Je tudi predmet, pri katerem je potrebno vedeti kako se kaj varno in tehnično pravilno (s tem tudi energetske ekonomično) izvede, da bomo uspešni. To pa je pogoj, da bomo kasneje v življenju to radi počeli. Športna vzgoja spodbuja tudi razvijanje spretnosti vodenja oz. nudi veliko možnosti za medsebojno sodelovanje. Že v naravi predmeta je torej ideja po pridobivanju znanja in spretnosti za življenje [2].

Športni način življenja je sistem vrednot, ki jih postopno pridobimo v življenju in postanejo naš osebni življenjski slog. Življenjski vzorci postanejo individualna potreba posameznika, katera prihaja iz njega samega, vzpostavi se notranja disciplina, daje nam univerzalno življenjsko energijo, in s tem odpira nove razsežnosti bivanja [3].

2. KAJ JE INFORMACIJSKO-KOMUNIKACIJSKA TEHNOLOGIJA (IKT)?

Elston pojem informacijsko-komunikacijsko tehnologijo (v nadaljevanju IKT) opredeli kot tehnologijo, ki se uporablja za

upravljanje z informacijami in kot pomoč pri komunikaciji [4]. IKT je skupen izraz različnih računalniških, informacijskih in komunikacijskih naprav, ki so postale naš vsakdanji spremljevalec [5]. Tehnološki napredek je zajel tudi področje šolstva, zato so se bile šole primorane informatizirati. IKT je postal nepogrešljiv pripomoček pri učenju in poučevanju. Glavni cilji vključevanja IKT v pouk so informacijska pismenost, nove spretnosti in bogatejše izkušnje. Za ustrezno in smiselno rabo IKT pri pouku je odgovoren usposobljen učitelj. Tehnologija omogoča učiteljem, da pouk načrtujejo bolj učinkovito, od učencev pa zahteva, da so pri pouku aktivni in motivirani [6].

Enotne definicije, ki bi natančno opredelila IKT ni, vsem pa je skupno to, da se v opredelitvi omenja beseda komunikacija. V literaturi je mogoče zaslediti več opredelitev IKT.

2.1 IKT V IZOBRAŽEVANJU

IKT je danes del učnega načrta srednjih šol. Uporablja se lahko zgolj kot eden od učnih pripomočkov ali pa se IKT poučuje pri ločenem oziroma posebnem predmetu [7]. Proces vpeljevanja IKT v srednjih šolah se je pri nas začel s projektom računalniške pismenosti. V projektu, ki se je izvajal leta 1972, je sodelovalo 30 šol. V času projekta so se izvajala izobraževanja za učitelje. Izdana sta bila tudi učbenika za učitelje in učence [8].

Nove tehnologije podpirajo izobraževanje, ga nadgrajujejo in naredijo bolj fleksibilnega. Omogočajo učinkovitejšo komunikacijo učitelja z učenci, ki pred uporabo IKT ni bila mogoča [9].

Cilji uvajanja sodobne IKT v izobraževanje se lahko razdelijo v tri sklope:

- pridobivanje določenih znanj in spretnosti vezanih na sodobne tehnološke procese pri poznejšem vključevanju v delo;
- zagotavljanje ključnih informacij o IKT, njenem delovanju in posledicah vsem učencem;
- izboljšanje pogojev učenja in poučevanja [10].

Vpliv IKT je v izobraževalno okolje prinesel številne nove učinkovite metode, hkrati pa je nova tehnologija omogočila razvoj novih učnih metod, ki so jih glede na zastavljene cilje izobraževanja oblikovali učitelji [11].

Uvedba IKT v pouk ima naslednje pomembne vplive na izobraževanje:

- razvijanje spretnosti učencev, ki so potrebne za življenje in delo v 21. stoletju;
- učitelje spodbuja k spremembi načina učenja v razredu z interaktivnimi in dinamičnimi viri;
- za učence zagotavlja bogatejšo izkušnjo učenja in več motivacije [8].

2.2 UPORABA IKT PRI PREDMETU ŠPORTNA VZGOJA

Učenje in poučevanje s pomočjo IKT, svetovnega spleta in virtualnih okolij, je vsekakor tudi pri pouku športne vzgoje dobrodošlo in potrebno, saj ponuja številne priložnosti za kvalitetnejše usvajanje zastavljenih ciljev ter doseganje čim boljših rezultatov učenja. Uporaba IKT nadgradi in bogati klasično poučevanje in naj ne bo predmet učenja ali orodje za učenje, temveč medij, ki pomaga pri pridobivanju znanja. Največkrat se pri športni vzgoji uporablja video kamera ali fotoaparati, razna CD in DVD gradiva, svetovni splet, merilnike srčnega utripa, štoparice in prenosni računalnik [12].

Učitelj športne vzgoje ima možnost uporabiti IKT v učnem procesu pri:

- načrtovanju pouka: priprava na pouk, letna delovna priprava, program športnih dni, interesnih dejavnosti, šole v naravi
- ustvarjanju spodbudnega učnega okolja: motivacija učencev pri vzdržljivostnih aktivnostih z merilci utripa, spremljanje napredka učencev
- pripravi materialov – učnih lističev in kartonov
- teoretični nadgradnji praktičnega pouka: predstavitev informacij z možnostjo večkratnega dostopa, ponovitev, sprotnega dopolnjevanja
- vodenje in spremljanje tekmovanj: razredna in šolska tekmovanja, lige
- komuniciranju z učenci, starši in drugimi učitelji ter njihovemu informiranju
- učenju na daljavo
- analizi stanja znanja in gibalnih ter funkcionalnih sposobnosti otrok v različnih fazah učnega procesa
- iskanju različnih virov informacij, zbiranju in obdelavi podatkov [13].

Z aktivnimi metodami dela in ob vseh možnostih, ki jih IKT tehnologija omogoča, učitelji motivirajo učence in dijake za športno udejstvovanje v šoli in vsakdanjem življenju. Ob tem naj upoštevajo njihove individualne zmožnosti ter razpoložljivost, ustreznost in dostopnost opreme.

2.2.1 GIMNASTIKA

Gimnastika je oblika telesnih vaj, katerih glavna značilnost je natančno izpolnjevanje časovnih in prostorskih elementov gibanja. Je sistem izbranih vaj in metodičnih postopkov [14]. Gimnastična vadba ima zaradi raznovrstnih učinkov pomemben vpliv na otrokov razvoj, saj otrok pridobiva osnovna gibalna znanja, izboljšuje gibalne sposobnosti, se 13 nauči nadzorovati svoje telo v različnih položajih in smereh gibanja, oblikuje pravilno držo, hkrati pa pridobiva tudi občutek za lepoto gibanja [15].

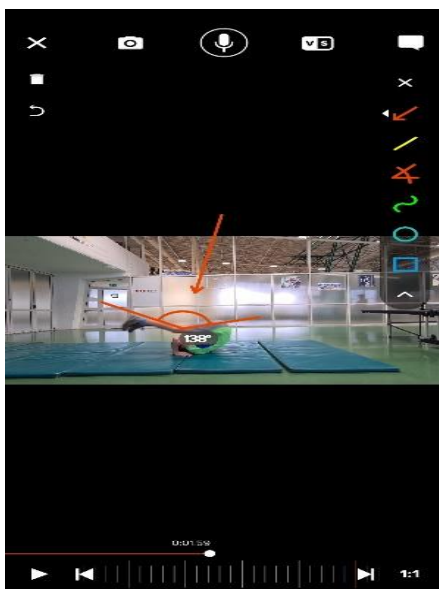
Gimnastika je umeščena v učne načrte športne vzgoje na vseh ravneh in oblikah šolanja, tako da je izbor ciljev, vsebin in

standardov znanja prilagojen stopnji razvoja učencev ali dijakov [14].

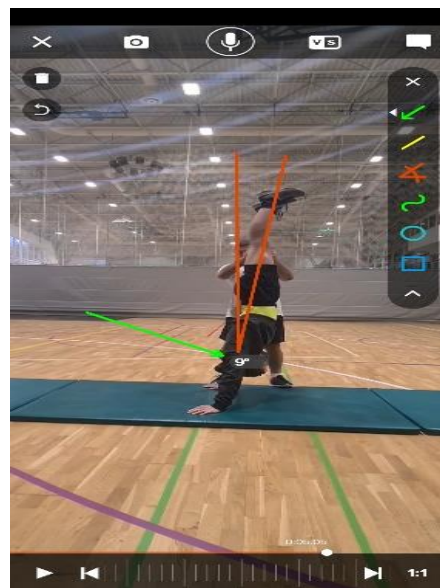
2.2.2 UČENJE OSNOVNIH AKROBATSKIH PRVIN S POMOČJO IKT

Pri poučevanju osnovnih akrobatskih prvin (preval naprej, preval nazaj, preval letno, premet v stran, stoja na rokah, stoja na lopaticah ...) si lahko pomagamo s programom/aplikacijo CoachNow. Slednji nam omogoča video analizo gibanja na dva načina:

- predstavitev pravilne izvedbe posamezne vaje v počasnem posnetku,
- vsak vadeči si lahko po opravljenem gibanju, le-to ponovno ogleda v počasnem posnetku in tako vidi vse svoje morebitne pomanjkljivosti ter napake same izvedbe.



Slika 1. Analiza gibanja pri prevalu nazaj



Slika 2. Analiza gibanja pri stoji na rokah

Dijaki prvega letnika so si pred izvedbo posamezne osnovne akrobatske prvine, le-to ogledali v počasnem posnetku. Tako so vsi poleg teoretične razlage dobili tudi vizualno predstavitev pravilne izvedbe. Po zaključenem ogledu, ogrevanju in vadbi predvaj, je sledila njihova praktična izvedba končnega gibanja. Končno izvedbo vsakega dijaka smo tudi posneli, da so si lahko tudi sami ogledali (Slika 1 in 2).

3. ZAKLJUČEK

Pri urah športne vzgoje lahko uporaba IKT prinaša veliko pozitivnih učinkov tako učiteljem kot tudi dijakom, a vseeno je potrebno posvetiti pozornost temu, da njeno vnašanje v pouk ni prekomerno in le takrat, kadar je smiselno. Uporaba IKT naj ne bo za vsako ceno in vsekakor ne namesto praktičnega dela pouka. Predvsem naj bodo sredstva IKT praktičnemu pouku športne vzgoje v pomoč in dopolnitev. Uporablja naj se predvsem tam, kjer učiteljem olajša in skrajša čas priprav na delo in kjer se zaradi uporabe kažejo boljši rezultati znanja.

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Digitalne veščine s poštevanko v medgeneracijskem okolju

Digital skills with multiplication in intergenerational environment

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POVZETEK

Učenje poštevance v tretjem razredu je za marsikaterega učenca velik izziv. Cilj ob koncu tretjega razreda je, da učenec poštevanko avtomatizira. Prav tako pa je pomembno, da poleg memoriziranja rezultatov otrok poštevanko tudi razume.

Učitelji za učenje poštevance uporabljamo različne metode in didaktične pristope, s katerimi poskušamo učence navdušiti. Kar nekaj naših učnih ur, ki so bile namenjene poštevanki, je bilo izvedenih v družbi devetošolcev.

Cilji naših medgeneracijskih druženj so bili, da učenci tretjega razreda utrdijo znanje poštevance s pomočjo tabličnih računalnikov, dobijo veselje za vajo doma in postanejo samozavestnejši pri uporabi informacijsko-komunikacijske tehnologije. Pri doseganju ciljev so jim pomagali devetošolci, ki so skozi vsa srečanja urili svojo potrpežljivost in motivatorske vrline. Tudi devetošolci so v vlogi mentorstev in spodbujevalcev utrdili svoje znanje poštevance.

Naloge so bile izvedene s pomočjo aplikacije Quizlet. Rezultata naših medgeneracijskih druženj sta bila boljše znanje poštevance in višja motivacija za njeno učenje. K temu sta zagotovo botrovala uporaba sodobne informacijsko-komunikacijske tehnologije, ki je popestrila učne ure, ter dobro mentorstvo starejših učencev.

KLJUČNE BESEDE

poštevanka, medgeneracijsko druženje, tablični računalnik, mentorstvo, informacijsko-komunikacijska tehnologija

ABSTRACT

Learning multiplication in the third grade can present a huge challenge for many a pupil. The goal at the end of the third grade is for a pupil to automatise it. Furthermore, it is important for a pupil not only to memorise the results, but also to understand multiplication.

When teaching multiplication, teachers use different methods and didactical approaches to motivate pupils. Quite a few lessons dealing with multiplication have been carried out in the company of the ninth graders.

The goals of our intergenerational lessons for the third-grade pupils were to revise their knowledge of multiplication with the help of tablets, to motivate them to practice at home and to boost their self-confidence when using information and communications technology. Ninth-grade pupils helped achieving the previously mentioned goals while practising their skills of patience and motivation during the lessons. Not only the third-grade pupils, but also the ninth-grade pupils revised their knowledge of multiplication while encouraging younger pupils and being good motivators.

The multiplication tasks were carried out with the help of the application Quizlet. The result of our intergenerational lessons were better knowledge of multiplication and higher motivation to study it. The goals were achieved successfully by good mentorship of the older pupils and by using modern information and communications technology which diversified lessons.

KEYWORDS

multiplication, intergenerational socialising, tablet, mentorship, modern information and communications technology

1 UVOD

Medgeneracijsko povezovanje, združeno z utrjevanjem poštevance, prinaša znanje, ki je v življenju pomembno. Tega se zavedajo tako tretješolci kot tudi devetošolci, ki se vsakič znova razveselijo novih nalog in izzivov. Nekateri izzivi so lažji, spet drugi veliko težji. Toda lažje jih premostimo, če imamo ob sebi nekoga, ki nas spodbuja in verjame v nas. Mojim tretješolcem je uspelo uspešno opraviti vse naloge in izzive. Pot ni bila enostavna, toda z vajami in nalogami, ki so njim pisane na kožo, jim je odlično uspelo. Seveda pa ne smemo pozabiti, da so to otroci generacije Z, ki komaj čakajo, da je učna ura začinjena s pravo mero IKT.

Mnogi bi rekli, da je učenje poštevance "piflarija". Zagotovo je pred avtomatizacijo poštevance potrebnih veliko konkretnih ponazoril, vaje, predvsem pa različnih tipov didaktičnih iger, preko katerih se učenci poštevanko učijo z večjo motivacijo. Naloga učitelja je, da poučevanje in učenje poštevance prilagodi potrebam učencev.

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2 GENERACIJA Z

Učence, ki jih poučujem, lahko poimenujemo tudi otroci generacije Z, saj so rojeni med letoma 1996 in 2018. Za otroke generacije Z je značilno, da so se rodili v času pametnih telefonov in tablic. Malčkom generacije Z ni tuje sestaviti sestavljanko na telefonu svojih staršev, svoje prve glasove in besede lahko povedo v pametni telefon, da jih slišijo stari starši na drugi strani linije. [2] Če povzamem: Ti učenci so obkroženi z elektronskimi napravami, rokovanje z njimi pa jih zanima. In zagotovo je to povezano z visoko stopnjo motivacije učencev, ko pri pouku uporabljamo tablične računalnike ali uro izvedemo v računalniški učilnici.

3 MEDGENERACIJSKO DRUŽENJE IN UPORABA APLIKACIJE QUIZLET PRI UTRJEVANJU POŠTEVANKE

Tudi pedagoška stroka je naklonjena uporabi IKT pri pouku. Meni, da uporaba IKT pri poučevanju omogoča več sodelovanja in povezovanja, učenje je bolj aktivno, spodbuja pa tudi vseživljenjsko učenje. [3]

Strinjam se z Dušico Kunaver, ki pravi, da mora učitelj znati zbuditi zanimanje za učno snov. Jo oživiti z drobnimi zanimivostmi in ob tem učenca naučiti, kako naj se uči. [4] Včasih so te drobne zanimivosti didaktične igre, ki imajo pri pouku zelo pomembno vlogo (Slika 1). Diane Ackerman pravi, da je igra najljubši način učenja naših možganov. Učenje poštevance je zabavnejše, če poteka skozi igro. Nekatere igre so namizne, nekatere računalniške. Učitelji moramo hoditi v koraku s časom. Večkrat se je že pokazalo, da stvari, ki so učence motivirale nekoč, danes učencev ne motivirajo več.



Slika 1: Medgeneracijsko utrjevanje poštevance v telovadnici

Z učiteljico angleščine Bredo Banovšek že več let medgeneracijsko povezujeva svoje učence. Medgeneracijsko povezovanje učence bogati, krepi njihovo duševno zdravje, jim ponuja občutka sprejetosti in varnosti, spodbuja empatijo in skrb za druge. Starejši učenci v času skupne šolske ure prevzamejo določeno mero odgovornosti, se trudijo, da bi bili dobri mentorji, motivatorji in zgled mlajšim. Mlajši učenci že pred poukom pozdravljajo svoje starejše znance in prijatelje. Večkrat jih objamejo in z njimi izmenjajo nekaj besed. Eden od temeljnih ciljev naših medgeneracijskih druženj je tudi to, da starejši učenci pomagajo mlajšim pri učenju, jih naučijo, kako se učiti in utrjevati učno snov.

V preteklem šolskem letu je bila glavna nit naših medgeneracijskih srečanj utrjevanje poštevance. Ponavljanje in utrjevanje je potekalo na različnih krajih: v učilnici, naravi, na bližnjem hribu, v šolski telovadnici in računalniški učilnici.

Učne ure, ko so bili v uporabi tudi tablični računalniki, so bile še posebno zanimive. Učencem sem s pomočjo aplikacije Quizlet pripravila vaje za utrjevanje in ponavljanje poštevance.

3.1 Utrjevanje poštevance z aplikacijo Quizlet

Quizlet je aplikacija, s pomočjo katere lahko učitelji pripravimo kartice, teste in igre za preverjanje in utrjevanje snovi. Ena od pozitivnih strani omenjene aplikacije je, da učenec lahko spremlja svoj napredek. [5]

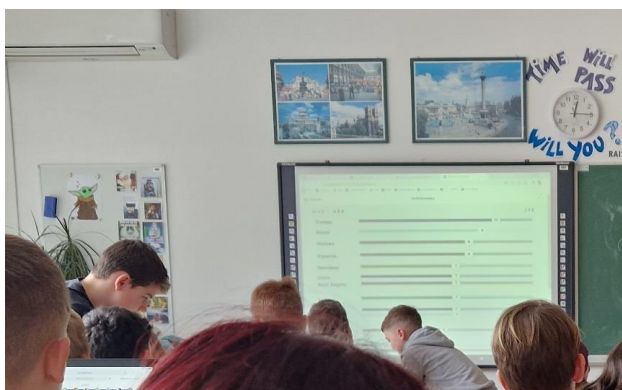
Na začetku šolske ure si je vsak tretješolca izbral devetošolca, s katerim bo tisto uro sodeloval. Devetošolci so mlajšim učencem pomagali pri prevzemu tabličnega računalnika in njegovi uporabi. O uporabi elektronskih naprav smo se večkrat pogovarjali pri pouku. Pred omenjeno učno uro sem učence seznanila s primernim obnašanjem in spoštljivim ravnanjem s tabličnim računalnikom. Pokazalo se je, da v mojem oddelku tretjega razreda veliko otrok doma nima na razpolago tablice, zato je bila pomoč starejših učencev zelo dobrodošla.

Učenci so k nalogam pristopili s skeniranjem QR-kode, ki so jo videli na tabli. Skeniranje QR-kode je bila naloga tretješolcev, ki so to naredili pod budnim očesom devetošolcev (Slika 2). Vsak par se je vpisal z imenoma obeh, da je lahko pozneje spremljal svoj napredek.



Slika 2: Skeniranje QR-kode

Ena od nalog je bila zastavljena tako, da se je učencem na tabli izpisal račun poštevance in različno obarvani rezultati. Naloga učencev je bila, da na tablicah čim hitreje kliknejo barvo, ki prikazuje pravi rezultat. Motivacija je bila ob prikazu najhitrejših dvojic višja (Slika 3). Devetošolci so se trudili, da so tretješolce med računanjem spodbujali in jih usmerjali. Včasih jim je bilo težko zadržati pravilno rešitev zase, toda vedeli so, da glavni cilj ure ni tekmovanje, temveč utrjevanje in medgeneracijsko povezovanje. Po končani aktivnosti so tretješolci izračunali nekaj računov, ki so jim jih zastavili devetošolci. Vse to je pomagalo, da so bili pri naslednji nalogi bolj motivirani, bolj "ogreti" in še hitrejši.



Slika 3: Na tabli prikazan napredek parov med utrjevanjem

Druga naloga je potekala znotraj večjih mešanih skupin, ki jih je izbral računalnik na podlagi vpisanih dvojic (Slika 4). Vsi, starejši in mlajši, so se razveselili živalskega imena skupine, ki jim ga je dodelila aplikacija. S tablicami so tudi tokrat delali mlajši učenci. Na tabli se je prikazal račun, na vsakem tabličnem računalniku pa en rezultat, ki ni bil

nujno pravilen. Naloga učencev je bila, da čim hitreje ugotovijo, na kateri tablici je ustrezen rezultat, in ga kliknejo. Pri tej nalogi sta se čutila skupinski duh in sodelovanje. Misim, da sta obe vrlini pomembni na mnogih področjih v življenju (v učilnicah, na delovnih mestih in v družinah.)



Slika 4: Mešane skupine tekmujejo v znanju poštevance

Ob koncu ure so devetošolci pohvalili svojega tretješolca. V učilnici je prevladovalo prijateljsko vzdušje. Tudi starejši učenci so priznali, da jim utrjevanje poštevance koristi. Nekateri so povedali, da so presenečeni nad hitrostjo računanja tretješolcev.

Cilj učne ure je bil dosežen. Učenci so z veseljem in visoko stopnjo motivacije reševali naloge in na njim zanimiv način utrdili svoje znanje poštevance.

4 ZAKLJUČEK

Medgeneracijsko povezovanje, združeno z utrjevanjem poštevance, prinaša znanje, ki je v življenju pomembno. Tega se zavedajo tako tretješolci kot tudi devetošolci, ki se vsakič znova razveselijo novih nalog in izzivov. Nekateri izzivi so lažji, spet drugi veliko težji. Toda lažje jih premostimo, če imamo ob sebi nekoga, ki nas spodbuja in verjame v nas. Mojim tretješolcem je uspelo uspešno opraviti vse naloge in izzive. Pot ni bila enostavna, toda z vajami in nalogami, ki so njim pisane na kožo, jim je odlično uspelo. Seveda pa ne smemo pozabiti, da so to otroci generacije Z, ki

komaj čakajo, da je učna ura začinjena s pravo mero IKT.

ZAHVALA

Velika zahvala gre sodelavki in prijateljici Bredi Banovšek, ki svoje ure večkrat prilagodi tako, da lahko izvedeva medgeneracijska druženja. Hvala tudi vodstvu šole, ker ima posluh za nakup IKT-opreme.

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Prednosti samostojnega e-učenja strokovnih vsebin pri pouku angleščine za višješolske študente informatike

The benefits of self-directed e-learning of professional content in the English course for IT students at higher education level

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POVZETEK

Množični odprti spletni tečaji (ang. Massive Open Online Courses) so oblika e-izobraževanja, namenjena množični udeležbi in vsakomur dostopna prek spleta. Prispevek predstavlja vključevanje takšnih tečajev v izobraževalni proces pri predmetu strokovna terminologija v angleščini za študente informatike na višji strokovni šoli kot primer dobre prakse. Predstavljeni so tudi rezultati študije zadnjih štirih študijskih let, ki prikažejo, katere strokovne vsebine in katere ponudnike tečajev študenti izbirajo ter predvsem, kakšne so prednosti te prakse. Študenti tečaje kritično presojujejo, največkrat so z njihovo izvedbo in doseženimi cilji zelo zadovoljni. Cenijo, da imajo prosto izbiro tem in lahko pridobijo strokovna znanja, ki jih sami želijo. Opravljeni tečaji so popestritev izobraževalnega procesa, nadgradnja znanja strokovne angleščine, omogočajo sledenje hitremu napredku informatike, hkrati pa predstavljajo podporo izobraževanju in študiju tudi strokovnih vsebin.

KLJUČNE BESEDE

Množični odprti spletni tečaji, e-izobraževanje, jezik stroke, informatika, strokovna znanja.

ABSTRACT

Massive Open Online Courses are a form of e-learning designed for mass participation and accessible to everyone online. This paper presents the integration of such courses into the educational process of the course Professional Terminology in English for IT students at a technical college as an example of good practice. The results of the study over the last four academic years are also presented, showing which professional content and which course providers students choose and, above all, the benefits of this practice. Students critically evaluate the courses, and are mostly very satisfied with their performance and the objectives achieved. They appreciate having a free choice of topics and being able to acquire the expertise they want. The courses are an enrichment of the educational process, they upgrade the knowledge of professional English, allow to keep up with the rapid progress of informatics, and at the same time support the education and study of professional subjects.

KEYWORDS

Massive Open Online Courses, e-learning, language of the profession, informatics, professional skills.

1 UVOD

Množični odprti spletni tečaji (ang. Massive Open Online Courses, s kratico MOOC) so tečaji, namenjeni udeležbi in odprtemu dostopu prek spleta. V prispevku bomo za množične odprte spletne tečaje uporabljali poimenovanje s kratico iz angleškega poimenovanja, torej MOOC, ali pa tečaji MOOC.

So del e-izobraževanja, omogočajo pa veliko število udeležencev, ki v izobraževalnem procesu lahko sodelujejo hkrati [1]. Uporabnikom omogočajo prost dostop in neomejeno udeležbo pri katerem koli tečaju po lastni izbiri. Na voljo so najrazličnejša tematska področja, tako bolj splošna (tečaji različnih veščin) kot tudi področja posameznih strok (tečaji strokovnih znanj). Poleg običajnih načinov poučevanja, kot so predavanja, videoposnetki in bralno gradivo, omogočajo MOOC tudi platformo za interaktivne forume.

Začetni tečaji MOOC so bili za udeležence brezplačni, v zadnjih letih pa je vse več ponudnikov, pri katerih je potrebno plačati neko pristojbino ali plačati za dostop do vaj in/ali certifikatov. Med najbolj popularnimi in znanimi ponudniki so coursera, edX, Future Learn, iversity, Udacity itd. Z njimi sodelujejo ugledne svetovne univerze in podjetja, npr. Harvard University, Stanford University, Massachusetts Institute of Technology, IBM, Google itd.

Prosto dostopne spletne tečaje na VŠŠ Kranj vključujemo v okvir predmeta Strokovna terminologija v angleščini v programu Inženir informatike že 11 let. Začeli smo torej približno štiri leta po prvem spletnem tečaju (Connectivism and Connective Knowledge, ki sta ga ustvarila George Siemens in Stephen Downs leta kot kreditni predmet na univerzi v Manitobi), leta 2012, ko so se MOOC zares razmahnil, precej pred letom 2018, ko je v javnem razpisu Inovativne in prožne oblike poučevanja in učenja Ministrstvo RS Slovenije za šolstvo in šport pozvalo univerze, da v svoje programe usposabljanja akademskega osebja vključijo tudi spletne tečaje MOOC [2], le da smo jih namenili za študente.

V nadaljevanju je predstavljena vključitev MOOC v študij kot primer dobre prakse, predstavimo pa tudi rezultate študije, ki zajema izvedbo predstavitev opravljenih tečajev v zadnjih štirih študijskih letih. Raziskali smo, katere strokovne teme študenti najpogosteje izbirajo, katere ponudnike tečajev največkrat izberejo, predvsem pa, kako so zadovoljni z izvedbo tečajev ter kaj so iz njih pridobili oz. kakšne so najpomembnejše prednosti takšnega e-izobraževanja.

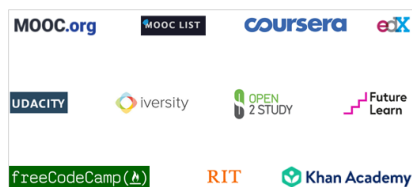
2 VKLJUČEVANJE TEČAJEV MOOC V DEJAVNOSTI PREDMETA STROKOVNA ANGLEŠČINA

Prosto dostopne spletne tečaje MOOC na VSŠ Kranj vključujemo v okvir predmeta Strokovna terminologija v tujem jeziku - angleščina, ki ga na tem mestu skrajšano poimenujemo z izrazom strokovna angleščina.

Namen uvedbe MOOC kot dodatnega vira za doseg izobraževalnih ciljev je bil spodbuditi študente, da za predstavitev strokovnih tem v tujem jeziku izberejo vir, ki zagotavlja strokovnost in je sodoben. Od študentov se pričakuje, da izbrano temo predstavijo kritično, na ustrezni zahtevnosti ravni, obenem pa poglobijo znanje angleščine ter pridobijo nova znanja in kompetence na področju informatike [3].

Katalog znanja za predmet strokovna angleščina predpisuje študentom 36 ur samostojnega dela za izdelavo seminarja. V okviru teh ur opravijo tečaje MOOC, obvezno s področja informatike. Med udeležbo na tečaju ustvarjajo zapiske o poteku tečaja, o svojih opažanjih, o pridobljenih novih strokovnih znanjih, oblikujejo svoje mnenje o samem tečaju in ga ocenijo z ocenami od 1 do 5. Po končanem tečaju pripravijo predstavitev svojih tečajev in zapišejo evalvacijo, nato pa vsebino in potek izbranega MOOC in izkušnje z njim delijo s kolegi in predavateljico v okviru seminarjskih vaj.

Veliko študentov s to obliko e-izobraževanja še ni seznanjenih, zato so uvodne kontaktne ure predmeta namenjene predstavitvi tečajev MOOC in podrobnim navodilom za izbiro tečaja, pripravo in izdelavo predstavitve ter oddajo le-te kot tudi oddajo evalvacije tečaja v ustrezni obliki v e-učilnico. V e-učilnici so zato ves čas na voljo natančna navodila, zgledi, roki za oddajo ter logotipi nekaterih ponudnikov MOOC s hiperpovezavami do njihovih spletnih, kot jih prikazuje Slika 1.



Slika 1: Logotipi s hiperpovezavami do ponudnikov MOOC

Ure seminarjskih vaj s predstavitvami študentov so vedno izredno pestre, raznolike in zelo zanimive. Pogosto se med študenti po predstavitvah razvijejo poglobljene strokovne debate, ki seveda potekajo v angleščini, kar predstavlja dodatno priložnost za aktivno rabo jezika stroke za vse udeležene.

3 PREDNOSTI TEČAJEV MOOC

Splošno priznane prednosti tečajev MOOC so, da so na voljo širokemu in raznolikemu občinstvu po vsem svetu, in sicer brezplačno (z izjemami, navedenimi v uvodu prispevka – op. a.), ter so tako postali javna dobrina. Ponujajo jih profesorji najboljših šol in univerz. Uspešnost učencev je mogoče preprosto spremljati s pomočjo sprotnih ocenjevanj in povratnih informacij. Prav tako je možno pridobiti podatke o motivaciji, spletni interakciji, skupinskem sodelovanju in učnih navadah udeležencev.

Vključenost predavateljev in učencev po vsem svetu odpira možnosti za uporabo inovativnih in izboljšanih pedagoških tehnik. Mreža, ki je ustvarjena znotraj vsakega tečaja, omogoča izmenjavo znanja in odprto povezovanje na svetovni ravni. Lahko se jih uporablja kot orodje v programu kombiniranega učenja, kjer lahko učenci dostopajo do več informacij, kot jih je na voljo v razredu [4, 5].

E-izobraževanje predstavlja večjo prilagodljivost glede na čas, prostor, učni stil in dinamiko posameznika. Zaradi interaktivnosti omogoča hitrejši dostop do raznolikih virov in do znanja ter omogoča razvoj novih znanj in kompetenc [6].

3.1 Tečaji MOOC s stališča študentov

Iz rezultatov nekaterih raziskav lahko na splošno izvemo, kaj študenti cenijo v tečajih MOOC. V nadaljevanju bodo prikazane paralele z rezultati študije, ki jo predstavlja ta prispevek. Pred tem pa je predstavljeno, katere strokovne vsebine in katere ponudnike tečajev študenti izbirajo.

Kot je zapisano v poglavju 2, je edina obveznost študentov, da izberejo temo tečaja s področja informatike, izbira točne teme in ponudnika pa je prosta. Iz pogovorov s študenti po predstavitvah izhaja, da je razlog za izbiro določene teme vedno osebna želja po določenem novem znanju ali poglobljanju oz. dopolnjevanju predhodno pridobljenega znanja.

V rezultatih študije zadnjih štirih študijskih let so zastopane najrazličnejše teme: programiranje, računalniška strojna in programska opreme, oblikovanje spletnih strani, kibernetika varnost, kodiranje, obdelovanje podatkov, mreženje, oglaševanje, računalniška tehnična podpora, ustvarjanje glasbe računalniških iger, umetna inteligenca, internet stvari, trgovanje s kriptovalutami, socialna omrežja, računalništvo v oblaku, super-računalništvo in še bi lahko naštevali. Po pogostosti smo teme razvrstili v štiri skupine. Daleč v ospredju sta temi programiranje (36%) in spletne strani (23%), s po 3 odstotki sta zastopani še temi omrežja in kibernetika varnost, vse ostale teme, ki so zastopane le enkrat ali dvakrat, pa so uvrščene v skupino »ostalo« (Slika 2).

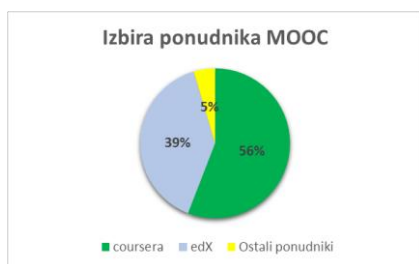


Slika 2: Izbira teme tečaja

Statistike kažejo, da so v svetu med ponudniki MOOC najpogosteje izbrani coursera na prvem mestu, FutureLearn na drugem in edX na tretjem mestu [7].

Študenti informatike v predstavljeni študiji pa so največkrat izbrali ponudnika coursera, nato edX, ponudnik FutureLearn pa je skupaj z Udacity, iversity, RIT, Open2study in Khan Academy v preostalih 3 odstotkih, ki so bili izbrani enkrat do trikrat v vseh štirih študijskih letih. Med razlogi za izbiro študenti navajajo dostopnost točno določene teme pri ponudniku pa tudi

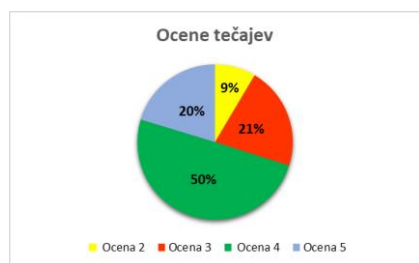
popularnost posameznih ponudnikov na socialnem omrežju TikTok. Izbira ponudnikov v odstotkih je prikazana na Sliki 3.



Slika 3: Izbira ponudnika MOOC

Nekateri teoretiki so skeptični do tega, da se povprečni študenti lahko spopadejo s tem izobraževalnim slogom, vendar raziskava New York Times kaže, da so študenti hvaležni za izzive in strukturo, ki jih ponujajo MOOC. Nekateri študenti med drugim cenijo, da »lahko delajo s tehničnimi nalogami v učnem okolju, povezanem z oblakom. Drugi študenti, ki objavljajo na določenih forumih MOOC, pogosto komentirajo "osebnostne" ali vodstvene lastnosti profesorjev, ki izvajajo te tečaje, kar je smiselno, saj si lahko bolj spodobni izobraževalni stili pomagajo pri izzivu dostopa do izobraževanja« [8]

Evalvacije študentov v predstavljeni študiji so večinoma pozitivne, tečaji so jim všeč in v glavnem izpolnijo njihova pričakovanja. Skupaj 70% študentov je tečaje ocenilo kot zelo dobre (50%) ali odlične (20%). Natančneje so ocene razvidne iz Slike 4.

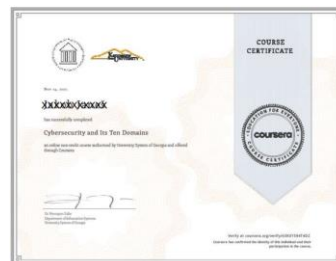


Slika 4: Ocene tečajev

Pozitivni komentarji se nanašajo na zanimivost teme, dobro in razumljivo razlago predavateljev, dobre kvize, interaktivnost, uporabnost pridobljenega znanja v praksi, možnost posvetovanja z drugimi udeleženci. Nekateri povedo, da so na tečaju uživali, drugim je bilo všeč, da so govor predavateljev v video posnetkih lahko spremljali tudi v obliki podnapisov. Cenijo tudi, da so lahko izvajanje aktivnosti tečaja prilagodili svojim urnikom in sposobnostim.

Med negativnimi komentarji zasledimo slabe razlage, angleščino z izrazitim naglasom, slabšo razumljivost, slabo odzivnost strani, odsotnost interaktivnosti, predolge ali prekratke lekcije, preveč informacij. Nekaterim so se tečaji zdeli preveč ali premalo zahtevni, včasih nesistematični. Večino pa je zelo motilo, da so bili nekateri deli (vaje, povratne informacije ali certifikat) plačljivi kljub temu, da je bil tečaj označen kot prosto dostopen. To je bil tudi razlog, da so nekateri sicer odlične tečaje ocenili z oceno 4 ali celo 3 in da jih večina ni pridobila

certifikata. Nekateri ponudniki so še vedno podelili brezplačen certifikat, ena študentka pa se je odločila za nakup certifikata, ker je ocenila, da ga bo lahko uveljavila kot prednost pri zaposlitvi. Na sliki certifikata študenta smo zakrili njegovo ime zaradi varstva osebnih podatkov (Slika 5).



Slika 5: Certifikat študenta

Večina študentov navaja, da so pričakovano strokovno znanje usvojili ali poglobili. Nekaj jih je žal izbralo premalo zahtevne ali preveč zahtevne tečaje in zato niso pridobili dovolj strokovnega znanja. Marsikdo je izrazil nameru, da bo kasneje izven študijskih obveznosti v skladu s svojo željo opravil še kakšen MOOC.

3.2 Tečaji MOOC s pedagoškega stališča

Način delovanja in interakcijo vseh deležnikov v spletnih tečajih ilustrira t.i. Okvir za oblikovanje in vrednotenje MOOC »Framework for the design and evaluation of MOOCs«, ki ga je razvil laboratorij Lytics Lab na univerzi Stanford [9] in je prikazan na sliki 6.



Slika 6: Okvir za oblikovanje in vrednotenje MOOC [9]

Tečaji MOOC predstavljajo, če povzamemo prikaz na sliki, interaktivno učno okolje, v katerem je učenje pogojeno s predznanjem in željo oz. nameru učenca. S pomočjo tehnološke infrastrukture so vsebine, navodila in ocene znotraj skupnosti posredovane učencu. Učenje temelji na dokazih in zagotavlja izboljšanje znanja.

Na podlagi tega razumevanja je s pedagoškega vidika vključevanje MOOC v samostojno delo višješolskih študentov pri predmetu strokovna angleščina smiselno, saj je inovativno, izkustveno in učinkovito in je dobrodošlo kot pomoč pri doseganju izobraževalnih ciljev višješolskega kurikula tako pri strokovni angleščini kot tudi pri usvajanju novega in poglobljanju obstoječega strokovnega znanja študentov, kar zagotavlja tudi medpredmetno povezovanje študijskih vsebin.

Pri predstavitev vsak študent tudi posreduje znanje svojim kolegom, kar je prednost zanj, ker na ta način svoje znanje še utrdi, kot za kolege in tudi predavatelja strokovne angleščine, ki slišijo raznolike nove vsebine s področja stroke.

Aktivna raba strokovne angleščine študentov med sprejemanjem vsebin samih tečajev MOOC, pri reševanju nalog ter pri sporazumevanju s predavatelji in soudeleženci tečaja pri študentih pomembno in opazno nadgrajuje znanje angleščine stroke. Enako velja tudi pri nastopih za predstavitve tečajev in strokovnih debatah, ki se po njih pogosto razvijejo med kolegi.

Z gotovostjo lahko trdimo, da opisani primer dobre prakse zagotavlja doseganje izobraževalnih ciljev predmeta, kot so: razvijanje samoiniciativnosti, ustvarjalnosti in natančnosti, komuniciranje s strokovnjaki s področja informatike v tujem jeziku, uporaba literature v tujem jeziku pri reševanju problemov s področja informatike, spremljanje razvoja stroke s poznavanjem in spremljanjem strokovne literature v tujem jeziku, razvijanje pripravljenosti za sodelovanje pri skupinski izvedbi nalog. Zagotovljeno je tudi doseganje predmetno-specifičnih ciljev, da znajo pripraviti kvalitetno predstavitev, opisovati postopke, delovno okolje, poznajo različna področja informatike. Oddani in evalvirani pisni izdelki študentov prav tako uresničujejo cilj, da znajo tuj jezik uporabljati slovnično in pravopisno pravilno.

Nenazadnje so predstavljene vsebine tečajev MOOC tudi pomemben vir za zagotavljanje poznavanja novosti s področja stroke, kar je ob rapidnem razvoju sodobne tehnologije zelo pomembno za študente kot strokovnjake in kar precejšen izziv za predavatelja, katerega osnovna poklicna usmeritev največkrat ni informatika.

4 ZAKLJUČEK

Študija dosežkov in zadovoljstva študentov z vključevanjem tečajev MOOC v dejavnosti predmeta strokovna terminologija v angleščini v zadnjih štirih študijskih letih je pokazala, da gre za primer dobre prakse.

Vključevanje samostojnega e-učenja strokovnih vsebin s področja informatike v okviru predmeta strokovna angleščina v obliki množičnih spletnih tečajev MOOC prinaša številne prednosti za višješolske študente informatike. Na opravljenih tečajih na zanimiv in inovativen način pridobijo nova strokovna znanja, obogatijo obstoječe strokovno znanje, hkrati pa nadgradijo znanje strokovne angleščine.

Predstavitve tečajev, njihovih vsebin in izkušenj študentov pomenijo aktivno rabo strokovne angleščine za študente in njihove kolege, saj spodbujajo strokovne debate med njimi v angleščini. Obenem so tudi vir dodatnega znanja in spremljanja novosti na področju informatike, ne le za študenta, ki je opravil

tečaj, pač pa tudi za njegove kolege in nenazadnje za predavatelja strokovne angleščine, katerega osnovna profesionalna usmeritev večinoma ni informatika.

Študenti cenijo, da imajo prosto izbiro, saj so tečaji MOOC priložnost za pridobitev tistih znanj, ki jih želijo imeti, a jih iz različnih vzrokov v okviru institucionalnega izobraževanja še niso uspeli usvojiti. Izbirajo najrazličnejše strokovne teme, prevladujejo pa tečaji s področja programiranja in oblikovanja spletnih strani.

Tečaji so jim večinoma zelo všeč iz različnih razlogov, npr. zanimivosti in kvalitete predavanj, vaj in video vsebin, interaktivnosti ter možnosti prilagajanja svojemu urniku in svojemu stilu učenja. Nekateri študenti žal naletijo tudi na tečaje, ki so po njihovem mnenju manj zanimivi, katerih razlage so manj razumljive, ki so preveč ali premalo zahtevni, najbolj pa jih moti, da so nekateri deli tečajev plačljivi.

Večina študentov navaja, da so pridobili pričakovano strokovno znanje ali ga poglobili. Marsikdo je izrazil nameru, da bo kasneje izven študijskih obveznosti v skladu s svojo željo opravil še kakšen MOOC.

S pedagoškega stališča poleg omenjenega vključitev MOOC v dejavnosti predmeta strokovna angleščina kot oblika izkustvenega učenja predstavlja tudi dobrodošlo podporo pri uresničevanju številnih izobraževalnih ciljev, obenem pa popestri tako samostojne dejavnosti študentov kot tudi seminarske vaje predmeta.

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Računalniški kognitivni treningi za otroke z motnjo pozornosti s hiperaktivnostjo

Computer – based cognitive training for children with attention deficit and hyperactivity disorder

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POVZETEK

Računalniški kognitivni trening za otroke z motnjo pozornosti s hiperaktivnostjo so namenjeni premagovanju specifičnih primanjkljajev in zmanjševanju simptomov, povezanih z motnjo pozornosti. Tovrstni treningi postajajo vse bolj pogosto uporabljeni in raziskani, vendar pa še ni povsem jasno kako učinkovito vplivajo na generalizirane funkcionalne primanjkljaje na področju izvršilnih sposobnosti, kot so težave na področju pozornosti, impulzivnosti, zmanjšane inhibicije na področju vedenja in čustvovanja, primanjkljaje na področju načrtovanja in organizacije ter delovnega spomina. Primanjkljaji na področju izvršilnih sposobnosti, predstavljajo pomemben del motnje pozornosti s hiperaktivnostjo in morda tudi osnovo za ostale simptome motnje. V literaturi lahko pogosto zasledimo računalniške kognitivne treninge izvršilnih sposobnosti in delovnega spomina, ki predpostavljajo, da lahko s pomočjo izboljšanja teh izvršilnih sposobnosti zmanjšamo simptome motnje pozornosti s hiperaktivnostjo. V splošnem kažejo na to, da imajo računalniški kognitivni treningi potencialno pozitiven učinek na kognitivne sposobnosti otrok z motnjo pozornosti s hiperaktivnostjo, prav tako so nekatere študije pokazale tudi ugoden vpliv na zmanjšanje disfunkcionalnega in impulzivnega vedenja. Namen prispevka je predstavitev tovrstnih raziskav in preučitev učinkovitosti različnih tipov računalniškega kognitivnega treninga ter s tem možnosti uporabe treningov pri praktičnem delu z otroki z motnjo pozornosti s hiperaktivnostjo.

KLJUČNE BESEDE

Motnja pozornosti s hiperaktivnostjo, računalniški kognitivni trening, izvršilne sposobnosti, delovni spomin

ABSTRACT

Computer cognitive training paradigms for children with attention deficit and hyperactivity disorder are designed for overcoming specific deficits and reduction of symptoms of the disorder. Such trainings are becoming more and more used and researched, but it is not entirely clear how they affect generalized functional deficits of executive functions, such as attention

deficit, impulsivity, lack of behavioural and emotional inhibition, planning and organization skills, and working memory. Executive functions deficit represents a great share of attention deficit and hyperactivity disorder symptoms and possibly represents the basis for other symptoms of the disorder. There are many studies of computer-based cognitive training that assumes that improving those functions can reduce attention deficit and hyperactivity disorder symptoms. In general, they show that computer-based cognitive training has the potential to improve cognitive functioning of children with attention deficit and hyperactivity disorder. Some studies also showed reduction of dysfunctional and impulsive behaviour. The purpose of this paper is to review those articles and to evaluate effectiveness of different types of computer-based cognitive training and options of practical implementation for working with children with attention and hyperactivity disorder.

KEYWORDS

Attention deficit and hyperactivity disorder, computer-based cognitive training, executive functions, working memory

1 UVOD

1.1 Motnja pozornosti s hiperaktivnostjo ali brez nje

Motnja pozornosti s hiperaktivnostjo (ADHD; angl. *attention deficit hyperactivity disorder*) ali brez nje (ADD; angl. *attention deficit disorder*) je motnja, ki se praviloma pojavi v otroštvu in jo označuje vzorec težav na področju pozornosti, impulzivnosti in/ali hiperaktivnosti, pogosto pa se nadaljuje tudi v kasnejših razvojnih obdobjih [1]. Predstavlja eno izmed najpogostejših motenj v obdobju otroštva [2]. Motnja pozornosti je kompleksna in heterogena motnja, ki se od posameznika do posameznika lahko razlikuje v stopnji izraženosti simptomov, starosti ob začetku motnje, situacijsko povezanim pojavljanjem simptomov in v stopnji sopojavačnosti z drugimi motnjami [1].

1.2 Primanjkljaji na področju izvršilnih sposobnosti pri otrocih z motnjo pozornosti s hiperaktivnostjo

Izvršilne sposobnosti predstavljajo širok konstrukt, ki se nanaša na različne procese, med katere spada pozornost, delovni spomin, fleksibilnost mišljenja, načrtovanje in regulacija ciljno usmerjenih vedenj [3]. Izvršilne sposobnosti omogočajo posameznikovo regulacijo vedenja, mišljenja in čustvovanja [4].

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Obstaja predpostavka, da so primanjkljaji na področju izvršilnih sposobnosti osnova za simptome, s katerimi se srečujejo otroci z ADHD in igrajo pomembno vlogo pri pojasnjevanju težav, s katerimi se otroci s to diagnozo vsakodnevno srečujejo [5]. Kljub temu, da raziskave večinoma potrjujejo, da se pri otrocih z ADHD statistično pomembno pogosteje pojavljajo primanjkljaji na področju izvršilnih sposobnosti, pa se primanjkljaji na področju izvršilnih sposobnosti ne pojavljajo pri vseh otrocih z diagnosticirano ADHD, kar kaže na to, da primanjkljaji na področju izvršilnih sposobnosti niso nujno povezani z vsemi simptomi motnje [6]. Raziskave [6, 7, 8], ki preučujejo delež posameznikov z ADHD, ki imajo primanjkljaje na področju izvršilnih sposobnosti, so poročale o deležu med 30% in 50%. Ti podatki kažejo na veliko heterogenost motnje z vidika tovrstnih primanjkljajev.

Simptomi ADHD, predvsem simptomi na področju pozornosti, se pogosto povezujejo s primanjkljaji na področju delovnega spomina [9]. Delovni spomin predstavlja sposobnost začasnega shranjevanja omejenega števila informacij [10] z namenom aktivnega upravljanja s temi informacijami. Omogoča opravljanje različnih vrst kompleksnih aktivnosti, kot so učenje, sklepanje in odločanje [11]. Učinkovito delovanje delovnega spomina predstavlja osnovo za delovanje različnih kognitivnih funkcij, zato je ključnega pomena za uspešno funkcioniranje v vsakdanjem življenju.

Primanjkljaji na področju inhibicije čustvenega odziva in neprimerne vedenjskega odziva so v literaturi pogosto omenjeni kot nevropsihološka značilnost posameznikov z ADHD [12]. Pri posameznikih z ADHD tako lahko govorimo o zmanjšani inhibiciji na kognitivnem, vedenjskem in/ali čustvenem nivoju [13]. Regulacija čustev je proces nadziranja, vrednotenja in prilagajanja čustvenih reakcij [14]. Čustvena impulzivnost se nanaša na hitrost in verjetnost, s katero se bo posameznik odzval s primarnim (najpogosteje negativnim) čustvom kot odziv na situacijo, v primerjavi z ostalimi v enakem razvojnem obdobju [1]. Primarna čustvena reakcija posameznikov z diagnozo ADHD ne odstopa v intenziteti, temveč v manjši zavedni samoregulaciji čustev [1].

1.3 Računalniški kognitivni trening za otroke z motnjo pozornosti s hiperaktivnostjo

Raziskave kažejo, da izvršilno funkcioniranje in s tem povezana možganska aktivnost ni nespremenljivo, ampak se lahko spreminjajo s pomočjo ponavljanja nalog ali treningom [15]. Kognitivni trening temelji na konceptu nevroplastičnosti, ki predpostavlja, da imajo možgani zmožnost spremembe in reorganizacije na podlagi novih izkušenj [2]. Raziskovalci, ki preučujejo učinek kognitivnega treninga na različne kognitivne sposobnosti posameznikov predpostavljajo, da lahko na podlagi učinkov treninga zmanjšamo simptome in izboljšamo funkcioniranje posameznika [2]. Pri uporabi kognitivnega treninga za izboljšanje funkcioniranja posameznika s primanjkljaji na različnih področjih je glavni cilj doseči izboljšanje na neposredno treniranih funkcijah, kot so pozornost in delovni spomin (bližnji transfer) in, še pomembneje na kognitivnih funkcijah in simptomih, ki niso bile trenirane (daljni transfer) [2]. Naloga, ki predstavljajo »bližnji transfer« so naloge, ki imajo z nalogo, ki je bila vključena v trening več skupnih značilnosti kot naloga »daljnega transfera«, ki imajo s trenirano

nalogo manj skupnih značilnosti in je možnost, da pride do transfera na te naloge, manjša [16].

Računalniški kognitivni treningi (npr. računalniški kognitivni treningi delovnega spomina) so pogosto raziskana in vse pogosteje uporabljena metoda za zmanjšanje simptomov in s simptomi povezanih primanjkljajev pri otrocih z ADHD [17]. Študije, ki vključujejo računalniške kognitivne treninge za otroke z ADHD, uporabljajo različne metodološke pristope. V splošnem se tovrstne intervencije osredotočajo na kognitivne treninge z eno domeno (npr. delovni spomin), vendar pa študije kažejo, da imajo otroci z ADHD primanjkljaje na različnih področjih kognitivnega funkcioniranja, še posebej na področju izvršilnih sposobnosti. Izvršilne sposobnosti, pri katerih se pojavljajo z motnjo povezani primanjkljaji, pa so vezane na različna možganska področja [18]. Zato nekateri raziskovalci menijo, da lahko trening, ki se nanaša na različne izvršilne sposobnosti, potencialno predstavlja najbolj učinkovito metodo pri zmanjšanju primanjkljajev na področju izvršilnih sposobnosti ki se pojavljajo pri ADHD.

V nadaljevanju prispevka je pregled literature o vplivu računalniških kognitivnih treningov na različne vidike funkcioniranja otrok z ADHD, s poudarkom na tem katere vrste treningov so se do sedaj izkazale kot najbolj učinkovite in kateri dejavniki vplivajo na to, da je računalniški kognitivni trening učinkovit.

2 PREGLED LITERATURE

2.1 Vrste računalniškega kognitivnega treninga za krepitev izvršilnih funkcij

Študije, ki preučujejo računalniške kognitivne treninge za otroke z ADHD kažejo različne rezultate (glej tabelo 1). Eden izmed razlogov za razhajanja so zagotovo različne kognitivne sposobnosti, katere računalniški kognitivni treningi trenirajo. Med najpogosteje uporabljenimi računalniškimi treningi so računalniški kognitivni treningi delovnega spomina [3, 9, 10, 19], prav tako se v literaturi pojavljajo računalniški kognitivni treningi pozornosti [20, 21]. Nekoliko manj raziskav je takšnih, ki se osredotočajo na računalniški kognitivni trening več različnih kognitivnih funkcij (multimodalni računalniški kognitivni trening) [2].

Med najpogosteje uporabljenimi računalniškimi kognitivnimi treningi delovnega spomina je Cogmed (angl. *Cogmed working memory training*; CWMT), ki razvija sposobnost vzdrževanja informacij v verbalnem in vidno-prostorskem delovnem spominu [22]. Program temelji na formatu računalniške igre in prilagaja težavnost glede na uspešnost posameznikov [9]. Nekatere predhodne študije, ki uporabljajo CWMT so pokazale, da se je pri otrocih z diagnozo ADHD s pomočjo treninga zmanjšalo število simptomov, povezanih z diagnozo. V eni izmed raziskav [3], ki je preučevala vpliv CWMT na oceno funkcioniranja otrok z ADHD s strani staršev so ugotovili, da so udeleženci izboljšali svoje sposobnosti ohranjanja pozornosti, načrtovanja in delovnega spomina, prav tako so starši po treningu ocenili pomembno zmanjšanje števila simptomov ADHD, vendar pa rezultati niso pokazali pomembnega izboljšanja simptomov, ocenjenih s strani učiteljev. V drugi raziskavi [10] so preučevali učinek CWMT na vzorcu otrok z ADHD, pri čemer so ugotovili, da je trening vplival na napredek na trenirani nalogi, prav tako pa

so otroci napredovali na netrenirani nalogi delovnega spomina in izboljšali rezultat na Ravenovih progresivnih matricah, ki predstavlja neverbalni test kompleksnega mišljenja. Ob tem so avtorji izmerili tudi motorično aktivnost na podlagi pogostosti premikov glave med računalniškim testom in ugotovili, da se je motorična aktivnost pomembno zmanjšala v skupini, ki je bila vključena v trening delovnega spomina. Motorična aktivnost, izmerjena s pomočjo tovrstne metode je v predhodnih raziskavah otrok z ADHD korelirala z vedenjskimi ocenami hiperaktivnosti [10].

V raziskavi, kjer so preverjali učinek računalniškega kognitivnega treninga pozornosti pri otrocih z ADHD [20], so uporabili računalniški program, ki je sestavljen iz štirih setov strukturiranih nalog, ki so namenjene treniranju sposobnosti ohranjanja pozornosti, selektivne pozornosti, usmerjanja pozornosti in izvršilne pozornosti. Program se prilagaja glede na uspešnost udeležencev. Udeleženci so statistično pomembno napredovali na netrenirani nalogi bralnega razumevanja in prepisovanja, prav tako pa so starši poročali o zmanjšanju simptomov ADHD, povezanih s pozornostjo. V pilotni študiji, kjer so preverjali učinek računalniškega kognitivnega treninga pozornosti za funkcioniranje otrok z ADHD [21] so ugotovili, da so starši otrok poročali o zmanjšanju intenzivnosti simptomov ADHD. Učitelji in učenci sami niso prepoznali nobenih pomembnih razlik v funkcioniranju pred in po treningu pozornosti.

Kljub predpostavkam, da so treningi, ki trenirajo več različnih kognitivnih funkcij uspešnejši od tistih, ki trenirajo samo eno, nekatere raziskave te predpostavke ne potrjujejo. V raziskavi [2], ki preučuje učinek računalniškega kognitivnega treninga različnih kognitivnih funkcij, kot so ohranjanje pozornosti, inhibicija odziva, kognitivna fleksibilnost, delovni spomin, prepoznavanje vzorcev in formiranje kategorij, rezultati niso pokazali statistično pomembnega učinka na skorajda nobeno preverjeno področje funkcioniranja (npr. motorične sposobnosti, pozornost, prostorski delovni spomin, inhibicija odziva itd.). Avtorji so ugotovili, da ima intervencija učinek le na sposobnost načrtovanja, izboljšanje na tem področju pa so prepoznali tudi dlje časa po zaključku treninga (po 12. in 24. tednih).

2.2 Trajanje računalniškega kognitivnega treninga

Eden izmed dejavnikov, ki vplivajo na uspešnost računalniškega kognitivnega treninga je najverjetneje tudi trajanje kognitivnega treninga. V študiji [9], kjer so uporabili 5 tednov trajajoč trening (znotraj 5 tednov 25 treningov po 30-45 minut) se je rezultat računalniškega treninga delovnega spomina (CWMT) pokazal na izboljšanje verbalnega in neverbalnega delovnega spomina. V drugi študiji [10], kjer so prav tako uporabili 5 tednov trajajoč trening (izvajal se je vsak dan po 25 minut) pa se je kot učinek računalniškega treninga delovnega spomina pokazalo izboljšanje pri reševanju nalog delovnega spomina, prav tako pa se je pojavil transfer na sposobnost kompleksnega mišljenja in zmanjšane motorične aktivnosti.

V želji po povečanju učinka treninga so nekatere študije podaljšale čas trajanja treninga, ob predpostavki, da bo večja količina treningov prinesla večji napredek udeležencev, vendar te predpostavke na podlagi rezultatov treninga niso uspeli potrditi [2]. Menijo, da je morda izboljšanje celo bolj verjetno pri nekoliko krajšem treningu, saj predstavlja manjšo obremenitev

za otroke in njihove družine [2], saj je večina treningov potekala v domačem okolju. Nekatere raziskave pa kažejo, da so treningi, ki trajajo skupno vsaj 8 ur pogoj za uspešnost treninga delovnega spomina [15]. Po drugi strani pa so v drugi raziskavi [19] prepoznali pozitivne učinke (na vizualno-prostorski kratkoročni in delovni spomin) računalniškega kognitivnega treninga, ki temelji na principu računalniške igre, le po treh 30 minutnih treningih. Avtorji ugotavljajo, da lahko z uporabo treninga v obliki računalniške igre, manjše število treningov privede do podobnega napredka kot večje število treningov drugega formata. Uspešnost kognitivnega treninga lahko v tem primeru v večji meri pripišemo motiviranosti udeležencev za opravljanje treninga, ki je v formatu računalniške igre in zato za udeležence bolj privlačen in zanimiv.

2.3 Motivacija za opravljanje nalog računalniškega kognitivnega treninga pri otrocih z motnjo pozornosti s hiperaktivnostjo

Tudi druge raziskave potrjujejo, da se trening izvršilnih sposobnosti v obliki računalniške igre kaže kot možnost za višanje motivacije in učinkov samega treninga pri otrocih z ADHD [23]. To pojasnjujejo s tem, da igranje iger dviguje nivo sproščanja dopamina v striatalnih možganih, kar poviša dolgoročno potenciacijo nevrnalnih povezav v striatumu in vpliva na povečanje motivacije in zmožnosti učenja.

Najpogostejši računalniški kognitivni treningi za otroke z ADHD uporabljajo postopke, s katerimi avtomatsko prilagodijo težavnost naloge, da bi nenehno stimulirali udeleženca, da doseže meje svojih sposobnosti [24]. Prilagajanje težavnosti vpliva na motivacijo udeležencev, saj preprečuje znižanje motivacije zaradi prevelike težavnosti naloge in posledičnega občutka frustracije ob reševanju, prav tako pa preprečuje zmanjšanje motivacije ob reševanju naloge, ki je za udeleženca preveč enostavna.

Nagrajevanje je eden izmed dejavnikov, s katerim lahko izboljšamo zunanjo motivacijo udeležencev za opravljanje nalog računalniškega kognitivnega treninga. Ker so ojačitve v obliki nagrajevanja v veliki meri povezane z nivojem motivacije, raziskave predpostavljajo, da nizek nivo notranje motivacije vpliva na slabšo izvedbo pri otrocih z diagnozo ADHD. Študije kažejo, da je visoko intenzivno ojačanje v obliki nagrajevanja učinkovitejše pri izboljšanju izvedbe na nalogah pri otrocih z ADHD v primerjavi z otroki brez diagnoze ADHD [25]. Otroci z ADHD preferirajo takojšnjo nagrado, v primerjavi z odloženo. Raziskovalci menijo, da je rešitev za izboljšanje motivacije za izvedbo računalniškega kognitivnega treninga pri otrocih dodajanje elementov računalniške igre v naloge treninga. Otroci z ADHD izkazujejo višji nivo motivacije za naloge izvršilnih sposobnosti z elementi računalniške igre, v primerjavi z nalogami izvršilnih sposobnosti brez elementov računalniške igre. Raziskava je pokazala, da so otroci pri nalogi z elementi računalniške igre vztrajali dlje časa, tudi brez nadzora odrasle osebe [19].

2.4 Vpliv računalniškega kognitivnega treninga na vedenje otrok z motnjo pozornosti s hiperaktivnostjo

Nekateri avtorji so tako želeli preveriti ali lahko računalniški kognitivni treningi vplivajo na vedenje otrok z ADHD [20, 26]. V raziskavi [26], kjer so preučevali učinek računalniškega kognitivnega treninga delovnega spomina pri otrocih z ADHD na disfunkcionalne vedenjske vzorce, povezane z motnjo, so ugotovili, da je trening pripomogel k pomembnemu zmanjšanju z ADHD povezanega disfunkcionalnega vedenja, kar so avtorji ocenjevali s pomočjo opazovanja odkrenljivosti od zastavljene naloge (usmerjanje pogleda stran od naloge) in opazovanjem igranja s predmeti, ki niso del naloge. Prav tako pa so se izboljšale sposobnosti na nalogah delovnega spomina. Vendar pa rezultati niso pokazali nobenih statistično pomembnih izboljšanj v ocenah vedenja s strani staršev udeležencev.

3 REZULTATI

V tabeli 1 so natančneje predstavljeni izsledki raziskav, ki preverjajo učinek računalniškega kognitivnega treninga na različne kognitivne sposobnosti otrok z ADHD.

Tabela 1: Učinek računalniškega kognitivnega treninga glede na vrsto trenirane naloge

Trening	Testirana področja	Napredek/učinek treninga
RKT (Cogmed)	DS, Pozornost, simptomi ADHD	Simptomi ADHD (ocena staršev)
RKT (Cogmed)	DS, akademski dosežki, pozornost, aktivnost, impulzivnost	DS
RKT DS	DS, kompleksno mišljenje (RPM), motorična aktivnost	DS, kompleksno mišljenje (RPM), motorična aktivnost
RKT DS (rač. igra)	Vizualno-prostorski KS in DS, motivacija	DS, motivacija
RKT pozornosti	Akademski uspešnost, vedenje	Sposobnost bralnega razumevanja in prepisovanja, simptomi ADHD (ocena staršev)
RKT pozornosti	ADHD simptomi	ADHD simptomi (ocena staršev)
Multimodalni RKT (več različnih kognitivnih funkcij)	Motorične sposobnosti, pozornost, prostorsko načrtovanje, DS,	načrtovanje

inhibicija odziva, vedenje

RKT = računalniški kognitivni trening; DS = delovni spomin; KS = kratkoročni spomin; RPM = Ravenove progresivne matrice

Večina raziskav, vključenih v pregled literature s področja računalniških kognitivnih treningov se osredotoča na treniranje delovnega spomina. Kljub temu, da smo v pregled literature zajeli raziskave, ki uporabljajo enak tip treninga, pa le-te preiskujejo različna možna področja, na katera trening potencialno vpliva in se pri njih kažejo različni izsledki. V splošnem, raziskave, ki smo jih vključili v pregled literature kažejo, da lahko računalniški kognitivni trening delovnega spomina (Cogmed) potencialno vpliva na zmanjšanje zaznanih simptomov ADHD, ocenjeni s strani staršev [3] in na delovni spomin [9]. Podoben napredek se kaže tudi na računalniških kognitivnih treningih delovnega spomina drugačnega tipa na delovni spomin (bližnji transfer), kompleksno mišljenje in zmanjša motorično aktivnost [10], ki se značilna za otroke z ADHD. Računalniški kognitivni trening delovnega spomina, ki je zasnovan kot računalniška igra pa ob napredku na področju delovnega spomina kaže tudi napredek na področju motivacije [19]. Rezultati študij, ki preverjajo učinek računalniškega kognitivnega treninga pozornosti [20, 21] pa v večji meri preverjajo učinek na zaznane simptome ADHD in potrjujejo predvsem učinek treninga na zaznavanje prisotnosti simptomov ADHD s strani staršev. Multimodalni trening, vključen v pregled literature med različnimi vidiki funkcioniranja otrok z ADHD prepoznavna napredek treninga le na področju prostorskega načrtovanja [2], kar kaže na to, da multimodalni trening ni vplival na izboljšanje več različnih kognitivnih funkcij v primerjavi s treningi, ki se osredotočajo le na eno trenirano področje.

4 ZAKLJUČEK

Raziskave na področju računalniških kognitivnih treningov za otroke z ADHD kažejo, da tovrstni treningi vplivajo na izboljšanje nekaterih kognitivnih sposobnosti, kot so sposobnost načrtovanja, delovnega spomina, kratkoročnega spomina, hkrati pa kažejo tudi pozitiven učinek na spretnosti, ki so vezane na akademske sposobnosti in vpliv na zmanjšanje pojavljanja simptomov, ki so vezani na ADHD.

Na podlagi predhodnih raziskav torej lahko do neke mere sklepamo o dejavnikih, ki vplivajo na uspešnost računalniških kognitivnih treningov pri otrocih z ADHD.

Glede na dosedanje raziskave ni povsem jasno, ali je najboljša strategija za treniranje kognitivnih sposobnosti prav multimodalni računalniški kognitivni trening. Nekateri avtorji [2] sicer predpostavljajo, da je sočasno treniranje več različnih izvršilnih sposobnostibolj učinkovito (še posebej za prenos učinkov na vsakdanje življenje) kot pa treniranje enega tipa izvršilne sposobnosti v posameznem treningu, saj tudi funkcioniranje v vsakdanjem življenju zahteva uporabo različnih izvršilnih sposobnosti hkrati. Vendar pa rezultati raziskave, ki preverja razliko med testiranjem enega in več izvršilnih sposobnosti [18] kažejo, da treniranje treh različnih izvršilnih sposobnosti znotraj enega treninga nima večjega učinka na

vsakodnevno funkcioniranje kot treniranje dveh različnih izvršilnih sposobnosti.

Pregled raziskav potrjuje, da med pomembne dejavnike za uspešnost računalniškega kognitivnega treninga spada tudi trajanje treninga, vendar pa raziskave kažejo, da dlje časa trajajoči treningi niso nujno uspešnejši od krajših treningov. Pozitiven učinek treninga se lahko pojavi že pri krajšem treningu, vendar pri tem pomembno vlogo igra motivacija posameznika za opravljanje treninga [19]. Računalniški kognitivni trening, ki vsebujejo komponente računalniške igre, naj bi vplivali na povečanje motivacije in s tem izboljšali možnost napredka pri otrocih z ADHD.

Pri oblikovanju in načrtovanju računalniškega kognitivnega treninga za otroke z ADHD je potrebno upoštevati heterogenost skupine otrok s tovrstno motnjo in različno izražene primanjkljaje na različnih področjih. Obstoječe študije namreč v večji meri ne prilagajajo intervencij obstoječim kognitivnim primanjkljajem udeležencev v raziskavi. Pristopi v prihodnje bi morali biti zasnovani na podlagi potreb posameznikovega kognitivnega profila [2], kar je tudi pomembna aplikacija pri načrtovanju tovrstnih intervencij v praksi.

Dosedanje študije računalniškega kognitivnega treninga za otroke z ADHD kažejo nekatere zelo obetavne rezultate in potrjujejo pomemben vpliv na izboljšanje nekaterih kognitivnih in vedenjskih značilnosti in primanjkljajev, ki so vezani na ADHD. Vendar pa so rezultati študij kljub temu precej nekonsistentni, zaradi česar je potrebnih več raziskav, preden bi lahko bil kognitivni trening uveljavljen kot eden izmed učinkovitih načinov odpravljanja oziroma zmanjševanja simptomov motnje pozornosti s hiperaktivnostjo.

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E-knjige in dijaki

E-books and students

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POVZETEK

Biblos je spletni portal za nakup in izposojanje knjig, v katerega so vključene slovenske splošne knjižnice in knjigarne. Ministrstva za vzgojo in izobraževanje je zagnalo pilotni projekt šolski Biblos ali ŠBiblos, ki od novembra 2022 osnovnim in srednjih šolam zagotavlja izposojanje elektronskih knjig. Projekt traja eno leto, glede nadaljevanja še ni zagotovil, se bo pa verjetno pri odločanju preverjalo odzive šol oziroma dijakov in statistiko izposoje. V prispevku bomo predstavili, kako smo na Gimnaziji Moste odzvali in pripravili na projekt, saj smo delovanje preizkusili z dijaki v razredu. Ministrstvo predlaga, da naj bi dijaki e-knjige prebrali preko pametnih telefonov, zato smo tudi testiranje izvedli na ta način. Pred tem je bilo potrebno urejanje podatkovne baze elektronskih naslovov, saj je ŠBiblos povezan s programsko opremo Cobiss, ki jo danes uporablja večina šolskih knjižnic. Projekt smo oglaševali preko plakatov in spletne strani. Uporabo smo spodbujali tudi pri profesorjih, predvsem pri slovenščini, saj so na platformi voljo nekatera domača branja in je to tudi glavna spodbuda za vzpostavitev dostopa šolam. V prispevku bomo predstavili nekatere ugotovitve in različna mnenja dijakov ter statistiko izposoje.

KLJUČNE BESEDE

Domača branja, e-knjige, knjižnično informacijska znanja, digitalno opismenjevanje.

ABSTRACT

Biblos is an online portal for buying and borrowing books, which includes Slovenian public libraries and bookstores. The Ministry of Education launched a pilot project, called ŠBiblos, which provides electronic books to primary and secondary schools from November 2022. The project lasts for one year, and there are no guarantees regarding its continuation, but it is likely that the responses of the schools or students and the borrowing statistics will be checked when making a decision. In this paper, we will present how we reacted and prepared for the project at Gimnazija Moste, as we tested the platform with students in the class. The Ministry suggests that students should read e-books via

smartphones, so we also conducted the testing in this way. Before that, it was necessary to edit the database of emails, as ŠBiblos is connected to the Cobiss software, which is used by most school libraries today. We advertised the project through posters and the website. We also encouraged the use with professors, especially in the case of Slovenian language classes, as some home readings are available on the platform and this is also the main incentive for establishing access to schools. In the article, we will present some findings and different opinions of the students, as well as the borrowing statistics.

KEYWORDS

E-books, home readings, ICT, library information skills, digital literacy.

1 UVOD

Doba digitalizacije je prinesla preobrazbo v načinu dostopa do informacij in njihove uporabe. Med mnogimi spremembami izstopa vzpon elektronskih knjig ali e-knjig, ki so prinesle revolucijo v svet književnosti. Kljub temu, da so e-knjige prisotne že kar nekaj časa, pa je njihov prihod v slovenskem prostoru zakasnen, saj na majhnem trgu ni bilo nekega večjega tržnega motiva [4]. Približno pred desetletjem so se slovenske založbe začele ukvarjati z idejo ponudbe e-knjig. Kasneje so se temu trendu pridružile seveda še splošne knjižnice, šolske knjižnice pa ne kaj dosti. Čas zaprtja šol in izvajanja pouka na daljavo v koronskem času, je bil dodatna spodbuda za vzpostavitev dostopa do e-knjig in v šolah predvsem dostop do domačih branj. V nadaljevanju bomo raziskali svet e-knjig in njihovo uporabo v šoli ter vpliv na mlade bralce.

2 E-KNJIGE

Obstaja več definicij e-knjige. Za namen prispevka se po pregledu različnih definicij naslanjam na Bibliotekarski terminološki slovar, ki pravi, da je elektronska knjiga monografska publikacija v elektronski obliki na elektronskem mediju, predvsem na optičnem disku, internetu, ki se jo lahko uporablja le s temu namenjeno posebno programsko opremo na osebem računalniku oz. prenosni napravi za listanje in branje [3].

Poenostavljeno lahko rečemo, da gre pri e-knjigi za vsebino, ki je bila izdana v elektronski obliki (in ne za napravo, ki je nosilec vsebine). Torej tiskane knjige naj se nebi razlikovale od e-knjig, samo medij prenosa je drugačen.

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2.1 Prednosti e-knjig

Z vidika uporabnika je gotovo poglavitna prednost e-knjig praktičnost in prenosljivost v primerjavi s klasičnimi tiskanimi knjigami, kar predvsem pride prav na potovanjih, ko smo omejeni s prtljago. Nakup e-knjig je enostaven, če le imamo nekaj tehničnega znanja, enako enostavno je omogočena tudi izposoja. Torej nas od branja loči le nekaj klikov in nam ni potrebno hoditi v knjigarno ali knjižnico, prav tako nam ni potrebno skrbeti glede zamudnine, saj se vračilo e-knjige zgodi avtomatsko [1].

E-knjige so predrugačile branje, še posebej med mladimi. Njihova digitalna narava se dobro ujema z generacijo, ki je navajena tehnologije, saj ponujajo udobje in prilagodljivost. Mladi bralci imajo s pomočjo e-knjig lahko celotno knjižnico kar v žepu, kar omogoča branje na poti brez težav. Poleg tega e-bralniki in aplikacije za branje omogočajo uporabnikom spreminjanje velikosti pisav, označevanje odlomkov ter takojšnje iskanje definicij, kar izboljšuje izkušnjo branja. V izobraževalne namene lahko e-knjige vključujejo animacije, videoposnetke in interaktivne kvize, ki poučevanje naredijo bolj privlačno in učinkovito [6].

Tudi dostopnost je s pomočjo e-knjig močno napredovala. Mladi bralci z okvaro vida ali učnimi težavami imajo na voljo prilagodljive oblike besedila in funkcijo branja besedila v govor. Poleg tega e-knjige rušijo geografske ovire in omogočajo mladim bralcem dostop do raznolikega nabora naslovov, ki morda niso bili na voljo v lokalnih knjigarnah. Rečeno velja pa predvsem za tujino, v Sloveniji je omejenost z jezikom slabost, je pa res, da ogromno Slovencev bere v angleščini.

Prav tako e-knjige delujejo brez papirja in so prijaznejše do e-okolja, če seveda predpostavljamo, da bralne naprave ob zaključeni življenjski dobi primerno zavržemo ali recikliramo. Način objave knjige brez tiskanja tudi omogoča nepoznamim avtorjem lažje in ugodnejše izdajanje del.

2.2 Slabosti e-knjig

Nemalo bralcev ima veliko raje tiskano knjigo, saj jim prinaša posebno izkušnjo že v vonjem, listanjem, morda izmenjavo ali obdarovanje s knjigo med prijatelji. Pojavljajo se tudi težave s piratstvom ter skrbi glede zbiranja osebnih podatkov in preferenc uporabnikov, ki jih morda beležijo aplikacije. Omenili smo že jezikovno omejitev, ki je v slovenskem prostoru slabost, saj je trg majhen in niso vse knjige dostopne v e-obliki. Mladi so izpostavljeni angleškim vsebinam in tako posegajo tudi po e-knjigah v angleščini.

Janežič [1] opozarja predvsem odvisnosti od naprav: mehanske poškodbe naprav ob trkih, baterija in pomnilnik, ki sta odvisna od zmogljivosti naprave, s tem pa je tudi povezan finančni vidik, saj si ne more vsak privoščiti najboljšega in najdražjega bralnika. Dodatna slabost na slovenskem trgu so dražje e-knjige, saj je trg manjši, dodatno pa je zakonodaja takšna, da je e-knjiga v Evropi višje obdavčena [5].

Sicer pa je tudi nekaj zdravstvenih pomislekov, saj danes večina mladih bere e-knjige preko telefonov, ki imajo LCD zaslone. Prav tako je branje na telefonu lahko odvrta pozornost, saj se pojavljajo obvestila, sporočila, e-pošta ipd. kar bralce ponese na druge aplikacije. V šolstvu si prav gotovo ne želimo, da bi mladi preživeli več časa pred telefoni.

3 PONUDNIKI E-KNJIG

3.1 Biblos

Najbolj znana ponudnika knjig v tujini sta seveda vodilna Amazon in Barnes&Noble. Poleg tega so na voljo tudi odprte strani kot Gutenberg project, Google Books, Open Library itd. V Sloveniji šele v zadnjih letih dohitevamo angleško govoreča področja pri ponudbi knjig. Sprva so se založbe tega lotile postopno, tako da e-knjige ponujajo neposredno prek svojih spletnih strani ali partnerjev, končno pa so z vzpostavitvijo največje spletne knjigarne Biblos prišle v sliko tudi knjižnice in naposled šolske knjižnice.

Biblos je prva slovenska eknjižnica in eknjigarna, ki ponuja e-knjige v formatu epub. Biblos je projekt študentske založbe Beletrina. Portal sodeluje s knjižnicami in knjigarnami, kar pomeni, da si lahko elektronske knjige kupimo in obdržimo ali izposodimo preko knjižnice kjer smo vpisani, in jih potem seveda tudi vrnemo oz. se vračilo izvede avtomatsko. E-knjige lahko odpiramo na računalnikih, bralnikih, tablicah ali pametnih telefonih. V nekaterih knjižnicah tudi ponujajo možnost izposoje bralnikov.

3.2 Pilotni projekt šolski Biblos

Ministrstva za vzgojo in izobraževanje je 1. 11. 2022 odprlo pilotni projekt ŠBILOS, ki osnovnim in srednjim šolam ter zavodom omogoča izposoje e-knjig. Izposoja poteka preko platforme sBiblos (<https://www.sbiblos.si/>), ki ga upravlja ponudnik Beletrina. Stroške izposoje krije nosilec projekta.

Platforma sBiblos je povezana s sistemom COBISS, ki ga upravlja zavod IZUM. Uporaba je tako omogočena tistim šolam, katerih šolske knjižnice so vključene v sistem COBISS in imajo v ta namen urejeno dokumentacijo. Nabor dostopnih e-knjig je bil izbran na javnem razpisu Ministrstva za vzgojo in izobraževanje Izgradnja zbirke e-knjige za domače branje za izposoje v šolskih knjižnicah. Nekatero knjige, ki se jih obravnava za domača branje še niso dostopna, ponavadi je v takšnih primerih vzrok neurejenost avtorskih pravic, namreč vsaka e-knjiga je posebej izdana v elektronski obliki, zato je potreben celoten uredniški postopek.

Ministrstvo je z okrožnico Pospesitev izposoje e-knjig za domače branje v šolskih knjižnicah knjižničarjem naložilo velik zalogaj dodatnega dela, ker pa smo po naravi knjižničarji radovedni in delovni, smo se v novem projektu hitro in dobro znašli. Ministrstvo predlaga, da se v projekt vključijo tudi profesorji slovenščine. Pri pouku slovenščine naj bi obravnavali vsaj eno domače branje v obliki e-knjige in s tem testirali uporabo ter ugotavljali dobre in slabe lastnosti e-knjig.

4 PRIPRAVA IN IZVEDBA PROJEKTA ŠBIBLOS

Na Gimnaziji Moste smo se na projekt odzvali proaktivno. Najprej sem se knjižničarka udeležila izobraževanja in se na delo z dijaki temeljito pripravila. Beletrina in IZUM sta pripravila izobraževanja na to tematiko. Pri razlagi so nam nudili podporo, odgovore na nemalo vprašanj, a sem kljub nisem počutila popolnoma gotovo kako bom zadevo izpeljala in razložila dijakom. Delo sem razdelila v naslednje faze.

4.1 Promocija projekta

Za spodbujanje ozaveščenosti o projektu in o dostopu smo uporabili več pristopov, med katerimi so bila obvestila in plakati, ki smo jih oblikovali sami. Informativne plakate smo obesili po šoli ter v prostorih šolske knjižnice, objavili na spletni strani šole, obveščali preko kanala eAsistent, Facebook in Instagram.

4.2 Testiranje

Seznanjanje z uporabo aplikacije je bilo nujno za pripravo na uro ali bolje rečeno delavnico, ki je potekalo skozi podrobno razlago in je omogočila dijakom praktično delo. Z namenom zagotoviti kakovostno izkušnjo in preveriti delovanje, smo izvedli testiranje z manjšo skupino dijakov v šolski knjižnici. Med testiranjem so dijaki preizkusili funkcionalnosti aplikacije in podali povratne informacije, ki so mi pomagale pri pripravi ure v razredu.

4.3 Urejanje podatkovne baze v Cobissu in zagotavljanje dostopa za dijake in zaposlene

Dostop do platforme je omogočen na dva načina. Prvi je preko Moje knjižnice. Uporabnik si nastavi geslo in uporabi enako geslo tudi za sBiblos. Pri tem mora šolski knjižničar v program Cobiss vnesti vse e-poštne naslove dijakov, da se lahko zgodi nastavitev gesla in povezava. Drugi način je bil zagotovljen s 1. 1. 2023 in sicer prijava preko AAI računa. Predvsem ta način se mi zdi zelo prijazen za uporabnika, saj dijaki že imajo AAI dostop za e-učilnice. Vendar pa se je pri tem na naši šoli pojavil problem. Namreč e-pošta in domena za dostop se razlikujeta. Konkretno to pomeni, da je naša domena »gmoste.si«, e-poštni naslovi, ki jih uporabljamo zaposleni in jih tudi dobijo dijaki, pa imajo v končnici domeno »gimoste.si«. Druga težava pa je tudi ta, da dijaki šolskih e-poštnih naslovov ne uporabljajo, temveč imajo svoje osebne. To smo ugotovili pri prvih neuspelih poskusih dostopa v testni fazi. Po komunikaciji s podporo na IZUM-u, smo ugotovili, da dokler se domene ne ponotijo ostanemo pri prvem načinu dostopa.

Dostop preko Moje knjižnice poteka tako, da si nastavimo svoje poljubno geslo. Do nastavitve gesla pridemo lahko preko klika na Moja knjižnica/Pozabljeno geslo (pri čemer mora biti e-naslov ki ga uporabimo enak vnesenemu e-naslovu v Cobissu). Pri vnašanju e-naslava v sistem Cobiss, sem ugotovila, da ob uvozu podatkov članov avtomatsko pošlje povezavo za nastavitev gesla. To je zelo dobro in smiselno, slaba stran tega pa je, da pošlje to le tistim, ki naslovov še niso imeli vnesenih. Dijakom, ki so imeli vnesene naslove že ob vpisu, pa tega ob ponovnem vnosu e-naslava ne pošilja avtomatsko, zato sem morala ročno »poklikati« ukaze za pošiljanje sporočila za nastavitev gesla. Ker poslana povezava velja le 24 ur, sem te naslove vnašala tik pred izvedbo ure, tako da so dijaki imeli zagotovljeno delujočo povezavo. Ko imamo urejene dostope do Moje knjižnice, lahko nadaljujemo s prijavo v sBiblos z enakim geslom, uporabniško ime pa je generirano iz združenega akronima šolske knjižnice in številke člana.

4.4 Delo z dijaki

Projekt smo vključili v ure pouka KIZ (knjižnično informacijsko znanje), torej v sklopu dejavnosti obveznih izbirnih vsebin. Dijakom smo obrazložili na kratko kaj je namen pilotnega projekta, ki ga je sprožilo ministrstvo. V razredu smo

predstavili platformo, po korakih uredili dostope Moje knjižnice in nato vpis v sBiblos. Dijaki so pri tem uporabljali telefone, saj je takšno uporabo predlagalo ministrstvo. Skupaj z dijaki smo pregledali ponudbo, preizkusili izposojno in se pogovorili o dobrih in slabih lastnostih e-knjig. Prav tako smo dijakom nudili individualno pomoči pri vzpostavitvi in uporabi storitve, če so le to potrebovali v razredu ali so zanj prosili v šolski knjižnici. Aktivnosti so bile izvedene za 2. in 3. letnike prejšnjega šolskega leta, v vsakem letniku imamo po pet oddelkov kar znaša po 150 dijakov v letniku. V jeseni pa načrtujemo še izvedbo za 2. in 1. letnikih novega šolskega leta.

To je glavna faza izvajanja projekta, saj med njo poteka neposredna komunikacija in knjižničar najlažje pridobi povratne informacije. Več o tem bomo opisali v naslednjem poglavju.

4.5 Težave pri delu in povratne informacije dijakov

Dijaki so podaljšali komentarje glede uporabe spletne platforme sBiblos med samim potekom pouka, ko smo zadevo preizkušali. Prva kritika se je nanašala na registracijo, ki jo je potrebno opraviti preko spletne strani, pred uporabo aplikacije za branje, saj niso našli možnost za registracijo neposredno preko aplikacije. Opozorili smo jih da to naredijo le enkrat in so potem ves čas prijavljeni v aplikacijo. Nekateri dijaki so imeli težave z delovanjem aplikacije na novejših telefonih, pri tem Biblos ponuja rešitev, vendar je potrebno aplikacijo naložiti preko druge povezave. Pri tem mora biti knjižničar oz. izvajalec pouka dobro podkovan, da zazna vse težave in ponudi nanje rešitve. Nekateri so se pritožili zaradi počasnega nalaganja in občasnega zmrzovanja aplikacije in so predlagali naj aplikacijo nadgradijo za boljšo izkušnjo uporabnika. Zelo dober je predlog nadgradnje, ki vključuje funkcijo pretvorbe besedil v zvok kar bi omogočilo poslušanje knjig z izbiro glasu in hitrosti branja.

Med komentarji so izpostavili tudi preference glede branja na papirju v primerjavi z branjem na zaslonih. Presenetljivo veliko število dijakov se je odzvalo, da so fizične knjige bolj prijetne za branje in omogočajo izklop od elektronskih naprav brez motečih dejavnikov. Morda je ta kritika povezana s tem, da so dijaki uporabljali telefon. Če bi imeli na voljo bralnike bi verjetno hitreje vzljubili e-knjige. V vsakem razredu smo preverili ali imajo doma na voljo bralnik prilagojen za branje e-knjig. V 2. letnikih so naznanili, da imajo doma bralnike štirje dijaki. V 3. letnikih pa je le ena dijakinja povedala, da imajo bralnik doma starši. Torej kot vidimo so bralniki še premalo razširjeni, da bi e-knjige v šolah dobile polni zagon.

Kljub nekaterim kritikam so se dijaki med pogovori odzvali tudi pozitivno. Povedali so, da je dobro imeti dostop do e-knjig, saj se včasih spomnejo na domača branja šele med vikendom, ko nimajo dostopa do knjižnice. Prav tako so nekateri izrazili pomen prilagajanja besedila (velikost in tip pisave) zaradi slabšega vida. Tisti dijaki, ki so aktivni bralci in že koristijo e-knjige pa so izpostavili prednosti branja e-knjig. Zlasti berejo knjige v angleščini, ki jih lahko dobijo brezplačno. Ob pregledu ponudbe so dijaki izrazili željo po večji izbiri knjig, zlasti tistih, ki jih potrebujejo za domače branje. Obrazložili smo jih, da se seznanji gradiv počasi večajo, vendar je postopek upočasnen zaradi urejanja avtorskih pravic, ki morajo biti ob e-izdaji ponovno pridobljene.

Težave s katerimi smo se srečevali pri izvajanju projekta so bile povezane s komunikacijo, saj na nekatera tehnična vprašanja

pri uporabi aplikacije nismo dobili jasnega odgovora s strani Izum-a ali Beletrine. Pri samem delu v razredu smo imeli zelo raznolike izkušnje. V nekaterih oddelkih je delo steklo tekoče, ponekod pa smo porabili ogromno časa za vzpostavljanje registracije, nalaganje aplikacije in reševanje težav z nekompatibilnimi telefoni.

4.6 Pregled izposoje

Dodajam še pregled izposoje e-knjig. Seznime izposoje pridobimo iz Cobissa, izpis z oznako E-STA-IO1 nam poda sliko o elektronskih virih. Tabela 1 in tabela 2 prikazujeta porast izposoje e-knjig, vendar je to verjetno posledica uporabe pri urah pouka KIZ, ki smo jih izvedli.

Tabela 1: pregled izposoje na dan 17. 4. 2023

ponudnik	vrsta licence	izposoje	naslovi
biblos	zakup izposoj za skupino knjižnic	27	19
	skupaj	27	19
skupaj	zakup izposoj za skupino knjižnic	27	19
	skupaj	27	19

Tabela 2: pregled izposoje na dan 19. 5. 2023

ponudnik	vrsta licence	izposoje	naslovi
biblos	zakup izposoj za skupino knjižnic	174	57
	skupaj	174	57
skupaj	zakup izposoj za skupino knjižnic	174	57
	skupaj	174	57

Podobno ugotavlja pri svojem delu z dijaki tudi knjižničarka na drugi šoli [2], kjer so prav tako izvajali pouk z uporabo aplikacije. Nadaljnje preverjanje izposoje, ki ga prikazuje tabela 3, prikazuje le eno izposojeno e-knjigo več. V vmesnem času so bile v večjem delu poletne počitnice, zato morda razlog v neizposoji, saj dijaki med počitnicami ne posegajo po domačih branjih.

Tabela 3: pregled izposoje na dan 10. 8. 2023

ponudnik	vrsta licence	izposoje	naslovi
biblos	zakup izposoj za skupino knjižnic	181	58
	skupaj	181	58
skupaj	zakup izposoj za skupino knjižnic	181	58
	skupaj	181	58

Iz tega lahko predpostavljamo tudi, da na sBiblosu morda še ni dovolj raznoliškega gradiva, ki bi dijake pritegnilo za branje v prostem času, saj tisti, ki berejo posegajo po angleški literaturi.

Ugotavljam, da bo v prihodnje potrebno več spodbude in sodelovanja z učitelji slovenščine.

4.7 Sodelovanje z učitelji slovenščine

Vključevanje učiteljev se je začelo z uvodno predstavitevjo pilotnega projekta profesorjem slovenščine. Sledilo je ureditev dostopa in tehnična pomoč pri registraciji ter prikazu nalaganja e-knjig na računalnik ali bralnik. En bralnik smo naročili prav za učitelje slovenščine. S tem smo zagotovili, da imajo na voljo vsa orodja s katerimi lahko preizkušajo uporabo e-knjig. Dodatno

smo tudi predstavili platformo ostalim zaposlenim na pedagoški konferenci, kar je okrepilo ozaveščenost o možnostih uporabe.

Učitelji slovenščine so zadevo preizkusili, vendar imajo nekateri pomisleke glede uporabe z dijaki, saj zagovarjajo dobrobiti branja fizičnih knjig. Zagovarjajo namreč stališče da ob branju na papirja tem možgani delujejo drugače kot pri branju z zaslonov. Kar zadeva delovanje možganov, so nekatere raziskave res nagnjene k temu, da bi lahko bilo branje na papirju bolj globoko in reflektivno, medtem ko bi lahko branje na zaslonih spodbudilo bolj površinsko branje in hitro skeniranje informacij. Vendar pa menimo, da je to odvisno predvsem od individualnih preferenc in navad bralca. Gotovo pa je precejšna razlika pri branju s telefonov ali z bralnikov, ki pa še niso dovolj razširjeni med dijaki.

Učitelje slovenščine bomo spodbujali naj dostop uporabijo vsaj za eno domače branje pri pouku in šele nato ugotavljajo učinkovitost branja z zaslonov. Vendar pa lahko učitelje razumemo, da se izogibajo navodilom ministrstva naj dijaki pri pouku uporabljajo telefone, saj najverjetneje veliko dijakov hitro preklopi pozornost na druge vsebine, ki jih imajo na telefonih.

5 ZAKLJUČEK

Gotovo je dobro in nujno, da se dijakom predstavi in ponudi sBiblos, saj moraj ovedeti da imajo na voljo e-domača branja, čeprav niso še vsa na voljo. Vendar pa dijaki zaenkrat vseeno raje posegajo po klasični knjigi v tiskani obliki, česar smo knjižničarji veseli, saj se s tem ohranja obiskovanje knjižnic in s tem spodbujanje branja ter izposoje. Statistika izposoje to trditev podpira. Seveda pa bomo na šoli spodbujali k izposoji e-knjig kadar bi bil tiskan izvod izposojen, dostopen pa v elektronski obliki. Prav tako menimo, da bi e-domača branja v izobraževanju lažje zaživele, če bi imeli dijaki na voljo zmogljive bralnike, ki bi jim omogočili prijetnejšo bralno izkušnjo. Dodaten dejavnik uporabe bo v prihodnje še dopolnitev aplikacije, kot so komentirali dijaki. Dobro je da smo se izvajanja projekta lotili spodbudno, saj smo s tem pridobili nove izkušnje in povratne informacije dijakov pri dejanski uporabi sBiblosa..

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Uporaba aplikacije Photomath pri matematiki

Using Photomath in Mathematics

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POVZETEK

Živimo v dobi digitalne tehnologije in tudi izobraževanju ni prizaneseno. Digitalna tehnologija je tukaj in z njo se moramo naučiti živeti. Naučiti se moramo uporabljati tehnologijo tako, da si jo podredimo, ne pa, da nas zasvoji. V prispevku želim prikazati uporabo aplikacije Photomath, in sicer kako učence naučiti uporabljati na videz matematično aplikacijo v različnih situacijah. Učence moramo navaditi, da si lahko samostojno preverjajo naloge in vadijo na različne načine, ki so jim blizu. Seveda ne smemo pozabiti tudi na preverjanje usvojenega znanja in diferenciacijo pouka v razredu. Čeprav je ime aplikacije popolnoma matematično, jo lahko uporabljamo tudi pri drugih predmetih, kjer prihaja do računanja matematičnih izrazov ali enačb.

Z uporabo aplikacije Photomath želim, da učenci vrednotijo podatke. Učence tudi usmerim v iskanje drugih aplikacij za reševanje prej omenjenih matematičnih problemov, s tem učenci brskajo po spletu in iščejo ustrezne primerne vire. V kolikor učenci delajo v paru, v osmem in devetem razredu, sodelujejo z uporabo digitalne tehnologije in raziskujejo rešitve različnih zastavljenih problemov.

Izkazalo se je, da so učenci bolje usvojili znanje kot v skupini, kjer so naloge reševali s pomočjo Photomath aplikacije. Učencem so bile ure bolj zanimive, sami pa so poskusili najti enačbo, ki je Photomath ne bi znal rešiti. Učenci so začeli sodelovati in si postavljati medsebojne izzive. Ure so za učence tako zelo pestre in veliko bolj privlačne.

KLJUČNE BESEDE

aplikacija, popestritev pouka, lajšanje računanja

ABSTRACT

We live in the age of digital technology and education is not spared either. Digital technology is here and we have to learn to live with it. We must learn to use technology in such a way that we subdue it without making us addicted. Digital technology should make our lives easier. In this paper, I want to demonstrate the use of the Photomath application, namely how to teach students to use a seemingly mathematical application in various situations. We have to get students used to being able to independently check assignments and practice in different ways that are close to them. Of course, we must not forget about the verification of acquired knowledge and the differentiation of lessons in the classroom. Although the name of the application is completely mathematical, it can also be used in other subjects where mathematical expressions or equations occur.

Using Photomath, I want students to evaluate data. In the introductory lessons, I and the students test whether we can completely trust the application. I also direct students to find other applications for solving the previously mentioned math problems. This allows students to browse the web for relevant, suitable resources. If students work in pairs, in the eighth and ninth grade, they collaborate using digital technology as well as they explore solutions to various problems. Thus, I divide the development of digital competences into smaller sections, where we get to know and develop each of them from the sixth to the ninth grade.

It turned out that the students acquired knowledge better than in the group where the tasks were solved with the help of the Photomath application. The students found the lessons more interesting, and they themselves tried to find an equation that Photomath could not solve. With the help of ICT, students began to collaborate and set mutual challenges. This makes the lessons very varied and much more attractive for the students.

KEYWORDS

application, diversifying learning, offloading computation

1 UVOD

Učenci neprestano uporabljajo telefone in različne aplikacije. Prej znajo uporabljati aplikacije kot pisati in brati. V šolstvu se moramo spremeniti in prilagoditi novim generacijam. Učenci se spreminjajo, v šole dobivamo učence, ki so veliko bolj večji uporabe tablic in telefonov, kot pa držanja barvic. Učenci nimajo številskih predstav in ne znajo brati in pisati, lažje jim gre tipkanje in tapkanje po različnih digitalnih napravah. A je to lahko zastrašujoče? Mogoče. Vendar na učiteljih je, da jih vpeljemo v svet tako pisanja in branja kot smiselne uporabe digitalne tehnologije.

Zaradi sprememb pri učencih moramo tudi učitelji narediti korak naprej in prilagoditi pouk novim generacijam [1]. Spreminja se svet, ne samo učenci, tukaj je digitalna tehnologija, ki se svetlobno hitro razvija, učenje in pouk pa ostajata enaka. Pa temu ni nujno potrebno, da je tako. Res je, da prilagoditve pouka ne smejo posegati in spreminjati učnega načrta [3], kar bi bilo nujno potrebno, ampak moramo v danih okvirjih najti nove poti, kako učence motivirati za delo in jih usmeriti na pravo pot. Ena od teh poti bo prikazana v nadaljevanju, kjer lahko digitalno tehnologijo izkoristimo tako, da si z njeno pomočjo olajšamo reševanje matematičnih problemov, z malo spretnosti, pa lahko prikazano prenesemo tudi na druga predmetna področja.

2 PREDSTAVITEV APLIKACIJE IN UPORABA PRI POUKU

2.1 Predstavitev aplikacije

Photomath je aplikacija, ki deluje tako na operacijskem sistemu Android kot tudi na iOS [4]. Deluje v različnih jezikih, žal v slovenščini še ni na voljo, vendar pa to na uporabo ne vpliva. Matematika je svetovni jezik, kjer poznavanje jezika za uporabo aplikacije ni nujno potrebno. Seveda je smiselno, če aplikacijo uporabljamo pri pouku, da učencem povemo, kaj pomeni katera nastavitvev. Med nastavitvami aplikacija omogoča različne zapise ulomkov, kakor tudi različne postopke množenja. Na mestu decimalne vejice lahko izbiramo med uporabo decimalne vejice ali decimalne pike. Pri ponavljajočem decimalnem zapisu lahko med nastavitvami nastavimo, kakšen zapis ponavljajočih števk želimo ali s črtico nad števki, kot se učimo v šoli, ali pikami. Aplikacija omogoča tudi različne zapise binomskega koeficienta. Vse opisane nastavitve omogoča brezplačna različica aplikacije, ki je dovolj obširna in primerna za uporabo v osnovni šoli, menim pa, da tudi višje.

V brezplačni različici obstajata dve možnosti uporabe aplikacije: ali uporabljamo aplikacijo kot kalkulator, ali pa slikamo matematični problem (enačbo, izraz,...). V obeh primerih nam aplikacija izračuna vrednost zapisanega. Zakaj je Photomath boljše uporabljati kot preprosto uporabiti le kalkulator? Odgovor je preprost. Ko za rešitev težave uporabimo Photomath, imamo le en klik do razlage postopka, kako pridemo do rešitve. Tako pri zapletenih izrazih ali enačbah učenec dobi povratno informacijo, kje je naredil napako pri reševanju naloge. Pri slikanju enačb in izrazov je pomembno tudi to, da je lahko izraz zapisan ročno in aplikacija prepozna zapis. Seveda je pomembno, da se potrudimo in čim lepše zapišemo izraz. Brezplačna verzija podpira tudi načrtovanje nekaterih grafov in iskanje rešitev s pomočjo narisane grafa, vendar pa v brezplačni različici ne moremo samo risati grafa.

V kolikor se odločimo za plačljivo verzijo aplikacije nam aplikacija omogoča različne dodatke, kot so: učitelji lahko ustvarjajo razrede in učencem dodelijo naloge, različni virtualni pripomočki (risanje grafov, grafični prikaz računanja z ulomki,...), reševanje besedilnih nalog (če so le te v jeziku, ki ga aplikacija podpira), različni nasveti in matematične definicije.

2.2 Uporaba aplikacije Photomath pri pouku

Aplikacijo Photomath lahko začnemo uporabljati že zelo zgodaj [2]. Kakor hitro se učenci srečajo z računskimi operacijami, jim lahko pokažemo, kako račun izračuna Photomath. Sama učim učence od šestega do devetega razreda, tako da se moji učenci, če ne prej, srečajo z aplikacijo v šestem razredu. Pri pouku uporabimo aplikacijo najprej za preprosto računanje, potem pa ugotavljamo, kako nam aplikacija še lahko pomaga pri reševanju matematičnih težav.

V šestem razredu začnemo z uporabo in spoznavanjem aplikacije Photomath. Aplikacijo začnemo spoznavati že na začetku šolskega leta pri računskih izrazih v naravnih številih [3]. Tukaj učenci uporabljajo tako kalkulator na aplikaciji kot tudi možnost slikanja izrazov. Enako naredimo pri enačbah [3]. Aplikacija prikaže tudi postopek reševanja, zato lahko zelo pripomore k učiteljevi razlagi. Aplikacija nam v začetku služi le

kot preverjanje postopkov računanja. Z uporabo aplikacije nadaljujemo pri računanju z decimalnimi števili, kjer pri raziskovanju poti do rešitve aplikacija natančno prikaže tako podpisovanje pri seštevanju in odštevanju kot tudi premik decimalne vejice pri deljenju in upoštevanje vejice pri množenju. V aplikaciji uporabljamo tudi možnost pretvarjanja decimalnih števil v ulomke in obratno.

Tako kot v šestem razredu uporabljamo Photomath tudi v sedmem razredu pri računanju z ulomki. Aplikacija omogoča lep pregled nad koraki računanja tako si učenci sami lahko preverjajo rešitve in korake računanja tako v šoli kot tudi doma.

V osmem razredu so učenci že večji uporabe aplikacije Photomath v večini jo imajo že naloženo na svojih napravah, tako uporaba šolskih naprav skoraj ni več potrebna. Veliko ur znova namenimo uporabi aplikacije same, kjer aplikacijo uporabljamo za reševanje enačb, računskih izrazov, razstavljanju in poenostavljanju zapisanih izrazov.

V devetem razredu je veliko časa namenjenega reševanju enačb, kjer učenci s pridom uporabljajo aplikacijo pri reševanju domačih nalog, pri preverjanju rezultatov in postopkov reševanja enačb. Photomath uporabljamo tudi pri linearni funkciji, saj lahko z aplikacijo izrisujemo različne grafe, hkrati pa vidimo tudi postopek risanja grafov.

Ker učence učimo uporabe aplikacije je smiselno, da to tudi preverjamo in ocenjujemo. To naredimo tako pri ustnem kot pisnem ocenjevanju znanja.

3 UGOTOVITVE

Izkazalo se je, da so učenci veliko bolj motivirani, če uporabljajo digitalno tehnologijo pri pouku in doma, kot pa samo svinčnik in papir. Pri urah matematike je veliko več učencev sodelovalo in delalo domače naloge, kot pa v skupini, kjer jim nismo predstavili aplikacije Photomath. Ko so učenci ugotovili, da lahko nalogo rešujejo s pomočjo aplikacije, so nalogo opravili prav vsi, v skupini, kjer so nalogo morali rešiti samostojno, pa se je izkazalo, da večina učencev naloge ni rešila. Hitro se je razvedelo, da si pri reševanju nalog lahko pomagajo z aplikacijo Photomath in je tudi skupina, kjer aplikacije niso imeli predstavljene, začeli uporabiti aplikacijo in rešili nalogo. Menim, da je bolje, če učenci nalogo rešijo s pomočjo, kot da je sploh ne rešijo. Aplikacija namreč vedno reši enačbe in izraze po enakem postopku, tako učenec utrjuje enak postopek znova in znova. Po večkratnih ponovitvah, si postopek tudi zapomni.

Seveda se je smiselno vprašati, kako preverjati znanje učenca. V ta namen pri pisnem preverjanju in ocenjevanju znanja imajo učenci nalogo, ki je samostojno ne morejo rešiti, saj presega njihov nivo znanja, lahko pa jo rešijo s pomočjo aplikacije. Zadnjih pet minut pri preizkusu znanja lahko učenci uporabijo aplikacijo. V kolikor imajo svoje naprave, uporabijo svojo napravo, če pa svojih naprav nimajo, jim v šoli zagotovimo šolske tablice. Učenec se lahko odloči ali reši nalogo in pokaže svoje znanje uporabe aplikacije ali pa si s pomočjo aplikacije pomaga pri drugih nalogah in se odpove točkam pri težji nalogi. Seveda je potem tudi ocena ustrezna, saj učenec ne prikaže celotnega znanja.

Drug način preverjanja in ocenjevanja usvojenega znanja pa je pri ustnem preverjanju in ocenjevanju, kjer ima učenec na izbiro ali nalogo reši samostojno ali s pomočjo aplikacije

Photomath, lahko pa je vprašanje zastavljeno tudi tako, da učenec mora uporabiti aplikacijo.

Ugotavljamo, da na ta način učence uvajamo v svet digitalizacije, kjer jim prikažemo smiselno uporabo aplikacij, ne samo za igro, ampak tudi kot pripomoček, ki te pripelje k hitrejši rešitvi.

Ob koncu šolskega leta vedno naredimo tudi anketo o delu med letom. V anketi so učenci zapisali, da so spoznali veliko novega pri matematiki, predvsem pa, kako digitalno tehnologijo uporabljati tako, da si olajšajo težave. V anketi sodelujejo vsi učenci šole in izkazalo se je, da jim je drugačen način dela ljubši in bližji. Učenci razumejo, da morajo znati marsikaj rešiti tudi samostojno brez uporabe digitalne tehnologije, z digitalno tehnologijo si lahko zastavljene probleme olajšajo.

4 ZAKLJUČEK

Menim, da je aplikacija zelo uporabna pri reševanju matematičnih problemov tako v osnovni šoli kot tudi kasneje. Učitelji moramo učence vpeljati v smiselno uporabo digitalne tehnologije in jim pomagati, da jo uporabljajo v svoj prid. Tukaj je tudi že umetna inteligenca, ki če jo želimo smiselno uporabljati, jo moramo poučevati in uporabljati že od osnovne šole naprej. V vseh učnih načrtih imamo zapisano, da moramo razvijati digitalne kompetence pri učenci, a le učitelji smo tisti, ki to res lahko osmislimo in učencem prikažemo digitalne kompetence, kot nekaj uporabnega.

V prispevku je prikazana uporaba aplikacije pri matematiki. Aplikacija Photomath je uporabna tudi pri drugih predmetih. Pri geografiji jo lahko uporabimo že v šestem razredu, saj računamo razdalje na zemljevidu in v naravi, pri fiziki imamo nič koliko enačb in nam lahko aplikacija pomaga najti pot do pravilne rešitve. Photomath lahko uporabljamo tudi pri kemiji, kjer računamo masni delež in rešujemo različne kemijske enačbe. Pravzaprav lahko Photomath uporabimo povsod, kjer potrebujemo kalkulator ali moramo poenostaviti ali izračunati dani izraz ali rešiti enačbo. Enačbe ne rabimo zapisovati v matematični jezik, saj aplikacija prepozna ročni zapis. Aplikacija omogoča reševanje in zapis takšen, kot ga potrebujemo.

Menim, da učencem damo veliko, a zavedati se moramo, da bomo morali na nivoju države nekaj spremeniti, da bomo otroke uvedli v nov svet poln ovir in preizkusov.

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(Za)Kaj je nova eTorba?

What and Why is new eTorba (eSchoolBag)?

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POVZETEK

Leta 2022 je Ministrstvo za šolstvo, znanost in šport s partnerjema Akademsko raziskovalno mrežo Slovenije (Arnesom) in Inštitutom informacijskih znanosti (IZUM-om) pristopilo k projektu »E-torba 2023: E-vsebine, e-storitve za podporo uvajanju novih pristopov v vzgoji in izobraževanju«. V okviru projekta nastaja nacionalna platforma za elektronske učne vire (platforma eTorba), poteka razvoj eUrejevalnika ter nadgradnja obstoječih elektronskih učbenikov in gradiv. Pri razvoju platforme in njenih orodij je potrebno upoštevati naj sodobnejše tehnične standarde in obenem sodobna spoznanja o naravi učenja z elektronskimi učnimi viri, vključno s teorijo kognitivne obremenitve in kognitivno teorijo multimedijskega učenja. Kakovostna elektronska učna gradiva in okolje za njihovo branje nudijo nove priložnosti in načine učenja, ki jih tiskana gradiva ne omogočajo, obenem pa so pomembni tudi z vidika dostopnosti za učence, ki imajo disleksijo, so slabovidni ali imajo težave z branjem. S premišljeno pripravljenimi trajnostnimi orodji in platformami lahko pripravimo in ponudimo kakovostne elektronske učne vire ter tako dvignemo kakovost pouka v Sloveniji.

KLJUČNE BESEDE

Elektronski učni vir, e-učbenik, i-učbenik, eTorba, eUrejevalnik, eBralnik, kognitivna teorija multimedijskega učenja

ABSTRACT

In 2022, the Ministry of Education, Science and Sport, together with its partners Arnes and IZUM, started the project »E-torba 2023: e-content, e-services to support the introduction of new approaches in education and training«. The project includes the creation of a national platform for electronic learning resources (eTorba platform), the development of an eEditor and the upgrading of existing electronic textbooks and materials. The development of the platform and its tools should take into account the state-of-the-art technical standards and at the same time the current knowledge on the nature of learning with electronic learning resources, including the cognitive load theory and the cognitive theory of multimedia learning. High-quality electronic learning resources and their reading environment offer new opportunities and ways of learning that printed textbooks do

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not, and are also important for the accessibility for learners who are dyslexic, visually impaired or have reading difficulties. With sustainable tools and platforms that are well thought out, we can develop and deliver quality electronic learning resources to raise the quality of teaching in Slovenia.

KEYWORDS

Electronic learning resource, e-textbook, interactive textbook, eTorba, eUrejevalnik (eEditor), eBralnik (eReader), cognitive theory of multimedia learning

1. UVOD

Dvajseta leta 20. stoletja. Thomas Alva Edison, eden največjih izumiteljev vseh časov, izrazi prepričanje, da prihaja revolucija v izobraževanju: učbenike, ki kraljujejo v šolskih klopeh, bodo nadomestile učinkovitejša gibliva slika.

Natanko sto let pozneje, v dvajsetih letih 21. stoletja, so v šolskih torbah in na klopeh učbeniki še vedno zelo domači. Pa je vendarle kaj drugače? Je. Tiskane učbenike danes dopolnjujejo elektronski učni viri, v njih pa so svoje mesto našle in obdržale tudi gibljive slike.

Zakaj učbeniki ostajajo glavno učno sredstvo digitalni revoluciji navkljub? In kakšno je stanje na področju elektronskih učnih virov v Sloveniji? Kakšne doprinose lahko pričakujemo v slovenskem šolstvu z novo eTorbo? Na ta vprašanja odgovarja pričujoči prispevek.

2. ZAKAJ VLAGATI V RAZVOJ ELEKTRONSKIH UČNIH GRADIV?

V zadnjih sto letih se je izobraževalna tehnologija razvijala hitreje kot kdaj koli. Če so jo, tudi Edison, sprva razumeli predvsem v smislu medija, jo danes Association for Educational Communications & Technology (AECT) definira kot »študij in etičn[o] uporab[o] teorije, raziskav in najboljših praks za napredovanje znanja ter posredovanje in izboljšanje učenja in uspešnosti s strateškim načrtovanjem, upravljanjem in izvajanjem učnih in izobraževalnih procesov in virov.«[1], [2] Izobraževalna tehnologija ni le medij, ampak opravlja tri vloge: vlogo vira, vlogo upravljanja in organiziranja ter vlogo sredstva za učenje.[3] Kadar uporabljamo tehnologijo s ciljem spodbujanja učenja, govorimo o učenju s tehnologijo.[4, str. 164]

Tako kot se tehnologija stalno spreminja, se spreminja tudi učenje s tehnologijo. Od prvih začetkov, ko so v pouk vključevali radio in televizijo, se je ob prihodu računalnikov razširil s

priložnostmi za obdelovanje besedila, programiranjem in nato tudi računalniškimi simulacijami. Dostop do svetovnega spleta je povečal dostop do virov in novih načinov komunikacije. Danes zmožnosti umetne inteligence, vstopanje v virtualno in navidezno resničnost, 3D-tisk ter drugi viri in orodja omogočajo načine učenja, kakršnih v zgodovini še ni bilo.

Ko uvajamo tehnologijo v izobraževanje, se ne osredotočamo nanjo, ampak na gradnjo kakovostnih učnih okolij. V ospredju je učinkovito učenje, torej takšno, ki »ustvari pri učencih zavzetost za učenje in [...] je dobro uravnavano.«[5, str. 139] Pri tem se zavedamo, da raziskave težko pokažejo očiten učinek na rezultate učenja zaradi svoje kompleksnosti in ker pripomore k obvladovanju kompleksnih kognitivnih zmožnosti, ki jih standardizirani testi ne morejo določiti.[6], [7], [8, str. 77] Poleg tega je učenje bolj kot od učnih pripomočkov in učil odvisno od metod poučevanja. Metode so namreč tiste, ki sprožajo učenje, in enake metode poučevanja so lahko učinkovite z uporabo različnih učnih pripomočkov in učil. Uporaba sodobne tehnologije tako postane pomembna takrat, ko omogoča metode, ki sicer ne bi bile izvedljive.[4, str. 172], [9, str. vii] Tudi Neil Selwyn poudarja, da mora biti eno glavnih vprašanj, ki si jih zastavljamo: *Kaj tehnologija omogoča, kar ni bilo mogoče prej?*. [10, str. 174]

Pri načrtovanju in izvajanju pouka učitelju in pri samostojnem učenju učencu pomagajo učbeniki. Kakovosten učbenik omogoča vpogled v temeljno znanje predmetnega področja (predstavlja legitimno obliko znanja [11, str. 685]), hkrati pa spodbuja raziskovalne aktivnosti, zastavlja probleme in napeljuje k uporabi drugih informacijskih virov. [12, str. 177 in 182]

Pravilnik o potrjevanju učbenikov določa, da je učbenik lahko v tiskani obliki, v elektronski obliki ali tiskani in elektronski obliki, pri čemer učbenike v elektronski obliki razvršča v dve ravni:

- v prvi ravni so digitalizirani učbeniki (d-učbeniki), »ki so elektronske izdaje tiskanih učbenikov in vsebujejo samo besedilo in slike«, [13] takšen učbenik tudi ne zahteva neposrednega vpisovanja in podajanja rešitev ter odgovorov na vprašanja;
- v drugi ravni pa so interaktivni učbeniki (i-učbeniki), »ki vključujejo interaktivne elemente, konstrukcije in interaktivne naloge z večkratno povratno informacijo v besedilo. I-učbenik lahko omogoča shranjevanje odgovorov in spremljavo uporabnika.« [13]

Osnovna načela učbenika v elektronski obliki po Zmazek idr. so, da pokriva vsebino učnega načrta, je interaktiven, vključuje multimedijo, prinaša induktivni pristop, z rdečo nitjo drži učenčevo pozornost in motivacijo od začetka do konca, je unikaten in upošteva vse didaktične principe, ki veljajo tudi za tiskana gradiva.[14, str. 129–130] Takšen učbenik od učenca pričakuje, da svojo pozornost razporedi med različne vrste podatkov, in če ti niso ustrezno razporejeni, je lahko učenje manj učinkovito, kot bi bilo s tiskanim gradivom. Zato strokovnjaki poudarjajo pomen razporeditve in zaporedja elementov učbenika

(slik, besedila), njihovo medsebojno usklajevanje in integriranje – med drugimi načela za zmanjšanje nepotrebne procesiranja med učenjem z multimedijo predstavljajo raziskave Richarda Mayerja.[4, str. 170] [15]

Kaj torej elektronski učni viri omogočajo, kar ni bilo mogoče že prej? Navajamo nekaj priložnosti:

1. **Uporabo multimedije.** Mayerjeva kognitivna teorija multimedijskega učenja temelji na hipotezi, da imamo ljudje ločena kanala za obdelovanje verbalnih in vizualnih podob/informacij, in opažanjih, da imamo omejeno kapaciteto za količino informacij, ki jo lahko posamezen kanal sprejme naenkrat. Z multimedijo učenec sprejema tako vizualne kot besedilne (verbalne) informacije. Le-te v delovnem spominu organizira in poveže, kar vodi v boljše učenje. Multimedijsko načelo pravi, da »se ljudje učijo globlje, kadar jih spodbujamo k povezovanju slik in besed.«[4, str. 177] kar je značilno npr. za animacijo.
2. **Povratne informacije** imajo enega najpomembnejših učinkov na učne dosežke.[5, str. 124], [16, str. 182], [17], [18, str. 85] Učencu in učitelju pomagajo razumeti, kje na poti doseganja učnega cilja se učenec nahaja, kakšen je njegov napredek, določiti primanjkljaje v znanju, nerazumevanje, s tem pa tudi odziv, ki izboljša učenje. Da lahko to dosežemo, mora biti povratna informacija čim prejšnja (ampak ne vedno: raziskave kažejo, da so takojšnje povratne informacije najkoristnejše za proceduralno znanje ali ko je naloga precej nad učenčevimi zmožnostmi, v drugih primerih pa se kot učinkovitejša kaže povratna informacija z zamikom [5, str. 129]), konstruktivna, specifična in povezana z učnim ciljem. [19], [20] Tehnologija pomaga učitelju pri podajanju povratne informacije s samodejnimi odzivi o pravilnosti odgovora in namigi, povratnimi informacijami o stanju, o tem, kje učenec potrebuje podporo idr. Umetna inteligenca danes te možnosti še razširja in lahko učenca med učenjem z elektronskimi učnimi viri spremlja in podpira (npr. Khanmigo na Khan Academy [21]). Še posebej se kot pomembne kažejo povratne informacije in namigi pri vodenem odkrivanju med in po reševanju problema.[20] Elektronski učni viri omogočajo spremljanje napredka učenca ter takojšnji odziv v primeru napačnega razumevanja in težav.
3. **Interaktivnost.** Učbenik se odziva na učenčeva dejanja in prinaša interaktivne zglede, primere, prikaze, konstrukcije in že omenjene interaktivne naloge s samodejno povratno informacijo o uspehu pri reševanju.
4. **Poudarjanje bistvenega (označevanje)** je eno od načel, ki po Mayerju zmanjša nepotrebno procesiranje in s tem izboljša učinkovitost učenja.[4, str. 175], [15] V Sloveniji si namreč učenci učbenike izposojajo v učbeniških skladih, zato po njih ne smejo pisati, učbeniki v elektronski obliki pa te ovire nimajo.

5. **Načelo samorazlage.** Ena od tehnik učinkovitega učenja je, da učenec razlaga vsebino samemu sebi, s svojimi besedami.[15], [18] V učbeniku, ki je v elektronski obliki, si lahko takšno razlago učenci zabeležijo ali jo celo posnamejo.
6. **Načelo individualizacije.** Pomembna je možnost prilagajanja učnega procesa posamezniku,[17], [22] kar se še posebej nujno kaže pri prilagajanju učencem s posebnimi potrebami.
7. **Lastna hitrost učenja.** Na učenje pozitivno vpliva učenčev nadzor nad potekom multimedijske predstavitve.[22]

3. KAKŠEN JE RAZVOJ ELEKTRONSKIH UČNIH VIROV V SLOVENIJI?

Prva elektronska učna gradiva so v Sloveniji nastala že v devetdesetih letih, zagon pa so dobila po letu 2006 (obsežnejša e-gradiva) in 2011 (interaktivni učbeniki). Ministrstvo, odgovorno za šolstvo, je vanje investiralo z namenom, da širijo nove načine poučevanja in učenja ter tako prispevajo k razvoju izobraževalnega sistema.[23] Potrjevanje učbenikov v elektronski obliki je bilo uvedeno leta 2010, pri čemer pa je lahko kot elektronski učbenik potrjen že samo digitalizirani tiskani učbenik. Danes se takšna rešitev kaže kot manj primerna, saj številne raziskave kažejo, da branje na elektronskem mediju poteka drugače kot na papirju. To pomeni, da bi morali biti učbeniki v elektronski obliki ustvarjeni z mislijo na to, kako se učimo s tehnologijo in kako izkoristiti prednosti, ki jih ponuja za še učinkovitejše učenje.

Leta 2011 je bila izdana publikacija *Izhodišča za izdelavo e-učbenikov*,[24] na podlagi izhodišč so bili izdelani tudi e-učbeniki v nadaljnjih projektih ministrstva.[25] Tehnična izhodišča za pripravo interaktivnih učbenikov so bila pripravljena leta 2011 v okviru projekta E-učbeniki za naravoslovne predmete. Med drugim so določala, da se bodo interaktivni učbeniki uporabljali na različnih napravah in da učne enote sestavljajo osnovni gradniki.[26, str. 56] Vsa gradiva so bila dana v uporabo pod licenco Creative Commons.

Izdelani elektronski učni viri se po letu 2015 niso več nadgrajevali, primanjkljaj pa se je še povečal v času epidemije covid-19 in zaradi novih tehničnih standardov za uporabo in prikazovanje (ukinitev Flasha in uveljavitev HTML5).[27]

Leta 2019 je Programski svet za digitalno izobraževanje dobil nalogo priprave novega *Akcijskega načrta digitalnega izobraževanja* (ANDI). V njem je predstavljena vizija digitalnega izobraževanja v Sloveniji, in sicer »vzpostavljeno izobraževanje in usposabljanje, ki posameznike pripravlja na kakovostno življenje in delovanje v digitalni in zeleni družbi, primerljivo z najuspešnejšimi državami.«[28] Tako ANDI naslavlja šest področij. Namen področja *Ekosistem digitalnega izobraževanja* je »zagotoviti celovit, zmogljiv, delujoč, varen in motivacijski podporni ekosistem za vsakega deležnika v

izobraževanju.«[28] V njegovem okviru so z vidika elektronskih učnih virov pomembni sledeči cilji:

- »poenotenje in povezovanje vsebin, katalogov in orodij, e-storitev v celovito okolje (Slovensko izobraževalno omrežje) z vidika izobraževalca in učečega se na vseh področjih izobraževanja in usposabljanja;
- virtualno okolje posameznika za personalizirano in sodelovalno učenje in poučevanje; [...]
- nadgradnja obstoječih in izdelava novih e-vsebin na vseh področjih izobraževanja ter njihovo redno vzdrževanje;
- zagotoviti e-vsebine za podporo izobraževanju in nadaljnem usposabljanju strokovnih delavcev v izobraževanju;
- vzpodbujati izdelavo in uporabo prosto dostopnih učnih virov (OER) ter razvijati učinkovite poslovne modele za zagotavljanje OER in licenčnih e-gradiv.«[28]

Leta 2022 je ministrstvo skupaj s partnerjema Akademsko raziskovalno mrežo Slovenije (Arnesom) in Inštitutom informacijskih znanosti (IZUM-om) pristopilo k projektu »E-torba 2023: E-vsebine, e-storitve za podporo uvajanju novih pristopov v vzgoji in izobraževanju« (v nadaljevanju: E-torba 2023), katerega namen je »izboljšanje učnega procesa, ki bo temeljil na uporabi inovativnih pristopov in večji uporabi možnosti, ki jih omogoča sodobna IKT pri procesih izobraževanja.«[27, str. 7] cilj pa »izboljšanje kompetenc in dosežkov mladih ter večja usposobljenost izobraževalcev preko večje uporabe sodobne IKT pri poučevanju in učenju, in sicer na področju izobraževalnih e-storitev in e-vsebin.«[27, str. 7] Tako se v okviru projekta nadgrajujejo obstoječi interaktivni učbeniki in nekatera elektronska gradiva, poleg tega pa pripravlja pet novih elektronskih gradiv za nove pedagoške modele. Za nadgradnjo in pripravo elektronskih učnih virov se razvija eUrejevalnik, za njihovo objavo in uporabo pa portal eTorba, v okviru katere deluje eBralnik elektronskih učnih virov.

4. KAJ OMOGOČA eUREJEVALNIK?

Kot smo ugotovili, za kakovosten učbenik v elektronski obliki ni dovolj, da tiskano gradivo prenesemo v digitalno obliko, ampak mora upoštevati naravo učenja z elektronskimi gradivi. To se je upoštevalo tudi pri razvoju novega eUrejevalnika, ki ga razvija IZUM.

V eUrejevalniku gradivo nastaja skladno s sodobnimi tehnološkimi standardi v HTML-obliki. Zaradi časovnih omejitev projekta smo se pri določitvi specifikacij eUrejevalnika osredotočili predvsem na elemente in gradnike, ki so jih vsebovala obstoječa e-gradiva, in jih mestoma dopolnili – npr. ob kolažu slik smo ponudili možnost galerije slik, saj te s prikazom enega slikovnega elementa naenkrat zmanjšajo kognitivno obremenitev učenca. eUrejevalnik omogoča tudi vstavljanje interaktivnih in multimedijskih elementov, pri čemer interaktivne naloge nudijo ne le povratno informacije o pravilnosti rešitve, ampak tudi pojasnila in namige (nabor gradnikov je razviden na Sliki 1). Zaradi potreb slabovidnih učencev je zahtevan vnos opisa slike (atribut alt).



Slika 1: Gradniki v eUrejevalniku

Bistveni element vsakega učbenika sta njegova vizualna podoba in struktura. Učenec mora takoj videti in razumeti, kako so informacije organizirane in kakšna bo njegova navigacija po gradivu. Enotna oblikovna in uporabniška podoba je pri elektronskih učnih virih še pomembnejša kot pri tiskanih. [29, str. 33–34] Zato so pripravljene grafičnooblikovne predloge, in sicer za drugo vzgojno-izobraževalno obdobje, za tretje vzgojno-izobraževalno obdobje ter za srednješolsko in višješolsko izobraževanje, vsaka v svetli in temni izvedbi. Privzeta grafična vrednost gradnika je razlagalno besedilo, avtor pa lahko izbira tudi med drugimi možnostmi:

- definicija (za definicije in pomembne poudarke),
- razlaga besede (npr. pojma, tujke, neznane besede, prevod besede v učbenikih tujih jezikov),
- vir (npr. besedilo, zgodovinski vir ali drugo ponazorilo, na katerega se navezujejo naloge),
- dodatno (npr. zanimivost, dodatna informacija, namig, povzetek, spodbuda),
- dejavnost (naloge),
- odlomek (npr. iz časopisov, citat) in
- skrita vsebina.

V tako oblikovanem elektronskem učnem viru učenec takoj vidi, »kaj mora znati«, metapodatki pa bodo koristni tudi pri nadaljnjem razvoju eBralnika (lahko bo na primer omogočil, da bi se učencu na njegov ukaz prikazale samo vse definicije ali vse razlage besed oziroma pojmov).

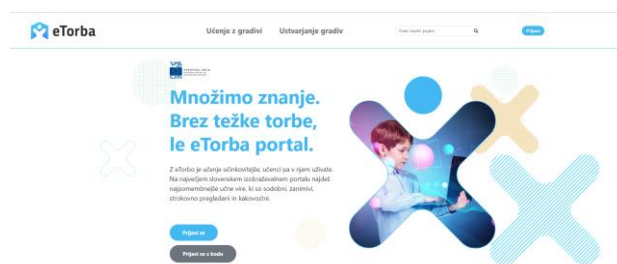
Vsak gradnik ima svojo identiteto (identifikacijsko številko, npr. #m254818, #m254821). Avtor jih lahko oblikovno ali vsebinsko povezuje med seboj, identifikacijska številka pa omogoča tudi, da lahko učitelj učenca usmeri neposredno na izbrani gradnik elektronskega učnega vira. Gradniku je mogoče tudi dodajanje ključnih besed, ki ga dodatno vsebinsko opisujejo in omogočajo kasnejšo lažjo orientacijo in učinkovitejše učenje (npr. z uporabo iskalnika v eBralniku).

Izdelan elektronski učni vir je mogoče izvoziti na portal eTorba ali na lokalni server avtorja gradiva (izvoz HTML5). Predvideno je branje na portalu eTorba s pomočjo posebej razvitega eBralnika, ki omogoča tudi uporabo naprednejših funkcij za prikaz in shranjevanje vsebine.

5. KAKO eBRALNIK SPODBUJA UČENJE?

Do elektronskih vsebin bodo učenci torej dostopali na portalu eTorba, nacionalnem portalu za e-vsebine. Vizija ministrstva je, da bi učenci na njem dostopali do vseh zanje relevantnih elektronskih učnih virov. Prijava za uporabo portala ni potrebna, je pa priporočena, saj omogoča uporabo naprednih funkcij eBralnika (označevanje, shranjevanje nalog). Učenci se prijavijo z AAI-računom.

Svojo eTorbo si lahko prijavljeni učenci personalizirajo: zaenkrat lahko shranijo (kasneje pa tudi arhivirajo) najljubša gradiva in spremenijo svojo uporabniško sliko ter dostopajo do svojih zaznamkov.



Slika 2: Zajem zaslona v testni različici portala eTorba

Tako kot pri razvoju eUrejevalnika smo tudi pri razvoju eBralnika upoštevali naravo učenja z elektronskimi viri. Med drugim upoštevali tudi kazalnike (sicer narejene za tiskane učbenike), ki so bili oblikovani v okviru projekta Za kakovost slovenskih učbenikov, [30] še posebej za prilagoditev otrokom z disleksijo.

Če pri interaktivnih učbenikih iz prejšnjih projektov poznamo fiksno, na tiskani učbenik spominjajočo se postavitev (prednost le-te je, da lahko natančno določimo postavitev strani), smo se v eBralniku odločili za drugačen pristop. Postavitev sledi principom odzivnega oblikovanja, kar pomeni, da se stran prilagodi velikosti in ločljivosti zaslona. [30] S tem omogoča uporabo na različnih zaslonih (npr. računalniški zaslon, telefon, tablica ...), nastavljanje pogleda in vključevanje različnih filtrov, npr. glede na standarde znanja (temeljna raven, minimalna raven, zahtevnejša raven) ali na izbirnost vsebine (splošna znanja, posebna znanja, izbirne vsebine). Z nastavitvami pogleda se stran prilagodi glede na izbran tip pisave (npr. Arial, Dyslexic), razmik med vrsticami, velikost pisave, višino vrstice, razmik med znaki, širino stranskih robov vsebine in skrite vsebine (npr. če učenec označi, da se mu prikazujejo samo splošna znanja, se mu izbirna in posebna ne bodo prikazala) in drugim nastavitvam. Te prilagoditve in način postavitve vplivajo na boljšo berljivost besedila, še posebej pa pomagajo otrokom z disleksijo [31] in slabovidnim otrokom. Funkciji izboljšanja berljivosti sledi tudi možnost izbire temnega ali svetlega pogleda.

Prilagodljiv način zaslona je pomemben tudi zaradi kognitivne obremenitve, saj je navigacija po strani lažja – vsebina je praviloma postavljena v enem stolpcu, zaradi česar je pozornost bolj osredinjena, pot branja bolj predvidljiva, naenkrat je tudi prikazana manjša količina podatkov. Ima pa takšna postavitev

lahko, v primeru, da avtorji ne upoštevajo narave učenja z elektronskimi učnimi viri, tudi slabost. Ljudje si namreč, ko beremo, ustvarjamo nekakšne kognitivne zemljevide – umeščamo podatke na stran.[32] Pri prilagodljivem načinu zaslonu, kjer ni vsa vsebina prikazana naenkrat, ampak se spreminja s tem, ko drsimo navzdol, si takšne mentalne slike težje ustvarjamo. Rešitev, ki jo zato morajo upoštevati avtorji, je, da pripravljajo več krajših učnih enot – vsebin, ki so prikazane na eni stani.

eBralnik omogoča večjo individualizacijo in aktivnosti pri učenju kot tiskani učbeniki iz šolskih skladov, saj učenca spodbuja k podčrtovanju in dodajanju zaznamkov. Prav tako pa si lahko pomaga tudi z razlago besede v Slovarju slovenskega knjižnega jezika Fran[33] oziroma Franček,[34] kar je še posebej dobrodošlo za učence, ki jim slovenščina ni prvi jezik. S tem tudi učence navaja in spodbuja k rabi *Slovarja slovenskega knjižnega jezika* in drugih jezikovnih priročnikov ter krepi njihov besedni zaklad in jezikovno zmožnost.

6. ZAKLJUČEK

Premišljena raba tehnologije spreminja učno okolje in učno izkušnjo. Če razmišljamo, da se bodo učenci s tehnologijo naučili več podatkov kot brez nje, smo se poučevanja lotili na napačen način, pravi Daniel Light. Na primer: urejanje besedil v programih ne pomeni nujno boljše slovnice, ampak odmika učence od tradicionalnih slovničnih vaj, spodbuja proces pisanja, ustvarja več priložnosti za pisanje, pregledovanje in deljenje svojega dela, posledično se izboljšajo komunikacijske sposobnosti učencev in spretnost v pisanem jeziku, lahko je tudi več priložnosti in motivacije za učenje in vajo pravilne slovnice, s pisanjem dolgih esejskih sestavkov pa razvijajo kritično mišljenje.[35, str. 11]

Tako učno okolje in učno izkušnjo spreminjajo tudi kakovostni elektronski učni viri. Pokazali smo na nekaj vidikov, ki jih je potrebno upoštevati pri pripravi takšnih virov, in na možnosti, ki jih za to prinašata nova eUrejevalnik in eBralnik. Projekt E-torba 2023 se novembra 2023 zaključuje, portal pa bo zaživel v rokah učencev in učiteljev. Hkrati pa se bo razvijal še naprej – ne le z novimi gradivi, ampak tudi s funkcionalnostmi, ki bodo še dodatno izboljšale poučevanje in učenje z elektronskimi učnimi viri z vidika načrtovanja učnih ciljev in spremljanja učencev, podpore tudi z vidika umetne inteligence, dodatnih vrst gradnikov, sodelovalnega učenja – če naštejemo le nekatere. S tem se razvoj elektronskih učnih virov v Sloveniji postavlja ob bok najrazvitejšim državam in hkrati omogoča doseganje cilja izobraževanje: spodbujati optimalni razvoj vsakega posameznika in ga opolnomočiti za življenje ter vseživljenjsko učenje v digitalni, informacijski družbi, družbi znanja.

ZAHVALA

Projekt E-torba 2023 se sofinancira iz Evropskega sklada za regionalni razvoj. Operacija se izvaja v okviru Operativnega programa 2014–2020, prednostna os 10: Znanje, spretnosti in vseživljenjsko učenje za boljšo zaposljivost; prednostna naložba 10.3: Vlaganje v izobraževanje, usposabljanje in poklicno

usposabljanje za spretnosti in vseživljenjsko učenje z razvojem infrastrukture za izobraževanje in usposabljanje; specifični cilj 10.3.1: izboljšanje kompetenc in dosežkov mladih ter večja usposobljenost izobraževalcev preko večje uporabe sodobne IKT pri poučevanju in učenju.



Zahvaljujemo se sodelavcem na IZUMU, ki razvijajo platformo eTorba, eUrejevalnik in eBralnik, ter sodelavcem na Arnesu, ki nam nudijo potrebno podporo. Za oblikovno podobo projekta je poskrbel Unibrand d.o.o., za oblikovne predloge e-učbenikov pa Barbara Jenko.

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Nove poti pridobivanja veščin in delovnih izkušenj v mednarodnem sodelovanju z industrijo pri študentih

New Forms of Upskilling in International Cooperation between Students and Industry

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POVZETEK

Na Institutu "Jožef Stefan" večina trenutnih praks prenosa znanja med študenti in industrijo vključuje posredno udeležbo študentov v sodelovanje med industrijo in raziskovalci. Podjetniške izkušnje pri študentih, ki so povečini vezane na izobraževalne delavnice, običajno ne upoštevajo geografskega ravnovesja ali enakosti med spoloma in redko vključujejo pridobitev veščin skozi konkretno sodelovanje z industrijo. V projektu Horizon Europe INDUSAC je glavni cilj razviti in potrditi preprost in uporabnik prijazen mehanizem sodelovanja med industrijo in študenti v kratkoročnih, 4–8 tednov trajajočih soustvarjalskih projektih, ki temeljijo na industrijskih izzivih. Prenos znanja iz industrije je tako razširjen z raziskovalcev tudi na študente, ki so dodatno motivirani tudi s finančno podporo. Uravnotežena zastopnost spolov in mednarodni značaj sta zagotovljena s pogoji, določenimi v razpisu za študente in raziskovalce. Poudarek je na pridobivanju novih veščin, ki se doseže z iskanjem rešitev za realne izzive, s katerimi se sooča industrija. Potek dela vključuje registracijo na spletni platformi INDUSAC, objavo izziva s strani podjetij, sestavljanje soustvarjalskih ekip, in oddajo motivacijskih pism za prijavo na reševanje izziva. Ko so motivacijska pisma ocenjena, izbrane ekipe s pomočjo podjetja nadaljujejo z reševanjem izziva. Po zaključku procesa podjetja in ekipe oddajo poročila in povratne informacije o procesu v smislu izkušenj s soustvarjalskim projektom ter pridobivanje veščin in poznavanja izbranih podjetniških področij. Delovni tok (razpis) bo do konca trajanja projekta INDUSAC izveden trikrat, s čimer bo tudi omogočeno hitro in dinamično reševanje izzivov ter na povratnih informacijah temelječa izboljšava samega procesa. Z reševanjem izzivov podjetij bodo študenti pridobili izkušnje mednarodnega sodelovanja ter podjetniške veščine, dostop do podjetij iz EU in pridruženih držav ter reference za prihodnje mreženje. Mehanizem INDUSAC bo s podporo vsaj 300 mednarodnim soustvarjalskim ekipam in ustvarjanjem dinamične skupnosti deležnikov iz industrije in akademskega sveta vzpostavil sistem soustvarjanja

kot katalizatorja za integracijo akademskega sveta v poslovne prakse in tehnične rešitve tudi v prihodnosti.

KLJUČNE BESEDE

Projekt INDUSAC, mednarodno sodelovanje, sodelovanje študenti-industrijo, pridobivanje veščin.

ABSTRACT

At the Jožef Stefan Institute, most of the current practices of knowledge transfer between students and industry involve the indirect participation of students in cooperation between industry and researchers. Entrepreneurial experiences for students, which are mostly gained through educational workshops, usually do not take into account geographical or gender balance, and rarely involve upskilling through direct engagement with industry. In the Horizon Europe INDUSAC project, the main objective is to develop and validate a simple and user-friendly collaboration mechanism between industry and students through short-term, 4-8 week co-creation projects based on industrial challenges. The transfer of knowledge from industry is thus extended from researchers to students, who are additionally motivated by financial support. Gender balance and international character are ensured by the conditions set out in the call for students and researchers. The focus is on upskilling, which is achieved by finding solutions to real-life challenges facing the industry. The workflow includes registration on the INDUSAC online platform, publishing of a challenge by companies, formation of co-creation teams, and submission of motivational letters for applying to solve the challenge. After the submissions are evaluated, selected teams proceed to solve the challenge with assistance by the company. After the completion of the project, companies and teams submit reports and feedback on the process in terms of experience with the co-creation project, and upskilling and gained knowledge on selected entrepreneurial areas. The workflow will be carried out three times during the INDUSAC project, which will enable quick and dynamic seeking of solutions to challenges and feedback-based improvement of the process itself. By solving business challenges, students will gain experience in international cooperation and entrepreneurial skills, access to companies from the EU and associated countries, and references for future networking. By supporting at least 300 international co-creation teams and creating a dynamic community of stakeholders from industry and academia, the INDUSAC mechanism will establish a system of co-creation as

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a catalyst for the integration of academia into business practices and technical solutions well into the future.

KEYWORDS

INDUSAC project, international cooperation, student-industry cooperation, upskilling

1 UVOD

Prednosti sodelovanja med industrijo in univerzami v sodelovalnih inovacijskih aktivnostih vključujejo povezanost in povečano bazo znanja, združevanje različnih zornih kotov, izkušenj, veščin in znanja, spodbujanje interdisciplinarnih interakcij, in spodbujanje prenos veščin in znanja [1]. Univerze pridobivajo podjetniški značaj in v tem sklopu spodbujajo ne le raziskovalce, pač pa tudi študente, k podjetniškemu udejstvovanju. Povezovanje študentov z industrijo lahko poteka na več načinov; v Sloveniji se lahko študenti, če želijo sami postati podjetniki, vključijo v izobraževalne programe npr. Javne agencije RS za spodbujanje investicij, podjetništva in internacionalizacije SPIRIT ali Ljubljanskega univerzitetnega inkubatorja, lahko pa se vključijo v sodelovanje z industrijo; na tem področju je med predstavniki univerz veliko zanimanja in tudi sicer še veliko prostora za izboljšanje in iskanje novih načinov povezovanja [2]. Institut »Jožef Stefan« (IJS) kot največja slovenska javna raziskovalna organizacija skozi vsakoletne Dneve odprtih vrat, tedenske obiske šol na Institutu in občasne šolske projekte (npr. H2020 projekt STEM4Youth, 2016-2018) spodbuja povezovanje med mladimi in znanostjo, nekoliko manj pa se ukvarja z neposrednim povezovanjem študentov z industrijo. V okviru aktivnosti obiskovanja podjetij, ki jih je v sklopu promocije tehnologij Instituta izvajal Center za prenos tehnologij in inovacij, so bili mladi raziskovalci občasno vabljeni na obisk v podjetje, študenti pa se z delom v podjetju lahko spoznajo posredno (npr. kadar sodelujejo z raziskovalnimi oddelki, ki sodelujejo z industrijo). Poleg tega izpopolnjevanje na področjih splošnih podjetniških veščin, kot so trženje, razvoj produkta ali izdelava poslovnih modelov, pogosto ni del rednega študijskega programa, pridobivajo pa takšni ciljnimi programi vse bolj na pomenu [3]. O teh veščinah se lahko študenti na Institutu poučijo na občasnih tematskih dogodkih (vsakoletni dogodek Mladi upi) in krajših podjetniških delavnicah, ki se jih običajno izvaja v okviru namenskih projektov za spodbujanje podjetništva (SPIRIT/MGRT projekt SIO 2018-2019) ali izobraževanja mladih (H2020 projekt NOCMOC 2018), pa še tedaj ne v obliki prakse oziroma reševanja konkretnih izzivov v obliki raziskovalnih nalog. Študentsko-industrijske iniciative pogosto potečejo brez posebne pozornosti do geografske uravnoteženosti ali enakosti med spoloma, in na nacionalni, ne pa mednarodni ravni, čeprav se prednosti mešanih ekip in sodelovanja v mednarodnih ekipah kažejo npr. v povečani dobičkonosnosti sredstev in finančni učinkovitosti v podjetju, pridobivanju novih veščin in znanj, ter povečanju regionalne kompetitivnosti (npr. [4-6]). In končno, sodelave med študenti in industrijo v obliki raziskovalnih nalog same po sebi pogosto niso finančno podprte

in je pomanjkanje sredstev med glavnimi ovirami za sodelovanje univerz z industrijo [1-2]; zato se nenehno išče sheme in mehanizme financiranja, da bi spodbudili majhne kratkotrajne projekte raziskav in razvoja; te možnosti ponujajo evropski projekti.

V trenutnem projektu Obzorja Evropa INDUSAC (Quick Challenge-driven, Human-centred Co-Creation mechanism for INDUSty-Academia Collaborations, številka EU projekta 101070297), ki se je začel septembra 2022 (www.indusac.eu), naslavljamo zgornjo problematiko. Glavni cilj projekta je razviti in potrditi preprost in uporabniku prijazen mehanizem sodelovanja med industrijo in študenti, ki bo omogočil kratke soustvarjalske projekte, ki temeljijo na industrijskih izzivih. Proces omogoča razvoj rešitev, ki obravnavajo potrebe in interese podjetij, študentov v EU, s posebnim poudarkom na državah, ki na področju raziskav, razvoja in inovacij zaostajajo (v nadaljevanju: widening države¹), in pridruženih državah². V projektu je prenos znanja osredotočen na študente, ki so za uspešno opravljen soustvarjalski projekt finančno nagradjeni, uravnotežena zastopanost spolov pa je zagotovljena s pogoji, določenimi v razpisu za študente in raziskovalce. Poudarek je na pridobivanju veščin, ki se doseže z iskanjem rešitev za vsakodnevne izzive, s katerimi se sooča industrija. V nadaljevanju navajamo delovni tok soustvarjalskega projekta za študente, je pa sicer projekt namenjen tudi raziskovalcem.

2 METODOLOGIJA IN ORODJA

Platforma INDUSAC. Za potrebe izvajanja soustvarjalskega projekta je vzpostavljena spletna platforma kot uporabniku prijazno in intuitivno orodje za objavo industrijskih izzivov, sestavljanje soustvarjalskih ekip, prijavo na razpise za reševanje izzivov, ter oddajo poročil.

Delovni tok na projektu. Delovni tok (Slika 1) se začne z registracijo podjetja na platformi INDUSAC in objavo podjetniškega izziva (npr. določen problem, ki ga je treba rešiti). Študenti se prav tako registrirajo na platformi, izberejo izziv za reševanje, sestavijo ekipo (ki lahko vključuje tudi raziskovalce) in predložijo t. i. motivacijsko pismo. Če so izbrane, ekipe nadaljujejo z reševanjem izziva in po opravljenem delu oddajo ustrezna poročila ter izpolnjene vprašalnike o izkušnjah in pridobljenih veščinah.

Registracija na platformi INDUSAC. Preden se lahko izvajajo soustvarjalski projekti, se morajo podjetja, študenti in raziskovalci registrirati na platformi. Registracija omogoča podjetju, da ustvari profil in objavi izziv, študentom pa omogoči oddajo motivacijskih pisem, sestavljanje ekip in oddajo poročil.

Objava industrijskih izzivov. Oktobra 2023 bodo podjetja objavljena, da objavijo izziv tako, da izberejo eno od devetih vnaprej določenih predlog za potencialne izzive, ki zajemajo predvsem podjetniške veščine in obsegajo teme od razvoja izdelka, tržne analize in strategije ter razvoja idej za storitve/izdelke do priprave poslovnega načrta in poslovnega modela. Izziv bo poleg opisa težave (brez zaupnih informacij) navedel tudi pričakovanja podjetij glede rešitev in glede

¹Widening države: Bolgarija, Hrvaška, Ciper, Češka, Estonija, Grčija, Madžarska, Latvija, Litva, Malta, Poljska, Portugalska, Romunija, Slovaška, Slovenija (vir: https://rea.ec.europa.eu/news/eu-committed-research-and-innovation-through-horizon-europe-widening-programme-2022-08-29_en#)

²Pridružene države: Albanija, Armenija, Bosna in Hercegovina, Ferski otoki, Gruzija, Islandija, Izrael, Kosovo, Moldavija, Črna Gora, Severna Makedonija, Norveška, Srbija, Tunizija, Turčija, Ukrajina, Maroko, Velika Britanija (vir: https://ec.europa.eu/info/funding-tenders/opportunities/docs/2021-2027/common/guidance/list-3rd-country-participation_horizon-euratom_en.pdf).



Slika 1: Poenostavljeni delovni tok projekta INDUSAC

sposobnosti soustvarjalske ekipe. Podjetje določi največje število ekip, ki so lahko izbrane za reševanje izdanega izziva.

Predložitev motivacijskih pisem. Kot del tekoče kampanje osveščanja so študenti z javnih univerz seznanjeni s projektom INDUSAC s promocijo s strani konzorcija INDUSAC in univerz samih prek družabnih omrežij in letakov. Novembra 2023 se bodo študenti lahko prijavi na razpis, ki vključuje sestavo soustvarjalske ekipe in pripravo skupnega motivacijskega pisma. Motivacijsko pismo vključuje opis motivacije in veččin ekipe za rešitev izziva.

Upravičenost soustvarjalskih ekip in članov ekipe. Soustvarjalska ekipa mora imeti najmanj tri do največ šest članov. Študenti morajo imeti državljanstvo in/ali urejen rezidentski status / biti rezidenti v državah članicah EU ali pridruženih državah. Člani ekipe morajo biti iz vsaj treh različnih držav članic EU ali pridruženih držav in vsaj 60 % članov ekipe mora biti iz widening držav. Ves čas trajanja dejavnosti morajo biti študenti vpisani na javne univerze. Posamezni študent bo lahko sodeloval v več kot eni soustvarjalski ekipi, vendar največ v treh različnih oddanih motivacijskih pismih. Ekipa mora biti uravnotežena po spolu, in vključevati vsaj dve od naslednjih treh opredelitev: [moški], [ženska] in [ne želi razkriti]. V vsaki ekipi mora biti vsaj en študent, tj. nobena ekipa ne sme biti sestavljena izključno iz raziskovalcev.

Ocenjevanje motivacijskih pisem. Kot je navedeno zgoraj, lahko podjetje za reševanje izziva izbere več kot eno soustvarjalsko ekipo. Motivacijska pisma ocenjuje predstavnik podjetja na podlagi številnih kriterijev – motiviranosti in entuziazma ekipe, ustreznosti pristopa, potencialnega vpliva rešitve na trg, kakovosti ekipe, razporeditve virov in transverznih kriterijev. Če število prejetih motivacijskih pisem na izziv preseže 200 % števila ekip, s katerimi je podjetje pripravljeno sodelovati, ocenjevalni odbor INDUSAC (ki ga sestavljajo člani konzorcija INDUSAC) izvede predizbor na podlagi istih meril, po katerih bodo motivacijska pisma ocenjevala tudi podjetja. Ocenjevalni odbor INDUSAC podjetju posreduje toliko motivacijskih pisem, kolikor jih ustreza 150 % števila ekip, s katerimi je podjetje pripravljeno sodelovati v okviru posameznega izziva.

Podpis izjave FSTP. Če je motivacijsko pismo odobreno, soustvarjalska ekipa podpiše Izjavo o finančni podpori tretjim osebam (ang. “financial support to third parties”, FSTP). FSTP v višini do 1.000 EUR bruto na študenta in do 3.000 EUR bruto na

soustvarjalsko ekipo prejmejo izključno študenti (ne pa tudi morebitni raziskovalci v ekipi), po zaključku projekta.

Proces soustvarjanja. INDUSAC bo soustvarjalskim ekipam zagotovil seznam izročkov, metod in orodij za reševanje izziva, vključno s t. i. mentorskim načrtom. V okviru 4-8 tednov trajajočega procesa bo podjetje sklicalo uvodni sestanek, in po potrebi nadaljnje vmesne sestanke z ekipo. Študenti bodo preučili podrobnosti in metode izziva ter podrobneje raziskali podjetje. Na prvem vmesnem sestanku s podjetjem bodo ekipe predstavile začetne rezultate. Nadaljnje delo se bo nato osredotočilo na razvoj rešitve. Na zaključnem sestanku bodo ekipe predstavile končno rešitev in prejele povratne informacije od podjetja, ki jih bodo upoštevale pri pripravi in oddaji končnega poročila.

Za zagotovitev nemotenega poteka bo proces soustvarjanja spremljal tudi konzorcij INDUSAC, in sicer na podlagi omenjenega mentorskega načrta, v katerem so natančneje opredeljeni posamezni koraki pri reševanju določenega tipa izziva. Mentorski odbor beleži napredovanje glavnih mejnikov in morebitne težave; v vsaki fazi lahko mentorski odbor preveri in svetuje glede elementov, kot so jasnost smernic INDUSAC, upoštevanje rokov, pravočasno posredovanje rezultatov ter komunikacija med podjetjem in soustvarjalsko ekipo.

Če bo v procesu nastala kakšna oblika intelektualne lastnine (IL; npr. patentna prijava), bodo delitev lastništva pravic IL, vrsta IL in upravljanje z njo, urejene z ustreznimi pogodbami med podjetjem in soustvarjalsko ekipo izven projekta INDUSAC.

Poročanje soustvarjalskih ekip. Po zaključku soustvarjalskega projekta ekipe predložijo poročila o izvajanju, vključno s povzetkom/opisom rezultatov (tj. rešitev izzivov), končnimi rezultati, kot je opredeljeno v izzivih, izpolnjenimi vprašalniki o pridobljenih veščinah in vprašalniki o poznavanju podjetniških metod (po enega pred projektom in enega po projektu), ter kratke prispevke o izkušnjah. Rešitve za izzive ocenjujejo ocenjevalni odbor in podjetje, ter vključujejo ocene glede kakovosti izročkov, kazalnikov poslovne uspešnosti, kazalnikov tehnične uspešnosti, in upoštevanja rokov. Proces soustvarjanja se zaključi, ko ocenjevalni odbor in podjetje ocenita in potrđita poročilo o izvedbi in študenti prejmejo finančna sredstva.

Poročanje podjetij. Poleg soustvarjalskih ekip podjetje zagotavlja tudi povratne informacije v obliki ocene kakovosti rešitve izziva, vključno s kakovostjo izročkov, poslovno

uspešnostjo, tehnično zmogljivostjo in upoštevanjem rokov. Podjetje izpolni tudi vprašalnik, v katerem navede svoje izkušnje med projektom.

Časovna dinamika projekta. Industrijski izzivi se bodo kontinuirano objavljali sproti. Motivacijska pisma bo tudi možno oddajati kontinuirano, vendar bodo ocenjena po treh presečnih datumih (januarja 2024, maja 2024 in oktobra 2024). Štiri tedne po zaključku razpisa soustvarjalske ekipe prejmejo odločitev o svojih prijavih. Če je motivacijsko pismo odobreno, mora ekipa v roku enega tedna podpisati izjavo o prejetju financiranja; potem pa se lahko začne reševanje izziva. Individualni soustvarjalski projekti bodo trajali 4–8 tednov. Tri mesece po prvem presečnem datumu bodo ekipe pozvane, da predložijo končna poročila v revizijo; dva tedna kasneje ocenjevalni odbor potrdi seznam študentov iz soustvarjalskih ekip, ki bodo prejeli finančno podporo; mesec dni kasneje vsi študentje s seznama prejmejo sredstva.

3 RAZPRAVA

Industrijska vlaganja v raziskave in razvoj so med najpomembnejšimi gonilniki gospodarske rasti in razvoja, sodelovanje med industrijo in univerzami pa je strateško pomembno za povečanje učinkovitosti in vpliva teh vlaganj [7]. Produktivnost razvoja in tehnološki portfelj v industriji sta marsikdaj povečana zaradi udeležbe univerz [8-9], ki imajo poleg podjetij osrednjo vlogo v procesih inovacije [1]. Javne raziskovalne organizacije zato vse bolj razširjajo svoje poslanstvo s pomočjo pisarn za prenos tehnologij, licenciranja, pravic IL, raziskovalnega sodelovanja, inkubatorjev in odcepljenih podjetij; poleg izobraževanja in raziskav se vključujejo tudi v regionalni razvoj, za kar morajo postati tudi vse bolj podjetniško naravnane, in podjetništvo promovirati tudi med študenti [10]. Pristop INDUSAC se skozi vključevanje študentov v neposredno sodelovanje z industrijo vklaplja v obstoječo shemo oblik prenosa znanja in prinaša številne prednosti. Prvič, razpisi za reševanje izzivov v okviru projekta so pripravljene s posebnim poudarkom na geografski uravnoveženosti in enakovredni zastopanosti spolov, da bi povečali vključenost. Razlike v vlaganju v raziskovalno razvojno dejavnost (v % BDP) med državami EU so lahko tudi do šestkratne [11] in zagotavljanje, da morajo biti člani soustvarjalske ekipe iz vsaj treh različnih držav, poveča možnosti za vključitev tudi tistih z nižjim razvojnim potencialom; poleg tega geografska oddaljenost predstavlja eno najmanjših ovir pri vzpostavitvi sodelovanja z industrijo [2]. Pogoj geografske pestrosti članom ekipe zagotovi tudi izkušnje z delom v mednarodnih ekipah ter omogoči izmenjavo znanja in izkušenj med posamezniki iz različnih okolij, ki se združijo v želji po skupnem ustvarjanju in inoviranju. To sodelovanje je dodatno okrepljeno s procesom, ki vključuje več kontrolnih točk in povratnih informacij med ekipo in podjetjem. To udeležence spodbuja k podajanju konstruktivnih kritik, predlogov in mnenj na različnih stopnjah. Iteracije in dodelave idej na podlagi prejetih povratnih informacij zagotavljajo stalne izboljšave in uspešne rezultate. Pogoj, da mora biti vsaj 60 % članov ekipe iz widening držav, dodatno poudarja podporo, namenjeno regijam,

ki ne dosegajo 70% povprečnega indeksa raziskovalne odličnosti³. K temu pripomore objavlanje širokega nabora različnih vrst izzivov, kar omogoča raznolikost vsebin in področij dela, možnosti posameznikov pa poveča tudi možnost sodelovanja v več kot eni soustvarjalski ekipi.

Soustvarjalska ekipa mora biti tudi uravnovežena glede na spol, pričakovani rezultat pa je vsaj 50-odstotna zastopanost žensk v soustvarjalskih projektih, kar bo prispevalo k premiku trenutnega trenda zaostajanja žensk za moškimi v podjetništvu [12-13]. Poleg enakosti spolov pa je projekt močno naravnat tudi na študente, saj mora vsaka ekipa vključevati vsaj enega študenta. Status študenta, ki se potrdi med registracijo, je še posebej pomemben, saj mehanizem INDUSAC daje poudarek na podporo mlajšim generacijam pri pridobivanju izkušenj pri delu z industrijo. K poudarjeni motiviranosti študentov prispeva tudi dejstvo, da denarno podporo prejemajo le študenti, ne pa tudi raziskovalci. Kombinacija geografskega ravnovesja in zahteve po sodelovanju študentov predstavlja tudi edinstveno priložnost za študente, da začnejo ustvarjati mednarodne mreže na svoji karierni poti.

Celoten proces je pomembno podprt z dejstvom, da eden glavnih rezultatov projekta, platforma INDUSAC, omogoča, da večina dejavnosti poteka priročno in uporabniku prijazno na enem mestu.

Bolj kot specifični tehnološki dosežki in izumi, je pri projektu INDUSAC osrednja tema prenosa znanja pridobivanje veščin. Soustvarjalske ekipe izpolnijo vprašalnike za izpopolnjevanje in poznavanje področij pred začetkom projekta in po koncu projekta. Cilj soustvarjalskega projekta je izboljšati večino/izkušnje študentov pri delu v mednarodnem okolju, delu s podjetji, reševanju konkretnih nalog, pomoči v skupini pri dogovoru o vsestransko sprejemljivi rešitvi, delu v skupini pri prepoznavanju skupnih ciljev, in dovednosti za upoštevanje predlogov. Komunikacijske in pogajalske veščine, k rezultatom usmerjeno razmišljanje, ustvarjalnost, kritično in analitično razmišljanje, upravljanje s časom in učinkovito načrtovanje ter vodenje so med veščinami, ki jih projekt INDUSAC najbolj spodbuja, saj se izkažejo za pomembne tako pri zaposlitvah kot tudi pri povečanju produktivnosti v industriji 4.0 in digitalni transformaciji proizvodnje [14]. Namen projekta je zlasti izboljšati poznavanje metod, kot so analiza SWOT, analiza uporabnosti, analiza trendov, analiza stroškov in koristi, analiza portfelja izdelkov / BCG Matrix, ustvarjanje tržnih strategij, analiza ponudbe vrednosti, razvoj poslovnega načrta, priprava poslovnega modela ter analiza ciljnih skupin, med študenti. Koncept, tj. kratkotrajnost soustvarjalskih projektov in trije ločeni presečni datumi, spodbujajo iskanje hitrih in dinamičnih rešitev z možnostmi naprednega reševanja problemov s podaljšanjem primarnega izziva v naslednji razpis.

Posebni kontrolni koraki (predizbire in ocene), kot so opredeljeni v metodologiji projekta INDUSAC, zagotavljajo, da proces soustvarjanja ni le vključujoč, temveč tudi visokokakovosten: postopek ocenjevanja zagotavlja visoko kakovostno ureditev sodelovanja. Posebne zahteve za poročila (tj. vnaprej določena struktura in vsebina dela) zagotavljajo kakovostno opravljene naloge. Poleg tega se z vzpostavitvijo treh zaporednih presečnih datumov v razpisu za študente in

³ Widening države po definiciji Evropske komisije dosegajo manj kot 70% povprečnega indeksa raziskovalne odličnosti držav Evropske unije (povzeto po <https://quantera.eu/spreading-excellence/>).

raziskovalce proces nenehno izpopolnjuje z izboljšavami metodologije INDUSAC, ki temeljijo na povratnih informacijah.

Z izkušnjami podpore vsaj 300 mednarodnim soustvarjalskim ekipam in ustvarjanjem dinamične skupnosti deležnikov iz industrije in javnih raziskovalnih organizacij skozi celotno življenjsko dobo projekta bo mehanizem INDUSAC vzpostavil sistem soustvarjanja kot katalizator za integracijo akademskega sveta v poslovne prakse in tehnične rešitve. Pričakuje se, da bo najmanj 70 % sodelujočih študentov poročalo o vsaj eni temeljni strokovni transverzalni in podjetniški veščini, ki se je znatno izboljšala skozi sodelovanje v projektu INDUSAC. Pričakuje se izboljššan nabor veščin študentov za vsaj 30 % v primerjavi s stanjem pred začetkom projekta, kar jim bo omogočilo, da bodo v kratkem času hitro razširili svoj nabor spretnosti in postali bolj pripravljeni na poslovno okolje. Po nekaterih podatkih skoraj polovica mladih navaja, da bi raje kot zaposleni delali kot podjetniki, skoraj polovica univerzitetnih študentov pa navaja, da nameravajo postati podjetniki v petih letih po zaključku študija [12]. Če bo projekt INDUSAC uspešen, bo predstavljal pomemben prispevek k uresničevanju teh ciljev in preko priporočil snovalcem politik tako na evropski kot na nacionalni ravni tudi vzpodbudno pobudo za podobne prakse prenosa znanja med industrijo in šolstvom v prihodnosti.

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UPORABA IKT PRI IZVAJANJU PRAKTIČNEGA USPOSABLJANJA

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POVZETEK

Pri napotitvi dijaka na praktično usposabljanje z delom (v nadaljevanju PUD) se organizatorji PUD-a soočajo z veliko količino dokumentacije, ki je potrebna za uspešno napotitev dijakov na PUD, za izvajanje, zaključek in uspešno izvedbo PUD. V prispevku je predstavljen način napotitve dijakov na PUD, pri čemer, organizatorji zahtevamo, da priprava dokumentacije, izdelava učne pogodbe, dnevnik dijakov in potrdila poteka s pomočjo uporabe kompetenc s področja IKT. Članek je namenjen razumevanju postopkov pri izvajanju PUD-a za učitelje, ki izobražujejo dijake, njihove starše oziroma skrbnik in mentorjem v podjetjih delodajalcev.

KLJUČNE BESEDE

Praktično usposabljanje z delom – PUD,
organizator praktičnega usposabljanja z delom,
delodajalec,
informacijsko komunikacijska tehnologija
- IKT

ABSTRACT

When placing a student on a practical training with work placement (hereinafter "PUD"), PUD organisers are faced with a large amount of documentation that is necessary for the successful placement of students on a PUP, for the implementation, completion and successful delivery of the PUD. This paper presents how students are placed on PUDs, whereby the organisers require that the preparation of documentation, the learning contract, the students' diaries and the certificates are done using ICT competences.

This article aims to provide an understanding of the procedures involved in the implementation of a PUD for teachers educating students, their parents/guardians and mentors in employers' companies.

KEYWORDS

Practical training with work – PUD,
organizer of practical training with work,
employer,
information and communication technology -
ICT

1 UVOD

Pri izvedbi PUD smo organizatorji PUD-a v preteklosti uporabljali dokumentacijo, ki so jo sestavljali univerzalni formularji, ki jih je bilo potrebno ročno izpolnjevati. Izpolnjevanje so opravljali dijaki, organizatorji PUD-a, administratorji v podjetjih, mentorji v podjetjih. Najprej smo začeli uporabljati različna orodja za izpolnjevanje, pripravo in hranjenje dokumentacije organizatorji PUD, v naslednjem koraku pa na uporabo spletnih iskalnikov, izpolnjevanje posameznih formularjev v elektronski obliki zahtevamo tudi od dijakov. V nadaljevanju so predstavljeni posamezni koraki napotitve dijakov na PUD, hranjenje dokumentacije in načini zagotavljanja varstva osebnih podatkov.

2 TEORETIČNI PREGLED

2.1 Praktično izobraževanje

Praktično izobraževanje v poklicnih srednjih šolah se izvaja kot PRA-praktični pouk, ki poteka v šoli in PUD-praktično usposabljanje z delom, ki se izvaja pri delodajalcih. V tem članku bom kot organizator PUD-a namenil načinu izvajanja PUD, spremljajočo dokumentacijo in prizadevanja za uporabo IKT pri vseh udeležencih PUD-a, organizatorjih PUD-a, delodajalcih, kjer dijaki opravljajo PUD in dijakih, ki jih na PUD pošiljamo. Šola določi v skladu s predpisanim programom posameznega izobraževanja obseg in termin izvajanja PUD-a. S temi podatki so dijaki seznanjeni o obsegu že pred samim vpisom v posamezni program, s terminom PUD-a pa na začetku šolskega leta za tekoče šolsko leto. Dijaki se na osnovi predpisane dokumentacije vključijo v delovni proces pri izbranem delodajalcu pod vodstvom mentorja v podjetju in nadzorom organizatorja PUD-a kot zastopnika šole. Med samim PUD-om dijak vodi dnevnik izvršenih del in nalog v podjetju. Po zaključku PUD-a pa organizator PUD-a na osnovi dnevnika in potrdila oceni dijakovo uspešnost v e redovalnico po dvostopenjski lestvici opravil/ni opravil.

2.2 Najpomembnejši cilji PUD

- pridobivanje praktičnih izkušenj v proizvodnem procesu in povezave med pridobljenim znanjem v šoli in praktičnimi nalogami,
- uporaba šolsko pridobljenega znanja v realnem delovnem procesu,
- pridobivanje znanj in spretnosti v delovnem procesu,
- izkušnje v medsebojnih odnosih in spoznavanje novega načina pridobivanja znanja,
- seznanitev z pripomočki, napravami in orodji idr.,
- učenje sodelovanja in timskega dela ter komunikacije in nastopa pred strankami in sodelavci,
- razvijanje odgovornosti za opravljeno delo, kakovost dela in upoštevanje predpisov.

2.3 Organizator praktičnega izobraževanja

Na srednjih poklicnih in strokovnih šolah je za urejanje dokumentacije in povezovanja podjetij in izobraževalne ustanove sistematizirano delovno mesto organizator praktičnega izobraževanja [3]. Organizator PUD je zadolžen za vse aktivnosti, ki vodijo k povezovanju dijaka in delodajalca, pripravo in vodenje dokumentacije, vrednotenje primernosti posameznega delodajalca, spremljanje dijaka med opravljanjem PUD-a, reševanju konfliktov in težav s strani dijaka in delodajalca v povezavi z opravljanjem PUD-a. Na koncu pa ocenjevanje uspešnosti in hranjene dokumentacije. Organizator PUD-a je tudi vezni člen med podjetji, ki sporočajo kakšna znanja potrebujejo, kakšen profil dijakov želijo in šolo. V tej vlogi nastopa kot promotor šole in poklicev, ki jih šola izobražuje. V tej vlogi lahko naredi veliko koristi in obratno s svojo odzivnostjo, komunikacijo, nastopom in ravnanjem. Zato stremimo k čim boljši podobi šole in poklicev, ki jih pokrivamo. Pri svojem delu mora organizator PUD-a dobro poznati poklicne standarde, zahtevana znanja pri posameznih poklicih, prav tako pa minimalne standarde za izvajanje PUD-a. Organizator PUD-a na začetku šolskega leta z razredniki obvesti dijake o pomenu PUD-a, trajanju, terminu in seveda o pripadajoči dokumentaciji in pomenu le te. Dijakom predstavi podjetja in možnost predlaganja novih. Dijake spodbuja, k samostojnemu iskanju ustreznih podjetij, navezovanju stikov in pridobivanju dokumentacije, ki omogoča opravljanje PUD. Dijakom je na voljo tudi Centralni register učnih mest [2]. Dijakom, je organizator PUD-a dolžan zagotoviti točne informacije in navodila, saj so večino časa med opravljanjem PUD-a prepuščeni mentorjem v podjetjih in sebi.

2.4 Priprava dijakov in napotitev na PUD

Organizator PUD dijake seznanja z dokumentacijo, ki je potrebna za izvedbo PUD-a, nalogo posameznega dokumenta, in pomenom posameznega dokumenta. Pri pojasnjevanju izpostavimo možnosti za iskanje informacij, izpolnjevanje dokumentov, komunikacijo in hranjenje dokumentov z uporabo IKT in spletnih orodij za iskanje informacij in podatkov.

Organizator PUD dijakom posreduje tudi informacije pot do podrobnejših informacij na spletnih straneh CPI, kjer so zelo podrobno opisani postopki naloge in namen pri izvajanju PUD. Navodila so navedena za dijake, mentorje in organizatorje PUD-a.

2.5 Poročilo o delu dijaka

Organizator PUD-a opozori dijake (na delovnem srečanju pred odhodom na PUD), da so dolžni voditi dnevnik oziroma poročilo o poteku izvajanja PUD-a. Skupek vseh poročil bo njihov pisni izdelek praktičnega usposabljanja z delom in pomembna informacija o količini in kakovosti poteka in hkrati tudi podlaga za oblikovanje zaključne ocene. Dijaki med PUD-om vodijo dnevnik z možnostjo dodajanja vsakodnevnih poročil o delu ali vodijo mapo oziroma poročila v elektronski obliki.

3 UPORABA IKT V PROCESU IZVEDBE PUD-a

3.1 Najava PUD

Dokument imenovan najava se uporablja, za potrditev delodajalca za pripravljenost sprejema dijaka v določenem terminu in obsegu na PUD. Dijak dobi najavo v šoli od organizatorja PUD-a. Spodbujamo dijake, da si sami najdejo ustreznega delodajalca, saj si s tem povečajo možnost razvoja svojih kompetenc v željeni smeri. Običajno si dijaki iščejo delodajalce, ki so v bližini njihovega bivanja. Dijake poučimo o načinu iskanja ustreznega delodajalca s pomočjo spletnih orodij. V primeru neuspešnega iskanja ustreznega delodajalca organizator PUD-a predlaga posamezna podjetja. Dijake pripravimo na pisanje prošnje za opravljanje PUD v e obliki. Predvsem pa osebno spodbujam fizični stik, navezavo stikov in pogovor z odgovornimi v podjetju. Sklepam, da osebni stik poveča samozavest dijaka, možnost za odobritev PUD-a. Tak postopek tudi kasneje koristi dijakom kot izkušnja, pri iskanju zaposlitve. Dijaki pri tem delu uporabljajo različne možnosti IKT povezav, mobilni telefon, elektronska sporočila, pa tudi različna družabna omrežja.

3.2 Kolektivna učna pogodba

Kolektivno učno pogodbo pripravi organizator PUD-a. Omenjena pogodba je dogovor med delodajalcem in šolo o opravljanju PUD za določenega dijaka v dogovorjenem terminu in je določena z zakonom [4]. V tem delu organizator PUD-a pripravi pogodbo, ki je v e obliki, zakonsko pa mora obstajati v fizični obliki, zato je natisnjena in fizično ožigosana s strani šole in delodajalca. Pogodba se v fizični obliki hrani na šoli, običajno pa tudi pri delodajalcu, ki v primeru nadzora izkazuje upravičenost prisotnosti dijaka v podjetju.

3.3 Delovno poročilo

Delovno poročilo ali dnevnik vodi dijak med opravljanjem PUD-a. Spodbujamo pripravo delovnih poročil v elektronski obliki. Žal so vsa poročila še vedno v fizični obliki, vendar vedno več dijakov ugotavlja prednost izdelave poročil s pomočjo IKT, zato te trend narašča. V prihodnosti, želim, da bi splošna navodila zahtevala izdelavo in oddajo poročil v elektronski obliki v vidu napredka in ekološkega ravnanja in enostavne hrambe delovnih poročil.

3.4 Nadzor PUD

V času, ko je dijak na PUD-u organizator PUD-a izvede nadzor pri delodajalcu. Vmesni preizkus je določen z zakonom [6] S tem dosežemo, da se delodajalec zaveda, da je pomemben člen v izvedbi PUD-a in da dijak n prepuščen sam sebi ampak je pod nadzorom organizatorja PUD-a. Dijaki, pa se zavedajo, da bo njihovo ravnanje in kakovost dela neposredno sporočena organizatorju PUD-a. S tem dosežemo manjše število nepravilnosti in napak, ki jih povzročijo dijaki.

3.5 Potrdilo PUD

Potrdilo PUD izda delodajalec dijaku in s tem izkazuje, da je dijak opravil zahtevano kvoto ur v delovnem procesu. Vsa potrdila so še vedno v fizični obliki, čeprav je vse pripravljeno, za možnost uvedbe in izdelave e potrdil, ki bi poenostavila pošiljanje, hrambo in evidenco potrdil.

S shranjenimi potrdili in podpisanimi in ožigosanimi pogodbami izkazujemo opravljen PUD za posameznega dijaka. Z evidencami pa lahko enostavno poiščemo in posredujemo informacije o terminih in delodajalcih za posameznega dijaka v preteklosti.

3.6 Hranjenje dokumentacije PUD in zagotavljanje varstva osebnih podatkov

Pri hranjenju dokumentacije, ki je zakonsko obvezna [5] pri izvedbi PUD-a ločimo dve vrste hranjenja:

- Fizična hramba, ki pride v poštev za pogodbe in potrdila o opravljenem PUD in
- E shramba, ki se nahaja na šolskem strežniku, kopije pa tudi na drugih lokacijah s pomočjo orodij za varovanje podatkov. V e shrambi shranjujemo vso ostalo dokumentacijo o izvedbi PUD-a (najava, razpored dijakov po posameznih delodajalcih, zapisniki in komunikacija s posameznimi delodajalci. S tem pridobimo možnost vpogleda administratorjev v šoli in organizatorjev PUD-a v evidence poteka opravljanja PUD za posameznega dijaka, podjetja ali delodajalca. Pri tem pazimo na varstvo osebnih podatkov dijakov in delodajalcev. Na varstvo podatkov, opozarjamo tudi dijake.

4 ZAKLJUČEK

V prispevku sem predstavil prizadevanje organizatorjev PUD-a šole za uporabo IKT znanj na področju praktičnega usposabljanja z delom. Ta članek je namenjen, kot pomoč ostalim učiteljem za lažje razumevanje postopka izvedbe PUD-a in prizadevanja organizatorjev PUD-a po čim večji uporabi IKT kompetenc, ki jih dijaki pridobijo v šoli. Na eni strani se trudimo organizatorji PUD-a povečati uporabo IKT na področju iskanja informacij, izdelave dokumentacije, komunikacije in hranjenja zahtevane dokumentacije. Na drugi strani pa stremimo k čim večji uporabi omenjenih znanj pri dijakih.

Zavedam se, da bodo v prihodnosti ta znanja za naše dijake nujno potrebna, če se želimo stopati v korak s sodobno družbo, se obnašati varčno in ekološko, k čemur strmijo tudi napredna in sodobna podjetja, ki bodo v prihodnosti zaposlovala naše dijake.

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Oblikovanje digitalne pesniške zbirke z aplikacijo CEWE

Creating a digital poetry collection with CEWE application

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POVZETEK

V 5. razredu sem imela nadarjeno učenko, ki piše pesmi in bi jih rada predstavila sošolcem, prijateljem in sorodnikom. Pri dodatnem pouku sva tako iskali možnost za objavo, vendar v digitalnem okolju in ne klasično tiskano oziroma fotokopirano verzijo. Seznanila sem se z brezplačno aplikacijo CEWE za oblikovanje foto knjige in jo pokazala učenki, saj drugih možnosti za oblikovanje pesniške zbirke žal nisva našli. Aplikacija je precej enostavna za uporabo in uporabniku omogoča številne možnosti pri oblikovanju. Učenka je samostojno raziskovala CEWE orodje, razvijala sposobnosti in gradila svojo samozavest. Uporaba aplikacije učenki ni predstavljala prav nobenih težav. Urejeno pesniško zbirko je z veseljem predstavila sošolcem. Sošolci so bili navdušeni nad izdelkom in jih je zanimalo, kako se naredi takšna knjiga. Na naslednji uri je sošolce naučila uporabljati aplikacijo. Predstavljena informacijsko-komunikacijska tehnologija ni uporabna samo v vsakdanjem življenju, ampak tudi za izobraževalne namene. Pomembno je, da učencem ponudimo možnost uporabe različnih aplikacij, da razvijamo in spodbujamo njihove talente in jim pomagamo na poti k uresničitvi njihovih ciljev.

KLJUČNE BESEDE

Poezija, IKT, dodatni pouk, nadarjeni učenec, spodbudno učno okolje, aplikacija CEWE

ABSTRACT

I have a talented student in 5th grade who writes poems and would like to present them to her classmates, friends and relatives. So, in extra lessons, we were looking for a way to publish them, but in a digital environment rather than the traditional printed or photocopied version. I was introduced the free CEWE photo book design app to my student, because unfortunately we couldn't find any other options for designing a poetry collection. The app is quite easy to use and gives the user a lot of options for

designing. The student explored the CEWE tool independently, develop her skills and build her confidence. She had no problems using the app. She was happy to present her edited poetry collection to her classmates. Her classmates were impressed by the product and were interested to know how to make such a book. At the next lesson, she taught her classmates how to use the app. The ICT presented is not only useful in everyday life, but also for educational purposes. It is important to give students the opportunity to use different applications, to develop and encourage their talents and to help them on the way to achieving their goals.

KEYWORDS

Poetry, ICT, extra lessons, talented student, stimulating learning environment, CEWE application

1 UVOD

Dodatni pouk je v OŠ namenjen učencem, ki pri posameznih predmetih presegajo določene standarde znanja. Tu otroci razvijajo svojo ustvarjalnost, poglobljajo in nadgrajujejo znanja, pridobivajo in povezujejo različne izkušnje in jih prenašajo v vsakdanje življenje. Učiteljeva vloga je, da samoiniciativne otroke, ki si želijo nekaj več, podpre.

Spodbudno učno okolje daje učencu občutek lastne vrednosti in v njem spodbudi še večjo zavzetost za delo. Pomembno je, da se učenec počuti varnega, sprejetega in slišane. Učitelj je na tej poti le usmerjevalec in spodbujevalec. Raziskave različnih disciplin z nevroznanostjo vred (OECD) pojasnjujejo, da je za učinkovit učni proces pomembna tudi vključenost učencev s čustvi in zaupen odnos [3].

Poezija pri učencih ni tako priljubljena za branje in povzemanje kot proza ali dramatika, ker je učencem pogosto nerazumljiva, težje prepoznajo bistvo in sporočilnost pesmi. V drugem izobraževalnem obdobju učenci doživljajo in zaznavajo poezijo tudi tako, da pesmim dodajajo verze, ki se rimajo, tvorijo asociacije ob besedi, preproste primere in nenavadne besedne zveze [4]. Od učencev se ne pričakuje, da samostojno tvorijo pesmi.

Učenka je skozi celotno šolsko leto ustvarjala svojo poezijo in pesmi zapisovala v dnevnik. Pri tvorjenju lastne poezije se je srečevala s samo seboj, vnašala svoja čustva in razvijala domišljijo. Besedno sporazumevanje je s pomočjo IKT tehnologije povezala tudi z nebesednim (likovnim in računalniškim opismenjevanjem).

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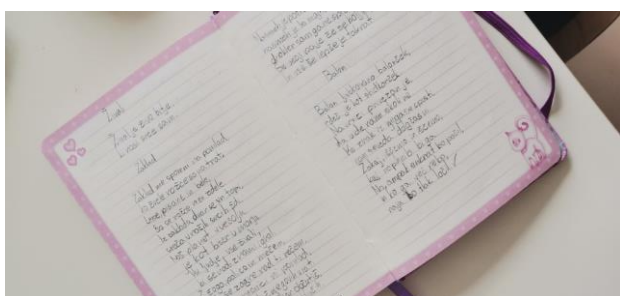
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V nadaljevanju prispevka bo natančneje predstavljen potek ustvarjanja in oblikovanja digitalne pesniške zbirke z brezplačno aplikacijo CEWE.

2 USTVARJANJE IN OBLIKOVANJE DIGITALNE PESNIŠKE ZBIRKE

2.1 Načrtovanje

Učenka je pesmi pisala v svoj dnevnik in me sredi šolskega leta prosila, da preberem njene pesmi. Priznati moram, da v svoji pedagoški karieri še nisem imela stika z učencem, ki bi napisal toliko zanimivih pesmi. Vedela sem, da je spretna v izražanju, pisanju, ustvarjanju, nisem pa vedela, da piše pesmi (Slika 1).



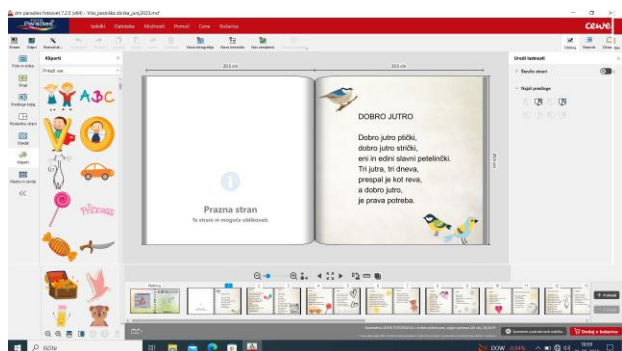
Slika 1: Učenkine dnevniki

Pri dodatnem pouku sem ji podala povratno informacijo in ji svetovala, naj se poigrava z besedami, domišljijo, zvočnostjo, prenesenimi pomeni in naj se ne osredotoča toliko na samo obliko. Zaupala mi je, da si želi, da bi njene pesmi prebrali tudi drugi in da bi rada imela svojo knjigo.

2.2 Kaj je aplikacija CEWE?

Aplikacija CEWE je brezplačna aplikacija za oblikovanje foto knjige. Omogoča uporabo najrazličnejših orodij, predlog, vstavljanje fotografij, posnetkov in besedil. Aplikacijo lahko spreminjamo in dopolnjujemo. Različni ponudniki pa kasneje ponujajo tudi tiskanje foto knjige, ki pa ni brezplačno. Učenki sem pokazala nekaj primerov foto knjige.

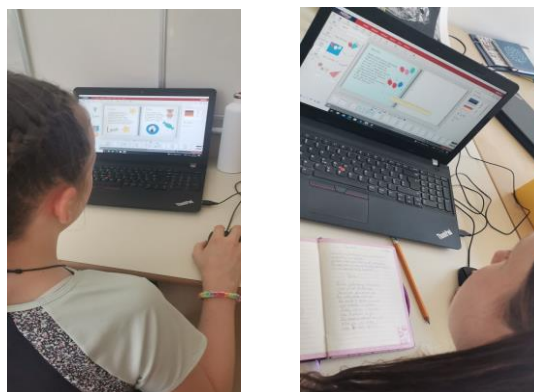
Učenka je na šolski prenosni računalnik po navodilih najprej prenesla programsko opremo in se seznanila z orodji in predlogami (Slika 2).



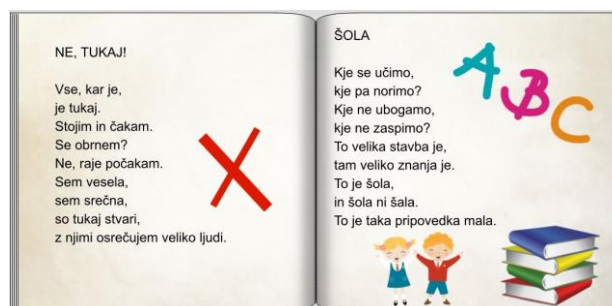
Slika 2: Aplikacija CEWE

2.3 Urejanje in oblikovanje v aplikaciji CEWE

Pesmi je pretipkala, izbrala ustrezen slog in velikost pisave, postavitev in ozadja (Sliki 3, 4). Pri oblikovanju se je poigravala z barvami in poskušala povezati sporočilnost pesmi z likovno podobo (Slika 5).



Sliki 3, 4: Urejanje



Slika 3: Oblikovanje

Na koncu sva skupaj pregledali verzice in pravopis. V tej začetni fazi ustvarjanja avtorskih besedil damo prednost ohranjanju interesa za umetnostna besedila in razvijanju ustvarjalnosti.

3 REZULTAT

Učenka je s svojo digitalno pesniško zbirko navdušila tudi ostale učence, ki so doma staršem povedali za omenjeno aplikacijo in jo tudi sami preizkušali (Slika 5).



Slika 5: Predstavitve digitalne pesniške zbirke in aplikacije sošolcem

Sošolci so si z veseljem ogledali njeno digitalno pesniško zbirko in prebrali njene pesmi. Večini so se njene pesmi dopadle in so presenetljivo hitro razbrali sporočilnost pesmi. Učenci so bili pri branju in analizi njenih pesmi bistveno bolj motivirani za delo, kot so sicer pri urah književnosti.

Pesniška zbirka v digitalni obliki učenki omogoča, da dodaja pesmi in spreminja oblikovanje. Za spomin na peti razred sem ji ob zaključku podarila tudi natisnjeno foto knjigo.

Neprecenljivo je videti otroka s solzami v očeh in začutiti neizmerno hvaležnost. Takrat je ves trud poplačan.

4 ZAKLJUČEK

V prispevku sem predstavila individualni pristop dela z nadarjeno učenko. Takšen pristop nama je omogočal, da sva se spoznavali bolj poglobljeno. Pri podpori in usmerjanju je bilo pomembno, da sem upoštevala učenkinine posebne sposobnosti in interese, da sem poznala njene želje in cilje in da mi je učenka zaupala.

Uporaba aplikacije CEWE se je izkazala kot enostavna in preprosta za uporabo in kot odličen pripomoček tudi za vsakdanjo rabo. Delo je potekalo precej lažje, ker je imela učenka že usvojene osnovne digitalne veščine.

Poezija je umetnost, ki ima posebno vrednost, če jo spozna tudi širša publika. Najenostavnejši način je zagotovo predstavitev v digitalni obliki.

Ustvarjena digitalna pesniška zbirka predstavlja novo izkušnjo in idejo, kako lahko poezijo približati širši publiki.

Želim si, da bi učenka to ljubezen do ustvarjanja in pisanja poezije še naprej ohranjala in prenesla tudi v kasnejše življenjsko obdobje.

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Vključevanje tehnologije IKT v pouk športne vzgoje*

Integration of ICT Technology into Physical Education Lessons

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POVZETEK

Podatki Nacionalnega inštituta za javno zdravje o življenjskem slogu slovenskih mladostnikov so nas pritegnili v takšni meri, da smo se odločili dijake ozavestiti o pomembnosti zdravega s pomočjo IKT tehnologije. Na naši šoli dijake osveščamo o zdravju in skušamo spodbujati zdrav način življenja na različne načine: s športnimi dejavnostmi, predavanji, delavnicami ter projektnimi tedni. Temeljni namen teh dejavnosti je, da dijake celostno poučimo o pomembnosti telesnega in duševnega zdravja, zato pogosto sodelujemo s strokovnjaki z različnih področij. Projektno delo nam daje možnost, da se poglobljeno ukvarjamo z določeno tematiko, ne samo teoretično, temveč tudi praktično. Zastavljeni cilj je bil, da dijaki sami ozavestijo pomen zdrave prehrane in gibanja. Poslužili smo se različnih raziskovalnih metod: pogovor, anketa, eksperiment, analiza, študij literature, praktične vaje. Dijaki so aktivno sodelovali, projektno delo se je izkazalo za ustrezno obliko učenja, zastavljeni cilj je bil dosežen.

KLJUČNE BESEDE

gibanje, IKT tehnologija, prehrana, projektni teden, zdravje, življenjski slog

ABSTRACT

Data from the National Institute for Public Health on the healthy lifestyle of Slovenian adolescents have intrigued us to the point, where we wanted to inform our students about the importance of a healthy lifestyle with the use of ICT technology. At the III. gymnasium Maribor, we try to raise awareness about health and encourage our students to live a healthier lifestyle with different sports activities, seminars, workshops and project weeks. The purpose of these activities is that we teach them about the importance of both physical and mental health, hence why we often work with experts from both fields. Project work allows us to dive deep

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into a specific thematic, not only theoretically, but also practically. The goal is for our students to develop a healthy lifestyle on their own. We used many different research methods: discussions, questionnaires, experiments, analysis, the study of literature and practical exercises. The students actively participated as project work has proven to be an adequate way of teaching. The goal we set for our project week has been met.

KEYWORDS

physical activity, ICT technology, nutrition, project week, health, healthy lifestyle

1 UVOD

Pomen zdrave prehrane je ključen za zdrav razvoj, saj telo za izgradnjo notranjih organov, mišic, kostnine in živčevja nujno potrebuje hranila, ki jih vsebuje hrana. V zgodnjem otroštvu otrokov jedilnik določajo starši oz. skrbniki, ki se praviloma trudijo in poskrbijo za pester izbor živil na otrokovem krožniku. Vsaj v večini primerov, otroci kot posamezniki ne morejo vplivati na izbor živil in uživati zgolj hrane, ki jim 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 lahko pusti posledice, ki se pokažejo kot nepravilna, neenakomerna rast za vse življenje, prav tako lahko vpliva na oblikovanje prehranjevalnih navad v kasnejšem življenju (NIJZ, 2020).

2 OPIS STANJA NA III. GIMNAZIJI MARIBOR

Na naši šoli imamo več kot 900 dijakov in dijakin. Pedagogi imamo poleg strokovnega dela tudi možnost, da dijake poučujemo oz. jih osveščamo z različnimi zanje pomembnimi vsebinami. Mednje vsekakor sodijo tudi teme o zdravem načinu življenja. Zaradi upada upoštevanja smernic zdrave prehrane skozi obdobje pubertete je bila posledično opravljena raziskava katere namen je bil ugotoviti prehranske navade mladostnikov. V njej so sodelovali dijaki tretjih letnikov III. gimnazije Maribor. Dijaki so sprva izpolnili vprašalnik, ki je preveril njihove prehranske navade, nato so preko didaktične delavnice, pri kateri 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.

3 PROJEKTNO DELO

Projektno delo je zelo pomembno pri povezovanju teorije in prakse v poklicnem in strokovnem izobraževanju, česar se zavedamo, zato se vsako šolsko leto potrudimo, da izpeljemo tak teden. To je priljubljena oblika neformalnega učenja, ki jo dijaki dobro sprejemajo. Tudi med profesorji je to utečena oblika, tako da se vedno znova poizkušamo nadgrajevati in izboljševati. Pri delu sodelujemo s strokovnjaki iz različnih področij, z zdravstvenimi delavci, s prehranskimi svetovalci, aktivnimi športniki, športnimi trenerji, itd. Povabimo jih v goste oz. se z njihovim delom seznanimo na njihovem delovnem mestu. Vedno so pripravljene sodelovati in nas prijazno sprejmejo. Vsak projekt je enkratna in časovno omejena organizacijska tvorba, ki ima svoj začetek in konec, ko so doseženi zastavljeni cilji (Atlagič, 2006). Projektno delo je načeloma timsko, pri čemer imajo dijaki možnost naučiti se sodelovati z drugimi in se spoprijemati z odpravljanjem sporov, ki se ob delu porajajo. Učitelj ima pri projektnem delu pomembno usmerjevalno in intervencijsko vlogo, ki zajema tudi pripravo na delo z dijaki in ustvarjanje čim boljše klime (Bahovec, 2007).

Za projektno delo je značilno naslednje (Bahovec, 2007):

- vsebinsko-problemski pristop;
- konkretnost tematike, življenjskost;
- ciljno usmerjena in načrtovana dejavnost s poudarkom na dejavnosti učencev;
- upoštevanje interesov učencev, njihovih potreb in sposobnosti. Pri tem sta poudarjena izkušnjsko učenje in kooperativnost.

Poznamo dva načina, kako lahko poteka projektno delo (Bahovec, 2007):

- določitev ciljev, načrtovanje, izvedba in utemeljitev ali
- izbira ustreznega problema, skupno načrtovanje poti do rešitve problema, izvajanje posameznih nalog, ki izhajajo iz problema, in preverjanje rešitev problema.

Faze, po katerih poteka projektno delo so (Bahovec, 2007):

- iniciativa,
- zasnova projekta,
- načrtovanje,
- izvedba in
- sklepna faza - predstavitev.

Ko načrtujemo projektno delo, izhajamo iz ciljev izobraževalnega programa. Prednost dajemo tistim ciljem, ki jih je mogoče najučinkoviteje dosegati. Pozornost je treba namenjati tako vsebinskim in procesnim ciljem, kot tudi

rezultatom. Cilji naj bi bili konkretni, dosegljivi, prilagodljivi, prepoznavni v aktivnostih, časovno opredeljeni in merljivi (Atlagič, 2006). Zelo pomembna faza je načrtovanje projektne dela, od njega so odvisni potek in rezultati celotnega procesa. Vloga dijakov pri projektnem delu v primerjavi s klasičnim poukom je močno spremenjena, saj morajo opravljati tudi tiste dejavnosti, ki jih pri klasičnem pouku opravljajo le učitelji (Žužej, 1991), pri tem pa moramo paziti, da nas ne zavedejo le interesi dijakov, saj moramo doseči zastavljene učne cilje. Vsakemu je treba dodeliti vlogo, ki je v skladu z njegovimi osebnostnimi značilnostmi, znanjem in s sposobnostmi, pri čemer se mora vsak posameznik zavedati odgovornosti, ki jo je s tem dobil (Atlagič, 2006).

4 PROJEKTNI TEDEN NA TEMO ZDRAVJE

4.1 Izbira teme

Temo izberemo profesorji športne vzgoje, prav tako skupino dijakov, ki jo bomo vodili skozi teden. Običajno si profesorji dodelimo tisto skupino dijakov, ki jih poučujemo, kar pa ni pravilo.

4.2 Postavitev ciljev

Pomembno je, da si postavimo realne cilje in jih prilagodimo skupini, s katero delamo. Cilji, ki jim sledimo so:

- Ozavestiti dijake o pomembnosti zdravega sloga življenja. Dijakom je potrebno predstaviti konkretne situacije, zakaj morajo na svoje zdravje paziti že zdaj in ne šele v starosti, ko se pojavijo težave. Poleg statistike, lahko prikažemo težave, s katerimi se spopadajo njihovi vrstniki. Prikaznega materiala je dovolj na spletu in v literaturi. Dijaki lahko sami spregovorijo o svojih težavah ali težavah nekoga, ki ga poznajo.
- Analizirati njihov slog življenja. S kratkim vprašalnikom lahko vsak pri sebi analizira stanje, ugotovi, kaj dela narobe oz. kaj bi lahko takoj naredil za svoje zdravje. Tako lahko vsak oceni svoje telesno in duševno zdravje.
- Poiskati izboljšave. Osredotočimo se na to, kaj lahko vsak dan storimo zase, poiščemo primere dobre prakse, uporabimo izkušnje drugih, ki so korenito spremenili svoj življenjski slog, poiščemo vzornike.
- Izvajati konkretne dejavnosti. Skozi projektni teden udeležujemo to, kar se učimo. Preizkušamo konkretne situacije, se družimo, pozitivno razmišljamo, se zdravo prehranjujemo, gibamo, skrbimo za telo in duha.

4.3 Priprava projekta in dijakov

Dobra priprava pomeni, da lahko v projektnem tednu delo prepustimo dijaku, učitelji pa postanemo le mentorji. Po uvodnih navodilih aktivno spremljamo njihovo delo, jih usmerjamo, svetujemo, opazujemo, pomagamo. Zelo pomembna je spodbuda tistih dijakov, ki se težje vključijo. Nekateri dijaki takoj prevzamejo različne vloge, razporedijo ostale in vodijo delo. Če takšnih dijakov ni v skupini, mora profesor dodeliti vloge in potem spremljati, kako se dijaki uveljavljajo. Vseskozi moramo opazovati, da vsi sodelujejo, da se dejavno vključujejo, da sprejemajo delo in ideje drug drugega, da koga ne izključujejo, drugega pa favorizirajo.

Pred začetkom se je potrebno dogovoriti z zunanjimi sodelavci: uskladiti termin in prostor, se seznaniti z vsebino in metodo njegovega dela, svojo vsebino prilagoditi njegovi, da se delo nadgradi, predstaviti skupino, s katero bo delalo, jih opozoriti na posebnosti in seveda predstaviti, kaj se od njih pričakuje. Menjava prostora, da se ne dogajajo vse dejavnosti na šoli, je za dijake dobrodošla sprememba. Ni važno, kakšen je prostor samo, da smo izven učilnice. Zelo dobrodošle so tudi oblike, ki jih izvajamo na prostem, na pohodu, po trim stezi ali na klopici v parku.

Izbrati je potrebno metode dela, ki so raznovrstne, npr. pregled literature, predavanja, delavnice, ankete, delo na terenu, druženje z različnimi ljudmi, da so dijaki dovolj motivirani. Naša želja je, da skozi projekt dijaki čim manj časa preživijo za računalniki, da poiščemo informacije drugače, iz literature, od ljudi, od strokovnjakov, da gremo na teren, da vidimo dogajanje v živo, da doživimo teorijo v praksi. Zelo pomembno je, da vsa dejstva, pred katera postavimo dijake, niso izmišljena, ampak iz resničnega sveta, iz njihove okolice ali bližine, njihovih vrstnikov.

4.4 Potek

Projektno delo je razdeljeno na štiri dni, v trajanju 6 šolskih ur.

Prvi dan

Dan pričnemo tako, da dijake seznanimo z načinom dela in jim predstavimo aplikacijo Energy for life (Imaxina Novas Tecnoloxias S.L.). 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 uporabnik pridobi in utrdi svoje znanje, kot tudi zabavna, da se ne naveliča in je pripravljen dlje časa ostati motiviran, se imenuje Energy for life. Aplikacija s pomočjo igrifikacije – uporaba dinosavra, 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 določijo s pismenimi sposobnostmi uporabnika. Velik poudarek je na znanstveni pismenosti, povezan z vizualnimi dražljaji, ki uporabnika spodbujajo k aktivni uporabi aplikacije. Zasnovana je tako, da se jo lahko uporablja ob spremstvu vodje učnega procesa ali pa se jo uporablja samostojno. Uporabnik lahko izbira med različnimi področji, ki jih lahko s pomočjo aplikacije osvoji in utrdi svoje znanje.

Pred zaključkom prvega dne se posvetimo še duševnemu zdravju. Povabimo študente psihologije, ki z dijaki spregovorijo o duševnih tiskah in stresu ter jih naučijo različne tehnike upravljanja stresnih situacij in tehnik meditacije.

Drugi dan

Dogovorjeno imamo predavanje v Zdravstvenem domu Maribor, kjer nam pripravijo predavanje na temo Mladostnik – zdravje - odvisnosti. Po končanem predavanju sledijo delavnice o morfologiji našega telesa. Dijaki v paru izmerijo in izračunajo svojo kostno maso, maščobno maso in mišično maso. Nadaljujemo s sestavljanjem zdravega jedilnika. Za vsak jedilnik izračunajo kalorično vrednost in poskušajo poiskati bolj zdravo izbiro. Posebej so opozorjeni na vrednost sladkorja, soli in maščob v pijačah in prigrizkih iz avtomatov. Posebno poglavje posvetimo uživanju vode. Poslikamo črtne kode priljubljenih sladkih izdelkov in pijač (npr. Frutabela, Kinder Bueno, čokoladni rogljiček, Redbull) in jim predstavimo aplikacijo Veš Kaj Ješ (Zveza potrošnikov Slovenije). Izpišemo vsebnosti sladkorja v pijačah in maščob v prigrizkih. Na spletu poiščemo rešitve, kako se izogniti slabim prigrizkom in jih nadomestiti z bolj zdravimi. Izmerimo vsebnost sladkorja v sladkih pijačah in jih spremenimo v dejanske vrednosti (primerjamo jih z vrečkami sladkorja po 5 gramov).

Tretji dan

Na pogovor povabimo znanega športnika, ki z dijaki spregovori o svojih športnih začetkih, procesu treninga, usklajevanju športa in šolskih obveznostih, psihološki pripravi in podobnem. Ta vrsta predavanja je za dijake izredno zanimiva, saj slišijo osebne izkušnje nekoga, ki je uspešen na svojem področju.

Za zaključek dneva se odpravimo na igrišče za odbojko na mivki. Dijaki in dijakinje sestavijo mešane ekipe in odigrajo tekme med razredi. Sprostitev v naravi izkoristimo za druženje in pogovor.

Četrty dan

Za zaključek projekta pripravimo pravo tekaško prireditev poimenovano Tretja teče, ki se je udeležijo vsi letniki šole. V sodelovanju s podjetjem Pro Time organiziramo tek za vse dijake šole. Pripravimo traso teka, razdelimo štartne številke s čipi, poskrbimo za osvežilne postaje na trasi, pripravimo darilne vrečke za najboljše ločene po letnikih in spolu, na koncu pa priredimo uradno razglasitev rezultatov. Prireditev je med dijaki dobro sprejeta in je postala tradicionalna.

5 EVALVACIJA

Projektno delo je velik izziv tako za dijake, kot učitelje. Obojim daje veliko zadovoljstva in predvsem izkustvenega učenja. Kot opiše Žužjeva (1995), se pri projektne delu odpre nepredvidljiva bogata paleta variant projektne učnega dela in je nemogoče predvideti vsa spoznanja, znanja, vse vzgojne učinke, vsa nova ustvarjalna hotenja – nemogoče je predvideti vse notranje, čustvene in s tem v zvezi miselne polemike, veliko ustvarjalnost, ki se kaže v bogatejšem govornem in pisnem izražanju ter umetniškem ustvarjanju. S tem načinom dela naj bi bil sprožen razvoj dijakovih osebnostnih sposobnosti tako na kognitivnem, psihomotoričnem in socialnem področju, ob samoaktivnosti in notranji motivaciji.

Motivacija za delo je včasih večja, včasih manjša, pomembna je izbira teme (nevsakdanje vsebine, ki so povezane s poklici, za katere se usposablja ali s tematiko iz vsakdanjega življenja, v katero se poglobijo), ki mora biti za dijaka zanimiva in poučna. Dijake je treba motivirati in jih pripraviti na delo. Dobro je treba pripraviti potek dela, da so dijaki motivirani v vseh fazah dela. Uporabiti je treba različne metode dela, multimedijška sredstva, skratka projektno delo naj bo čim bolj razgibano in zanimivo. Manjša skupina dijakov zagotavlja lažje delo.

Komunikacija je bistveno drugačna, saj dijake pri delu le usmerjamo; zaradi manjšega števila dijakov poteka med vsemi posamezniki na vseh ravneh, je vsestranska, živahna ter iskrenejša, saj dijaki ob delu na glas izražajo občutja, razmišljanja, svoje poglede ipd., se bolj odprejo. Pomembno je ustvariti dobro klimo v skupini.

Konflikt nastopi v primeru, ko dijaki ne morejo oziroma ne znajo sprejeti mnenja drugega, ko ne znajo medsebojno sodelovati, ko so neresni, niso pripravljene delati, ko ne upoštevajo dogovorov ipd. Ovire je treba odpravljati sproti in zmanjšati morebitne pomanjkljivosti oziroma slabosti.

Dodana vrednost projektne dela je, da se dijaki srečajo z drugačnim načinom dela in ob tem usvojijo znanja, ki so potrebna in pomembna za njihov poklic ali pa širijo njihove kompetence, ki so pomembne v vsakdanjem življenju. Urijo se v pridobivanju in iskanju informacij iz različnih virov, se računalniško opismenjujejo, vsi morajo biti dejavni, vadijo javno nastopanje, krepijo samozavest. Učijo se timskega dela, dojemajo pomembnost dogovorov, kompromisov ipd. So ustvarjalnejši in spoznavajo delo na terenu. Postajajo samostojnejši, odgovorni, iznajdljivi, domiselni, izvirni. Delo opravljajo z navdušenjem in zavzeto. Razvijajo sposobnost samostojnega opazovanja, primerjanja, povezovanja in logičnega sklepanja ter sposobnost samostojnega poročanja.

Slabosti se pokažejo tedaj, če dijaki niso pripravljene delati, se izogibajo, niso samostojni, če delo ne poteka timsko, kot je predvideno; če je klima v skupini slaba. Problem je, če nismo postavili ciljev oziroma so nedosegljivi, če k problemu nismo pravilno pristopili, če nismo upoštevali interesov dijakov, njihovih potreb in sposobnosti, če nismo skupaj načrtovali pot do rešitve problema, če si nismo postavili posameznih faz, jih preverjali ter utemeljili

6 ZAKLJUČEK

Pomen zdrave prehrane je ključen za zdrav razvoj, saj telo za izgradnjo notranjih organov, mišic, kostnine in živčevja nujno potrebuje hranila, ki jih vsebuje hrana. V zgodnjem otroštvu otrokov jedilnik določajo starši oz. skrbniki, ki se praviloma trudijo in poskrbijo za pester izbor živil na otrokovem krožniku. Vsaj v večini primerov, otroci kot posamezniki ne morejo vplivati na izbor živil in uživati zgolj hrane, ki jim je všeč. V času pubertete pa mladostniki počasi začnejo sami določati svoj jedilnik in pri tem večkrat ne upoštevajo smernic zdravega prehranjevanja. Nepravilen

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Kibernetska kriminaliteta – razumevanje in ukrepi za večjo varnost

Cybercrime - understanding and measures for greater security

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POVZETEK

Izraz kibernetska kriminaliteta širše opisuje kriminalne dejavnosti, v katerih so računalniki ali računalniška omrežja orodje, tarča ali kraj kriminalne dejavnosti. Vključujejo vse, od elektronskega kloniranja do napada zavrnitve storitve DDoS, kar lahko prizadene posameznike, podjetja in celo države. Pomeni lahko tudi tradicionalna kazniva dejanja, pri katerih se računalnike ali omrežja uporablja za omogočanje nezakonite dejavnosti in vključuje aktivnosti, kot so kraje identitete, finančne prevare, kraje podatkov, vdori v računalniške sisteme, širjenje zlonamerne programske opreme in napadi na omrežja. Kibernetski prostor je z nekaj milijardami uporabnikov po vsem svetu idealen kraj za kriminalce, saj lahko ostanejo anonimni in dobijo dostop do vseh oblik osebnih podatkov, ki jih zavestno ali nehoti shranjujemo v spletu. Grožnje internetni varnosti so v zadnjih letih močno porasle, kibernetska kriminaliteta pa prizadene milijarde žrtev po vsem svetu. Umetna inteligenca igra vse večjo vlogo v kibernetski varnosti. Zaradi svoje sposobnosti obdelave velikih količin podatkov in učenja na podlagi vzorcev umetna inteligenca omogoča bolj učinkovito odkrivanje, preprečevanje in odzivanje na kibernetske grožnje. V tem članku bomo raziskali pojav kibernetske kriminalitete, vrste napadov in ukrepe za boj proti tem grožnjam vključno z uporabo umetne inteligence in analizirali orodja za preiskavo kibernetske kriminalitete.

KLJUČNE BESEDE

kibernetska kriminaliteta, kibernetski prostor, umetna inteligenca, orodja za preiskavo kibernetske kriminalitete

ABSTRACT

The term cybercrime broadly describes criminal activity in which computers or computer networks are the tool, target or location of criminal activity. They include everything from electronic cloning to denial of service (DDoS) attacks, which can affect individuals, companies and even countries. It can also refer to traditional crimes where computers or networks are used to facilitate illegal activity, and activities such as identity theft, financial fraud, data theft, hacking, malware distribution and network attacks. With billions of users worldwide, cyberspace is an ideal place for criminals, who remain anonymous and gain access to all the forms of personal data we store online, knowingly or unknowingly. Threats to internet security have increased dramatically in recent years, and cybercrime affects billions of victims worldwide. Artificial intelligence plays an increasingly important role in cyber security. Its ability to

process large amounts of data and learn from patterns makes it more effective in detecting, preventing and responding to cyber threats. This article explores the phenomenon of cybercrime, the types of attacks and the measures to combat these threats, including the use of artificial intelligence and analyzed cybercrime investigation tools.

KEYWORDS

cybercrime, cyberspace, artificial intelligence, cybercrime investigation tools

1 UVOD

Mednarodno sprejete definicije kibernetske kriminalitete ni, vendar jo razumemo kot kaznivo dejanje, pri katerem je računalnik bodisi predmet kaznivega dejanja, na primer z lažnim predstavljanjem ali nezaželeno pošto, bodisi orodje za storitev kaznivega dejanja, na primer zločin iz sovraštva. Vdor v računalniške sisteme oz. omrežja in s tem dostop do računalnika je lahko primerljiv z vlomom in vstopom v stanovanjsko ali poslovno stavbo.

Kibernetska kriminaliteta obstaja v več oblikah, najpogostejša so kazniva dejanja, povezana z identiteto. To se zgodi z lažnim predstavljanjem in zavajanjem uporabnikov interneta v posredovanje osebnih podatkov, zlonamerno programsko opremo, ki zbira osebne podatke, in nezakonitim dostopom do naključnega računalnika na daljavo. Kriminalci uporabljajo te metode za krajo podatkov o kreditnih karticah ali celo krajo denarja. Internet je postal tudi prostor za kazniva dejanja, povezana z avtorskimi pravicami in pravicami intelektualne lastnine, pa tudi kazniva dejanja, kot so otroška pornografija in zloraba gradiva [6].

Z napredovanjem tehnologije je kibernetska kriminaliteta postala storilec lažje dostopna, le-ti pa ne potrebujejo več veliko računalniškega znanja in poznavanja tehnik, saj je večino programske opreme mogoče kupiti ali brezplačno pridobiti na spletu. Z anonimnostjo, ki jo zagotavlja kibernetski prostor, je organom pregona tudi težje izslediti kriminalce in jih locirati [2].

Za doseg svojih ciljev kibernetska kriminaliteta uporablja različne metode in strategije, klaterih razumevanje je ključno za učinkovito preprečevanje in obvladovanje kibernetskih napadov. Organizacije in posamezniki morajo izvajati ustrezne varnostne ukrepe, kot so redno posodabljanje programske opreme, ozaveščanje uporabnikov o varnostnih tveganjih, uporaba protivirusnih programov in požarnih zidov ter redno spremljanje in odkrivanje morebitnih napadov.

Ko govorimo o kibernetnem kriminalu, običajno govorimo o dveh glavnih kategorijah kaznivih dejanj. Prva kategorija je računalnik, povezan v omrežje, ki je tarča kaznivega dejanja in je primer napadov na zaupnost, celovitost in razpoložljivost omrežja. Drugo kategorijo sestavljajo tradicionalni prestopki, kot so tatvine, goljufije in ponarejanje, ki so storjeni s pomočjo računalnikov, povezanih v omrežje.

Ena večjih težav pri ustreznem definiranju in zaznavanju kibernetne kriminalitete je pomanjkanje konkretnih statističnih podatkov o teh kaznivih dejanjih. Prijava zločinov je prostovoljna, kar pomeni, da so številke skoraj zagotovo precej višje od uradnega podatka. Včasih jih organizacije sploh ne prijavijo in to prepuščajo organom pregona, dokler na koncu o prijavi ne odločajo sodišča.

Obstoječe zakone, ki prepovedujejo kibernetni kriminal, se lahko uporablja tako za ljudi, ki jih zgrešijo z uporabo računalnika, kot tudi za tiste, ki jih storijo brez uporabe računalnika ali omrežja. Vendar pa pogojev vedno ni mogoče dobro določiti. Eden od dejavnikov, ki otežuje opredelitev kibernetnega kriminala, je dilema o pristojnosti. Zakoni v različnih državah opredeljujejo pojme različno, zato je pomembno, da se organi pregona, ki preiskujejo kazniva dejanja, pa tudi skrbniki omrežij, ki se želijo vključiti v pregon kibernetnega kriminala, storjenega v omrežju, seznanijo z veljavnimi zakoni [1].

2 RAZISKAVA KIBERNETSKE KRIMINALITETE

Raziskava kibernetne kriminalitete je ključnega pomena za razumevanje, preprečevanje in obvladovanje kibernetnih groženj. S poglobljenim raziskovanjem se lahko izboljšajo varnostni postopki, razvijejo učinkovitejše obrambne strategije in se ustvarijo smernice za politike in zakonodajo na področju kibernetne varnosti.

Kibernetna kriminaliteta je področje, ki se nanaša na kazniva dejanja, storjena s pomočjo računalnikov, omrežij in internetnih tehnologij. Raziskava kibernetne kriminalitete vključuje preučevanje teh dejanj, njihovih vzorcev, metod in posledic, pa tudi razvoj strategij za njihovo preprečevanje in preiskovanje.

Raziskovalci na področju kibernetne kriminalitete analizirajo in razumejo vzorce, motive, tehnike ter vedenje zlonamernih akterjev v kibernetnem prostoru. Njihovi cilji vključujejo razvoj strategij za preprečevanje kibernetnih napadov, identifikacijo in obvladovanje tveganj ter izboljšanje kibernetne varnosti.

Raziskovalci kibernetne kriminalitete uporabljajo različne metode za zbiranje podatkov in analizo. To vključuje analizo sledi v računalniških sistemih, preučevanje podatkovnih baz, spremljanje komunikacij, sodelovanje s ponudniki storitev in preiskovalnimi organi ter uporabo različnih orodij in tehnologij za zaznavanje in preprečevanje kibernetnih napadov.

Poleg preučevanja tehničnih vidikov kibernetne kriminalitete se raziskovalci ukvarjajo tudi z analizo socialnih in pravnih vidikov. To vključuje razumevanje motivacij storilcev, preučevanje vloge družbenih omrežij in medijev pri širjenju kibernetnih napadov, preučevanje pravnih vidikov, povezanih s kibernetno kriminaliteto, ter oblikovanje politik in zakonodaje za boj proti njej.

Raziskave kibernetne kriminalitete so pomembne za razvoj varnostnih ukrepov in politik ter za izboljšanje ozaveščenosti javnosti o tveganjih, povezanih s kibernetno varnostjo. S pomočjo teh raziskav se lahko razvijejo učinkovitejše metode za preprečevanje in obvladovanje kibernetnih napadov, kar prispeva k večji varnosti in zaupanju v digitalno okolje [7].

3 ZNAČILNOSTI KIBERNETSKEGA PROSTORA

Spremembe, ustvarjene z računalnikom in povezovanjem v mrežo, so prinesle novo okolje, v katerem se uporabniki vse pogosteje zbirajo v kibernetnem prostoru, da bi medsebojno komunicirali. Dve ključni značilnosti kibernetnega prostora, ki sta pripomogli pri povečanju kaznivih dejanj, sta ogromno število uporabnikov in brezmejna uporaba interneta. Informacije med podjetji potekajo hitreje brez fizičnih potovanj ali fizične prisotnosti, s hitrejšimi odzivi na velike razdalje in večjim vplivom na globalno občinstvo. Medtem ko je ta tehnološki napredek prinesel družbi obilne koristi, je slaba stran, da te interakcije nudijo tudi idealno platformo za ustvarjanje zločinov. Nove tehnologije niso prinesle samo novega razreda kaznivih dejanj, temveč so tudi povečale število kibernetičnih posameznikov z že vnaprej pripravljenimi programi za kazniva dejanja [2].

Rast kibernetnih kriminalcev ima dva pomembna razloga: prvič, število ljudi, ki so tehnološko dovolj izobraženi, da bi zgrešili kibernetne zločine, eksponentno narašča. Drugič, zdi se, da tudi trg v kibernetni kriminaliteti narašča, saj osebe, ki uporabljajo svoje tehnično znanje za ustvarjanje in nato s prodajo svojih izdelkov omogočajo, da se netehnološko izobraženi ljudje vključijo v kibernetno kriminaliteto [12].

Nepridipravi v kibernetnem prostoru iščejo sisteme, da bi se infiltrirali in jih zlorabili. Samo zaradi tega ali kot intelektualni izziv, obstajajo nekateri, ki poskušajo vdreti v računalnik, da bi lansirali črve ali virus, ki bi lahko okrnili poslovanje organizacije. Zato je potreba po varnosti namenjena vsem uporabnikom interneta tako posameznikom kot podjetjem, da se prilagodijo potencialnim nevarnostim kibernetnega prostora in njegovi zmoglosti povzročitve večjih varnostnih incidentov. Razvoj ukrepov za boj proti tem grožnjam je ključnega pomena, saj slabo razvit varnostni sistem neustrezno varuje pred kibernetnimi napadi, pomanjkanje varnostnih ukrepov pa resno ogroža preživetje in donosnost poslovanja podjetja [13].

4 VRSTE KIBERNETSKIH NAPADOV

Obstaja več vrst kibernetnih napadov, ki se izvajajo s ciljem pridobitve nepooblaščenega dostopa, kraje podatkov, povzročanja škode ali motenja delovanja računalniških sistemov in omrežij.

Napad je lahko aktiven ali pasiven. Aktivni napad poskuša spremeniti sistemske vire ali vplivati na njihovo delovanje, medtem ko pasivni napad poskuša uporabiti informacije iz sistema, vendar ne vpliva na sistemske vire (npr. prisluškovanje) [14].

Napad se lahko izvede znotraj ali zunaj organizacije. Notranji napad je napad, ki ga sproži subjekt znotraj območja zaščite, ki je lahko uporabnik in je pooblaščen za dostop do sistemskih virov, vendar jih uporablja na način, ki ga niso odobrili tisti, ki

so pooblastilo odobrili. Zunanji napad začne zunaj organizacije nepooblaščen ali nelegitimen uporabnik sistema. Na internetu se potencialni zunanji napadi gibljejo od amaterskih potegavščin do organiziranih kriminalcev, mednarodnih teroristov in sovražnih vlad.

Napadi so lahko sintaktični ali semantični. Sintaktični napadi so preprosti, saj veljajo za zlonamerno programsko opremo, ki vključuje viruse, črve in trojanske konje. Semantični napadi pa so bolj zapleteni in vključujejo uporabo različnih računalniških taktik za spreminjanje vedenja uporabnikov računalnika.

Kibernetske napade glede na ciljane uporabnike združimo v dve vrsti: ciljne in nenamerne. V nenamernih napadih napadalci neselektivno ciljajo na čim več naprav, storitev ali uporabnikov. Pri tem jih ne zanima, kdo je žrtev, in uporabljajo tehnike, ki izkoriščajo odprtost interneta. Nenamerni napadi vključujejo lažno predstavljanje ter pošiljanje e-poštnih sporočil večjemu številu ljudi, katere prosijo za občutljive podatke (na primer bančne podatke) ali jih spodbudijo k obisku ponarejenega spletnega mesta. Pogosta je postavitev lažnega spletnega mesta ali ogrožanje zakonitega za izkoriščanje gostujočih uporabnikov. Ponujajo tudi odkupno programsko opremo, ki bi lahko vključevala razširjanje diska, ki šifrira izsiljevalsko zlonamerno programsko opremo. Pojavlja se skeniranje za izvedbo naključnih napadov na spletu.

Pri ciljanem napadu ima napadalec poseben interes za izbrano podjetje ali pa je plačan, da ga cilja. Napad lahko traja mesece, tako da bodo napadalci našli najboljšo pot za napad na izbrane sisteme (ali uporabnike). Ciljni napad je pogosto bolj škodljiv kot nenamerni, ker je posebej prilagojen napadom na sisteme, procese ali osebe, v pisarni in včasih tudi doma. Tudi pri ciljnih napadih je pogosto lažno predstavljanje, pošiljanje e-poštnih sporočil ciljnim osebam, ki lahko vsebujejo prilogo z zlonamerno programsko opremo ali povezavo, ki prenaša zlonamerno programsko opremo. Pogosto gre za napade istega cilja iz različnih mest omrežja, t. i. botnet, zlasti za izvedbo napada Distributed Denial of Service (DDoS). Med ciljnim napadi je tudi uničevanje dobavne verige z napadom programske ali druge opreme, ki se dostavi podjetju [5].

5 KATEGORIJE KIBERNETSKIH NAPADOV

Obstajajo tri osnovne kategorije kibernetskega kriminala. V prvem primeru je računalnik orodje zločina in zajema klasične oblike kaznivih dejanj, kot je goljufija ali ponarejanje, čeprav se v okviru kibernetskega kriminala nanašajo posebej na kazniva dejanja, storjena preko elektronskih naprav. Nekatera od teh kaznivih dejanj vključujejo otroško pornografijo, kaznivo nadlegovanje, goljufije, kršitve intelektualne lastnine in prodajo nezakonitih snovi in blaga.

V drugi kategoriji je računalnik predmet zločina in se nanaša na primere, ko računalnik sam po sebi postane tarča kaznivega dejanja ali je uporabljen za izvrševanje kaznivega dejanja. Pomembno je omeniti, da računalnik sam po sebi ni predmet zločina, temveč ga zločinci izrabljajo za svoje nezakonite dejavnosti. Prav tako je potrebno upoštevati, da so ta dejanja kazniva in se kaznujejo v skladu z zakoni in predpisi o računalniškem kriminalu v posameznih državah. Gre za nova kazniva dejanja, ki so posebej povezana z računalniško tehnologijo in internetom, na primer, nepooblaščen uporaba

računalniških sistemov, onemogočanje spletnih mest, ustvarjanje in zlonamerno razširjanje računalniških virusov.

Pri tretji kategoriji lahko računalnik deluje kot podpora pri izvrševanju različnih kaznivih dejanj, ki zajema uporabo računalnikov, ki jih kriminalci uporabljajo za krajo identitete in zlorabo kreditnih kartic. Uporaba računalnika kot podpore pri izvrševanju zločina je resna kršitev zakonodaje in se kaznuje v skladu s pravnimi določbami o računalniškem kriminalu [6].

6 STANJE KIBERNETSKE KRIMINALITETE

Kibernetska kriminaliteta narašča z eksponentno hitrostjo. V preteklem letu je bilo odkritih približno 900 poskusov lažnega predstavljanja na finančne institucije in več kot 9.000 odkritih poskusov napadov na tehnološka podjetja. Spletna mesta z lažnim predstavljanjem so tudi vse večje tehnološke organizacije, kot so Google, Apple, Facebook in Yahoo, ki so tarče lažnega predstavljanja, pa tudi Dropbox, kjer bi z lažnim predstavljanjem uporabnike lahko prevarali pri nalaganju svojih datotek. V povprečju se vsak dan sproži 85.000 zlonamernih IP-jev, s čimer je povprečna ocena ogleda vseh URL-jev po vsem svetu znašala 65 odstotkov.

Kibernetska kriminaliteta ni omejena samo na namizje naprave; mobilne naprave so se v zadnjih letih razvijale, z njimi pa tudi virusi, zlonamerna programska oprema in lažne prevare. Zaradi odprte platforma je Android izpostavljen različnim zlonamernim programom. V nedavni raziskavi je bilo 72 % vseh aplikacij za OS označeno kot sumljive, nezaželene ali zlonamerne, pri čemer so trojanski konji predstavljali največjo grožnjo.

Zunanja kibernetska kriminaliteta je v porastu, vendar se mnogi strokovnjaki strinjajo, da notranji napadi predstavljajo večje tveganje za podjetja in organizacije. Notranja tveganja je mogoče omiliti z povečanjem izobraževanja zaposlenih; vendar ogromno organizacij tega usposabljanja sploh ne izvaja.

Podatki kažejo, da mnogi odločevalci v organizacijah v celoti ne razumejo resnosti groženj, medtem ko podjetja, ki so postala žrtev kibernetskega kriminala, in podjetja z več kot tisoč zaposlenimi varnost jemljejo veliko bolj resno in imajo več procesov za zmanjšanje tveganja znotraj in zunaj organizacije. Stanje kibernetske kriminalitete kaže tudi na nenehno rast in napredovanje groženj v digitalnem svetu. Zaščita pred kibernetskimi napadi zahteva celovit pristop, ki vključuje izboljšanje kibernetske varnosti, ozaveščanje uporabnikov, sodelovanje med sektorji in državami ter razvoj naprednih tehnologij za odkrivanje in odzivanje na napade. Le z aktivnim in trajnim pristopom lahko obvladujemo kibernetsko kriminaliteto ter zagotovimo varno in zaupanja vredno digitalno okolje.

Pomembno je, da se zavedamo, da je kibernetska kriminaliteta dinamično področje, kjer se zlonamerni akterji nenehno prilagajajo in razvijajo nove metode napadov. Posledično je potrebno stalno izboljševanje varnostnih ukrepov in ozaveščanje, da se zmanjša tveganje in škoda, ki jih povzroča kibernetska kriminaliteta [3].

7 KIBERNETSKA KRIMINALITETA KOT MEDNARODNA GROŽNJA

Kibernetska kriminaliteta je pojav, ki prizadene vse države sveta, zlasti najbolj industrijsko razvite in računalniško podprte. Obstaja na stotine različnih virov, ki zagotavljajo podatke o obsegu kibernetske kriminalitete, vendar so statistični podatki nezadostni in razdrobljeni.

Globalna tveganja postajajo vse bolj problematična zaradi vse večje globalizacije. V tem primeru je kibernetska kriminaliteta še nevarnejša grožnja. Posledice novih tveganj so postale mednarodne in so lahko uničujoče in nepredvidljive. Globalna medsebojna povezanost naredi vsak nacionalni ekonomski proizvodni sistem ranljiv.

Letne stroške škode, ki jo povzroči kibernetska kriminaliteta, je težko oceniti iz več razlogov: nekatera podjetja si ne izmenjujejo informacij, v nekaterih primerih pa je težko oceniti, kakšna je dejanska izguba. Pri tej vrsti kaznivih dejanj je potrebno upoštevati tudi dejstvo, da na mednarodni ravni ni ustrezne zakonodaje. Prav tako je težko določiti, katera dejanja se v različnih nacionalnih državah štejejo za kazniva dejanja, da se pripravijo zanesljive mednarodne ocene.

Poleg tega imajo številna poročila zasebnih varnostnih podjetij omejitve, ker ne morejo zbrati vseh podatkov, zbranih na ravni posamezne nacionalne države. Le uradno poročilo, ki ga je sestavil vladni organ, bi lahko zagotovilo več podrobnosti o končnih statistikah. Vsekakor pa ta poročila varnostnih podjetij nakazujejo na resnost in trende v zadnjih letih glede kibernetske kriminalitete. Vsa poročila pravzaprav poudarjajo, da se tveganje kibernetskih napadov nenehno povečuje in da je vpliv na svetovno gospodarstvo vedno bolj zaskrbljujoč, kar bi moralo biti dovolj, da bi spodbudili mala in srednja podjetja, civilno družbo in vlade, da to grožnjo resneje sprejmejo in med seboj sodelujejo, da bi omejili škodo.

Po podatkih Kasperskega je vpliv kibernetske kriminalitete na svetovno gospodarstvo na žalost velik in se še povečuje, najbolj pa se boji napadov na kritično infrastrukturo. Zaskrbljujoče je tudi znatno povečanje kaznivih dejanj zoper podjetja, kot so goljufije ali kraje identitete [6].

Podjetji McAfeeja in CISCO ocenjujeta, da se razlika med letnimi stroški kibernetske kriminalitete svetovnega gospodarstva giblje med 375 in 575 milijardami dolarjev na leto. McAfee je tudi opozoril, da podjetja ponavadi podcenjujejo resnost kibernetskih tveganj in njihove stopnje rasti [11].

8 CILJI KIBERNETSKE KRIMINALITETE

Cilji kibernetske kriminalitete so raznoliki in pogosto povezani z željo po finančni koristi, kraji podatkov, političnih motivih, vohunjenju in zbiranju obveščevalnih podatkov ter izzivanju strahu in dezinformacij. Razumevanje teh ciljev je ključno za oblikovanje učinkovitih strategij za preprečevanje, odkrivanje in obvladovanje kibernetske kriminalitete. Potrebno je nenehno izboljševanje kibernetske varnosti, ozaveščanje uporabnikov in krepitev sodelovanja med državami, organov pregona in zasebnim sektorjem, da bi zmanjšali vpliv kibernetske kriminalitete na družbo in gospodarstvo.

Kibernetska kriminaliteta ima številne negativne posledice. Žrtve trpijo finančne izgube, kršitve zasebnosti, izgubo zaupanja v digitalno okolje ter se soočajo z nepopravljivo škodo. Poleg

tega lahko kibernetski napadi povzročijo motnje v poslovnih dejavnostih, izgubo produktivnosti, izpad sistemov in celo ogrozijo življenja, še posebej v primeru napadov na kritično infrastrukturo [6].

9 FAZE KIBERNETSKIH NAPADOV

Ker se kibernetski napadi nenehno razvijajo, je razumevanje njihovega delovanja ključno za učinkovito preprečevanje, odkrivanje in obvladovanje kibernetske kriminalitete. Organizacije in posamezniki morajo izvajati ustrezne varnostne ukrepe, kot so redno posodabljanje programske opreme, izobraževanje uporabnikov o varnostnih tveganjih, vzpostavitev naprednih varnostnih rešitev ter vzdrževanje odzivnih načrtov za obvladovanje kibernetskih napadov.

Kibernetski napadi običajno potekajo skozi več faz, pri čemer zlonamerni akterji sledijo določenemu postopku za izvajanje napada. Faze kibernetskega napada se razlikujejo glede na specifične tehnike in metode.

Med splošnimi fazami kibernetskega napada je zbiranje informacij (Reconnaissance) o ciljni organizaciji ali tarči. Gre za iskanje ranljivosti v sistemih, preučevanje javno dostopnih informacij, analizo omrežnih struktur in identifikacijo potencialnih ciljev.

Faza, v kateri se po zbiranju informacij zlonamerni akterji poskušajo vpisati v ciljni sistem ali omrežje, se imenuje vstop (Gaining Access). Vstopijo lahko z izkoriščanjem varnostnih pomanjkljivosti, uporabo hekerskih tehnik, kot je kraja gesel ali prek šibkih točk v varnostnih postopkih.

V fazi t. i. razširjanja (Escalation) zlonamerni akterji pridobijo dostop do ciljnega sistema, se poskušajo razširiti in pridobiti večji nadzor nad omrežjem, se premikajo po sistemih, iščejo dodatne ranljivosti, izkoriščajo privilegije ali uporabijo napredne tehnike za skrivanje prisotnosti.

V fazi pridobivanja cilja (Acquiring the Target) zlonamerni akterji dosežejo svoj cilj, ki je lahko različen, od kraje občutljivih podatkov do povzročanja škode ali izsiljevanja žrtev, sabotiranja sistemov ali drugih nezakonitih aktivnosti.

Po dosegu svojega cilja zlonamerni akterji poskušajo obdržati dostop do ciljnega sistema ali omrežja za nadaljevanje napadov. Ta faza se imenuje vzdrževanje dostopa (Maintaining Access) in vključuje skrivanje svoje prisotnosti, izogibanje odkrivanju in namestitve dodatnih orodij za nadzor.

Poznamo tudi fazo prikrivanja sledi (Covering Tracks), kjer se zlonamerni akterji trudijo otežiti preiskavo in identifikacijo tako, da brišejo dnevniške zapise, spreminjajo evidence ali manipulirajo z metapodatki, da bi zameglili svojo prisotnost oz. zabilisali svojo sledi [9].

10 KIBERNETSKA VOJNA IN KIBERNETSKI TERORIZEM

Kibernetska vojna se nanaša na uporabo računalniških virusov in trojanskih konjev zato, da se napadeni državi uniči vitalne računalniške sisteme, primerljive s škodo dejanske vojne in/ali ovirajo vitalne računalniške sisteme. Kibernetski terorizem predstavlja načrtovan, politično motiviran napad na informacije, računalniške sisteme, računalniške programe in podatke z namenom zaustavitve kritične nacionalne infrastrukture (kot so energetika, transport, vladne operacije) ali zastraševanje vlade ali

civilnega prebivalstva. To pomeni, da je končni rezultat kibernetnega vojskovanja in kibernetnega terorizma enak, da bo škodoval kritični infrastrukturi in računalniškim sistemom, povezanim znotraj meja kibernetnega prostora [9].

Dejavniki, ki prispevajo k temu, zakaj se kibernetni napadi sprožijo proti državi ali posamezniku, so faktor strahu, faktor spektakularnosti in dejavnik ranljivosti.

Napadi v okviru kibernetne vojne in kibernetnega terorizma lahko povzročijo resne posledice, vključno z motenim delovanjem državnih sistemov, gospodarskimi izgubami, krajo občutljivih informacij, izsiljevanjem in ogrožanjem javne varnosti. Zato je pomembno, da se države, organizacije in posamezniki aktivno ukvarjajo s preprečevanjem, odkrivanjem in obrambo pred takšnimi grožnjami ter vzpostavijo učinkovite mehanizme za kibernetno varnost.

V okviru kibernetnega vojskovanja mora posameznik prepoznati državne akterje, ki sodelujejo pri zagrešitvi teh kibernetnih napadov, kjer poleg glavnih akterjev Kitajske in ZDA, sodelujejo tudi številni drugi državni in nedržavni akterji, kot so Rusija, Izrael, Iran, Irak in Al Kaida.

11 UPORABA UMETNE INTELIGENCE ZA ZAGOTAVLJANJE KIBERNETSKE VARNOSTI

Umetno inteligenco se uporablja v kibernetni varnosti za prepoznavanje novih vrst zlonamerne programske opreme, proizvajanje opozoril za nevarnosti in varovanje kritičnih podatkov za organizacije in je ključna za zagotavljanje prihodnosti kibernetne varnosti. Toda z vse večjo vlogo umetne inteligence v kibernetni varnosti je treba razvijati tudi strategije za obrambo pred napadi, ki izkoriščajo umetno inteligenco. Tehnologija umetne inteligence omogoča hitro zaznavanje ne samo eksplicitnih groženj, ampak tudi anomalij obnašanja in ima velik potencial za bistveno izboljšanje kibernetne varnosti. V nadaljevanju navajamo primere uporabe umetne inteligence.

Umetno inteligenco se lahko uporablja za avtomatizacijo procesov odkrivanja in odzivanja na kibernetne napade. Z uporabo algoritmov strojnega učenja in globokega učenja lahko umetna inteligenca prepozna nenavadne vzorce, zazna sumljive aktivnosti in identificira potencialne grožnje, ki jih človeški analitiki morda spregledajo.

S pomočjo umetne inteligence je omogočena napredna analiza podatkov in prepoznavanje vzorcev, ki jih človeški analitiki morda ne bi opazili. S tem se povečuje učinkovitost in natančnost pri identifikaciji groženj ter zmanjšuje tveganje lažno pozitivnih ali lažno negativnih rezultatov.

Nadalje lahko umetna inteligenca analizira vedenje uporabnikov, sistemov in omrežij ter prepozna nenavadno ali sumljivo aktivnost. Na podlagi tega lahko sistem avtomatično zazna in prepreči morebitne napade, kot so phishing ali distribuirani napadi z zavračanjem storitve DDoS.

Z uporabo algoritmov strojnega učenja in analize vedenja lahko umetna inteligenca zazna znake zlonamerne programske opreme in posodablja varnostne mehanizme za preprečevanje in odzivanje nanje. Uporablja se jo za prepoznavanje in analizo zlonamerne programske opreme, vključno s škodljivo kodo, virusi, trojanskimi konji in izsiljevalsko programsko opremo.

Na podlagi zgodovinskih podatkov, vzorcev napadov in drugih dejavnikov lahko umetna inteligenca identificira

potencialne ranljivosti in priporoča ukrepe za njihovo odpravo ali zmanjšanje tveganj. To omogoča napovedovanje prihodnjih groženj z analizo ogromnih količin podatkov in ustvarjanjem napovedi o potencialnih tveganjih in ranljivostih.

Uporaba umetne inteligence v kibernetni varnosti uporabnikom pa še vedno predstavlja določene izzive. Napredne tehnike umetne inteligence sicer temeljijo na kakovostnih in reprezentativnih podatkih, a je pri tem ključnega pomena povečanje natančnosti in zanesljivosti analitičnih rezultatov.

Napadalci lahko sami uporabijo umetno inteligenco za izvajanje napadov. Zato je treba razviti tudi protiukrepe, ki se borijo proti napadom umetne inteligence znotraj kibernetne varnosti.

Za implementacijo in upravljanje sistemov umetne inteligence je potreben strokovni kader z znanjem na področju kibernetne varnosti in umetne inteligence.

Napadalci lahko zlorabijo umetno inteligenco, da ustvarijo in uporabijo zlonamerno programsko opremo ter izvedejo napade, ki se izognejo tradicionalnim varnostnim mehanizmom. Napredna tehnologija umetne inteligence, ki se uporablja za napredne analize in avtomatizirane odločitve, lahko postane tudi orodje za izvedbo napadov. Zato je pomembno, da se razvijajo tudi obrambni mehanizmi, ki prepoznajo in blokirajo takšne napade.

Sistemi umetne inteligence zahtevajo velike količine kakovostnih podatkov za učinkovito delovanje. V kibernetni varnosti pa so podatki, ki so na voljo za analizo, pogosto nepopolni, nezanesljivi ali zavajajoči. Pomanjkanje kakovostnih podatkov lahko vodi do napačnih zaključkov ali napak pri odkrivanju napadov. Zato je potrebno posebno pozornost nameniti zbiranju in preverjanju podatkov za uporabo v sistemih umetne inteligence v kibernetni varnosti [4].

Napadalci nenehno razvijajo nove in kompleksne načine za izvajanje kibernetnih napadov. Tradicionalni varnostni sistemi se pogosto težko spopadejo s temi napadi, zato je uporaba umetne inteligence v kibernetni varnosti privlačna. Vendar pa je izziv v tem, da sistemi umetne inteligence pogosto temeljijo na učenju iz preteklih podatkov, kar pomeni, da morda ne bodo prepoznali novih napadov, ki se razlikujejo od preteklih vzorcev. Nepoznani napadi in napredne grožnje zahtevajo stalno nadgradnjo in prilagajanje sistemov umetne inteligence.

Uporaba umetne inteligence v kibernetni varnosti lahko vključuje zbiranje in analizo velike količine osebnih podatkov. To postavlja vprašanja glede zasebnosti in etične uporabe teh podatkov. Pomembno je, da se pri razvoju in uporabi sistemov umetne inteligence upoštevajo smernice zasebnosti in etični standardi ter da se zagotovi varno in odgovorno ravnanje s podatki.

Umetna inteligenca ima velik potencial za izboljšanje kibernetne varnosti z avtomatizacijo procesov, napredno analitiko in prepoznavanjem groženj. Kljub izzivom, ki jih prinaša implementacija umetne inteligence v kibernetno varnost, je nujno, da uporabniki izkoristijo tehnološki napredek za učinkovito zaščito pred kibernetnimi napadi in zagotovijo varno digitalno okolje [8].

12 DRUGI UKREPI ZA POVEČANJE KIBERNETSKE VARNOSTI

Pri soočanju s kibernetскими kaznivimi dejanji je težava v neskladju med orodji in znanjem, ki je na voljo kibernetским zločincem, ter orodji in znanjem, ki so na voljo tistim, ki se morajo zoperstaviti temu pojavu. Orodja za izvajanje kibernetškega napada postajajo močnejša in lažja za iskanje in uporabo ter so relativno poceni. Spretnosti, potrebne za izvajanje kibernetškega napada, se zmanjšujejo. Z malo truda se lahko zločinec opremi s potrebnimi orodji in informacijami za izvedbo te naloge, razvoj temnega spleta pa stvari še poenostavi.

Za boj proti kibernetски kriminaliteti so potrebna močna zakonodajna dejanja, mehanizmi za kazenski pregon, ustrezni instrumenti, sodelovanje, najpomembnejše pa je znanje. Da bi se učinkovito spopadli s kibernetско kriminaliteto, je potrebno stalno izobraževanje in prilagajanje varnostnih ukrepov. Posamezniki, organizacije in države morajo biti osredotočeni na preprečevanje napadov, uporabo močnih gesel, redno posodabljanje programskih rešitev, izvajanje varnostnih kopij in skrbno ravnanje z občutljivimi podatki. Uporabnikom se še vedno svetuje, da se izogibajo kliku na vsako lažno predstavljajanje, saj ko kršitev postane javna, je prepogosto prepozno.

Celoten svet se osredotoča na obrambo sistemov, ne pa na prepoznavanje, zasledovanje in iskanje osebe, ki stoji za kibernetским zločinom. Potrebujemo nov pristop: kibernetškega kriminalca je potrebno ujeti za vsako ceno na kakršen koli način. Dejanski in potencialni kibernetски kriminalci se morajo zavedati, da to ni več kaznivo dejanje z majhnim tveganjem in da bodo ujeti in kaznovani, in šele takrat se bodo zmanjšali kibernetски napadi. Kibernetška vzgoja, kibernetška higiena, kibernetška budnost in kibernetška varnost niso dovolj dobri, potrebujemo kibernetške aretacije in pogoje kibernetškega zapora.

Kibernetски kriminalci so korak pred kibernetско varnostjo z nenehnim spreminjanjem taktike, iskanjem neznanih ranljivosti, brisanjem dnevnikov, da zakrijejo svoje sledi in uporaba naprednih tehnologij. Hitro, zanesljivo in dosledno kaznovanje je edini način, da se omeji kibernetška kriminaliteta [8].

13 ANALIZA ORODIJ ZA PREISKAVO KIBERNETSKE KRIMINALITETE

Forenzična programska oprema je v sodobnem digitalnem okolju nepogrešljiva. Orodja omogočajo temeljito preiskavo, ki jo je mogoče uporabiti za različne namene, kot je iskanje predhodno prikritih informacij, pridobivanje uporabnih podatkov, vzdrževanje celovitosti podatkov, dešifriranje šifriranih datotek in preučevanje najmanjših podrobnosti. Strokovnjaki jih potrebujejo za odkrivanje, analizo in interpretacijo digitalnih dokazov. Orodja lahko spadajo v veliko različnih kategorij, vključno s forenziko baz podatkov, zajemom diska in podatkov, analizo e-pošte in datotek, pregledovalnike datotek, internetno analizo, analizo mobilnih naprav, omrežno forenziko in analizo registra. Poleg tega mnoga orodja izpolnjujejo več kot eno funkcijo hkrati, pomemben trend v orodjih za digitalno forenziko pa so »ovitki«, ki združujejo na stotine specifičnih tehnologij z različnimi funkcionalnostmi v en krovni komplet orodij.

Digitalna forenzična orodja uporabljajo organi kazenskega pregona pri reševanju kaznivih dejanj, organizacije jih uporabljajo tudi za odzivanje na incidente in obnovitev podatkov

in jih lahko na primer uporabljajo za digitalno forenziko, da analizirajo, kako je prišlo do vdora ali so napadalci dostopali do podatkov ali jih izločili in kako so se zlonamerni akterji premikali po omrežju. S temi informacijami lahko organizacije natančno opišejo napad prizadetim deležnikom in organom pregona. Široka uporaba orodij zagotavlja informacije o taktikah, tehnikah in postopkih skupin kibernetškega kriminala.

Številni strokovnjaki za digitalno forenziko uporabljajo več orodij za obravnavo različnih vidikov forenzičnega postopka, odvisno od zahtev preiskave. V nadaljevanju so opisana najbolj uporabljena orodja.

Autopsy je priročno orodje za preiskavo trdega diska z operacijskim sistemom Windows OS in mobilnimi napravami z operacijskim sistemom Android. Je hitra in temeljita digitalna forenzična platforma in grafični vmesnik za Sleuth Kit in druga digitalna forenzična orodja. Uporabljajo ga organi pregona, vojska in korporativni preiskovalci.

CAINE ponuja obsežno forenzično preiskovalno platformo, zasnovano za vključitev drugih orodij in modulov v uporabniku prijazen grafični vmesnik. Njegovo interoperabilno okolje je namenjeno pomoči preiskovalcem v vseh štirih fazah preiskave: ohranjanje, zbiranje, pregledovanje in analiza. Poleg tega je na voljo z desetimi predpakiranih modulov (npr. Autopsy). Orodje, razvito v sistemu Linux, je popolnoma odprtokodno in na voljo brezplačno.

Microsoftov Computer Online Forensic Evidence Extractor (COFEE) je komplet forenzičnih orodij, ki izvleče dokaze iz operacijskega sistema Windows. Vsebuje več kot 150 funkcij in ima grafični uporabniški vmesnik, ki preiskovalca vodi skozi zbiranje in pregled podatkov ter pomaga pri ustvarjanju poročil po ekstrakciji. Dešifriranje gesel, obnovitev internetne zgodovine in drugi obrazci za zbiranje podatkov so vključeni v osnovni nabor orodij.

CrowdStrike je digitalna forenzična programska oprema, ki zagotavlja obveščanje o grožnjah in varnosti končne točke. Hitro lahko odkrije in obnovi kibernetške varnostne incidente. To orodje lahko uporabite za iskanje in blokiranje napadalcev v realnem času.

Od leta 1998 EnCase ponuja forenzično programsko opremo za pomoč strokovnjakom pri pridobivanju dokazov v primerih kazenskih preiskav, ki vključujejo kršitve kibernetške varnosti, tako da obnovi dokaze in analizira datoteke na trdih diskih, tablicah in mobilnih telefonih in omogoča izvedbo poglobljene analize datotek za zbiranje dokazov, kot so dokumenti in slike.

FTK Imager je komplet forenzičnih orodij, ki lahko ustvari kopije podatkov, ne da bi spremenil izvirne dokaze. To orodje omogoča, da določite merila, kot so velikost datoteke, velikost slikovnih pik in vrsta podatkov, da zmanjšate količino nepomembnih podatkov. Prav tako lahko pregledate in obnovite datoteke, ki so bile izbrisane iz koša pod pogojem, da njihovi podatkovni bloki niso bili prepisani, ustvarite zgoščene vrednosti datotek SHA1 ali MD5, izvozite datoteke in mape iz forenzičnih slik na disk in namestite forenzično sliko za ogled njene vsebine v Windows Explorerju.

Pred petnajstimi leti sta bila nesporna voditelja računalniške forenzike Encase Forensics in AccessData FTK. Njihova funkcionalnost se je med seboj dopolnjevala in omogočila izvlečenje največjega števila različnih vrst podatkov iz pregledanih naprav. Danes sta ta dva programa zastarela.

Trenutna funkcionalnost Encase ni v skladu z zahtevami sodobne programske opreme za pregled računalnikov in strežnikov z operacijskim sistemom Windows. Uporaba Encase ostaja pomembna v "nerutinskih" primerih, ko morate pregledati računalnike z operacijskim sistemom Mac OS ali strežnik z operacijskim sistemom Linux OS ali izvleči podatke iz redkih formatov datotek. Enscript makro jezik, vgrajen v Encase Forensics, vsebuje veliko knjižnico skriptov, ki jih izvajajo proizvajalec in z njimi lahko analizirate veliko število različnih operacijskih in datotečnih sistemov. AccessData FTK poskuša podpirati funkcionalnost izdelka, vendar čas obdelave za shranjevanje podatkov bistveno presega razumen čas, ki si ga povprečni strokovnjak lahko privoščiti za pregled.

Trenutno najbolj napredno orodje računalniške forenzike je Magnet AXIOM. Program se ne le postopoma razvija, temveč vključuje tudi pregled mobilnih naprav, pridobivanje podatkov iz skladišč v oblaku, pregled naprav z operacijskim sistemom MacOS itd. Program ima uporabniku prijazen in funkcionalen vmesnik, ki se lahko uporablja za preiskave, povezane z varnostjo računalnikov ali mobilnih naprav.

MAGNET RAM Capture omogoča preiskovalcem kibernetike varnosti obnovitev in analizo podatkov, shranjenih v pomnilniku računalnika. To brezplačno orodje lahko izvozi neobdelane pomnilniške podatke v neobdelanih formatih (.DMP, .RAW, .BIN), ki jih je mogoče naložiti v druga orodja za forenzično analizo, kot sta Magnet AXIOM in Magnet IEF. Podpira več različic operacijskih sistemov Windows.

Oxygen Software je eden najboljših programov za podatke, pridobljene iz mobilnih naprav. Integrirani pregledovalniki podatkovnih baz SQLite in datotek omogočajo, temeljit ročni pregled določene baze podatkov SQLite.

PALADIN je program, ki temelji na Ubuntuju in olajša različne forenzične analize. S pomočjo tega programa se lahko hitro in učinkovito poenostavi forenzične naloge. V njem je na voljo več kot 100 uporabnih orodij za preučevanje kakršne koli škodljive vsebine.

Registry Recon je računalniško forenzično orodje, ki uporabnikom omogoča, da vidijo, kako so se registri trenutnih in prejšnjih namestitev sistema Microsoft Windows spreminjali in hitro identificira vse zunanje naprave, povezane z osebnim računalnikom, tako da ekstrahira, obnovi in analizira podatke registra iz operacijskega sistema Windows.

SANS Investigative Forensics Toolkit (SIFT) je zbirka odprtokodnih tehnologij za odzivanje na incidente in forenzičnih tehnologij, zasnovanih za izvajanje podrobnih digitalnih preiskav v različnih okoljih. Je eno izmed najboljših forenzičnih orodij, ki varno pregleda neobdelane diske in več formatov datotek na samo za branje in ne spremeni dokazov, ki jih odkrije.

X-Ways velja za napredno in učinkovito orodje, ki hitro deluje, olajša obnovitev izbrisanih datotek in ponuja prenosljivost. Program ima vgrajen mehanizem za zmanjšanje lažno pozitivnih rezultatov, kar pomeni, da digitalni forenzični analitik, ki obnovi datoteke s trdega diska 100 GB, ne dobi 1 TB obnovljenih datotek (večina od njih so lažno pozitivni rezultati, kot se običajno zgodi, ko se uporablja programe za obnovitev).

Xplico, ustvarjen leta 2007, je orodje za analizo omrežne forenzike, ki prestrukturira podatke prek vohljača paketov. Specializiran je za identifikacijo protokola, neodvisnega od vrat, za rekonstrukcijo podatkov aplikacije in prepoznavanje njenih protokolov. Glavni cilj Xplico, ki je na voljo kot brezplačno in

odprtokodno orodje, je pridobivanje podatkov aplikacije iz zajema internetnega prometa. Xplico zagotavlja izhodne podatke in informacije v zbirki podatkov SQLite ali zbirki podatkov Mysql in/ali datotekah. Primerjava navedenih orodij za digitalno forenziko je prikazana v Tabeli 1.

Tabela 1: Primerjava orodij za digitalno forenziko

Ime	Platforma	Licenca	Leto	32/64 bitna različica
Autopsy	Windows, macOS in Linux	plačljiv	2000	32/64
CAINE	Linux	brezplačen in odprtokoden.	2009	64
COFFEE	Windows	plačljiv	2006	64
CrowdStrike	Windows, macOS in Linux	plačljiv	2011	64
EnCase	Windows	plačljiv	1998	64
FTK	Windows	plačljiv		64
Magnet AXIOM	Windows	plačljiv		64
Oxygen Forensic	Windows, macOS in Linux	plačljiv	2001	64
PALADIN	Windows, macOS in Linux	brezplačen in odprtokoden.		32/64
Registry Recon	Windows	plačljiv	2012	64
SANS Investigative Forensics Toolkit - SIFT	Ubuntu	plačljiv	2007	64
X-Ways	Windows	plačljiv	2004	32/64
Xplico	Windows	brezplačen in odprtokoden.	2007	64

Izbira najboljšega orodja za digitalno forenziko zahteva natančno preučitev številnih dejavnikov. Uspešne digitalne preiskave ter celovitost in zanesljivost procesov je mogoče zagotoviti z usklajevanjem orodja s poslovnimi cilji, varnostnimi standardi, strokovnim znanjem uporabnikov in proračunom.

V poslovnem svetu sta varnost in učinkovitost podatkov glavni prioriteti, ekipe za odzivanje na incidente pa morajo hitro ukrepati, da prepoznajo težave in jih odpravijo. Izbira pravilne programske opreme za digitalno forenziko, ki je v skladu s cilji podjetja in regulativnimi normami, zahteva temeljito razumevanje teh edinstvenih zahtev. Za organe kazenskega pregona je treba strogo izvajati skladnost in ohranjanje dokazov. Medtem ko imajo posamezni programi samo svojo funkcionalnost, je pogosto bolj učinkovito uporabljati več orodij skupaj. Po drugi strani pa je paket forenzične programske opreme celovitejša rešitev, ki lahko obravnava več težav hkrati, kar lahko pospeši in olajša stvari med preiskavo.

Trend zadnjih let je »fuzija« funkcionalnosti programov. Proizvajalci, ki prvotno razvijajo programe za mobilno forenziko, v svoje izdelke uvajajo funkcionalnost pregledov trdih diskov. Proizvajalci forenzičnih izdelkov, ki so specializirani za pregled trdih diskov, dodajajo funkcionalnost pregleda mobilnih naprav. Obe vrsti proizvajalcev dodajata funkcionalnost pridobivanja podatkov iz shramb v oblaku. Posledično imamo "večnamenske programe", s pomočjo katerih lahko izvajamo pregled mobilnih naprav, trdih diskov, pridobivamo podatke iz skladišč v oblaku in analiziramo podatke, pridobljene iz vseh teh virov.

Pri razvoju mobilne forenzike lahko vidimo, da so se programi za analizo mobilnih naprav razvili vzporedno s funkcionalnostjo mobilnih naprav. Pred tem je digitalni

forenzični analitik ali oseba, ki je naročila preiskavo, lahko dobila samo podatke iz telefonskega imenika, SMS, MMS, klicev, grafičnih in video datotek, sedaj pa digitalni forenzični analitik pridobi tudi ostale podatke.

Pri izbiri orodja za digitalno forenziko je raven znanja ključnega pomena. Medtem ko nekatere tehnologije zahtevajo samo osnovno strokovno znanje, druge zahtevajo več znanja. Pravilo je, da pretehtate svoje sposobnosti glede na potrebe znanja orodij, kar vam omogoča, da izberete najboljše orodje, ki ga lahko uporabite. Tudi znotraj iste kategorije orodij se bodo rezultati razlikovali, medtem ko nekatera orodja ustvarijo celovito poročilo, ki ga je mogoče takoj deliti z netehničnimi delavci, drugi programi vrnejo samo neobdelane podatke. Strukturirano poročilo vam lahko v nekaterih okoliščinah olajša delo.

Na izbiro orodja močno vplivajo tudi razpoložljiva sredstva. Čeprav je odprtokodna programska oprema pogosto brezplačna, lahko njena učinkovita uporaba zahteva visoko raven strokovnega znanja. Stroški, funkcionalnost in donosnost naložbe so dejavniki, ki jih je treba upoštevati pri odločanju o orodju. Večja podjetja si lahko privoščijo bolj izpopolnjene pakete, ki ponujajo več funkcij in pomoči.

Uporaba odprtokodnih forenzičnih orodij je dejansko precej drugačna od tistega, kar si predstavljamo. Obstaja nekaj težav, na katere lahko naletimo: omejena zmogljivost, nezanesljivost, pomanjkanje podpore, trojanski konji ali vohunska programska oprema, izguba podatkov in okvara OS. Poleg tega se odprtokodna forenzična orodja morda ne bodo več aktivno razvijala, posodabljala ali podpirala, če se razvijalci odločijo opustiti projekt. To lahko povzroči težave z uporabnostjo, pomisleke glede kibernetike varnosti in zanašanje na tehnologijo, ki je zastarela ali ni več ustrezna.

Področje digitalne forenzike nosi precejšen delež odgovornosti, zato je veliko bolje imeti zanesljiva profesionalna orodja. Ker ima večina plačljivih digitalnih forenzičnih rešitev običajno brezplačno 30-dnevno preskusno različico, jo lahko preizkusimo in ugotovimo ali so boljše alternativa odprtokodnim forenzičnim orodjem. Poleg tega plačljivi ponudniki rešitev programske opreme na področju digitalne forenzike vedno zagotavljajo usposabljanje, pomoč na kraju samem, vzdrževanje in nadgradnje. Številni lastniški sistemi imajo intuitivne vmesnike in podporo ena na ena, ki novim uporabnikom pomagajo hitro začeti delovati. Pri tej odločitvi je potrebno upoštevati tudi ostale dejavnike, na primer raven usposobljenosti ekipe, potrebo po edinstvenih zmogljivostih in prednost brezplačnega ali plačljivega vzdrževanja.

Zaupnost in varnost sta na področju digitalne forenzike izjemnega pomena. Izbrana programska oprema prepreči nepooblaščenim osebam dostop do podatkov med postopkom pregleda. Vedno je potrebno preveriti ali obstajajo obrambne funkcije, kot so šifriranje, preverjanje pristnosti in zaščita pred pisanjem, ki zagotavljajo dodatno stopnjo zaščite za orodje. Pred nakupom se je potrebno prepričati, če je bil izdelek temeljito pregledan zaradi varnostnih pomanjkljivosti in da je v skladu z vsemi ustreznimi predpisi in standardi [10].

14 ZAKLJUČEK

Kibernetika kriminaliteta v svojem trenutnem zagonu in žal porastu prizadene milijarde žrtev po vsem svetu. Za varnost

uporabnikov in gospodarstva je ključnega pomena nasprotovanje naraščajočemu pojavu kibernetike kriminalitete. Dogodki kibernetike kriminalitete postajajo vse bolj pogosti in razširjeni, njihov vpliv na svetovno gospodarstvo pa postaja zaskrbljujoč. Potrebno se je globalno odzvati, in sicer s skupnim naborom pravil in skupnimi načrti za tehnološki razvoj. Izvajanje politik kibernetike varnosti je naloga vsake države, vendar je treba v zvezi s tem pojavom spodbuditi mednarodno sodelovanje ter javna in zasebna partnerstva.

Med orodji za zagotavljanje kibernetike varnosti omogoča umetna inteligenca zaradi svoje sposobnosti obdelave velikih količin podatkov in učenja na podlagi vzorcev učinkovito odkrivanje, preprečevanje in odzivanje na kibernetike grožnje. Njena uporaba v kibernetiki varnosti ima potencial za izboljšanje učinkovitosti, natančnosti in hitrosti odziva na ogrožanje kibernetike varnosti. Vendar pa je treba upoštevati, da umetna inteligenca ni samostojna rešitev in je potrebna tudi človeška strokovnost in nadzor. Potrebno je sistematično in globalno delovanje in ustrezna zakonodajna podlaga. Ključnega pomena pa je tudi znanje in izobraževanje, razumevanje koncepta kibernetike kriminalitete, poznavanje ciljev in načina njenega delovanja ter poznavanje in uporaba učinkovitih ukrepov za zaščito pred njenimi napadi [8].

Področji umetne inteligence (AI) in strojnega učenja (ML) postajata vse bolj priljubljena in kažeta velik potencial za revolucijo digitalne forenzike. Ta orodja pomagajo avtomatizirati analitični proces, najti vzorce in napovedati prihodnja tveganja za kibernetiko varnost. Zlasti napovedna analitika, ki jo omogoča AI, nudi pomoč forenzičnim enotam pri njihovih prizadevanjih za preventivni boj proti kibernetiki napadom, kar ima za posledico hitrejše in učinkovitejše odzive.

Občuten premik v smeri računalništva v oblaku je povečal tudi pomen forenzike v oblaku. Ker je v oblaku shranjenih več podatkov, je nujno uporabiti posebne forenzične metode za preučevanje kibernetiki zločinov v oblaku.

Toda ta razvoj dogodkov s seboj prinaša tudi povsem nove težave. Z razvojem tehnologije se razvijajo tudi taktike kibernetiki kriminalcev. Zaradi priljubljenosti šifriranih naprav in vse večje uporabe kriptovalut je postalo težje prepoznati nezakonite dejavnosti. Poleg tega bodo v letu 2023 težave med jurisdikcijami in zakoni o zasebnosti še naprej velike ovire za digitalna forenzična podjetja.

Na digitalno forenziko vplivajo novi trendi kibernetike varnosti. Forenzika interneta stvari postaja nujna, saj se naprave interneta stvari (IoT) množijo in širijo prostor za potencialne kibernetike grožnje. Zaradi naraščajoče sofisticiranosti kibernetiki groženj sta potrebna stalen razvoj in izboljšanje forenzičnih orodij in postopkov.

Ko gre za boj proti kibernetiki kriminaliteti, so digitalna forenzična orodja ključnega pomena, saj so zanesljiva, prilagodljiva in enostavna za uporabo. Izbira ustrezne programske opreme za delo izboljša hitrost in natančnost preiskav, kar prispeva k varnejšemu spletnemu okolju. Izbira najboljših digitalnih forenzičnih orodij ni lahka naloga. Na podlagi raziskave, ki smo jo opravili je to nekaj priporočil in vsako od njih prinaša nekaj edinstvenega.

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Izkustveno učenje v visokem šolstvu: model in primera s področja digitalne in zelene preobrazbe

Experiential learning in higher education: a model and examples in the field of digital and green transformation

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POVZETEK

V tem prispevku obravnavamo model izkustvenega učenja v visokem šolstvu in primera njegove uporabe v praksi, pri čemer se osredotočamo na področje digitalne in zelene preobrazbe. Izkazalo se je, da se tudi v Sloveniji kaže potreba po pridobivanju izkustvenega znanja na tem področju, ki je nujno potrebno za povečanje konkurenčnosti in zaposljivosti študentov.

KLJUČNE BESEDE

digitalna preobrazba, izkustveno učenje, izkustveno znanje, visoko šolstvo, Slovenija, zelena preobrazba

ABSTRACT

In this paper, we discuss the experiential learning model in higher education and examples of its application in practice, focusing on the field of digital and green transformation. It has been shown that there is a need to acquire experiential knowledge in this field in Slovenia as well, which is absolutely necessary to increase the competitiveness and employability of students.

KEYWORDS

digital transformation, experiential learning, experiential knowledge, higher education, Slovenia, green transformation

1 UVOD

Digitalna in zelena preobrazba med študenti povzroča potrebo po pridobivanju izkustvenega znanja na tem področju, ki ga bodo lahko uporabljali pri opravljanju svojega poklica. V ta namen sta soavtorja tega prispevka razvila model, ki študentom omogoča pridobivanje izkustvenega znanja na tem področju [1]. Primera, ki ju obravnavamo v nadaljevanju tega prispevka, kažeta, da je to znanje nujno potrebno za povečanje njihove konkurenčnosti in zaposljivosti, česar se zavedajo tudi zaposleni v visokem šolstvu,

ki iščejo možnosti za njihovo vključevanje v reševanje problemov na teh področjih [1, 2].

V tem prispevku obravnavamo model izkustvenega učenja v visokem šolstvu in primera njegove uporabe v praksi, s čimer dopolnjujemo literaturo v slovenskem jeziku o izkustvenem učenju v visokem šolstvu. Pri tem se osredotočamo na vključevanje študentov v reševanje problemov na področju digitalne in zelene preobrazbe. Izkazalo se je, da tudi zaposlenim v gospodarstvu primanjkuje izkustveno znanje na tem področju, kar je koristna informacija za odločevalce v visokem šolstvu.

Ta prispevek ima poleg uvoda še štiri poglavja. V poglavju 2 podajamo pregled literature, v poglavju 3 metode, v poglavju 4 rezultate, v poglavju 5 pa razpravo in sklepe.

2 PREGLED LITERATURE

V tem poglavju podajamo pregled literature v slovenskem jeziku o izkustvenem učenju v visokem šolstvu. Leta 2021 je Znanstvena založba Filozofske fakultete Univerze v Ljubljani izdala učbenik Izkustveno učenje [3], katerega avtorice so B. Šteh, B. Marentič Požarnik in M. Šarič. Njegova posebnost je, da je namenjen med drugim tudi visokošolskim učiteljem, zato sta ga lahko soavtorja tega prispevka, ki sta zaposlena v visokem šolstvu, uporabljala pri svojem delu s študenti v okviru projektov, ki jih predstavljamo v nadaljevanju tega prispevka. Soavtorja sta svoje izkušnje z izkustvenim učenjem v praksi delila tudi z drugimi. Romih [4] je obravnaval izkustveno in skupnostno učenje kot načina pridobivanja izkustvenega znanja na področju študija, pri čemer je predstavljal svoje izkušnje iz San Antonia (Teksasa), ki jih je pridobil med svojim usposabljanjem na eni od sanantonijških (teksaških) univerz. Ugotovil je, da se vloga in pomen izkustvenega znanja v Združenih državah Amerike (ZDA) povečujeta. Romih [5] je obravnaval tudi vlogo in pomen izkustvenega in skupnostnega učenja, pri čemer je predstavljal svoje izkušnje iz Clevelanda (Ohia), ki jih je pridobil med svojim usposabljanjem na eni od clevelandskih (ohajskih) univerz. Ugotovil je, da sta izkustveno in skupnostno učenje pomembna za prihodnje iskalce zaposlitve. Romih in A. Primec [2] sta obravnavala pridobivanje znanj in veščin za zeleno preobrazbo med dodiplomskim študijem ekonomije in tehnike, pri čemer sta se osredotočila na primer projekta, ki ga obravnavamo v nadaljevanju tega prispevka. Ugotovila sta, da zelena preobrazba med študenti povzroča potrebo po pridobivanju znanj in veščin

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na tem področju, ki jih lahko uporabijo pri nadaljevanju študija in pokliū (praksi). Med drugim sta zapisala:

Skrb za zeleno prihodnost med študenti /.../ povzroča potrebo po pridobivanju znanj in veščin za zeleno preobrazbo. Izkazalo se je, da je zeleni prehod priložnost za sodelovanje med Univerzo v Mariboru (UM) in gospodarstvom pri izobraževanju študentov /.../ na področju zelene preobrazbe.

3 METODE

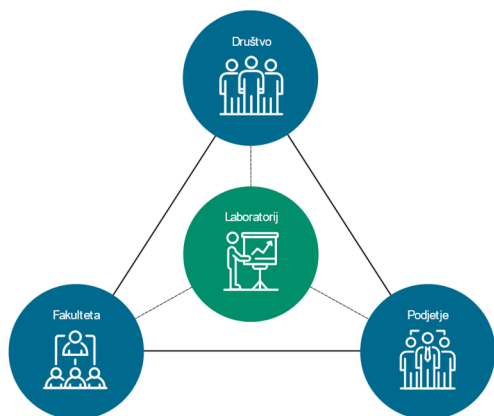
V raziskavi, katere rezultate podajamo v naslednjem poglavju, smo uporabljali metodo študije primera, pri čemer smo se omejili na obravnavo »modela« (izkustvenega učenja) in primerov njegove uporabe v praksi.

4 REZULTATI

To poglavje ima tri podpoglavja. V poglavju 4.1 obravnavamo »model« (izkustvenega učenja), v poglavju 4.2 primere njegove uporabe s področja digitalne in zelene preobrazbe, v poglavju 4.3 pa njegovo uporabnost (tudi na drugih področjih ter v srednjem in višjem šolstvu).

4.1 Model

V tem poglavju obravnavamo »model« (izkustvenega učenja), ki vključuje tri partnerje (iz lokalnega okolja): visokošolsko ustanovo (fakulteto) ter društvo in podjetje (Slika 1), ki sodelujeta pri izkustvenem učenju (v lokalnem okolju). Delo na projektu poteka v okviru »laboratorija« (za izkustveno učenje), katerega člani so študenti različnih fakultet (disiplin), vključuje pa reševanje problema, s katerim se spopada podjetje, ki sodeluje pri projektu. Glavna naloga visokošolske ustanove je, da poišče visokošolskega učitelja ali sodelavca, ta pa študente, ki so pod njegovim mentorstvom pripravljene reševati problem, s katerim se spopada to podjetje. Glavna naloga društva je, da skupaj s svojimi člani poišče podjetje, ki je pri tem pripravljeno sodelovati, glavna naloga podjetja pa, da skupaj s študenti poišče problem, ki so ga ti pripravljene reševati. Prednost vključitve društva v aktivnosti je ta, da imajo njegovi člani zveze in poznanstva v gospodarstvu.



Slika 1: »Model« (izkustvenega učenja)

4.2 Primeri s področja digitalne in zelene preobrazbe

V tem poglavju obravnavamo dva primera izkustvenega učenja v visokem šolstvu s področja digitalne in zelene preobrazbe, ki temeljita na uporabi modela, ki ga obravnavamo v poglavju 3.1. Digitalna in zelena preobrazba med študenti povzročata potrebo po pridobivanju izkustvenega znanja na tem področju, česar se zavedajo tudi zaposleni v visokem šolstvu [1, 2]. Romih in A. Primec [1] sta npr. zapisala:

Digitalna preobrazba med študenti UM povzroča potrebo po pridobivanju novih znanj in veščin, ki jim bodo koristila v njihovem pokliū. Tega se zaveda tudi UM, ki izvaja različne projekte, s katerimi izboljšuje zaposljivost prihodnjih iskalcev zaposlitve.

3.2.1 Laboratorij za digitalno ekonomijo

Laboratorij za digitalno ekonomijo (LDE) je prvi primer izkustvenega učenja v visokem šolstvu, ki ga obravnavamo v tem prispevku. Pri tem projektu so sodelovali Ekonomsko-poslovna fakulteta Univerze v Mariboru (EPF UM), Društvo ekonomistov Maribor (DEMB) in pet projektnih partnerjev iz lokalnega okolja (med drugim tudi največja banka v Sloveniji), ki so petim do- in trem podiplomskim študentom UM omogočili pridobivanje izkustvenega znanja na področju digitalne preobrazbe. Študenti so v okviru projekta reševali probleme na področju digitalne preobrazbe, s katerimi so se spopadali projektne partnerji iz lokalnega okolja. Cilj je bil, da predlagajo rešitve, ki bi jih lahko projektne partnerji iz lokalnega okolja uveljavili v praksi, kar so tudi naredili. Študenti so rezultate svojega dela predstavili DEMB-u in projektnim partnerjem iz lokalnega okolja, in si v strokovni monografiji, ki je izšla pri Univerzitetni založbi Univerze v Mariboru (Slika 2), in na študentskem posvetovanju Digitalna ekonomija 2022, ki so ga organizirali DEMB, EPF UM in Študentski svet EPF UM. Na ta način so pridobili tudi izkustveno znanje na tem področju.



Slika 2: Naslovnica strokovne monografije

3.2.2 Laboratorij za zeleno ekonomijo

Laboratorij za zeleno ekonomijo (LZE) je drugi primer izkustvenega učenja v visokem šolstvu, ki ga obravnavamo v tem prispevku. Pri tem projektu so sodelovali EPF UM, DEMB in

dva projektna partnerja iz lokalnega okolja (med drugim tudi druga največja banka v Sloveniji), ki so osim dodiplomskim študentom Univerze v Mariboru omogočili pridobivanje izkustvenega znanja na področju zelene preobrazbe. Študenti so v okviru projekta reševali probleme na področju zelene preobrazbe, s katerima sta se spopadala projektna partnerja iz lokalnega okolja. Tudi v tem primeru je bil cilj, da predlagajo več rešitev. Študenti so rezultate svojega dela predstavili na dogodku Zelena prihodnost, ki ga je organiziral DEMB, in študentskem posvetovanju Digitalna ekonomija in pravo 2023, ki so ga organizirali DEMB, EPF UM, Študentski svet EPF UM in Študentski svet Pravne fakultete UM.

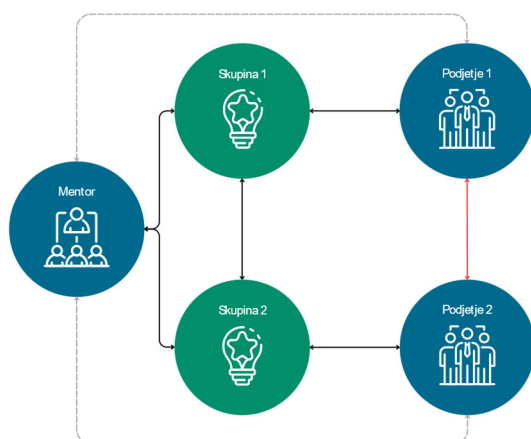
Romih in A. Primec [2] sta glede projekta zapisala:

Člani LZE so delali po skupinah, s čimer so razvijali lastnosti, kot so npr. etičnost, discipliniranost, komunikativnost, kritičnost, natančnost, odgovornost, organiziranost, moralnost, podjetnost, prilagodljivost, samozavestnost in timskost, ki jih bodo potrebovali v pokliu. Prva skupina je reševala problem, s katerim se srečuje energetska podjetja iz lokalnega okolja, druga pa problem, s katerim se srečuje finančno podjetje iz lokalnega okolja. Člani skupin so iskali rešitve, ki bi podjetjema pomagale pri uresničevanju njunih načrtov za zeleno preobrazbo, s čimer so uresničevali cilje študentskega projekta.

Posebnost tega projekta je bila tudi ta, da so lahko študenti pri svojem delu uporabljali klepetalni robot ChatGPT, kar jim je zlasti na začetku, ko so se seznanjali s problematiko na tem področju, olajšalo njihovo delo.

Delo na projektu je potekalo tako, da je omogočalo izmenjevanje izkustvenega znanja med:

- člani posamezne skupine (študenti),
- posamezno skupino in mentorjem,
- posamezno skupino in posameznim podjetjem,
- obema skupinama,
- mentorjem in posameznim podjetjem ter
- obema podjetjema (Slika 3).



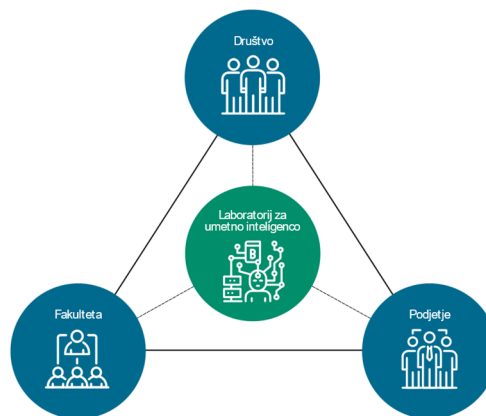
Slika 3: Izmenjevanje izkustvenega znanja

4.3 Uporabnost modela in predlog njegove uporabe

»Model« (izkustvenega učenja), ki ga obravnavamo v tem prispevku, je mogoče uporabiti tudi na drugih področjih ter v srednjem in višjem šolstvu, kjer se tudi kaže potreba po izkustvenem učenju. Zavedati se moramo, da se razmere v okolju, v katerem živimo in delamo, spreminjajo, kar povzroča tudi v šolstvu potrebo po prilagajanju. Na trgu dela se kaže potreba po iskalcih zaposlitve, ki imajo izkustveno znanje, zato je pomembno, da ga pridobijo že med svojim šolanjem [6].

Soavtorja tega prispevka sta »model« (izkustvenega učenja) uporabila tudi pri projektu S4S, pri katerem je sodelovala študentka T. Primec, ki je soavtorica tega prispevka.

V nadaljevanju tega poglavja podajamo **predlog** uporabe »modela« (izkustvenega učenja) na področju (uporabe) umetne inteligence. Naš predlog je, da bi študenti v okviru Laboratorija za umetno inteligenco (Slika 4) reševali problem na področju (uporabe) umetne inteligence, s katerim se spopada podjetje, ki bi sodelovalo pri tem projektu. Glavni cilj projekta bi bil podati pregled brezplačnih aplikacij in orodij, ki uporabljajo umetno inteligenco, ter jih razvrstiti glede na njihovo uporabnost v poslovanju podjetja.



Slika 4: »Laboratorij za umetno inteligenco«

Naš predlog je tudi, da bi glede na delovno področje pri tem projektu sodelovali študenti različnih disciplin (npr. ekonomije, prava, psihologije, računalništva, sociologije), ki bi na ta način pridobili znanja in veščine za delo v interdisciplinarni skupini.

5 RAZPRAVA IN SKLEP

Izkazalo se je, da je model (izkustvenega učenja), ki sta ga za potrebe projekta LDE, razvila soavtorja tega prispevka, uporaben tudi na področju zelene preobrazbe (zelenega prehoda). Dejstvo je, da se tudi v Sloveniji kaže potreba po izkustvenem učenju na tem področju, česar se zavedajo tudi zaposleni na UM.

Primeri, ki ju obravnavamo v tem prispevku, kažeta, da izkustveno učenje ni koristno samo za sedanjost, ampak tudi za prihodnost. Študenti lahko namreč izkustveno znanje, ki so ga pridobili z izkustvenim učenjem, uporabijo pri nadaljevanju študija in v poklicu. Tako je toliko pomembnejše, da oblikovalci visokošolske politike spodbujajo izkustveno učenje v visokem šolstvu.

ZAHVALA

Soavtorja tega prispevka z EPF UM se zahvaljujeta partnerjem in študentom, ki so sodelovali pri projektih LDE in LZE.

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Učinkovita digitalna orodja za formativno preverjanje znanja pri učencih s posebnimi potrebami

Effective Digital Tools for Formative Assessment of Knowledge in Students with Special Needs

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POVZETEK

Učitelji dajejo vedno večji poudarek na kvalitetno izvedbo formativnega preverjanja znanja med učnim procesom, da bi lahko zbirali informacije o znanju, ki so namenjene učencem in tudi njim samim. To je lahko dobra pomoč za učinkovitejšo vodenje pouka in pridobivanje novega znanja na drugačen način. Proces preverjanja znanja pa je lahko še učinkovitejši, če pri njem uporabimo dostopna digitalna orodja in spletne aplikacije. 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 nadaljevanju pa bom predstavila spletni aplikaciji Kahoot! in Plickers ter spletne matematične igre, ki nam služijo kot pripomoček pri formativnem preverjanju znanja pri delu z učenci v prilagojenem izobraževalnem programu z nižjim izobrazbenim standardom.

KLJUČNE BESEDE

Formativno preverjanje znanja, Kahoot!, Plickers, prilagojen program z nižjim izobrazbenim standardom, spletne aplikacije.

ABSTRACT

Teachers place increasing emphasis on the qualitative performance of formative assessment during the learning process in order to gather information about knowledge, which are meant for students and themselves. This can be a good help to manage lessons more efficiently and to gain new knowledge in a different way. The formative assessment process can be made even more efficient by using available digital tools and online applications. In the post, I am presenting how students with special needs use their mobile devices during math lessons and for homework. Adolescents use modern technology, especially phones, which are far from being used just for calling, but also for various other activities. Because of this, I came up with the idea to try and utilize their attachment and use mobile devices as motivators and

tools. In the following, we will introduce the Kahoot and Plickers online application, which serve us as a tool at formative assessment when working with students in adapted education program with a lower education standards.

KEYWORDS

Formative assessment, Kahoot!, Plickers, adapted educational program with lower education standards, online applications

1 UVOD

Vsak izobraževalni sistem teži k temu, da bi učenci kakovostno pridobili znanje ter ga znali kasneje tudi koristno uporabiti. Z razvojem tehnologije se je razvilo tudi izobraževanje in šolstvo. Posledično je to vplivalo tudi na razvoj metod poučevanja in preverjanje znanja. Matematika je še vedno eden izmed predmetov, ki učencem predstavlja največ težav, zato je toliko bolj pomembno sprotno spremljanje znanja učencev ter iskanje rešitev za odpravljanje napak. Način spremljanja znanja je odvisen od vsakega učitelja posebej, zato je zelo pomembno, na kakšen način zna učence motivirati, jim podati povratno informacijo in jih spodbuditi k aktivnemu učenju in iskanju rešitev za izboljšanje lastnega znanja. C. Razdevšek Pučko (2004) je ugotovila, da »preverjanje znanja izpolni formativno vlogo šele takrat, ko učencu ponudi kakovostno povratno informacijo in mu ponudi pot za odpravo teh pomanjkljivosti« [3].

Osrednji cilj je predstavitev spletnih aplikacij in spletne matematične igre za formativno preverjanje znanja pri pouku. Z učenci z lažjo motnjo v duševnem razvoju, ki obiskujejo osnovno šolo s prilagojenim programom z nižjim izobrazbenim standardom smo pri pouku matematike v 8. razredu spoznali in uporabljali aplikaciji Kahoot! in Plickers ter spletne matematične igre. Na ta način smo želeli prispevati k izboljšanju kakovosti učenja.

2 FORMATIVNO SPREMLJANJE ZNANJA

Brodnik pravi: da je formativno spremljanje »ena najpomembnejših aktivnosti za vzpostavljanje vezi med učencem in učiteljem z namenom premagovanja vrzeli med procesoma učenja in poučevanja. Učitelje navaja na strategije za izboljšanje poučevanja in na upoštevanje različnih vidikov učenja. Glavno vlogo pri tem ima dajanje povratnih informacij in navajanje

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učencev na samovrednotenje učenja in znanja. Pomembno vlogo in tudi vrstniško vrednotenje. Učence se navaja na večjo odgovornost za lastno učenje in znanje. Formativno spremljanje se lahko uvede tudi na klasične teste znanja, če ima povratna informacija namen izboljšati znanje in učni uspeh« [1].

Na vir se sklicujemo tako, da navedemo zaporedno številko vira v oglatem

»Formativno preverjanje, ki »hrani« učenca in učitelja ter starše za nadaljnji razvoj učenja, spodbuja fleksibilno organiziranje učnih stopenj.« To pomeni, da učitelj organizira živahnejši, bolj razgiban pouk, ki omogoča učencem, da razvijejo svoje mišljenje [2].

Wiliam opisuje formativno spremljanje kot »most med poučevanjem in učenjem.« Definicija poudarja predvsem učinek vrednotenja na učiteljeve odločitve pri poučevanju, pri tem pa upošteva pet glavnih strategij:

- razjasnitev, soudeležnost pri določanju in razumevanje namenov učenja in kriterijev za uspeh;
- priprava takšnih dejavnosti v razredu, s katerimi je mogoče pridobiti dokaze o učenju;
- zagotavljanje povratnih informacij, ki učence premikajo naprej;
- aktiviranje učencev, da postanejo drug drugemu vir poučevanja;
- aktiviranje učencev za samoobvladovanje njihovega učenja [4].

Definicij za formativno preverjanje znanja je veliko, med seboj so si dokaj podobne. Vsi omenjeni avtorji v ospredje postavljajo predvsem kvalitetno podajanje povratne informacije ob koncu formativnega preverjanja znanja. Učencu je treba podati, katere stopnje znanja je že dosegel, ga spodbuditi k iskanju pomanjkljivosti ter mu ponuditi možnosti in pokazati pot za odpravljanje pomanjkljivosti v njegovem znanju. Povratna informacija mora biti razumljiva, konkretna, uporabna ter povezana s ciljem učenja.

3 SPLETNE APLIKACIJE

3.1 Kahoot!

Gre za prosto dostopno in zelo preprosto spletno aplikacijo. 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« 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? 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 projicirani sliki 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. Kadar so bile matematične naloge kompleksnejše, morajo najprej nalogo rešiti v zvezek, šele potem so lahko izberejo pravi odgovor (Slika 1).

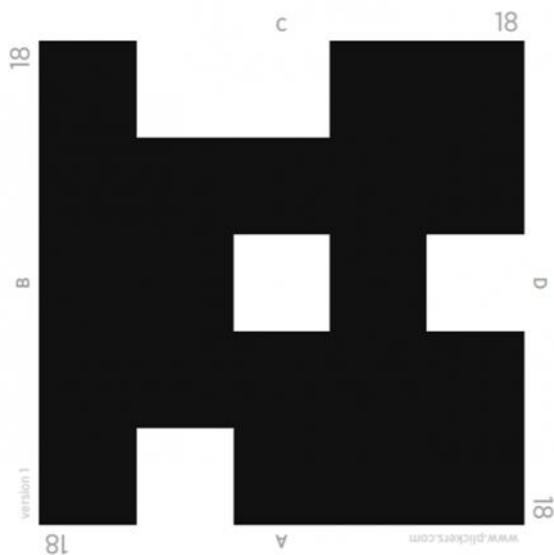
Za vsako nalogo sestavlja kviz določi časovni okvir, v katerem morajo udeleženci podati odgovor. Ko vsi odgovorijo oziroma poteče čas, dobijo udeleženci povratno informacijo o pravilnosti odgovora. Učenci so lahko razvrščeni na lestvici ne le po pravilnosti odgovora, ampak če želimo, lahko nastavimo, da šteje tudi hitrost, kar predstavlja še dodatno motivacijo.



Slika 1. Učenec rešuje primer deljenja števil z enomestnim deliteljem v zvezek, na mobilni napravi bo izbral pravilni odgovor

3.2 Plickers

Plickers je preprost glasovalni sistem, ki učiteljem omogoča zbiranje podatkov v formativni obliki v realnem času brez potrebe po napravah. Učencem omogoča, da javno odgovorijo na vprašanja z uporabo osebnega QR-kodnega lista, ki ga lahko bere samo optični bralnik, tako, da lahko vsi učenci odgovarjajo hkrati. QR-kodni list ima na vsaki strani zapisano črko. To pomeni, da lahko obračamo kodni list v vse štiri smeri, pravilen odgovor je vedno zapisan na vrhu kartice (slika 2).



Slika 2. QR-kodni list

Orodje Plickers lahko uporabljamo za hitra preverjanja razumevanja, če želimo vedeti, ali učenci razumejo določeno snov. Vsem učenec omogoča, da sodelujejo. Učitelj na projektorju pokaže vprašanje, učenci QR-kodni list obrnejo tako, da je črka za katero mislijo, da je pravilni odgovor na vrhu. Ko vsi učenci pokažejo kartice s QR kodami, učitelji z mobilnim telefonom, na katerem imamo nameščeno aplikacijo Plickers, posnamemo odgovore. Na zaslonu projektorja se pokažejo rezultati učencev.

Učitelj za delo potrebuje računalnik in tablico ali mobilni telefon. Učitelj lahko kreira vprašanja le na dva načina – pravilen/nepravilen odgovor ali oziroma več možnih odgovorov. Omejitev ima tudi pri številu kreiranih orodij – največ štirje odgovori. Orodje ne nudi možnosti časovne omejitve ter točkovanja odgovorov. Če povzamemo, orodje ne nudi veliko, je pa zelo uporabno za hitro formativno spremljanje, preverjanje in zelo enostavno za uporabo.

3.3 Spletne matematične igre

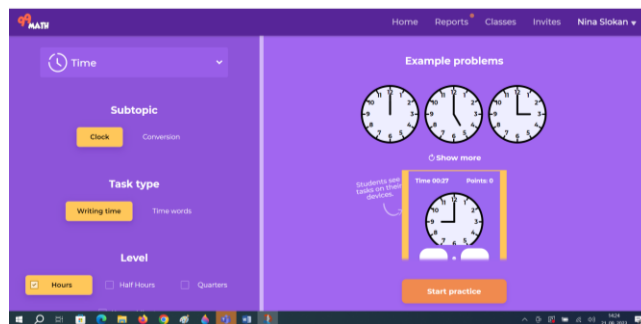
V prejšnjem šolskem letu sem odkrila nove spletne matematične igre. Na spletni strani www.99math.com se nahaja zbirka matematičnih iger za učence. Je spletna platforma, ki omogoča učiteljem ustvarjanje in uporabo matematičnih iger za poučevanje matematike v razredu.

Na spletni strani se lahko učitelji registrirajo, ustvarijo svoje razrede in povabijo učence, da se pridružijo. Nato lahko učitelji izbirajo med različnimi matematičnimi igrami, ki so na voljo na platformi, in jih uporabljajo med poukom. Te igre so zasnovane tako, da spodbujajo sodelovanje, tekmovanje in kritično razmišljanje.

Igre so prilagojene učnim ciljem in standardom znanja iz matematike ter ponujajo interaktivne izkušnje za učence. Vključujejo igre, kot so matematične dirke, kvizi, tekme v hitrosti odgovarjanja na matematična vprašanja in še več.

Prednosti spletnih matematičnih iger so, da lahko učitelji izberejo matematične igre, ki ustrezajo specifičnim učnim ciljem in potrebam svojih učencev. Spletna stran ponuja različne nivoje težavnosti in možnosti prilagajanja igre, da se prilagodi stopnji

znanja učencev. Zabavne in interaktivne matematične igre spodbujajo motivacijo in angažiranost učencev pri učenju matematike. Tekmovanje med učenci in dosežki spodbujajo pozitivno tekmovalnost in željo po doseganju boljših rezultatov. Učitelji lahko spremljajo napredek in dosežke učencev na zaslonu. To jim omogoča vpogled v razumevanje posameznih učencev, njihova močna področja in področja, na katerih morda potrebujejo dodatno podporo. Uporaba spletne strani www.99math.com lahko tako popestri matematično učenje v razredu, spodbuja sodelovanje in motivacijo ter omogoča bolj interaktivno in angažirano izkušnjo za učence (Slika 3).



Slika 3. Primer matematične igre: zapis časa

4 ZAKLJUČEK

Za razliko od tradicionalnega načina preverjanja znanja uporaba formativnega spremljanja, preverjanja znanja s pomočjo digitalnih orodij in spletnih aplikacij pri pouku vzpodbuja aktivno sodelovanje vseh učencev in ohranja nenehno učencev stik z obravnavano snovjo in utrjevanjem le-te. Prav tako ohranja stik z učiteljem, saj je lahko nenehno seznanjen s kvaliteto znanja svojih učencev. Učenci se pri takšnih preverjanjih pogosto srečujejo tudi z moderno digitalno tehnologijo, ki lahko pomembno prispeva k učenčevemu znanju in služi kot odličen motivator za učenje, vendar jo moramo premišljeno uporabljati. Za učence z lažjo motnjo v duševnem razvoju smo na začetku uporabili le dve spletni orodji, ki sta zelo enostavni za uporabo. V prihodnje pa smo postopoma vključevali še druga spletna orodja.

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Uporaba digitalnih gradiv pri izbirnem predmetu šah

Use of digital materials in optional chess lessons

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POVZETEK

V prispevku je predstavljen primer uporabe in izdelave digitalnih gradiv od 7. do 9. razreda pri izbirnem predmetu šah na Osnovni šoli Antona Martina Slomška Vrhnika. Šah spodbuja intelektualni razvoj, zlasti vpliva na razvijanje logičnega mišljenja ter na pridobivanje miselnih navad in veščin. V okviru izbirnega predmeta šah nastajajo digitalna gradiva, kjer učenci obravnavajo teme s področja šaha. Izbirajo lahko med temami, ki jih ponudi učitelj ali pa si izberejo svojo temo. Učenci igrajo šah preko spleta, kjer vadijo ali pa tekmujejo s šahisti po svetu. Izdelujejo kvize s pomočjo različnih aplikacij, kot so Kahoot, Wordwall, Quizlet, Ika, PowerPoint, Quizizz, Googlove ankete. Prav tako izdelujejo interaktivne učne liste v okolju Liveworksheets. Uporaba digitalne tehnologije pri učenju uči in navaja učence na samostojno učenje, kar bodo lahko uporabili kasneje v življenjskih situacijah. Prav tako vzbuja pozornost, aktivno učenje ter vpliva na razvoj notranje motivacije za delo. Učenci, ki obiskujejo šahovske ure skozi šolsko leto razvijajo spretnosti, strategije in koncept vseživljenjskega učenja, ki je danes nujno tako za profesionalni kot za osebni razvoj posameznika.

KLJUČNE BESEDE

izbirni predmet šah, digitalna gradiva, osnovna šola, vseživljenjsko učenje

ABSTRACT

The article presents an example of the use and production of digital materials from the 7th to 9th grade in the optional subject of chess at the Antona Martina Slomška Vrhnika Elementary School. Chess promotes intellectual development, especially influencing the development of logical thinking and the acquisition of mental habits and skills. As part of the chess elective course, digital materials are created where students discuss topics from the field of chess. They can choose from the topics offered by the teacher or they can choose their own topic. Students play chess online, where they practice or compete with chess players from around the world. They make quizzes using various applications like Kahoot, Wordwall, Quizlet, Ika, PowerPoint, Quizizz, Google Polls. They also produce interactive worksheets in the Liveworksheets environment. The use of digital technology in learning teaches and introduces students to independent learning, which they will be able to use later in life situations. It also arouses attention, active learning and influences the development of internal motivation for work. Students who attend chess lessons throughout the school year develop skills, strategies and the concept of lifelong learning,

which today is essential for both the professional and personal development of an individual.

KEYWORDS

optional chess lessons, digital materials, elementary school, lifelong learning

1 UVOD

Šah imenujemo kraljevska igra, ne zato ker v njej nastopa kralj in ne zato ker bi jo igrali kralji, temveč zato, ker je s svojo poštenostjo, neizčrpno vsebino in lepoto stvaritev, igra nad igrami, v vzgojnem in v kulturnem pomenu [1].

Šah ima številne koristi za učence. Najprej spodbuja razvoj kognitivnih sposobnosti, kot so logično razmišljanje, koncentracija, načrtovanje in kreativnost. Otroci, ki se ukvarjajo s šahom, se naučijo premišljenega načrtovanja, kar jim lahko pomaga pri reševanju problemov v šoli in v življenju. Poleg tega igranje šaha spodbuja razvoj vizualne in prostorske zaznave, kar je pomembno za uspešno učenje matematike in drugih predmetov. Šah je tudi odlična družabna aktivnost. Igranje šaha spodbuja socialne veščine in izboljšuje samozavest. Učenci se učijo sodelovanja, spoštovanja in spoštovanja pravil, ki so ključne veščine za uspeh v življenju [2].

2 DIGITALNA KOMPETENTNOST

V šolah po Sloveniji se zadnja leta poskuša dvigniti digitalno kompetentnost in tako izboljšati kakovost in učinkovitost izobraževanja in usposabljanj ter spodbujati razvoj inovativnih učnih okolij in prožnih oblik učenja, ki bodo prispevali k dvigu digitalnih kompetenc vodstvenih in strokovnih delavcev, otrok, učencev in dijakov [3].

Pri izbirnem predmetu šah so učenci uporabljali in izdelovali digitalna gradiva. Pri tem so bili posebej pozorni na kritično vrednotenje, izbiro in ustvarjanje digitalnih vsebin z upoštevanjem avtorskih pravic in licenc. Učenci so spoznali, kaj je digitalna vsebina, digitalni vir, digitalni podatek, licenca, katere slike lahko uporabijo pri svojih digitalnih gradivih, kako izdelati slike s pomočjo umetne inteligence, kako obdelati zvok in videoposnetek, kako urejati besedila, osnove slikovnih formatov, kako beležiti podatke in kako podatke predstaviti na zanimive načine. Pri tem so se dotaknili tudi osnov programiranja, kot npr. kakšne so osnovne lastnosti digitalnih naprav ter spoznali njihovo delovanje. Učenci so narejene vsebine delili s sošolci preko sistema shranjevanja podatkov v oblaku.

3 OPIS DELA IN REZULTATI

3.1 Gradiva za učitelje

V nadaljevanju je prikazanih nekaj gradiv, ki jih učitelji lahko uporabijo pri izbirnih predmetih šah.

Spletna učilnica ŠAH 7. – 9. razred – Na slovenskem izobraževalnem omrežju je spletna učilnica, kjer so zbrana gradiva za delo pri pouku izbirnih predmetov šaha. Spletna učilnica je dostopna na povezavi <https://skupnost.sio.si/course/view.php?id=2138>. Ima 26 poglavij, kjer najdemo gradiva za vse tri izbirne predmete Šah-1 (Šahovske osnove), Šah-2 (Šahovsko kombiniranje) in Šah-3 (Šahovska strategija) (slika 1). V spletni učilnici najdemo gradiva tako za opise posameznih izbirnih predmetov kot tudi vsebine zanje.



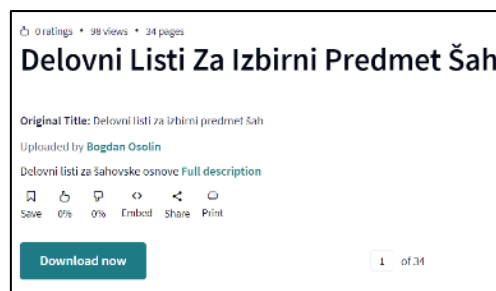
Slika 1: Spletna učilnica na sio.si

Kraljevska igra Šah – na tej spletni strani lahko naročimo učbenike za izbirne predmete šaha. Na Osnovni šoli Antona Martina Slomška Vrhnika učbenike uporabljamo pri vseh izbirnih predmetih (Šah-1, Šah-2 in Šah-3), saj so res kvalitetno narejeni. Ponujajo pa tudi gradiva za poučevanje interesne dejavnosti Šah (slika 2). Spletna stran je dostopna na <https://kraljevskaignra.com/ucbeniki/>.



Slika 2: Učbeniki za izbirne predmete šah

Delovni listi za izbirni predmet Šah-1. Na spletu najdemo tudi delovne liste, ki jih lahko uporabimo pri pouku šaha. Delovni listi so dostopni na <https://www.scribd.com/doc/241406762/Delovni-listi-za-izbirni-predmet-%C5%A1ah#> (slika 3).



Slika 3: Delovni listi za šah

Šahovska zveza Slovenije ŠZS – Na njihovi spletni strani najdemo največ novic o šahu v Sloveniji in po svetu. Spletna stran je razdeljena na sedem zavihkov: Več, Novice, Tekmovanja, Klubi, Igralci, Sodniki, ŠZS. Spletna stran je dostopna na <https://www.sah-zveza.si/> (slika 4). Učitelji, ki želijo učence prijaviti na tekmovanja v šahu, bodo na omenjeni spletni strani našli največ informacij. Prav tako bodo tukaj na enem mestu našli pravilnike, datume in opise tekmovanj, revijo Šahovska misel, veliko uporabnih povezav, predvsem pa vse aktualne novice o šahu.

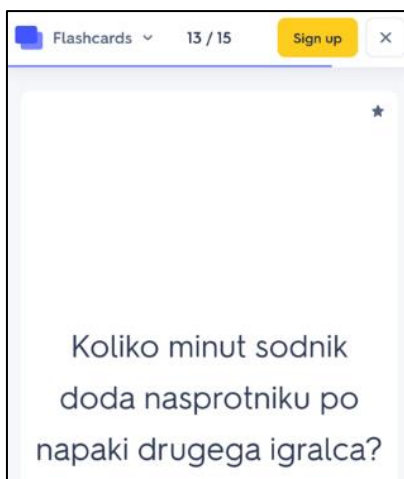


Slika 4: Spletna stran ŠZS

3.2 Digitalna gradiva pri pouku šaha

V začetku šolskega leta 2022/2023 smo učencem 7. – 9. razreda pri izbirnih predmetih šah ponudili možnost, da izdelajo digitalna gradiva na temo šaha. Skupaj smo določili kriterije za izdelavo predstavitev. Učiteljica je ponudila nekaj tem, učenci pa so lahko izbrali tudi svojo temo. Izdelava je bila obvezna za vse učence, ki obiskujejo izbirne predmete šah.

Del učencev si je izbral izdelavo kartic za učenje. Na spletu so poiskali spletno stran Wordwall (<https://wordwall.net/sl>), se prijavili s svojim uporabniškim računom, ki so ga predhodno ustvarili, nato pa izbrali gumb Ustvari dejavnost ter izbrali Flash karte. Spletna stran je v slovenščini, zato z izdelavo kartic učenci niso imeli težav. Na temo Pravilniki ŠZS so izdelali kartice za učenje. Na eni strani kartice je vprašanje, ko kartico obrneš, dobiš pravilni odgovor (slika 5). Kartice za učenje so učenci izdelovali tudi s pomočjo orodja Quizlet (<https://quizlet.com>). Učenci so kartice izdelali doma, nato pa so sošolci pri pouku v šoli utrjevali svoje znanje. V kolikor so želeli, so lahko znanje preverjali in utrjevali tudi kasneje, saj so bile vse povezave do izdelanih kartic shranjene v oblaku OneDrive.



Slika 5: Primer Flash kartice

Učenci so zelo radi izdelovali spletne kvize. Predstavljamo nekaj programov, v katerih so spletni kvizi nastali. Učenci so kvize izdelali doma, nato pa povezavo delili s sošolci, ki so kvize reševali v šoli pri pouku. Vsak učenec je kviz reševal samostojno na pametnem telefonu, šolski tablici ali na šolskem računalniku. Pri kvizih je zelo dobro, ker učenec dobi takojšnjo povratno informacijo o pravilnosti odgovorov. Po vsakem rešenem kvizu smo se pogovorili, katera vprašanja so nam šla dobro in kje smo bili slabši. Nato smo naredili analizo in skupaj poiskali pravilne odgovore.

Del učencev je raziskoval hitropotezni šah. Izdelali so kvize z več možnimi odgovori v Wordwall programu (slika 6). To spletno stran učenci dobro poznajo, zato jim izdelava kvizov v tem programu ni delala težav.



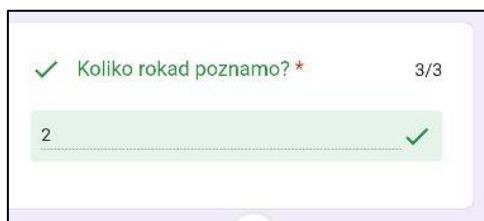
Slika 6: Spletni kviz narejen v programu Wordwall

Učenec 9. razreda je na temo premikanje šahovskih figur izdelal spletni kviz v programu Ika (slika 7). Spletni naslov do kviza je delil v oblaku, nato so sošolci rešili kviz na pametnih telefonih. Učenec spletne strani Ika (<https://www.ika.si>) prej ni poznal, zato je imel nekaj začetniških težav, ki pa jih je sam uspešno rešil. Povedal je tudi, da program za izdelavo kviza ni bil zahteven. V program Ika se lahko prijavimo z AAI prijavo.



Slika 7: Primer vprašanja kviza v Iki

Znanje o rokadah v šahu smo preverili s pomočjo kvizov narejenih v Googlovih obrazcih (slika 8). Tudi ta način dela učenci dobro poznajo, zato jim ni delal težav. Morajo pa imeti Googlov račun.



Slika 8: Spletni kviz o rokadah

Šahovske nazive smo raziskovali s kvizi narejenimi s PowerPointom (slika 9). Učenci PowerPoint navadno uporabljajo za predstavitve, izdelava kviza jim je zato od začetka delala nekaj težav. Pomagali so si z nasveti na spletni strani <https://zmaga.com/content.php?id=5472>. Kot slabost so izpostavili tudi, da je tako izdelan kviz najmanj zanimiv za sošolce.



Slika 9: Šahovski nazivi v kvizu

Znanje o osnovah šaha so učenci preverjali s kvizom, narejenim v programu Quizizz (slika 10). Kviz je izdelal učenec s statusom tujca, ki je program (<https://quizizz.com>) dobro poznal. Po rešenem kvizu je sošolcem razložil, kako izdelati kviz ali predstavitev v tem programu, saj so bili vsi navdušeni nad možnostmi, ki jih kviz ponuja (različni tipi vprašanj, več izbir odgovora, vstavljanje besed, anketa, vprašanja odprtega tipa, dodajanje slik in videoposnetkov, takojšnja povratna informacija). Brezplačna različica orodja omogoča pripravo neomejenega števila gradiv. Naenkrat lahko v kvizu sodeluje do 100 udeležencev.



Slika 10: Osnove šaha v programu Quizizz

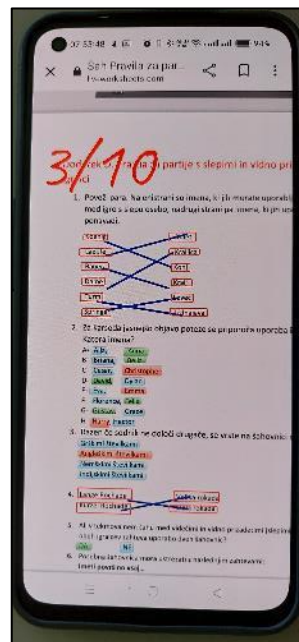
Največ učencev si je za izdelavo kviza izbralo orodje Kahoot (<https://kahoot.com/>), ker ga najbolj poznajo, saj ga uporabljajo tudi pri drugih predmetih. Učenec, ki je kviz naredil, je na tablo najprej projiciral povezavo do kviza (QR kodo ali pa povezavo) ter kodo za vstop v kviz. Nato so se učenci v kviz prijavili z vzdevki. Kviz se je začel, ko bo bili vsi učenci vpisani vanj. Vprašanja z odgovori so bila projicirana na tablo, učenci pa so na svojih telefonih videli le možno število odgovorov in njihovo barvo (slika 11). Na koncu smo si ogledali lestvico najboljših učencev in odstotke pravih odgovorov ter naredili analizo napačnih.



Slika 11: Kviz v Kahoot okolju

Učenci 9. razreda so izdelovali interaktivne učne liste v spletnem okolju Liveworksheets (slika 12). Ta naloga je učencem delala tudi največ preglavic, saj so se v tem spletnem okolju znašli prvič. Prijavo so hitro naredili, ko pa so ustvarjali učne liste, pa so imeli veliko vprašanj. So pa ob koncu ravno ti učenci povedali, da so se največ naučili, ker so bili soočeni z največ izzivi pri izdelovanju digitalnih gradiv. Na spletni strani

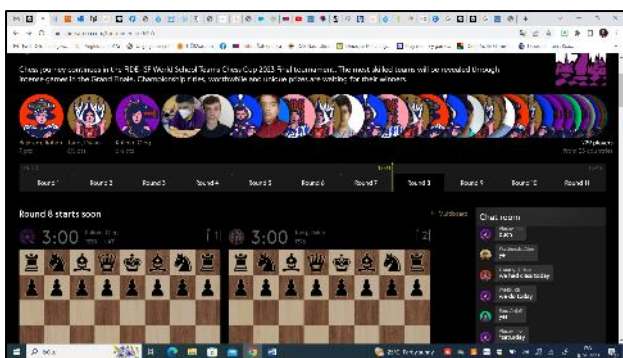
<https://www.liveworksheets.com/> smo poiskali že narejene interaktivne učne liste za šah, a smo ugotovili, da jih v slovenščini ni. So pa v drugih jezikih, a je na žalost bolj malo takšnih, ki bi jih lahko uporabili pri pouku. Zato bomo z izdelavo interaktivnih učnih listov v slovenščini v prihodnje nadaljevali.



Slika 12: Primer interaktivnega učnega lista

3.3 Svetovno spletno ekipno šolsko prvenstvo v šahu

V šolskem letu 2022/2023 je Svetovna šahovska organizacija FIDE razpisala Svetovno spletno ekipno šolsko prvenstvo v šahu v dveh kategorijah: open U15 in open U18. Učenci Osnovne šole Antona Martina Slomška Vrhnika so tekmovali v ekipi U15. Ekipo je moralo sestavljati najmanj štiri in največ sedem igralcev iste šole. Našo šolo je zastopalo 6 učencev. Igralci so igrali individualno, za ekipni rezultat pa se je štel seštevek točk štirih najboljših igralcev ekipe. Na turnirju se je odigralo 11 partij z igralnim časom 3 minute z dodatkom 2 sekundi po vsaki potezi. Prijavnina za turnir je znašala 25 € na udeleženca. Tekmovalcev iz 25 držav je bilo 227. Tekmovanje je potekalo v FIDE Online Areni: <https://chessarena.com/> (slika 13). Preko te spletne strani učenci velikokrat igrajo šah na spletu. Učenci so tekmovali od doma, morali so biti v Zoom sobi in v Online Areni. Z učiteljico mentorico so komunicirali preko Zooma in telefona. Ker je bilo tekmovanje ravno med prvomajskimi počitnicami, je bilo veliko komunikacije med učiteljico in učenci na daljavo preko zgoraj omenjenih kanalov.



Slika 13: Svetovno spletno ekipno šolsko prvenstvo v šahu

4 ZAKLJUČEK

Prikazani primeri iz prakse dokazujejo, da učenci zelo radi izdelujejo in uporabljajo digitalna gradiva. Ob tem ne utrjujejo le znanja o šahu, pač pa kritično razmišljajo, se učijo učenja, razvijajo prožne veščine, spretnosti in različne kompetence. Veliko pozornost se pri pouku namenja tudi varni rabi spleta, ki se jo lahko uvede tudi v vsebine pri izbirnih predmetih šaha.

Z učenci smo po izvedenih dejavnostih naredili evalvacijo učnih ur. Povedali so, da jim je bilo včasih težko začeti z

izdelavo digitalnih gradiv, še posebej takrat, ko programov niso poznali. Imeli so tudi nekaj težav, ker je učiteljica priporočila programe (npr. Mentimeter), ki niso omogočali več kot 3 brezplačna vprašanja. To so rešili tako, da so izbrali drug brezplačen program. Vsi učenci pa so se strinjali, da so se ob izdelavi digitalnih gradiv veliko naučili, tako o vsebinah iz šaha kot tudi o izdelavi digitalnih gradiv. V prihodnje si želijo še več spletnih šahovskih tekmovanj, saj jim je bilo zgoraj opisano tekmovanje zelo všeč. Izrazili so željo, da na šolo povabimo znanega šahista in z njim opravimo intervju, ki bi ga posneli in objavili na šolski spletni strani. Učenci so pohvalili tudi, da so jim bili takšni tipi nalog zanimivi, da so bili zaradi uporabe pametnih telefonov še dodatno motivirani. S takšnim načinom dela bomo še nadaljevali, saj je povečal željo učencev po učenju.

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Uporaba orodja ChatGPT pri promociji šole

Using ChatGPT tool for school promotion

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POVZETEK

Članek obravnava uporabo orodja ChatGPT pri promociji srednjih šol. V uvodu opisuje pomembnost digitalne transformacije v izobraževanju ter predstavi osnovne značilnosti orodja ChatGPT. Nadalje opisuje, kako lahko ChatGPT olajša in izboljša promocijo šole s personaliziranimi komunikacijskimi strategijami ter hitrim in učinkovitim ustvarjanjem oglasov. Orodje ChatGPT omogoča pripravo oglasnih materialov, kot so zgibanke in časopisni članki, s hitrimi rezultati ter prihrankom časa in sodelovanja različnih strokovnjakov. Kljub moči umetne inteligence pa človeški ustvarjalni um in empatija ostajata ključna za razvoj edinstvenih marketinških strategij in prilagoditev oglasa ciljni publiki. Zaključuje, da se bo v prihodnosti sodelovanje med človekom in umetno inteligenco še poglobilo, kar bo omogočilo ustvarjanje učinkovitih in inovativnih oglasnih sporočil.

KLJUČNE BESEDE

ChatGPT, oglaševanje, šola, promocija, umetna inteligenca.

ABSTRACT

The article discusses the use of the ChatGPT tool in promoting high schools. In the introduction, it describes the importance of digital transformation in education and presents the basic features of the ChatGPT tool. It further explains how ChatGPT can facilitate and enhance school promotion with personalized communication strategies and fast, efficient ad creation. ChatGPT enables the preparation of advertising materials such as brochures and newspaper articles with quick results and time-saving benefits by reducing the need for collaboration between various experts. Despite the power of artificial intelligence, the human creative mind and empathy remain crucial for developing unique marketing strategies and tailoring ads to the target audience. The conclusion suggests that in the future, collaboration between humans and artificial intelligence will deepen, allowing the creation of effective and innovative advertising messages.

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KEYWORDS

ChatGPT, marketing, school, promotion, artificial intelligence.

1 UVOD

V sodobnem svetu, ki ga zaznamuje hitri razvoj digitalne tehnologije, inovativna orodja spreminjajo različne vidike našega življenja. Tudi izobraževanje ni izjema. Z vsakim prehajanjem na novo desetletje se izobraževalni pristopi nenehno razvijajo, da bi se prilagodili potrebam in pričakovanjem sodobne družbe. V tem procesu digitalizacije je eden izmed revolucionarnih pripomočkov, ki je zavzel vodilno mesto med komunikacijskimi in marketinškimi strategijami, orodje ChatGPT.

Promocija šole je ključnega pomena za privabljanje talentiranih dijakov in vzpostavljanje ugleda Šolskega centra Kranj, kot vrhunskega izobraževalnega centra. Tradicionalni marketinški pristopi, kot so tiskani oglasi in letaki, so še vedno pomembni, vendar pa digitalna doba zahteva nove in bolj inovativne metode. ChatGPT ponuja številne prednosti, ki lahko šoli omogočijo doseganje širše publike na globalni ravni. Sposobnost hitre, natančne in osebno prilagojene komunikacije s potencialnimi dijaki omogoča, da se šola učinkovito predstavi in poudari svoje prednosti ter programe izobraževanja.

Poleg tega je orodje ChatGPT neprecenljivo tudi za interakcijo s trenutnimi dijaki in njihovimi starši, ter z vsemi udeleženci, s katerimi šola komunicira. Zmožnost zagotavljanja odgovorov na zastavljena vprašanja, podajanje različnih informacij in pomembnih obvestil lahko bistveno izboljša uporabniško izkušnjo.

2 PREDSTAVITEV ORODJA ChatGPT

ChatGPT je velik jezikovni model, ki ga je razvilo podjetje OpenAI. Ime je kratica za "Chat Generative Pre-trained Transformer 3.5", kar pomeni, da je del družine modelov Transformer, usposobljenih za generiranje besedila.

Glavna značilnost ChatGPT temelji na umetni inteligenci, ki temelji na globokem učenju. Njegovo znanje izhaja iz obsežnega preučevanja velike količine besedila, kot so knjige, članki, spletna mesta in druge informacije na internetu. Na podlagi tega usposabljanja je sposoben odgovarjati na vprašanja, sodelovati v pogovorih in generirati smiselne odgovore na različne teme.

Oblikovan je tudi za pomoč uporabnikom pri iskanju informacij, odpravljanju težav, zagotavljanju nasvetov in splošno za pomoč pri različnih izzivih.

Vendar pa je pomembno omeniti, da njegovo znanje temelji na podatkih, zbranih do septembra 2021, zato nima informacij o dogodkih, ki so se zgodili po tem datumu. Kranjc opozarja, da se je izkazalo tudi, da so odvisni od podatkov, na katerih so bili trenirani, kar lahko privede do napak ali neustreznih odzivov v določenih kontekstih. Poleg (ne)zanesljivosti se pojavlja tudi nedoslednost, saj se model spopada z izzivi, kako ohraniti doslednost v dolgih pogovorih ali razumevanju konteksta na enak način kot človeški sogovornici [1].

3 PROMOCIJA SREDNJIH ŠOL

Promocija srednje šole je ključnega pomena za pridobivanje novih dijakov in ohranjanje ugleda ter kakovosti izobraževalne ustanove. Dobro načrtovana promocijska strategija lahko pritegne pozornost bodočih dijakov in njihovih staršev, ki iščejo najboljše izobraževalne možnosti za svoje otroke.

Uspešna promocija srednje šole zahteva celovito strategijo, ki vključuje digitalno prisotnost, interakcijo s ciljno publiko in sodelovanje z lokalno skupnostjo. Predstavljanje kakovostnih izobraževalnih programov, dosežkov in šolskega duha bo privabilo nove dijake in zagotovilo trden temelj za uspešno prihodnost šole.

Znano je dejstvo, da je najboljšo priporočilo »od ust do ust«, zato je v prvi meri potrebno poskrbeti za kvalitetno izvedbo pouka, šolskih in občolskih dejavnosti, dobre in korektno odnose, oz. na splošno ugodno šolsko klimo. Vendar pa vse prej zapisano še ni dovolj. Potrebna je tudi splošna prepoznavnost, ki je povezana s pozitivno konotacijo [2].

Promocija večinoma še vedno poteka preko oglaševanja v tiskanih medijih, radijskih objavah, televizijskih objavah, plakatih, objavah na družbenih omrežjih ipd. Krmelj pravi, da nastanek enega oglasa zahteva ljudi z znanjem s področja ekonomije, oblikovanja, fotografije, filma, psihologije, jezikoslovja, umetnosti, kulture, računalništva... [3]. Ravno orodje ChatGPT pa lahko z združevanjem različnih znanj in idej bistveno poenostavi in pohitri izdelavo različnih vrst oglasov.

4 IZDELAVA OGLASOV Z ChatGPT

Oglasi so sporočila ali obvestila, ki jih podjetja, organizacije ali posamezniki ustvarijo, da promovirajo svoje izdelke, storitve, ideje ali dogodke ter dosežejo ciljno občinstvo. Namen oglasa je spodbuditi zanimanje, ustvariti zavedanje ali prepričati ljudi, da izvedejo določeno dejanje, kot je nakup izdelka, naročilo storitve, obisk dogodka ali podpora neki kampanji. Oglasi so običajno objavljeni v različnih medijskih kanalih, kot so televizija, radio, tiskani mediji, spletne platforme, družbena omrežja in na prostem (npr. plakati, reklamne table).

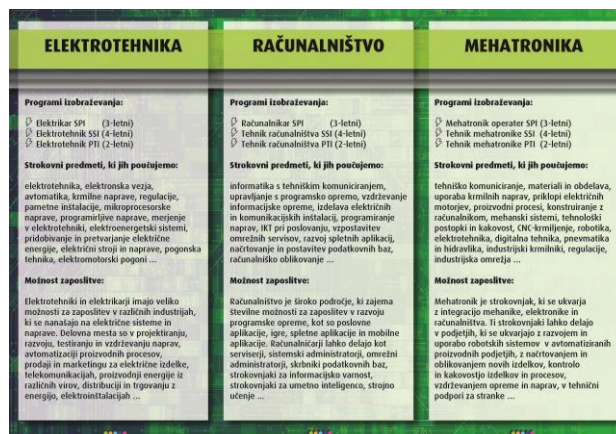
Odločili smo se, da z uporabo orodja ChatGPT pripravimo zgibanko, ki jo bomo učencem delili na promocijskih dogodkih in na informativnem dnevu. Takšno zgibanko pa se lahko

naknadno uporabi tudi kot digitalni oglas v spletnih medijih in na družabnih omrežjih. Slika 1 prikazuje prvo, slika 2 pa drugo stran končne verzije zgibanke.

Običajno bi pri pripravi takšne zgibanke morali sodelovati grafični oblikovalec, člani skupine za promocijo, ki bi opredelili koncept, večje število profesorjev vseh treh izobraževalnih smeri, ki bi zapisali strokovne predmete in možnosti zaposlitve po končanem izobraževanju, ter profesor slovenskega jezika, ki bi opravil lekturo.

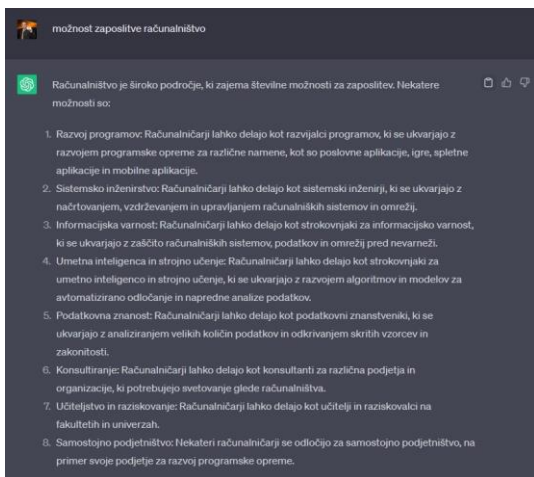


Slika 1: Prva stran zgibanke



Slika 2: Druga stran zgibanke

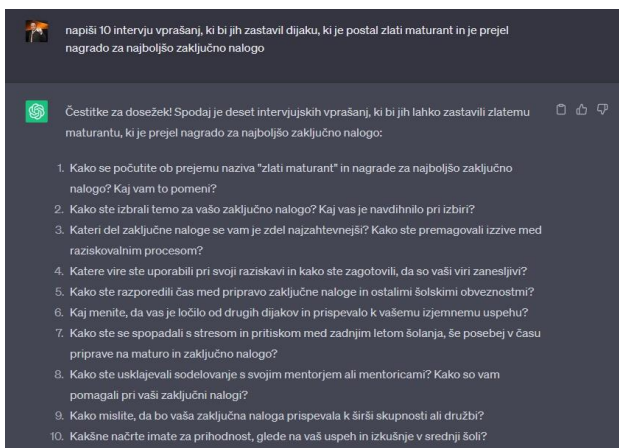
V našem primeru pa je z orodjem ChatGPT celotno vsebino pripravila ena oseba, nato pa zgolj z vodji strokovnih aktivov preverila pravilnost in ustreznost zapisanih podatkov. V tem primeru je bil prihranek na času prej zapisanih udeležencev oigromen. Slika 3 prikazuje uporabo orodja ChatGPT. Iz vrnjenega rezultata je bil zapisan povzetek možnosti zaposlitve iz področja računalništva.



Slika 3: Uporaba orodja ChatGPT

Naslednji primer, v katerem bomo lahko tudi empirično dokazali smiselnost uporabe ChatGPT-ja pa je priprava časopisnega članka. Le te šola objavlja v lokalnih časopisih kot del plačane promocije. Konkretno gre za intervju, kjer je bilo potrebno pripraviti vprašanja, ki smo jih nato zastavili zlatemu maturantu, ki je ob enem tudi prejel nagrado za najboljšo zaključno nalogo.

Za namen raziskave, smo trem učiteljem različnih strok naročili, da zapišejo deset vprašanj, ki jih bomo zastavili dijaku. Merili so tudi čas, ki so ga potrebovali za pripravo vprašanj. Rezultati so pokazali, da je bil povprečen čas za pripravo in zapis vprašanj 9 minut in 16 sekund, z uporabo orodja ChatGPT je bil čas vsega 3 minute in 8 sekund, pri čemer je upoštevano tudi branje teh vprašanj in izvedeni popravki. Slika 4 prikazuje vrnjene rezultate orodja ChatGPT, slika 5 pa končno verzijo, ki smo jo poslali dijaku.



Slika 4: Intervju vprašanja, ki jih je vrnil ChatGPT

1. Se nam lahko za začetek na kratko predstavite?
2. Kako se počutite ob prejemu naziva "zlati maturant" in nagrade za najboljšo zaključno nalogo? Kaj vam to pomeni?
3. Kako ste razporedili čas med pripravo zaključne naloge in ostalimi šolskimi obveznostmi?
4. Kako ste se spopadali s stresom in pritiskom med zadnjim letom šolanja, še posebej v času priprave na maturo in zaključno nalogo?
5. Kako ste izbrali temo za vašo zaključno nalogo? Kaj vas je navdihnilo pri izbiri?
6. Ste znanja potrebna za izdelavo zaključne naloge pridobili v šoli?
7. Kateri del zaključne naloge se vam je zdel najzahtevnejši in kako ste reševali določene probleme, ki so se pojavili pri izdelavi?
8. Kako bo vaša zaključna naloga uporabljena v prihodnosti? Razmišljate tudi o nadgradnji oz. razširitvi?
9. Kakšne načrte imate za prihodnost, glede na vaš uspeh in izkušnje v srednji šoli?
10. Kaj bi svetovali drugim dijakom, ki želijo doseči odlične rezultate pri maturi in pripraviti vrhunsko zaključno nalogo? Kakšni so vaši nasveti za uspešno šolsko pot?

Slika 5: Končna vprašanja

5 ZAKLJUČEK

Če želi šola pritegniti pozornost potencialnih uporabnikov, dobro predstaviti prednosti in koristi, ki jih bodo imeli uporabniki, če se vpišejo v določeno šolo, je pomembna učinkovita in uspešna promocija šole [4].

Kljub neverjetnim napredkom v umetni inteligenci, predvsem z razvojem orodja ChatGPT, človek še vedno ostaja ključen in nepogrešljiv element v procesu priprave oglasnih sporočil. ChatGPT brez dvoma predstavlja izjemno močno orodje, ki omogoča generiranje visokokakovostnih in relevantnih oglasov na podlagi ogromne količine podatkov in prepoznavanja vzorcev. Vendar pa obstaja več dejavnikov, zaradi katerih je človeški element nujen.

Prvič, človeški ustvarjalni um ima neprimerljivo sposobnost domišljije in ustvarjalnosti, kar omogoča razvoj edinstvenih in inovativnih marketinških strategij ter oglasnih kampanj. Čeprav ChatGPT lahko ustvari prepričljive oglasne sporočila, človek lahko v procesu dodaja tisti "čarobni prah", ki loči dober oglas od izjemnega.

Drugič, človek ima empatijo in razumevanje, ki omogočata boljše prilagajanje oglasa ciljni publiki. Medtem ko je ChatGPT sposoben analizirati podatke o potrošnikih, se človeški oblikovalec lahko bolje poveže s čustvi in potrebami ciljnega občinstva, kar vodi v bolj učinkovit vpliv oglasa na potrošnika.

Poleg tega je človeški nadzor ključen za zagotavljanje, da so oglasna sporočila ustrezna, etična in skladna z zakonodajo. ChatGPT lahko občasno generira kontroverzna ali neprimerna sporočila, ki bi lahko škodovala ugledu blagovne znamke ali ogrožala odnose s potrošniki. Tu vstopa v igro človek, ki skrbi za temeljit pregled in popravke.

V prihodnosti bo sodelovanje med človekom in umetno inteligenco verjetno postajalo še bolj poglobljeno, saj bodo oblikovalci oglasov uporabljali ChatGPT kot močno orodje za navdih, generiranje idej in optimizacijo procesa, medtem ko bodo sami dodajali svoje kreativne, človeške dodatke. Skupaj bodo ustvarjali oglasna sporočila, ki bodo učinkovito nagovarjala občinstvo, spreminjala percepcijo blagovnih znamk in spodbujala prodajo.

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Učenje gibalne igre s petjem preko pametnih naprav

Learning bans through smart devices

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POVZETEK

V prispevku je predstavljeno projektno delo učenje gibalne igre s petjem s pomočjo informacijsko komunikacijske tehnologije v vrtčevski skupini petletnikov. Z otroki smo se pogovarjali o gibanju, kako sami najlažje poskrbimo za svoje zdravje. Razgibali smo celotno telo in se dogovorili, da si odpremo priljubljeno spletno stran YouTube in se naučimo novo gibalno igro s petjem Kranjski Janez. Gre za zanimivo pesmico z zabavnim besedilom in gibi, ki jih ponavljamo vsi skupaj in se ob njih nasmejimo in razgibamo. Kot didaktični pripomoček smo pri dejavnosti uporabili računalnik in tablico, s pomočjo katerih smo si na spletni strani YouTube pogledali besedilo gibalne igre, nato pa še posamezne gibe. Gre za zanimivo besedilo in gibanje, ki privabi vse najmlajše otroke, predvsem pa otroke motivira in privabi ekran.

Omenjeni didaktični pristop je otroke umiril, bili so bolj zbrani. Poslušali so besedilo in ponazarjali gibe. Predstavljala jim je nov način učenja. Bili so bolj zadovoljni, motivirani. Skozi igro so se učili. Pokazali so izjemno vztrajnost in zanimanje. Računalnik in miška sta jih popolnoma prevzela, zato so lahko sami raziskovali po spletu. Ugotovili so, da je rokovanje z miško zahtevno. Predstavljala jim je izziv. Imeli so nekaj težav z vodenjem in klikom. Med dejavnostjo so ves čas sodelovali in si pomagali. Tablica je bila zabaven vir informacij. Njihova vztrajnost je bila nagrajena s končnim novim znanjem. Naučili so se novih gibov, besedila in upravljanja z računalnikom in miško. Ponosni so bili sami nase, ko so lahko sami na spletu poiskali priljubljen YouTube kanal in v brskalniku poiskali gibalne igre s petjem in se jih učili. Ugotovili so, da jih je na spletu veliko in da nam YouTube kanal ponuja tudi podobne poučne vsebine. Za konec smo se tudi sami posneli s pametnim telefonom in si ogledali naš posnetek. Z videnim smo bili zadovoljni.

Zavedali smo se, da je informacijsko komunikacijska tehnologija del vsakdanjega okolja tudi predšolskih otrok, ki bi ga bilo smiselno večkrat uporabiti pri učno vzgojnem procesu in jih podučiti o njeni didaktični vrednosti in izkoristiti priljubljenost elektronskih naprav. Novo znanje in izkušnje so pripomogle k boljši samopodobi, krepitvi samozavesti in nas popeljale v svet moderne tehnologije.

Ključne besede: : Gibalne igre s petjem, IKT, učenje, otroci, sprostitev, predšolsko obdobje

ABSTRACT

The paper presents the project work learning a movement game by singing with the help of information and communication technology in a kindergarten group of five-year-olds. We talked with the children about movement, the easiest way to take care of our health. We exercised our whole body and agreed to open the popular YouTube website and learn a new movement with singing Kranjski Janez. It is an interesting song with fun lyrics and movements that we all repeat together and laugh and get active while listening to them. As a didactic aid, we used a computer and a tablet in the activity, with the help of which we looked at the text of the movement games on the YouTube website and then the individual movements. It is an interesting text and movement that attracts all the youngest children, but above all it motivates children and attracts the screen. The mentioned didactic approach calmed the children, they were more collected. They listened to the next and illustrated the movements. He presented them with a new way of learning. They were more satisfied, motivated. They learned through play. They showed remarkable persistence and interest. They were completely taken over by the computer and mouse, so they could explore the web on their own. They found that handling the mouse is challenging. She presented them with a challenge. They had some management and click issues. During the activity, they cooperated and helped each other all the time. The tablet was a fun source of information. Their persistence was rewarded with the ultimate new knowledge. They learned new movements, text and computer and mouse management. They were proud of themselves when they could find a popular YouTube channel on their own and search for movement games with singing in their browser and learn them. They found that there are a lot of them online and that the YouTube channel also offers us similar educational content. Finally, we recorded ourselves with a smartphone and watched our video. We were satisfied with that we saw. We were aware that information and communication technology is part of the everyday environment of preschool children, which would make sense to use it repeatedly in the educational process to teach them about its didactic value and take advantage of the popularity of electronic devices. New knowledge and experience helped to improve self-image, strengthen self-confidence and lead us into the world of modern technology.

Keywords: Movement games with singing, ICT, learning, children, relaxation, preschool period

1. UVOD

Vse okoli nas je gibanje in učenje. Učimo se lahko na različne načine. Pedagogi smo primorani iskati različne metode dela, da privabimo in približamo dejavnosti vsem otrokom. Zavedamo se, da otrok potrebuje učenje z vsemi čutili- multisenzorično.

Sodobna tehnologija nas spremlja na vsakem koraku. Tako so tudi naši najmlajši po zgledu svojih staršev, nas vzgojiteljev vse bolj vpeti v informacijsko tehnologijo. Pri rokovanju s pametnimi napravami so vse bolj spretni in motivirani.

Informacijsko-komunikacijska tehnologija je del vsakdanjega okolja vseh odraslih in tudi predšolskih otrok. S smiselnim vključevanjem IKT v izvedbeni kurikulum vrta strokovni delavci upoštevajo svet v katerem otrok živi in mu omogočajo, da postopoma pridobi zmožnosti digitalne pismenosti. Za uspešno življenje v informacijski družbi morajo otroci razvijati svoje kompetence. Otroci za uporabo IKT sredstev kažejo velik interes in jih brez strahu preizkušajo in z njimi ustvarjajo [1].

Otroci stari pet let so pri vzgoji največkrat deležni dela po učnem pristopu ustvarjalni gib, za katerega je značilno, da jim vzgojiteljica zastavi gibalno-plesne izzive, pri katerih otroci sami raziskujejo in ustvarjajo. Tako jim je omogočeno aktivno učenje in spodbuja učne potencialne, krepi neverbalno komunikacijo, doprinese k intelektualni rasti, spominu, ter združuje kognitivne in čustveno- socialne sposobnosti [2].

Kot vzgojiteljica predšolske vzgoje, sem si zadala cilj, da izkoristim pozitivno plat tehnologije in ustvarim otrokom bolj spodbudno in moderno učno okolje. Na tak način približamo prvi stik in srečanje z moderno tehnologijo tudi tistim otrokom, ki tablico in računalnik nimajo na razpolago v vsakdanjem življenju.

2. POTEK DELA V SKUPINI

2.1. Uvodna motivacija

Zjutraj smo se zbrali v jutranjem krogu, kjer smo se z otroci pogovarjali o gibanju. Zakaj je gibanje pomembno in kako sami poskrbimo za svoje zdravje. Razgibali smo celo telo in preko pogovora prišli do gibalnih iger. Skupaj smo se odločili, da se naučimo novo gibalno igro s petjem o Kranjskem Janezu in da bo tokrat učenje potekalo preko pametnih naprav. Prižgali smo računalnik, tablico in začeli s predvajanjem gibov in izgovorjavo besedila. Gibalno igro smo predvajali večkrat in zraven nakazovali gibe. Najprej smo poslušali besedilo, ter zraven spremljali gibe.

2.2 Glavni del dejavnosti

Otroci so preko pametnih naprav (računalnika in tablice) večkrat predvajali gibalno igro s petjem Kranjski Janez, kot je razvidno iz slike 1. Besedilo jim je bilo zelo zanimivo in smešno. Skupaj smo zapeli: Kranjski Janez gre v planine in veselo si žvižga, pa zagleda eno »kukavco« jo pozdravi tako- pokažemo z roko gib. Tolčemo

po kolenih in se zopet vrnemo k Janezu, ki v planinah sreča tudi kravo, kozo, dihurja in Micko. Vsako žival posnemamo in tolčemo po kolenih, zraven pa pojemo »oj la ri oj la ri ti ti, oj la ri oj«. Po ponavljanju zopet predvajamo gibalno igro na tablici in zraven pojemo in kažemo gibe. Besedilo se ponavlja, le gibi se spreminjajo. Na koncu se vse skupaj še ponovi. Otroci so aktivno sodelovali in se smejali. Imeli smo tudi računalničarja, ki je vodil miško po ekranu. Posnetek je ustavil, pritisnil pavzo ali pa predvajal naprej. Kar nekaj otrok se je seznanilo z osnovami pri upravljanju YouTube kanala. To jih je še dodatno stimuliralo. Smo peli, kazali in se igrali s tablico ali računalnikom. Vedno je bila na voljo vsaj ena od naprav. Ves čas so bili aktivni. Na željo vseh smo se na koncu tudi posneli. Posnetek smo si pogledali na pametnem telefonu in bili zadovoljni. Želja je bila, da naredimo še več posnetkov, a za prvič je bilo dovolj.



Slika 1: Oglad bansa Kranjski Janez

3. ZAKLJUČEK

Spoznali smo, da je vključevanje IKT- orodja v vzgojno delo zelo koristen in v tem času tudi nujno potreben. Vsekakor je omenjeni didaktični pristop popestril naše vzgojno delo. Otrokom smo omogočili vključitev v digitalno pismenost in jim zagotovili enake možnosti in zmanjšali razlike med njimi. Šlo je za procesno učenje, katerega cilj je bil učenje, dožemanje, izražanje v posameznem razvojnem obdobju. Računalnik je močno motivacijsko sredstvo, ki ne potrebuje posebnih stimulacij za delo. Otroci so spoznali, da nam računalnik ponuja veliko možnosti za učenje. Z vztrajnostjo gradimo svoje znanje in ga

lahko širimo med vrstnike. Ni šlo zgolj za posnetek in predvajanje gibalne igre., temveč za stik s pametnimi napravami, rokovanje z njimi, seznanjanje z osnovami in spoznanje koristnih učnih vsebin. Vsi so imeli možnost rokovanja in učenja. Na koncu so bili zadovoljni tudi s posnetkom, ki sem ga sama posnela na svojem pametnem telefonu. Zanimivo jim je bilo opazovati samega sebe. Niso bili kritični.

Postavili smo temelje in lahko bomo gradili naprej tudi v prihodnje.

4. VIRI IN LITERATURA

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3.apr.2020

(Dostopno 5.4.2023)

Med blokovnim in tekstovnim programiranjem

Between block and text programming

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POVZETEK

MakeCode Arcade je brezplačna spletna platforma za učenje programiranja, ki omogoča izdelavo retro iger z blokovnim programiranjem in JavaScriptom. Primerna je za vse, ne glede na predhodno znanje o programiranju. Nudi enostavno uporabo in širok nabor funkcij za ustvarjanje edinstvenih iger. S prizadevanji za spodbujanje "ustvarjanja" so se razvila številna orodja, ki uspešno vključujejo mlade v t.i. STEAM dejavnosti. MakeCode Arcade sistem pa združuje fizično in digitalno izkušnjo ter omogoča uporabo blokovnega programiranja ter JavaScripta za izdelavo iger, kar ponuja interaktivno in bogato učno izkušnjo.

KLJUČNE BESEDE

MakeCode Arcade, JavaScript, bloki

ABSTRACT

MakeCode Arcade is a free online platform for learning programming that allows the creation of retro games using block-based programming and JavaScript. It is suitable for everyone, regardless of prior programming knowledge. It offers a wide range of easily-accessible features for creating unique games. With efforts to promote "making," various construction tools have been developed, successfully engaging young people in STEM activities. The MakeCode Arcade system combines physical and digital experiences, using block-based programming, and JavaScript to create games, providing an interactive and rich learning experience.

KEYWORDS

MakeCode Arcade, JavaScript, blocks

1 UVOD

MakeCode Arcade je brezplačna spletna platforma za učenje programiranja, ki omogoča izdelavo retro iger z bloki in JavaScriptom.

Je brezplačen in dostopen vsem, ne glede na predhodno znanje o programiranju. MakeCode Arcade je odličen način za

učenje programiranja. Je enostaven za uporabo in ponuja široko paleto funkcij, ki omogočajo ustvarjanje edinstvenih iger.

2 PREGLED LITERATURE

V zadnjih nekaj letih so se prizadevanja za spodbujanje "ustvarjanja" - medpredmetnih dejavnosti, ki vključujejo kulturo naredi-si-sam, elektroniko, znanost, inženiring in ustvarjanje - močno razširila [1].

Na temelju teh prizadevanj je bilo ustvarjenih več orodij (npr. LilyPad [2], Lego Mindstorms), katerih namen je zmanjšali ovire za vstop v programiranje in predstaviti računalniške koncepte v različnih oblikah (npr. robotika in e-tekstil). Številna od teh orodij so bila zelo uspešna pri privabljanju, vključevanju in poučevanju mladih v dejavnosti STEAM (znanost, tehnologija, umetnost, inženiring in matematika) [3].

Zaradi nenehno rastoče priljubljenosti iger med otroki danes (zlasti za zabavo) so raziskovalci in pedagogi začeli uporabljati igre za spodbujanje pozitivnih učnih izkušenj [5], pri čemer temeljijo na temeljnih načelih oblikovanja iger (ogrodje, interaktivnost in iskanje napak pri delovanju) [10]. Novejši pristop, ki je že pokazal veliko uspehov, vključuje učence, ki izdelujejo ali programirajo svojo igro [7]. Nekatera orodja, ki izražajo ta pristop (npr. Scratch, Kodu Game Lab), omogočajo tistim z omejenimi spretnostmi razvoja iger ali programiranja, da ustvarijo igre. S tem, ko otrokom in drugim omogočamo učenje tako z igranjem kot ustvarjanjem iger, se lahko izboljša računalniško razmišljanje in reševanje problemov [8].

Nekateri komercialne igre so začeli presegati računalniški zaslon in so se premaknile v fizični svet [4]. Tako, na primer, platforma Nintendo Labo uporablja različne pristope za združevanje elementov izdelave in gradnje v igralne izkušnje. Računalniška orodja so začela povezovati oblikovanje iger z oblikovanjem igralnih vmesnikov, ta kombinirani pristop pa je spodbudil sodelovalno učenje, ustvarjalno izražanja in učenje računalniških konceptov [9].

Da bi začeli nasloviti nekatere izzive pri načrtovanju in gradnji igre, so ustvarili sistem MakeCode Arcade. MakeCode Arcade temelji na konceptih fizičnega računalništva z uporabo blokov, [6], saj prinaša več prednosti za začetnike. Prav tako temelji na konceptih programiranja, ki spodbujajo uporabo poenostavljenih grafičnih, blokovnih uporabniških vmesnikov, kot je MakeCode Arcade, saj poenostavijo programske koncepte,

in blokovne omejitve pomagajo pri poučevanju in izvajanju sintaktično pravih programskih izjav [11].

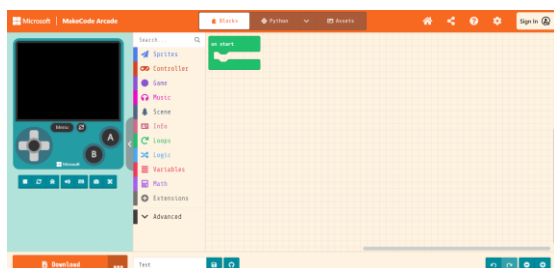
3 REZULTATI

3.1 Platforma

MakeCode Arcade je platforma za programiranje in razvoj iger, ki jo je razvilo podjetje Microsoft. Namenjena je otrokom, začetnikom in ljubiteljem programiranja, ki lahko ustvarijo svoje računalniške igre brez zapletenega kodiranja. Platforma je zasnovana tako, da olajša učenje programiranja in spodbuja ustvarjalnost.

MakeCode Arcade uporablja blokovno programiranje, kar pomeni, da lahko uporabniki ustvarjajo igre s premikanjem blokov kode in jih povezujejo skupaj. To omogoča hitro in intuitivno ustvarjanje iger, tudi brez predhodnega znanja programiranja. Platforma ponuja tudi možnost za prehod na tekstovno programiranje v jeziku JavaScript za naprednejše uporabnike.

MakeCode Arcade vključuje grafično uporabniško okolje (GUI), ki omogoča uporabnikom, da vizualno oblikujejo in urejajo svoje igre. Uporabniki lahko ustvarjajo likovne elemente, kulise, zvoke in interakcije ter jim dodajajo logiko in pravila igre. Obstaja tudi možnost izvoza iger in njihovo deljenje s skupnostjo.



Slika 1: Uporabniški vmesnik

Platforma podpira različne vrste iger, vključno z arkadnimi igrami, sestavljanjkami, platformnimi igrami in še več. MakeCode Arcade zagotavlja tudi simulacijo igralnega okolja, v katerem se lahko preizkusi in igra ustvarjene igre neposredno v brskalniku ali pa se jih prenese in zaigra na mikrokontrolerih, kot so Circuit Playground Express, BBC micro:bit in drugi.

MakeCode Arcade je brezplačna platforma, ki ponuja širok nabor orodij za učenje, raziskovanje in ustvarjanje iger. S svojo enostavno uporabo in prilagodljivostjo je odličen izhodiščni korak za vse, ki jih zanima svet programiranja in razvoja računalniških iger.

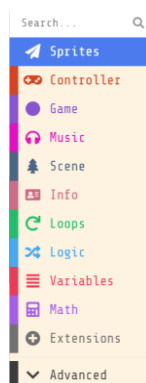
3.2 Bloki

Bloki v MakeCode Arcade so vizualni gradniki kode, ki se lahko premikajo in povezujejo skupaj s čimer se ustvari igra. Omogočajo enostavno in intuitivno programiranje, saj ni treba pisati kode v tekstovni obliki. Namesto tega se sestavlja logika igre z različnimi bloki, ki se jih povlečete in spusti v ustrezne dele kode.



Slika 2: Bloki za sprite

V MakeCode Arcade najdete različne vrste blokov, ki pokrivajo širok nabor funkcionalnosti, kot so premiki likov, upravljanje vhodnih naprav, obdelava trkov, zvoka, animacije, pogoji, zanke in še več. Te bloke se lahko kombinira in povezuje skupaj, da se ustvari želeno delovanje igre.



Slika 3: Skupine blokov

Na primer, če želimo premakniti lik na zaslonu, lahko uporabimo bloke za nastavev smeri in hitrosti lika. Blok, ki premakne lik v določeni smeri, ga lahko povežete s blokom, ki nastavi hitrost lika. Na ta način lahko določite, kako se bo lik premikal glede na vhodne ukaze ali pogoje v igri.

Poleg osnovnih blokov za upravljanje likov, gibanje in interakcijo, lahko uporabite tudi bloke za ustvarjanje pogojev, zank, funkcij in spremenljivk. To vam omogoča, da razvijete bolj kompleksno logiko igre, kot so upravljanje nivojev, zdravje likov, števec točk in drugih igralnih elementov.

MakeCode Arcade vam omogoča tudi, da ustvarjate lastne bloke, ki združujejo več ukazov v en sam blok. To vam omogoča, da zmanjšate ponavljanje kode in ustvarite bolj pregledno strukturo.

V celoti izdelana koda, ki jo sestavite s pomočjo blokov, se lahko pretvori v tekstovno obliko v jeziku JavaScript, kar omogoča naprednejšim uporabnikom, da preidejo na tekstovno programiranje.

Bloki v MakeCode Arcade so močno orodje za učenje in razvoj iger, saj ponujajo vizualno, interaktivno in dostopno izkušnjo programiranja, ki spodbuja ustvarjalnost in raziskovanje.

3.3 Koda

JavaScript je pomemben del platforme MakeCode Arcade, saj omogoča naprednejšim uporabnikom razširitev in prilagoditev iger ter programiranje kompleksnejših funkcionalnosti.

V MakeCode Arcade lahko uporabniki začnejo s programiranjem igre z bloki kode, vendar imajo tudi možnost prehoda na tekstovni način programiranja v jeziku JavaScript. Ko se uporabnik počuti udobno s koncepti blokovne kode, lahko preklopi na JavaScript in piše svojo kodo, kar omogoča večjo prilagodljivost in natančen nadzor nad igro.



Slika 4 Primer JavaScript okolja

Z uporabo JavaScripta v MakeCode Arcade lahko uporabniki ustvarjajo kompleksnejšo logiko igre. Bloki imajo svoje ekvivalente v JavaScriptu, zato lahko uporabniki pišejo svoje funkcije, razširjajo obstoječe bloke in ustvarjajo svoje lastne bloke. To omogoča izvajanje naprednejše logike, kot so algoritmi za umetno inteligenco nasprotnikov, obdelava naprednih fizikalnih simulacij ali implementacija naprednih mehanik iger.

JavaScript omogoča uporabnikom, da ustvarijo in manipulirajo večje število likov, predmetov, zvokov, animacij in drugih igralnih elementov. S tem lahko uporabniki razširijo svoje igre z več nivoji, različnimi izzivi in bogatejšim vizualnim doživetjem.

JavaScript v MakeCode Arcade omogoča tudi uporabo zunanjih knjižnic, ki so na voljo v ekosistemu JavaScripta. To pomeni, da lahko uporabniki izkoristijo že obstoječe knjižnice za izvajanje določenih nalog, kot so matematični izračuni, obdelava zvoka, animacija in še več.

MakeCode Arcade ima razširjeno skupnost ustvarjalcev iger, ki delijo svoje projekte in izkušnje. Z uporabo JavaScripta lahko uporabniki ustvarijo napredne igre in jih delijo s skupnostjo. Prav tako lahko prispevajo k skupnosti, tako da delijo svoje izboljšave, razširitve in dodatne bloke.

JavaScript v povezavi z MakeCode Arcade omogoča platformo, ki združuje enostavnost uporabe blokovne kode s fleksibilnostjo in močjo tekstovnega programiranja. Upabniki lahko tako postopoma razvijajo svoje veščine programiranja in ustvarjajo igre, ki izražajo njihovo ustvarjalnost in inovativnost.

4 ZAKLJUČEK

MakeCode Arcade ima vizualno grafično uporabniško okolje z bloki, ki omogočajo enostavno in intuitivno programiranje. Upabniki lahko ustvarjajo igre s premikanjem in

povezovanjem blokov kode, kar olajša razvoj iger brez potrebe po pisanju kompleksne kode. Poleg tega MakeCode Arcade omogoča tudi prehod na tekstovno programiranje v jeziku JavaScript, ki omogoča naprednejšim uporabnikom večjo prilagodljivost in nadzor nad igro.

Skozi platformo MakeCode Arcade se uporabniki učijo osnov programiranja, hkrati pa razvijajo svoje veščine in ustvarjalnost pri izdelavi iger. S povezovanjem blokov in JavaScripta se zagotavlja kombinacija enostavnosti uporabe in moči tekstovnega programiranja, kar omogoča bogato in interaktivno učno izkušnjo.

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Skrivnosti finske pedagogike

Secrets of Finnish pedagogy

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POVZETEK

Finski šolski sistem se ponaša z dolgoletnim uspehom in mednarodnim priznanjem kot eden najboljših na svetu. Temelji na visoko izobraženih učiteljih, ki uživajo visoko stopnjo avtonomije in spoštovanja v družbi. Ključna načela finske pedagogike, kot so enakost, igra, sodelovanje, reševanje problemov ter pozornost do dobrega počutja učencev, so omogočila, da se učenci bolj angažirajo in motivirajo za učenje, razvijajo boljše kritično mišljenje in postanejo pripravljeni na uspešno delovanje v delovnem svetu. Aplikacija LessonApp sledi tem načelom in ponuja učiteljem ter učencem raznolike in inovativne pristope k poučevanju ter učenju, kar prispeva k visokokakovostni izobrazbi v Finski in mednarodno priznani učiteljski skupnosti.

KLJUČNE BESEDE

Finski šolski sistem, LessonApp, motivacija

ABSTRACT

The Finnish school system is regarded as one of the best in the world, with a long-standing track record of international recognition. It is based on highly educated teachers who enjoy a high level of autonomy and respect in society. Key principles of Finnish pedagogy, such as equality, play, collaboration, problem-solving, and a focus on students' well-being, have enabled students to become more engaged and motivated in learning, develop better critical thinking skills, and be prepared for successful participation in the workforce. The LessonApp application follows these principles, offering teachers and students diverse and innovative approaches to teaching and learning, contributing to high-quality education in Finland and a globally acclaimed teacher community.

KEYWORDS

Finnland School System, LessonApp, motivation

1 UVOD

Finsko redno ocenjujejo kot državo z enim najboljših šolskih sistemov na svetu. Na PISA raziskavi (mednarodna raziskava uspešnosti učencev), je Finska že vrsto let na vrhu lestvice. Kaj je skrivnost finskega šolskega sistema?

Finska je pokazala, da je mogoče ustvariti visokokakovostni šolski sistem, ki je dostopen vsem učencem, ne glede na njihov socialni status.

2 PREGLED LITERATURE

Mednarodna priznanost finskega izobraževalnega sistema temelji na doseganju visokih akademskih rezultatov v mednarodnih primerjavah, predvsem v raziskavi PISA, ki jo izvaja OECD. Finski uspeh se pogosto pripisuje visoki ravni izobraževanja, zelo selektivnemu izobraževanju učiteljev (približno 10% jih je izbranih) in visokemu spoštovanju učiteljev v družbi ter avtonomiji učiteljev kot strokovnjakov. V sistemu ni uradnih nadzornih mehanizmov: ni obveznega učiteljskega dnevnika, ni šolskih inšpektoratov, ni standardiziranih preizkusov, ni obveznega učnega gradiva in nacionalni učni načrt je zelo ohlapen. [1] [2]

V preteklem desetletju je ideja o "finski izvrstnosti" prerasla nacionalne meje [3] [4]. Na mednarodni ravni "finski model" daje upanje vzgojiteljem, ki se spopadajo s testiranjem in vse bolj omejeno avtonomijo. V bistvu nasprotuje izobraževalnim sistemom, usmerjenim v trg, upravljavskim režimom odgovornosti in deprofesionalizaciji, s katerimi se mnogi spopadajo. Finski primer je tako za mnoge predstavljan kot verodostojen proti-primer. Na nacionalni ravni pa je mednarodno priznanje, ki ga je prineslo prvo poročilo PISA, za več kot desetletje zagotovilo neodvisen položaj šol in izobraževalnih delavcev. Po PISA so se lahko vzgojitelji mirno posvečali svojemu delu, brez zunanje pritiska za kakršnekoli spremembe. Razglašeni so bili za "najboljše na svetu". Tako je finsko izobraževanje postalo blagovna znamka in izvozni izdelek.

Finska pedagogika je v študente usmerjen pristop k izobraževanju, ki poudarja aktivno učenje, sodelovanje in reševanje problemov. Finski učitelji verjamejo, da lahko vsi otroci učijo in da jih je treba spodbujati k raziskovanju svojih interesov in talentov.

Nekateri ključni principi finske pedagogike so:

- Enakost: Vsi otroci imajo pravico do kakovostnega izobraževanja, ne glede na svoje ozadje ali okoliščine.
- Igra: Otroci se najbolje učijo skozi igro, zato finske šole poudarjajo aktivno učenje in praktične dejavnosti.
- Sodelovanje: Učenci se spodbujajo k sodelovanju v skupinah za reševanje problemov in dokončanje projektov.
- Reševanje problemov: Finski učitelji verjamejo, da učenci najbolje učijo z reševanjem problemov, zato učencem

pogosto predstavljajo realne izzive, s katerimi se lahko spopadejo.

- Povratne informacije: Finski učitelji učencem redno dajejo povratne informacije, da lahko spremljajo svoj napredek in po potrebi naredijo prilagoditve.
- Dobro počutje: Finske šole verjamejo, da učenci potrebujejo, da so zdravi in srečni, da se lahko učinkovito učijo, zato se osredotočajo na ustvarjanje podpornega in spodbudnega okolja.

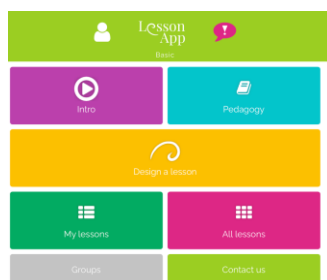
Tu so nekatere od prednosti finske pedagogike:

- Učenci so bolj angažirani in motivirani za učenje. Ko se učencem da priložnost, da raziščejo svoje interese in delajo na projektih, ki jih zanimajo, so bolj verjetno, da bodo angažirani in motivirani za učenje.
- Učenci razvijejo boljše problemske in kritične misleče sposobnosti. Finska pedagogika poudarja problemsko reševanje in kritično mišljenje, ki sta bistvena znanja za uspeh v današnjem svetu.
- Učenci so bolj pripravljeni na delovno mesto. Veščine, ki jih učenci pridobijo v finskih šolah, kot sta sodelovanje in reševanje problemov, so v delovnem svetu zelo cenjene.
- Učenci so srečnejša in bolj zdrava. Finske šole se osredotočajo na ustvarjanje podpornega in spodbudnega okolja, kar pomaga učencem, da so srečnejša in bolj zdrava. [5]

3 REZULTATI

3.1 LessonApp

LessonApp temelji na sodobni, raziskovalno usmerjeni pedagogiki. LessonApp sledi istim načelom, ki jih učitelji na Finskem spoznajo med svojim izobraževanjem ter jih vsakodnevno uporabljajo v svojih učilnicah.

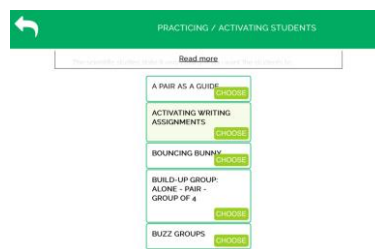


Slika 1 Pregled zaslona aplikacije

V aplikaciji so aktivnosti razdeljene po posameznih sklopih. Ti sklopi so povezani s tem kako naj bo sestavljena učna ura: uvodne aktivnosti, preverjanje obstoječega znanja, pridobivanje novega znanja, vaje/aktiviranje učencev, refleksija. Znotraj posameznih sklopov pa najdemo opisane aktivnosti.



Slika 2 Sklopi učne ure



Slika 3 Primeri aktivnosti znotraj sklopa "Vaje / aktiviranje učencev"



Slika 4 Opis aktivnosti: Znanstveni eksperiment

Aplikacija omogoča

- Učenje kot aktiven, ne pa pasiven proces, pri katerem znanje gradi učeči-se posameznik.
- Znanje je vzajemno zgrajeno v povezavi s svetom okoli nas.
- Prejšnje znanje, razumevanje in izkušnje so pomembni pri učenju novih stvari.
- Vloga učitelja je podpirati in spodbujati učni proces.
- Pozitivna čustva spodbujajo učenje.

Koristi za učence:

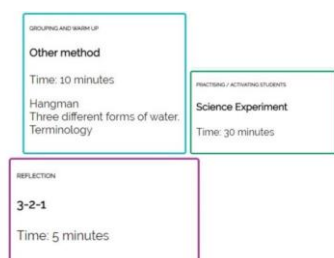
- Raznolike in navdihujoče lekcije.
- Podpora različnim učnim slogom in učencem z različnimi učnimi strategijami.
- Učenci bodo dosegli boljše učenje.
- Izboljšanje dobrega počutja v šoli.
- Sreča in veselje do učenja.
- Manj stresnih šolskih dni.

Koristi za učitelje:

- Učitelji razvijajo spretnosti načrtovanja in priprave na pouk.
- Dobro počutje pri delu: prihranek časa, manjši pritisk.
- Uporabne ideje z manj napora: izbrane vsebine, ustvarjene s strani učiteljev za učitelje.
- Pomoč in praktične ideje za poučevanje na daljavo.
- Kolegialna podpora: sodelovanje z drugimi učitelji.
- 150 načinov za aktiviranje učencev.
- Dnevno delo je bolj navdihujoče in nagradujoče.
- Sodelovanje v mednarodni učiteljski skupnosti.

3.2 Primer učne ure

Za primer si oglejmo predstavitev učne ure o treh agregatnih stanjih vode:



Slika 5 Tri sklopi učne ure

Cilji učenja:

- Učenci bodo znali imenovati tri agregatna stanja vode ter podati primere, kako se voda spreminja med njimi.
- Poiščejo nekatere dejavnike, ki vplivajo na hitrost izparevanja.
- Znali bodo opredeliti preproste korake znanstvene metode.
- Z uporabo znanstvene metode bodo izvedli eksperiment v svojem vsakdanjem življenju.
- Naučili se bodo formulirati hipotezo za vsako vprašanje.

Materiali:

- Ledene kocke
- Voda
- Posode / kozarci
- Aparat za kavo ali električni grelnik vode
- (različne snovi za eksperimente)

Ogrevanje: Igra vislic (10 minut):

Učenci so pred lekcijo prebrali o tej temi iz učbenikov, ter si ogledali video o treh stanjih vode. Začeli bodo lekcijo s pregledom besedišča te teme s skupno igro vislic. Primerne besede za igro so: tekočina, trdota, plin, zamrzovanje, taljenje, kondenzacija, para, vrenje, izhlapevanje.

Razdelitev v skupine:

Razdelitev v skupine je vedno pomembna, če želimo doseči čim bolj učinkovito delo učencev. Pri izvajanju eksperimentov imam veliko možnosti za oblikovanje skupin.

Uporabili bomo naključne skupine. Za to imamo plastične kovance različnih barv. Skupno bomo dali 25 kovancev (pet vsake barve) v klobuk, vsak učenec pa bo nato potegnil en kovanec. Skupine bodo oblikovane glede na barve in vsaka skupina naj ima vseh pet različnih barv. Te "pisane skupine" bomo uporabili med eksperimenti. Za zadnji del te lekcije bomo uporabili različne "skupine ene barve".

Znanstveni eksperiment (30 minut):

Ta del lekcije se bo začel z eksperimentom, ki ga bomo opravili skupaj. Ta eksperiment bo potreboval več časa in

verjetno ga ne bomo dokončali med to lekcijo, vendar ga bomo uporabili za vadbo osnov izvajanja eksperimenta in oblikovanje hipoteze. Ta prvi eksperiment lahko obravnava taljenje, vprašanje pa bi lahko bilo "Katera od teh dveh posod vsebuje več tekoče vode?" Ideja je, da imamo dve podobni posodi. Druga posoda bo napolnjena z ledenimi kockami, druga pa bo imela tekočo vodo do polovice posode.

Po tem prvem eksperimentu bodo učenci delali v skupinah in izvedli še 2-3 eksperimente. Ti eksperimenti se bodo vedno začeli s formuliranjem hipoteze in nato nadaljevali s preprostimi koraki znanstvene metode. Ti eksperimenti bodo predstavili vsa tri stanja vode in prikazali nekatere od naslednjih pojavov: zamrzovanje, kondenzacija, vrenje, izhlapevanje in nekatere dejavnike, ki vplivajo na hitrost izhlapevanja.

Refleksija: 3, 2, 1 v skupinah (5+ minut):

Za zadnji del te lekcije se oblikuje nove skupine na podlagi barvnih plastičnih kovancev. V teh skupinah ene barve bodo učenci na kratko razpravljali in zapisali tri stvari, ki so se jih naučili med lekcijo, ter dve zanimivi stvari, o katerih bi radi izvedeli več. Nazadnje bodo učenci zapisali eno vprašanje, ki bi ga želeli postaviti na to temo.

4 ZAKLJUČEK

Finski šolski sistem velja za enega najboljših na svetu, kar se odraža v visokih akademskih rezultatih učencev na mednarodnih primerjalnih raziskavah, kot je PISA.

LessonApp je aplikacija, ki temelji na finski pedagogiki in sledi njenim načelom. Omogoča učencem raznolike in navdihujoče lekcije ter podpira učitelje z različnimi strokovnimi vpogledi, idejami za poučevanje ter sodelovanjem v mednarodni učiteljski skupnosti.

Opisan je primer lekcije o treh stanjih vode, ki uporablja finski pristop k poučevanju, vključuje raziskovalno usmerjen pristop, aktivno sodelovanje učencev ter izvajanje znanstvenega eksperimenta.

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Vsebinski poudarki izobraževanj o spletnih orodjih za šolske knjižničarje v Narodni in univerzitetni knjižnici

Thematic highlights of the National and University Library's training courses on online tools for school librarians

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POVZETEK

Med nalogami Narodne in univerzitetne knjižnice je tudi izobraževalna dejavnost za knjižničarje. Prispevek predstavi vsebinske poudarke izobraževanj o spletnih orodjih za šolske knjižničarje temelječih na sodobni informacijsko komunikacijski tehnologiji, ki jih je organizirala Narodna in univerzitetna knjižnica. Prikazani so zastavljeni cilji ter pomen izobraževanja za šolske knjižničarje.

KLJUČNE BESEDE

Narodna in univerzitetna knjižnica, izobraževanje, IKT, šolski knjižničarji, splet

ABSTRACT

The National and University Library among other activities provides training for librarians. This paper presents the content of the training courses on online tools for school librarians based on modern information and communication technology, organized by the National and University Library. The objectives and the relevance of the training for school librarians are presented.

KEYWORDS

National and University Library, training, ICT, school librarians, web

1 UVOD

Temeljno poslanstvo Narodne in univerzitetne knjižnice (dalje NUK) je zbiranje in varovanje ter zagotavljanje uporabe nacionalne zbirke knjižničnega gradiva, strokovna podpora knjižnicam pri izvajanju javne službe in nacionalnemu bibliografskemu sistemu ter vključevanje v mednarodne knjižnične povezave [1]. Zakonodaja opredeljuje, da nacionalna knjižnica izvaja knjižnično dejavnost kot javno službo [2] ter skrbi za nacionalno pisno dediščino, hkrati pa sodeluje v nacionalnem vzajemnem bibliografskem sistemu. NUK pa poleg vsega naštetega opravlja še druge dejavnosti in naloge, med katerimi je izjemno pomembna izobraževalna dejavnost za

knjižničarje (za namene tega prispevka izraz knjižničarji uporabljamo za vse strokovne knjižničarske delavce) v Sloveniji.

Za izobraževalno dejavnost, katere potencialni udeleženci so slovenski knjižničarji, založniki ter uporabniki knjižnic, v NUK skrbi in jo organizira Oddelek za izobraževanje, razvoj in svetovanje. Vsebine izobraževanj so razdeljene v štiri sklope – vsebine namenjene začetnikom v stroki, knjižničarjem, ki želijo izpopolniti svoje strokovno znanje, tistim, ki usposablajo za delo v sistemu vzajemne katalogizacije, ter uporabnikom knjižnic (raziskovalcem, študentom in ostali zainteresirani javnosti) [3]. V prispevku je glavnina besedila namenjena vsebinskim poudarkom izobraževanj o spletnih orodjih za šolske knjižničarje temelječih na sodobni informacijsko komunikacijski tehnologiji (dalje IKT), ki jih je NUK v preteklih letih že organiziral. Nekateri poudarki bodo podkrepljeni tudi vizualno s slikami in zajemi zaslonov.

2 VLOGA NARODNE IN UNIVERZITETNE KNJIŽNICE PRI IZOBRAŽEVANJU ŠOLSKIH KNJIŽNIČARJEV

Kot je bilo že zapisano, so med drugimi nalogami NUK tudi organizacija in izvajanje izobraževalnih vsebin. Vsako koledarsko leto je na NUK-ovi spletni strani objavljen program izobraževanj, v katerem lahko zainteresirani knjižničarji izbirajo med različnimi strokovnimi spopolnjevanji in permanentnimi izobraževanji za zaposlene v knjižnični dejavnosti [4]. Stalno strokovno izobraževanje je za vsakega strokovnega knjižničarskega delavca izjemnega pomena, kar je razvidno tudi iz Etičnega kodeksa slovenskih knjižničarjev, kjer je zapisano, da mora vsak knjižničar znova in znova izpopolnjevati svoje strokovno znanje ter ustvarjalno prispevati k razvoju knjižničarske stroke in njene dejavnosti [5]. Med udeleženci različnih izobraževalnih vsebin v NUK so tudi šolski knjižničarji, ki permanentno in načrtovano dopolnjujejo svoje strokovno znanje.

NUK organizira in izvaja različne oblike izobraževanj za že omenjene ciljne skupine na dveh fizičnih lokacijah (računalniška učilnica na Turjaški ulici 1 in predavalnica na Leskoškovi cesti 12) ter prek spleta (ZOOM) ob uporabi spletnih učilnic [6]. V letu 2020 je bilo potrebno zaradi zdravstvene situacije vzpostaviti izobraževanja prek spleta [7]. Dostopnost vsebin ter gradiv izobraževanj je bilo zagotovljeno s spletno učilnico, ki je

osnovna aplikacija za uporabo pri izobraževalnem procesu na daljavo [8].

Glavni vsebinski poudarki usposabljanja za šolske knjižničarje so bili usmerjeni v teoretična izhodišča in umeščenost neformalnega izobraževanja v posameznikov karierni razvoj ter predstavitev načinov in kriterijev za zagotavljanje pridobivanja znanja, veščin ter kompetenc za delo v šolski knjižnici.

Vsako leto so bile posebej načrtovane in organizirane izobraževalne vsebine za šolske knjižničarje, ki so obravnavale digitalno okolje, različne vrste kompetenc ter uporabo IKT. S tem v mislih so bila v preteklih letih pripravljena naslednja izobraževanja:

- ABC šolskega knjižničarstva,
- Krepitev kompetenc šolskega knjižničarja,
- Spletna orodja in aplikacije za šolske knjižnice in
- Uporabnost spletnih orodij v šolski knjižnici.

Kot je zapisano v 105. členu Zakona o organizaciji in financiranju vzgoje in izobraževanja (ZOFVI) se strokovni delavci v vzgoji in izobraževanju strokovno izobražujejo in usposablajo [9]. Šolski knjižničarji imajo za lastno strokovno spopolnjevanje in uresničevanje svojih potreb in zahtev informacijske družbe po kompetentnem vključevanju v okolje na voljo dovolj širok spekter izobraževalnih možnosti [10]. Potencialni udeleženci izobraževanj, ki so zaposleni v šolskih knjižnicah, so bili o razpisanih izobraževanjih v NUK vsakič obveščeni po e-pošti ter prek portala Knjižničarske novice (<https://knjiznicarske-novice.si/>), kjer so vabila na izobraževanja objavljena v kategoriji Izobraževanja in dodana v koledar dogodkov (<https://knjiznicarske-novice.si/koledar-dogodkov/>).

3 INFORMACIJSKO KOMUNIKACIJSKA TEHNOLOGIJA IN SPLETNA ORODJA ZA ŠOLSKE KNJIŽNIČARJE TER OPIS IZVEDENIH IZOBRAŽEVALNIH VSEBIN

Šolski knjižničarji so strokovnjaki za učinkovito upravljanje informacijskih virov, kar vključuje tudi upravljanje dostopa do teh virov in izvajanje ustreznih pravil. Zato so izobraževanja za šolske knjižničarje ključna za njihov strokovni razvoj in izboljšanje kompetenc ter zagotavljanje kakovostnih storitev za uporabnike in šolsko skupnost.

Izobraževanja za šolske knjižničarje so se v NUK do leta 2023 izvajala predvsem v spletnem okolju. Vsebine izobraževanj so bile prilagojene za potrebe in naravo dela v šolskih knjižnicah, šolske knjižnice namreč izvajajo knjižnično dejavnost, potrebno za izvajanje javne službe na področju vzgoje in izobraževanja [11].

Za vsako izobraževanje je bila pripravljena tudi namenska spletna učilnica, do katere so tečajniki dostopali v času tečaja in še 14 dni po končanem tečaju.

Razvoj kompetenc in naravnosti profesionalnega šolskega knjižničarja je moč doseči na različne načine, cilj izobraževanja šolskega knjižničarja pa je usvojitve učiteljskih in knjižničarskih znanj [12].

Namen pripravljenih vsebinskih področij je bil prepoznati ter zagotavljati, da šolski knjižničarji s pridobljenim znanjem ter veščinami nato v svoji praksi zagotavljajo kakovostne storitve,

ki prispevajo k izboljšanju izobraževalnega procesa in hkrati podpirajo svoje uporabnike pri razvijanju mnogih veščin, ki so ključne za uspešno vključevanje v sodobno informacijsko družbo.

Izobraževanja, namenjena šolskim knjižničarjem, so med drugim pokrivala naslednje vsebine:

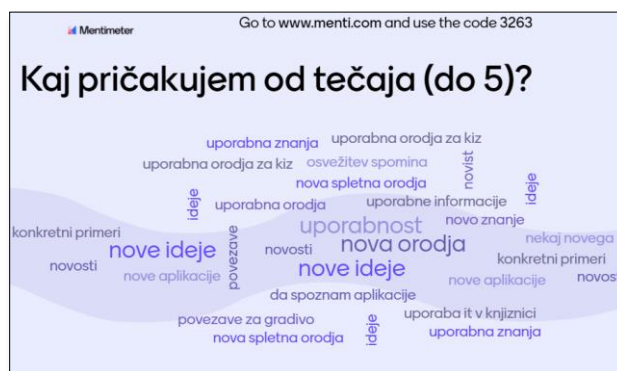
- zakonodajni okvirji delovanja šolske knjižnice,
- šolske knjižnice in njihovi deležniki,
- predstavitev in spodbujanje pismenosti,
- digitalna pismenost,
- krepitev digitalnih kompetenc,
- uporaba brezplačnih aplikacij ter spletnih orodij v šolski knjižnici,
- izobraževanje s pomočjo aplikacij in spletnih orodij, prikaz praktičnih primerov ter
- domače in tuje dobre prakse šolskih knjižnic.

Zastavljene smo imeli naslednje izobraževalne cilje:

- Predstavitev organizacije in dela v šolski knjižnici ter možnosti optimizacije dela.
- Seznanitev z zakonskimi obveznostmi delovanja šolske knjižnice.
- Seznanitev s koristimi aplikacijami in spletnimi orodji za delo v šolski knjižnici.
- Usposobljenost šolskih knjižničarjev za izobraževalce na področju informacijske pismenosti in digitalnih kompetenc.

3.1 Opis izvedenih izobraževalnih vsebin

Na začetku izvedbe vsakega izobraževanja so bili udeleženci pozvani, da s pomočjo aplikacije Mentimeter (<https://www.mentimeter.com/>) odgovorijo na uvodno vprašanje. Na Sliki 1 so besede in besedne zveze, ki so jih s pomočjo aplikacije Mentimeter zapisali udeleženci (anonimno) na vprašanje 'Kaj pričakujem od tečaja?'.

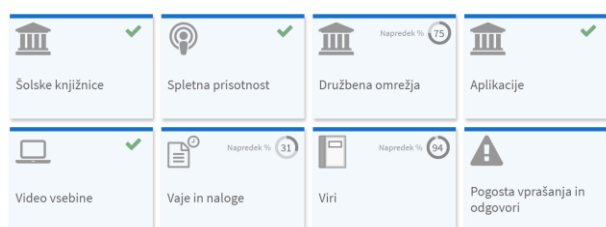


Slika 1: Odgovori na uvodno vprašanje – kaj udeleženci pričakujejo od tečaja. Najpogosteje so zapisali: nove ideje, uporabna znanja in uporabna orodja za KIZ.

Šolske knjižnice se nenehno soočajo s spremembami pri svojem delu, novih zakonodajnih okvirjih ter pri delu z novo, sodobno tehnologijo. Izobraževanja v NUK so se zato osredotočala na učenje uporabe različnih orodij in aplikacij, ki lahko izboljšajo in olajšajo delo v šolski knjižnici. S pridobljenim znanjem in idejami

se lahko poenostavijo določeni delovni procesi, hkrati pa so šolski knjižničarji v koraku z novostmi ter lažje in boljše motivirajo svoje uporabnike za storitve, ki jim jih nudijo (e-knjige, spletni viri, dodatne naloge, motivacijski programi ipd.). Vse to je pomembno tudi (kot se je izkazalo med epidemijo) za izboljšanje spletne prisotnosti.

Slika 2 prikazuje NUK-ovo spletno učilnico za šolske knjižničarje ter pripravljena poglavja in vsebine izobraževanja. Vsebine v učilnici so vezane na vsebine tečaja. Pripravljena so bila posamezna poglavja z vsebinami, navodili, predstavitvami ter vajami (zelo uporabno pri tečaju o aplikacijah). Posebna poglavja so bila namenjena spletni prisotnosti (načini komunikacije z deležniki ter dostopnost), družbenim omrežjem (opisi, prednosti, slabosti ter nasveti), aplikacijam (več različnih aplikacij, ki so jih udeleženci spoznavali ter uporabljali), video vsebine (posnetki, napotila ter video primeri) ter vajam in nalogam (v naprej pripravljene vsebine, kvizi, vtičniki). Zadnji dve poglavji sta bili namenjeni virom ter pogostim vprašanjem z že podanimi odgovori



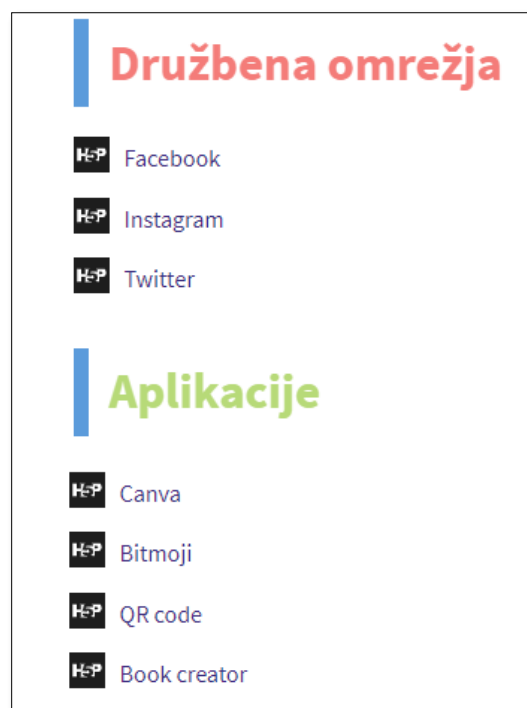
Slika 2: Vpogled v spletno učilnico za šolske knjižničarje (v NUK).

Šolski knjižničarji aktivno sodelujejo s sodelavci v svoji ustanovi, predvsem učitelji oziroma profesorji. Izobraževanja pomagajo krepiti in razvijati posameznikove veščine sodelovanja ter poučevanja informacijske in drugih vrst pismenosti in tako pripomorejo k uresničevanju zastavljenih ciljev.

Vsebinski poudarki NUK-ovih izobraževanj o spletnih orodjih so bili usmerjeni v krepitev digitalnih kompetenc, ki so ključne v sodobni informacijski družbi.

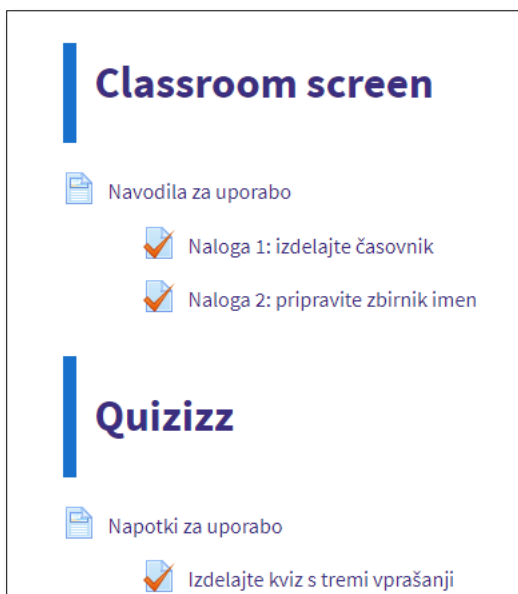
Udeleženci so se seznanili z različnimi spletnimi orodji in platformami za komunikacijo, sodelovanje, ustvarjanje ter organizacijo dela ter učinkovitega upravljanja. Osredotočali so se tudi na razumevanje varnosti na spletu, prepoznavanje lažnih novic, etičnost ter upravljanje z digitalno identiteto. Poleg tega so se poglobljeno seznanjali z različnimi družbenimi omrežji ter upravljanjem vsebin. Izdelali so tudi svoj spletni avatar (s pomočjo različnih aplikacij).

Na Sliki 3 je viden pogled v spletno učilnico, kjer so za udeležence (skladno z zastavljenimi cilji) pripravljena določena sklopi, vsebine in gradiva izobraževanja. Pripravljena so bila posamezna področja in napotki z navodili za delo. V prvem delu je bil poudarek na treh izbranih družbenih omrežjih (Facebook, Instagram in Twitter) ter aplikacijah (Canva, Bitmoji, QR Code in Book creator), v katerih so se sodelujoči preizkusili. S prihodom družbenih omrežji in rastjo »lažnih novic« imajo knjižničarji dolžnost omogočiti dostop do resničnih in verodostojnih podatkov ter učence naučiti, kako dostopati do informacij, jih kritično vrednotiti in prepoznati njihovo verodostojnost [13].



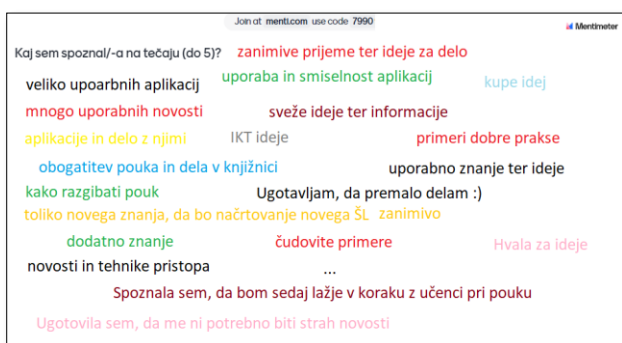
Slika 3: Vpogled v spletno učilnico Spletna orodja in aplikacije za šolske knjižnice.

Na Sliki 4 prikazujemo vsebino oziroma poglavja spletne učilnice, kjer so bila navodila za delo z določenimi aplikacijami ter naloge, ki so jih udeleženci reševali. Vsebinski poudarki izobraževanj o spletnih orodjih so bili osredotočeni na krepitev in razvoj digitalnih veščin, ki knjižničarjem omogočajo učinkovitejšo uporabo različnih spletnih platform in orodij. Pripravljena so bila natančna navodila, kako se posameznik loti dela z aplikacijo oziroma spletnim orodjem. Ob tem je bilo zelo pomembno izkustveno učenje, saj je vsak sam izdelal oziroma opravil nalogo skladno z navodili – nekateri so svoje izdelke in rezultate delili tekom izobraževanja z ostalimi v živo. Nekateri ustvarjeni izdelki, ki so nastali med izobraževanjem in so jih udeleženci shranili v spletni učilnici, so bili tudi iztočnica v vsaki naslednji ali nadaljevalni izobraževalni obliki.



Slika 4: Zaslonska slika spletne učilnice z napotki za delo z določenimi aplikacijami.

Ob koncu izvedbe vsakega izobraževanja so bili udeleženci pozvani, da s pomočjo aplikacije Mentimeter (<https://www.mentimeter.com/>) odgovorijo na zaključni vprašanji. Na Sliki 5 so besede in besedne zveze, ki so jih s pomočjo aplikacije Mentimeter zapisali udeleženci (anonimno) na vprašanje 'Kaj sem spoznal/-a na tečaju?'.



Slika 5: Prikaz zaključnih misli po tečaju, ki so jih udeleženci podali anonimno s pomočjo aplikacije Mentimeter.

Na Sliki 6 pa je grafični prikaz odgovorov na vprašanje 'Ali so vsebine, predstavljene na tečaju, uporabne?'. V tem primeru se je kar 80 % udeležencev strinjalo, da so vsebine uporabne v praksi.



Slika 6: 80 % udeležencev tečaja je odgovorilo, da so vsebine, ki so bile predstavljene, tudi uporabne v praksi.

4 ZAKLJUČEK

V besedilu smo na kratko predstavili in opisali izobraževalno dejavnost NUK za šolske knjižničarje. Izobraževanja na daljavo smo izvajali s pomočjo spletne aplikacije ZOOM in spletnih učilnic, kar je udeležencem omogočilo uspešno delo.

Šolski knjižničarji se morajo permanentno izobraževati in razvijati svoje strokovne in specifične kompetence. Različne oblike izobraževanj ter sodelovanje spodbujajo razvoj in pridobivanje novega znanja ter izmenjavo dragocenih izkušenj. Strokovno izobraževanje jim omogoča osvežitev znanj o novih pristopih k poučevanju, uporabi sodobnih tehnologij ter vodenju in upravljanju knjižnic. Poleg tega se med izobraževanjem seznanjajo s trendi v informacijskem svetu, kar jim omogoča širše razumevanje potreb učencev in učiteljev ter boljše prilagajanje storitev knjižnice. Skozi strokovno izobraževanje šolski knjižničarji širijo svoj vpliv na učno okolje, spodbujajo ustvarjalnost in kritično razmišljanje ter prispevajo k celovitemu razvoju šolske skupnosti.

Čas in trajanje posamezne izvedbe izobraževanj ter sama komunikacija so bili prilagojeni udeležencem. Udeleženci so pridobili in nadgradili sposobnosti sodelovanja, komuniciranja, reševanja in uporabe spletnih orodj (tudi spletne učilnice) ter krepili posamezne stopnje digitalnih kompetenc (digitalne kompetence segajo na področja informacijske pismenosti, komuniciranja in sodelovanja, izdelovanja digitalnih vsebin in drugo) [14]. Še posebej pa so znanja na področju informacijske tehnologije nadgradili udeleženci izobraževanja Spletna orodja in aplikacije za šolske knjižnice. Vse tri izvedbe izobraževanj so vsebinsko zaokrožile delo v šolski knjižnici. Vsebinski poudarki izobraževanj o spletnih orodjih so zasnovani tako, da posameznikom omogočajo samozavestno in odgovorno delovanje v digitalnem okolju. S pridobljenimi znanji, idejami ter primeri imajo udeleženci izobraževanj več možnosti za učinkovito uporabo pridobljenega znanje.

Šolski knjižničarji svoje novo pridobljeno znanje prenašajo svojim uporabnikom (učencem, dijakom, študentom ter sodelavcem) oziroma so v koraku z novostmi ter trendi.

Iz izkušenj po zaključenih izvedbah izobraževanj lahko trdimo, da šolski knjižničarji potrebujejo dodatna izobraževanja, z vse večjim poudarkom na digitalnih in IKT vsebinah. Po udeležbi na izobraževanjih v NUK so lahko v svoj strokovni prostor vpeljali nove strategije, nove načine dela in podajanja vsebin ter so ob tem razvijali določene strokovne kompetence.

Pomembno se nam zdi poudariti, da so bila izobraževanja izvedena na način, ki je omogočal, da so bile vsebine dostopne širšemu krogu potencialnih udeležencev, kar so v anketnem vprašalniku potrdili ter zapisali njihovi udeleženci. Vsi udeleženci so po zaključku opravili evalvacijo ter zapisali poročila. Nekateri izmed njih pa so napisali tudi strokovne članke na temo o spletnih aplikacijah, koraku s sodobno tehnologijo ter delu z aplikacijami.

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Pišek - pišče, ki rešitve išče: prenova portala

Chicklet - chicken searching for solutions
portal renovation

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POVZETEK

V današnjem digitalnem svetu je algoritmičen način razmišljanja en od ključnih konceptov. Uspešno ga razvijamo preko poučevanja programiranja.

Za učenje programerskih veščin uporabljamo sisteme za samodejno preverjanje pravilnosti, preko katerih učenci dobijo takojšnjo povratno informacijo. Leta 2018 smo na Fakulteti za matematiko in fiziko Univerze v Ljubljani v sodelovanju s France-IOI pod okriljem ACM Slovenija razvili portal Pišek. Z njim smo želeli slovenskemu šolskemu prostoru ponuditi okolje, kjer bi začetniki na enostaven način v slovenskem jeziku spoznavali prve korake programiranja. Ta je bil že od samega začetka dobro sprejet med učenci in učitelji.

Portal vsebuje zbirko nalog in hkrati služi kot okolje za izvajanje Tekmovanja v programiranju z delčki Pišek. Leta 2023 je bila v projektu "S Piškom se učimo programirati" zbirka osvežena s številnimi novimi nalogami. Prvotna verzija gostuje na strežniku v Franciji, in je zato vezana na potrebe francoskih kolegov. Zato smo v sklopu projekta "Sistem za samodejno preverjanje programerskih nalog", ki je potekal sočasno s prej omenjenim, postavili nov portal Pišek – Novi, ki vsebuje številne novosti, kot je na primer slovenskemu šolskemu sistemu prijazna Arnes AAI prijava.

Trenutno obstoječo alfa različico sistema, smo se, ob zaključku projekta, odločili odpreti za javnost, saj bo sčasoma postala edini sistem. Sistem trenutno vsebuje del ustrezno prirejenih in izboljšanih nalog ter vrsto novih, ki jih na starem sistemu ni možno udejanjiti. Ob njihovem nastanku so bili oblikovani novi grafični materiali in pripravljena nova programska knjižnica.

Novi sistem ima obogaten menijski sistem, ki vsebuje:

- Razdelek za mednarodno predstavitev kolegom iz tujine, za namene novih sodelovanj.
- Razdelek namenjen italijanski in madžarski manjšini za lažje vključevanje tovrstnih šol v tekmovanje.
- Možnost vzpostavitve novih učnih poti, kjer bodo učitelji in drugi uporabniki lahko predlagali in nato sami ustvarili izbere nalog.
- Delitev nalog na osnovne programerske koncepte za učenje temeljev programiranja.

Poleg postavitve samega sistema Pišek-Novi smo razvili tudi več orodij, kot je baza nalog s ključnimi podatki. Razvoj teh se nadaljuje, saj smo razvili tudi prototip iskalnika nalog, namenjenega učiteljem za lažje iskanje nalog za potrebe pouka ali priprav na tekmovanje.

KLJUČNE BESEDE

programiranje z delčki, računalniška tekmovanja, učna gradiva, samodejno preverjanje pravilnosti

ABSTRACT

In today's digital world, algorithmic thinking is one among basic concepts. We can successfully develop it through teaching programming.

To acquire programming skills, we utilize systems for automatic correctness checking, providing students with immediate feedback. In 2018, in collaboration with France-IOI and under the umbrella of ACM Slovenia, we developed the Pišek portal at the Faculty of Mathematics and Physics, University of Ljubljana. Its purpose was to offer the Slovenian educational environment an easy environment for beginners to learn the basics of programming in SLOvene language. The portal was well-received among students and teachers from the very beginning.

The portal contains a collection of exercises and also serves as a platform for the Pišek Competition in block programming. In 2023, the collection was refreshed with numerous new tasks within the "Learning to Program with Pišek" project. The original version of the portal is hosted on a server in France and is thus dependent on the needs of French colleagues. Therefore in a concurrent project "System for automatic assessment of programming tasks", we set up the new Pišek – Novi portal introducing various innovations, including Arnes AAI (ARNES Authentication and Authorization Infrastructure) login, tailored to the Slovenian education system.

Upon concluding the project, we decided to make the alpha version of the system available to the public, as it is intended to become the central system. The new system includes a portion of exercises that were adapted and

improved, alongside new tasks that cannot be implemented on the old system. New graphic materials were also designed, and a new software library was developed. The new system features an enhanced menu system that encompasses:

- A section for international presentation to colleagues from abroad, aimed at fostering new collaborations.
- A section dedicated to the Italian and Hungarian minorities, facilitating their involvement in competitions.
- The possibility of creating new learning paths, where teachers and users can suggest and develop task selections.
- Task categorization based on fundamental programming concepts to help learners grasp programming basics.

In addition to setting up the Pišek-Novi system, we have developed several tools, including a task database with key data. Development of these tools is ongoing, including the prototype of a task search engine designed for teachers to easily find tasks for lessons or competition preparation.

KEYWORDS

block based programming, programming competitions, learning materials, automatic assessment

1 ZAKAJ SISTEM PIŠEK

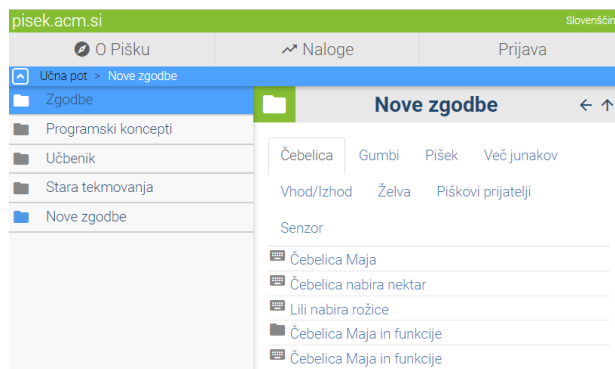
Algoritično mišljenje je pomembna kompetenca v informacijski družbi. Pot do njega preizkušeno vodi prek spoznavanja programskih konceptov. Te se v šoli žal redko poučujejo, izvenšolske iniciative pa dosegajo le omejen del populacije. Kritično tudi primanjkuje gradiv v slovenskem jeziku, za podporo pedagogov in samoučenja. Osnove programiranja postajajo del pismenosti sodobnega človeka. Za krepitev poučevanja teh osnov v Sloveniji je potrebno pripraviti ustrezna orodja in učna gradiva, za lažje izobraževanje in dodatno motivacijo do učenja. Pri tem bi organizatorji izobraževanj (primarno šole) potrebovale prijazen tehnični način priprave nalog.

Pri poučevanju programiranja se učinkovito poslužujemo sistemov za samodejno preverjanje pravilnosti programskih rešitev. V ta namen smo že v sklopu prejšnjih aktivnosti razvili portal, ki smo ga poimenovali po njegovem glavnem junaku Pišku – Sistem Pišek, ki vsebuje obsežno zbirko nalog (slika 1).

Portal Pišek [1] je nastal leta 2018 pod okriljem ACM Slovenija (<http://www.acm.si/>) in UL Fakultete za matematiko in fiziko Univerze v Ljubljani (<http://www.fmf.uni-lj.si/>) v sodelovanju s France-IOI (<http://www.france-ioi.org/>) [3].

Z uporabo sistema Pišek, ki je v celoti v slovenskem jeziku, z vsebinami, ki so prilagojene našemu učnemu

okolju, smo želeli slovenskim učencem omogočiti razvijanje računalniškega mišljenja in veščin programiranja v maternem jeziku [6 - 8]. Portal služil kot zbirka nalog za usvajanje prvih korakov v algoritično razmišljanje in programiranje z delčki, ter kot okolje za izvajanje *Tekmovanja v programiranju z delčki Pišek*.



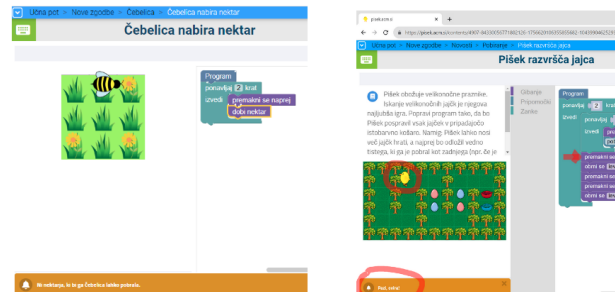
Slika 1: Portal sistema Pišek (<https://pisek.acm.si>)

Portal omogoča razmeroma samostojno učenje in razvoj algoritičnega mišljenja. V besedilih nalog se skrivajo miselni izzivi, ki jih učenci rešujejo z uporabo programskih konceptov. Pri tem uporabniki kode ne pišejo, ampak jo sestavljajo s pomočjo slikovnih delčkov (kot pri sestavljanju puzzle (slika 2)).



Slika 2: Programiramo s sestavljanjem delčkov

Dodatna prednost Piška je takojšnja povratna informacija, ki učence usmerja na poti do pravilne rešitve, učiteljem pa olajša delo v prenapolnjenih učilnicah ter omogoča večjo individualizacijo pouka (slika 3).



Slika 3: Takojšnja povratna informacija

Sistem Pišek je svojo nepričakovano veliko uporabo dosegel tudi v času pandemije COVID19. Številni učitelji so nam poročali o primernosti uporabe sistema pri

poučevanju na daljavo. Že do sedaj se je sistem Pišek, ki omogoča samodejno preverjanje pravilnosti zastavljenih programerskih nalog uporabljal za dva osnovna namena:

- kot platforma za izvedbo Tekmovanja v programiranju z delčki Pišek,
- kot zbirka nalog in sistem s samodejnim preverjanjem pravilnosti rešitev.

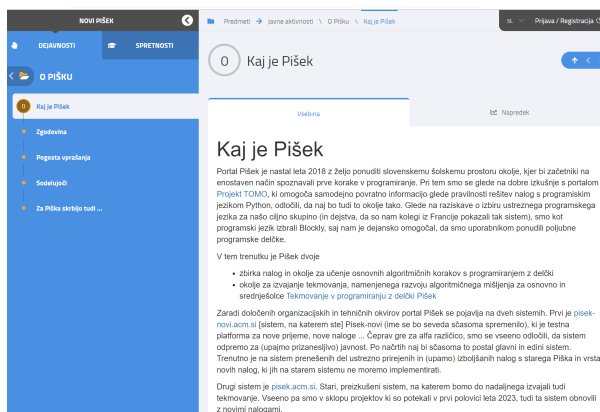
Portal uporabe spletnih tehnologij omogoča učenje povsod in s tem prispeva k premagovanju digitalne ločnice [16 - 8].

2 PRENOVA SISTEMA PIŠEK

Prvotna verzija sistema Pišek (<https://pisek.acm.si/>) [1] gostuje na francoskem strežniku, zaradi česar je njegov razvoj omejen na potrebe naših mednarodnih kolegov. Čeprav sistem zanesljivo deluje, smo želeli pri nadaljnjem razvoju imeti bolj proste roke.

Med izvedbo tekmovanj 1. in 2. šolsko Tekmovanje v programiranju z delčki Pišek je Programski Svet tekmovanja Pišek med mentorji izvedel anketo glede želenih funkcionalnosti sistema. Prav tako smo izvedli več usmerjenih intervjujev z učitelji, ki so bili med najbolj aktivnimi uporabniki sistema in so bili pripravljene sodelovati. Rezultate ankete smo uporabili kot izhodišče glede pričakovanj in želja o portalu kot učnem orodju.

Na podlagi analize ankete smo si za enega glavnih ciljev zadali postavitev svojega strežnika Pišek – Novi (<https://pisek-novi.acm.si>) [2] z novostmi, kot so AAI prijava (slika 4). Ta bo omogočala lažjo uporabo v slovenskem šolskem prostoru, saj ima večina slovenskih učencev že ustrezna uporabniška imena.



Slika 4: Pišek - Novi

Nov strežnik je testna platforma za nove prijeme in nove naloge. Ob zaključku projekta smo sistem odprli za javnost, saj bo sčasoma postal glavni in edini sistem. Sistem trenutno vsebuje del ustrezno prirejenih in izboljšanih nalog s starega Piška ter vrsto novih nalog, ki jih na starem sistemu ni bilo možno implementirati.

Poleg novega sistema so tekom projekta nastale nove funkcionalnosti sistema, kot so zasnova baze podatkov, iskalnik nalog in še več drugih orodij.

Pokazalo se je tudi, da je obstoječih nalog na starem sistemu premalo, določene naloge pa je bilo potrebno konceptualno dodelati, prav tako pa so potrebovale

splošno osvežitev in preново. S projektom smo se zato v dobršni meri posvetili ravno skrbnemu pregledu obstoječih nalog ter njihovi predelavi in poenotenju. Poenotili in posodobili smo tako uporabniški vmesnik nalog, kot njihovo strukturo in grafično podobo.

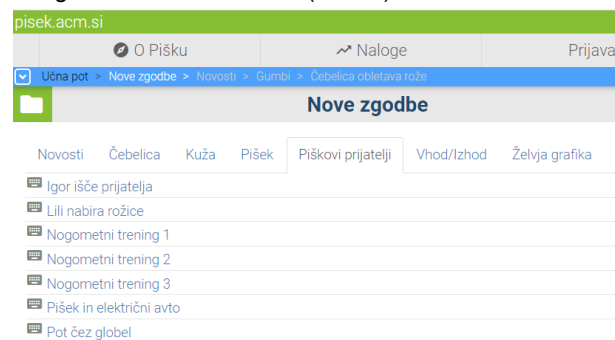
3. REZULTATI PRENOVE

3.1 Novi portal

Glavni rezultat portala je zagotovo postavitev novega sistema Pišek na strežnikih, ki jih upravljamo v sklopu ACM Slovenija in so postavljeni pri nas. Sama postavitev je temeljila na javno, preko GitHub-a dostopnih repozitorijev programske kode [4 - 5]. Tudi naša implementacija je trenutno na voljo na GitHub repozitoriju (<https://github.com/SmidMarko/Pisek>) [3].

3.2 Osvežitev sklopa nalog

Eden od glavnih ciljev prenove je bila osvežitev sklopa nalog na Sistemu Pišek. Na sistemu (<http://pisek.acm.si>) smo tako pregledali in popravili številne že obstoječe naloge in dodali vrsto novih (slika 5).



Slika 5: Nove zgodbe

Glede na pridobljene povratne informacije s strani uporabnikov (predvsem od učiteljev), smo veliko nalog, ki so bile »večstopenske« razdelili na več posameznih nalog (v primerih iz slike 6 na tri). Namreč pokazalo se je, da je pogosto določena stopnja primerna za neko ciljno skupino, za katero pa druga stopnja ni primerna, in podobno. Zato je bolj smiselno, da so stopnje ločene na posamezne naloge. Pri tem smo morali seveda prilagoditi vsebino nalog.

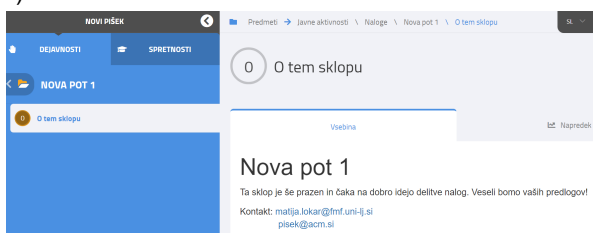


Slika 6: Naloga z več stopnjami

3.3 Nove učne poti

S samostojnim strežnikom smo pridobili možnost priprave učnih poti za različne izobraževalne potrebe. Tako bi lahko učitelj zasnovali sklop nalog, ki se ukvarja le z osnovnimi koncepti, kot so premik naprej, zasuk levo, zasuk desno. V ta namen smo v tem trenutku že predvideli dva tovrstna vnosa v menijskem sistemu.

Vzpostavitev nove učne poti torej zahteva sodelovanje učiteljev in upravljavcev sistema. V prihodnosti načrtujemo, da bodo uporabniki, registrirani kot učitelji, imeli možnost samostojne priprave novih učnih poti (slika 7).

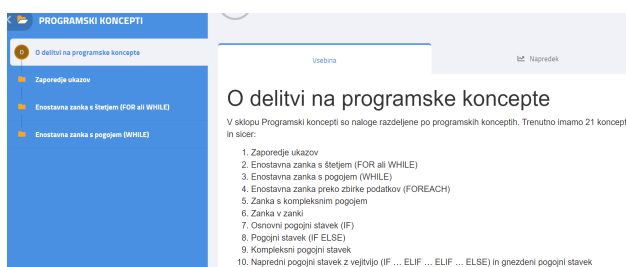


Slika 7: Možnost dodajanja novih učnih poti

3.4 Delitev na koncepte

Na podlagi ankete smo ugotovili, da si učitelji želijo, da bi same naloge bolj podrobno razvrstili glede na v nalogi uporabljene programske koncepte (slika 8). S postavitvijo novega strežnika in s tem dostopom do celotnega menijskega sistema smo to možnost pridobili.

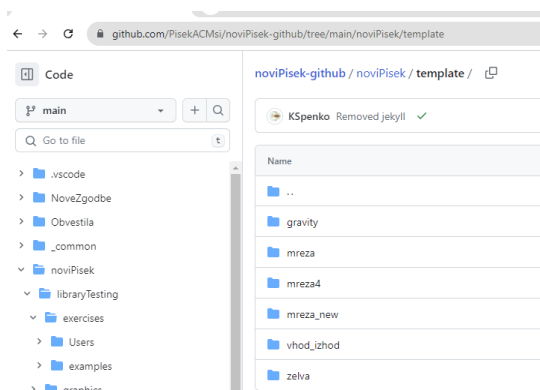
Trenutno je le manjši del nalog razvrščen glede na koncepte, saj je samo razporejanje presegalo tako časovne zmožnosti projekta, kot tudi samo znanje sodelujočih študentov. Ustrezna delitev je namreč odvisna od didaktičnih izkušenj, ki pa jih, še posebej, ko k projektu zaradi različnih okoliščin nismo mogli pridobiti študentov višjih letnikov pedagoških smeri z vsaj nekaj tovrstnimi izkušnjami, sodelujoči niso imeli.



Slika 8: Shema delitve na programske koncepte

3.5 Prenovljena programska knjižnica

Nastala je nova knjižnica programskih gradnikov (v JavaScriptu, z navezavo na Blockly (slika 9)), ki bo v svoji polni meri zaživela na Novem Pišku.

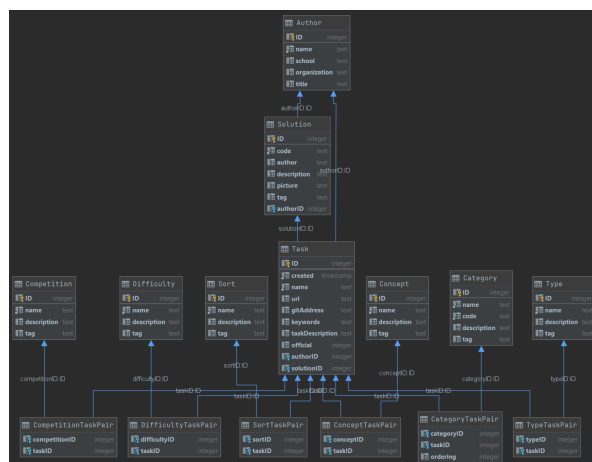


Slika 9: GitHub z novo knjižnico

Pri tem smo izhajali tudi iz tega, da bomo namesto različnih uporabniških vmesnikov, uporabljali poenoten vmesnik.

3.6 Zasnova baze

Število nalog, ki so vključene v zbirko, raste. Vedno bolj je potrebno, da so naloge ustrezno opisane (težavnost, uporabljeni programski koncepti, tip naloge, uporaba programskih vzorcev, ...). Zato je bilo nujno zasnovati bazo, ki bo hranila vse te podatke. Ustrezno modeliranje in razvoj ustreznih programov je naloga, ki bi zahtevala samostojen projekt take ali večje obsežnosti. Zato smo se v sklopu prenove osredotočili na razvoj prototipa in zasnove, ki bo v nadaljevanju služila za končno bazo (slika 10).



Slika 10: Del sheme baze

Izdelali smo program, ki iz zbirke nalog shranjenih na Git repozitoriju, zbere podatke o nalogah in jih shrani v .csv datoteko, ki je osnova za bazo nalog.

3.7 Iskalnik

Ustvarili smo nekaj prototipov novega iskalnika nalog (slika 11). Ta naj bi najprej omogočal, da učitelj pridobi seznam spletnih naslovov za naloge z obeh platform (<https://pisek-novi.acm.si/s/> in <https://pisek.acm.si/>) (slika 12)). Kot ena od možnih razvojnih točk novega portala je tudi to, da bi iskalnik vgradili v sam portal, ter ga povezali z ustvarjanjem novih učnih poti.



Slika 11: Prototip Iskalnika nalog



Slika 12: Rezultati iskalnika nalog

3.8 Nadgradnja grafične podobe

Na osnovi povratnih informacij učencev in dijakov, glavnih uporabnikov sistema Pišek, smo v sklopu projekta precej pozornosti posvetili pripravi novih grafičnih elementov (slika 13).



Slika 13: Grafični element

Študenti so pri izdelavi grafične podobe izkazali veliko zagona in pripravili tako njene zasnove kot tudi kasnejšo njeno realizacijo (slika 14).



Slika 14: Idejna zasnova grafičnih elementov

Zasnova je omogočila, da so sodelavci na projektu skupaj izbrali najbolj priljubljene različice grafične podobe. Pri spremembah je lahko prišlo kar do bistvenih razlik.

Spoznali smo, da lahko videz posameznih elementov vpliva na težavnost naloge. Tako je naloga, kjer so kvadratki mreže podani implicitno, predvsem za začetnike precej težja od naloge z narisano mrežo (slika 15).



Slika 15: Osvežitev grafične podobe

3.9 Priprava grafičnih predlog za Tekmovanje v programiranju z delčki Pišek

Prav tako so v okviru prenove nastale predloge za plakate za vabilo na Tekmovanje v programiranju z delčki, diplome, shematska predstavitev tekmovanj ACM Slovenija, med katere spada tudi Pišek (slika 16).



Slika 16: Osnutek plakata in vzorčno priznanje za tekmovalce

3.9.1 Promocijski Video

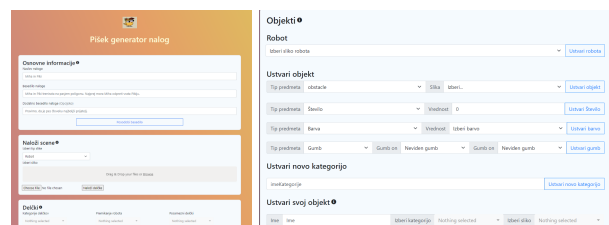
V času projekta je potekalo 2. šolsko tekmovanje v programiranju z delčki Pišek, kar smo izkoristili, da smo na nekaj sodelujočih šolah posneli samo izvedbo. Te posnetke bomo kasneje uporabili za promocijo. Prav tako smo na Tik Tok objavili video, ki je promoviral sam portal (slika 17).



Slika 17: Slikovno gradivo za promocijski video

3.9.1 Nova orodja za delo s sistemom Pišek

V sklopu projekta je bilo razvitih tudi več "pomožnih programov", ki bodo omogočali lažjo izvedbo Tekmovanja v programiranju z delčki Pišek. Tega se je v š.l. 2022/23 udeležilo preko 4000 učencev in dijakov osnovnih in srednjih šol.



Slika 18: Sestavljalnik nalog

Upamo, da bodo razvita orodja bistveno pomagala pri izvedbi tekmovanj. Orodja so namenjena tudi mentorjem, učiteljem in samim udeležencem tekmovanja pri pripravi na tekmovanje, spremljanju rezultatov in drugemu. Med njimi bi še posebej omenili prototip programa, ki bo omogočal sestavljanje predlog za nove naloge brez potrebe po tehnični seznanjenosti z realizacijo naloge

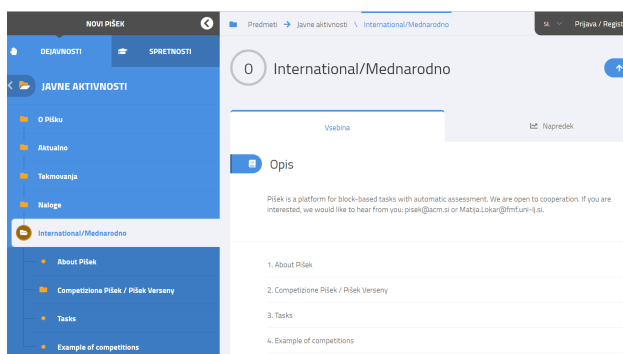
(slika 18). S tem bomo omogočili, da bodo učitelji, ki že sedaj množično uporabljajo Sistem Pišek kot učno sredstvo, sodelovali pri pripravljanju in predlaganju novih nalog.

3.10 Mednarodna vpetost

S postavitvijo svojega strežnika smo dobili tudi možnost za vzpostavitev novega, obogatenejšega menijskega sistema. Tako smo lahko dodali razdelke za:

- mednarodno predstavitev, ki bo Sistem Pišek predstavil tudi kolegom iz tujine in jih na ta način povabil k sodelovanju,
- za italijansko in madžarsko manjšino, ki bo omogočal lažje vključevanje tovrstnih šol v tekmovanje.

Pripravili smo tudi sklop nalog v angleškem jeziku, ki bodo služile kot primeri za vzpostavitev mednarodnega sodelovanja (slika 19). Pri tem smo želeli doseči, da so naloge res popolnoma enake. Končni cilj pri razvoju je priprava sistema, ki bi omogočal (kot npr. Scratch) preklopa nalog v izbrani jezik uporabnika (kar med drugim pomeni poleg prevoda besedil tudi preimenovanje napisov na delčkih, obvestil ...).



Slika 19: Razdelek za mednarodno sodelovanje

4 ZAKLJUČEK

Za učna gradiva velja, da niso nikoli dokončana. Želimo si, da bi v prispevku opisana gradiva in orodja nenehno razvijali, dodajali nove naloge in s tem nadgrajevali uporabniško izkušnjo. Med samim projektom prenove smo poleg idej, ki so izhajale iz pridobljenih izkušenj, izvedene ankete in intervjujev, dobili številne ideje, kako obogatiti naloge in jim dodati še več interaktivnosti. Tudi idej za dodatne naloge ni zmanjkalo, a smo se zaradi časovnih omejitev omejili na obstoječ nabor.

Projekt prenove se je zaključil z izjemno pozitivnimi rezultati. Sodelujoči študenti so pridobili veliko koristnih

izkušenj. Sistem Pišek in z njim povezano *Tekmovanje v programiranju z delčki* Pišek pa sta bila obogatena z obilico novih vsebin in dodatnih funkcionalnosti, ki bodo uporabne pri uvajanju začetnikov v svet programiranja in pri izvedbi samega tekmovanja.

5 ZAHVALA

Prenova portala Pišek je deloma potekala v okviru projekta **S Piškom se učimo programirati** in v okviru projekta **Sistem za samodejno preverjanje programerskih nalog** na podlagi javnega razpisa "Projektno delo za pridobitev praktičnih izkušenj in znanj študentov v delovnem okolju 2022/2023" v okviru Operativnega programa za izvajanje Evropske kohezijske politike v obdobju 2014–2020. Projekta sta sofinancirala Republika Slovenija in Evropska unija iz Evropskega socialnega sklada (slika 20). Za res aktivno sodelovanje pri prenovi se zahvaljujemo Mihi Cirmanu s podjetja CodeBrainer, dr. Andreju Brodniku z Univerze v Ljubljani ter Marku Šmidu in dr. Tomažu Kosarju iz Univerze v Mariboru.



Slika 20: Sofinancerji projekta

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Računalniški program MuseScore pri pouku glasbene umetnosti *

Computer Program MuseScore in Music Class

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POVZETEK

Pri pouku glasbene umetnosti je poleg ostalih glasbenih dejavnosti vseskozi prisotna težnja po izvajanju in zapisovanju glasbe. V mlajših razredih glasbo zapisujejo s simboli in jo po navodilih le-teh tudi izvajajo, v višjih razredih pa učenci za zapisovanje in izvajanje glasbe postopoma začnejo uporabljati note. Učenci do 6. razreda spoznajo osnovne notne vrednosti in tonsko abecedo, hkrati pa jih že povezujejo v smiselne dele in nastajajo prve skladbe. Pri zapisovanju not so otroci relativno uspešni, medtem ko pa jim manjka povezava med zapisom in zvokom, kar se kaže v tem, da zapisanega ne znajo izvajati ali obratno. Omenjen problem pri nekaterih učencih težko odpravimo kljub temu, da naredimo veliko vaj, ki vsebujejo izvajanje in zapisovanje. Ker je postala informacijsko-komunikacijska tehnologija dostopnejša kot kadarkoli prej in je pomemben pripomoček v vzgojno izobraževalnem procesu, lahko danes notne zapise naredimo z različnimi računalniškimi programi, ki zapisane note tudi izvajajo. Pri pouku glasbene umetnosti smo z učenci 6. razredov za zapisovanje glasbe uporabili prosto dostopni program MuseScore. Z njegovo pomočjo so učenci urili svoje znanje o notnem zapisu in njegovi zvočni sliki, hkrati pa so preživeli zanimivo uro v računalniški učilnici ob uporabi sodobne tehnologije. Program MuseScore je za otroke zanimiv in, tako kot drugi podobni programi, predstavlja dodano vrednost pri poučevanju povezovanja glasbenega zapisa z izvajanjem. Takšen način dela z računalniškim programom je odličen in dokazuje, da je potrebno v vzgojno izobraževalni proces uvajati sodobno tehnologijo, saj ima pozitivne učinke.

KLJUČNE BESEDE

Glasbena umetnost, notni zapis, MuseScore

ABSTRACT

Beside other musical activities, a tendency to perform and write music is present throughout music classes. In the younger grades, music is written with symbols and performed by following their instructions, whereas in the higher grades, students gradually

*Article Title Footnote needs to be captured as Title Note

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start using musical notes to perform and write music. Up to the sixth-grade, students learn about the general note forms and the musical alphabet. At the same time, they combine them into meaningful pieces and start creating their first compositions. Students are relatively successful when writing musical notes but have trouble connecting written parts with the sound, which results in them being unable to perform what they have written down and vice versa. This problem is hard to fix for some students despite doing many exercises, which include performing and writing. Information and communication technology has become more accessible than ever before and is a valuable tool in the educational process. Therefore, musical notation can today be made with different computer programs, which also perform the written notes. With the sixth-grade students, we used a freely available program MuseScore to write down music during music classes. With the help of the program, students were training their knowledge of musical notation and its sound picture. Furthermore, they have spent an exciting hour in the computer room with the help of modern technology. MuseScore spikes interest in students and it, like other similar programs, brings added value when teaching students about the connection between musical notation and performance. This type of work with a computer program is perfect, and it proves that the educational system needs to be combined with modern technology because of its positive effects.

OPTIONAL: KEYWORDS

Music class, musical notation, MuseScore

1 UVOD

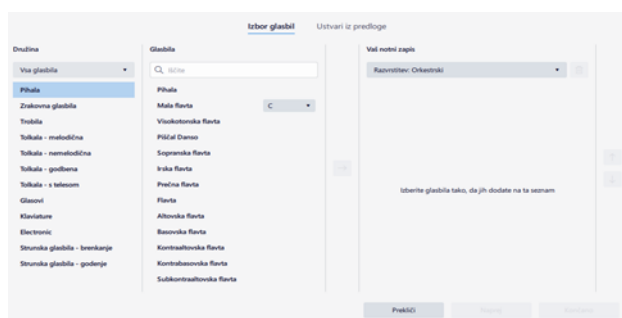
Orientiranje v grafično-slikovnem in notnem zapisu je eden izmed standardov v učnem načrtu za glasbena umetnost v osnovni šoli [1]. Poznavanje notnega zapisa in njegova uporaba je torej ena od pomembnejših tem pri pouku. Delovni zvezek za glasbena umetnost v 6. razredu [2] ponuja nekaj vaj, kar pa ne zadostuje za temeljito utrjevanje zapisa in njegovo uporabo. Kadar otroci naredijo zapis v zvezek, je to šele del naloge, saj stremimo tudi k izvajanju zapisanega, pri čemer se osredotočamo predvsem na ritem. Pri omenjenih dejavnostih sem opazil konstantne težave, zato sem skušal to odpraviti na inovativen način s pomočjo medpredmetne povezave med glasbo in računalništvom.

Tovrstna metoda dela ima veliko pozitivnih učinkov, predvsem pa je pri takšnem pouku motivacija otrok za učenje večja in na ta

način učenci pridobijo več poglobljenega znanja [3]. Zato sem glasbeno opismenjevanje povezal z računalništvom in uporabo programov, ki izvajajo zapisane note. Eden od takih računalniških programov za zapisovanje glasbe je program MuseScore, ki je prosto dostopen na spletu [4]. Lahko ga uporabljajo tako otroci s šibkim glasbenim znanjem kot otroci, ki obiskujejo glasbeno šolo in so večji notnega zapisa.

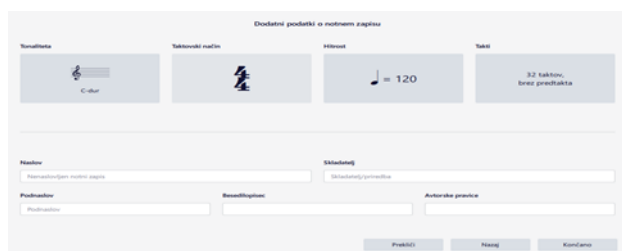
2 PROGRAM MUSESCORE

Program MuseScore je ob uporabi osnovnih funkcij enostaven in nezahteven. Pred zapisovanjem skladbe je na izbiro cela paleta glasbil (Slika 1), za katere želimo zapisati skladbo. Glasbila so sistematično urejena in z nekaj kliki najdemo vsa glasbila, ki jih lahko slišimo v simfoničnem orkestru ter večino ostalih glasbil, ki jih poznamo.



Slika 1: Izbira glasbil

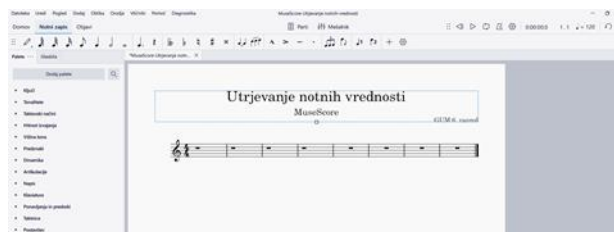
Po izbiri glasbila je potrebno določiti vse ostale značilnosti glasbenega zapisa (Slika 2), ki jih je mogoče kasneje med zapisovanjem skladbe poljubno spreminjati. Program po predlogi ponuja nekaj rešitev, sami pa moramo dopisati naslov skladbe, podnaslov, skladatelja, besedilopisca in nosilca avtorskih pravic.



Slika 2: Izbira glasbenih značilnosti in naslovne informacije

Po opisanim začetnem koraku, lahko pričnemo z zapisovanjem skladbe, in sicer tako, da najprej določimo notno vrednost in šele nato tonsko višino. Program že v naprej izpolni vse takte s pavzami (Slika 3), ki jih je potrebno pri delu neprestano poljubno spreminjati ali pa po želji pustiti.

Musescore predvaja napisano glasbo in tako lahko preverimo, ali se notni zapis sklada z našimi glasbenimi idejami. Ob koncu imamo, podobno kot pri ostalih programih, možnost shraniti dokument na različne medije in tudi izvoziti skladbo v drugih formatih. Zahtevnejši uporabniki bodo našli še mnogo možnosti, ki pa so za našo stopnjo izobraževanja prezahtevne.



Slika 3: Izpolnjeni takti, ki jih lahko spreminjamo

2.1 Musescore pri pouku

Preden sem učencem predstavil program MuseScore, smo ponovili notne vrednosti in tonsko abecedo. Nadalje smo nekoliko več pozornosti namenili taktovskemu načinom, saj v programu ni mogoče pisati brez poznavanja le tega. Pri vsakem utrjevanju smo zapisano glasbo tudi izvajali. Delo s programom sem razdelil na dve uri, in sicer na spoznavalno uro programa, v kateri smo utrjevali notne vrednosti in na nadaljevalno delo, pri katerem smo notnim vrednostim dodali tonsko abecedo. Vsako izmed teh dveh ur smo enako pozornost namenili tako zapisu kot izvajanju glasbe.

2.2 Spoznavanje s programom musescore

V prvi uri dela s programom je bilo potrebno najprej otrokom razložiti osnovne funkcije in način zapisovanja not. Osredotočili smo se samo na notne vrednosti brez tonske višine.

Uporabili smo štiričetrtinski taktovski način, ki je relativno enostaven in dovoljuje nekaj več variiranja z notnimi vrednostmi. Najprej smo ustvarili dva takta, ki sta si podobna, a kljub vsemu so morali otroci v drugem taktu spremeniti notne vrednosti. Ker to ni predstavljalo večjih težav, sem v naslednjih dveh taktih nekoliko otežil zapis, saj so morali uporabiti tudi pavzo.

V prvih štirih taktih, ki so jih ritmično izpolnili po navodilih (Slika 4), so spoznali osnovni princip zapisovanja not, zadnje takte pa so lahko izpolnili sami. Pri samostojnem delu sem določil nekaj smernic, in sicer:

- učenec uporablja notne vrednosti, ki se nahajajo v prvih štirih taktih,
- učenec znati pravilno izvajati glasbeni zapis, ki ga je zapisal.

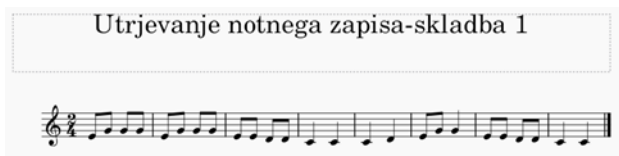
Nenavaden zapis, ki bi bil nesmiseln in posledično težko izvedljiv, bi lahko nakazoval na otrokovo neznanje obravnavane snovi. Otroci, ki obiskujejo glasbeno šolo, so bili pri nalogi uspešnejši in so ustvarili nekoliko bolj kompleksne skladbe, ki so jih tudi pravilno izvajali. Pri izvajanju taktov so si lahko pomagali s programom. Če je bilo njihovo izvajanje enako kot izvajanje programa, je pomenilo, da so pravilno izvajali ritem. Če se je izvajanje razlikovalo, so se lahko, po metodi odmeva, s pomočjo programa naučili pravilno izvajati ritem ali pa so potrebovali pomoč učitelja.



Slika 4: Izpolnjeni takti po mojih navodilih

2.3 MuseScore in zapisovanje tonskih višin

Med prvo in drugo uro dela s programom MuseScore je bilo nekaj tednov premora. Zanj sem se odločil, saj sem po prvih pozitivnih odzivih upal, da si bodo otroci namestili program na domači računalnik, hkrati pa smo med tem časom snov še dodatno utrdili. Moja predvidevanja so bila pravilna, saj je kar nekaj otrok program uporabljalo doma in ti otroci so bili v drugi uri uspešnejši od sovrstnikov, ki tega programa niso imeli doma. V drugi uri sem otrokom pripravil dve skladbi, ki so ju morali prepisati v program. Vsebovali sta različne notne vrednosti ter različne tonske višine (Slika 5). Ker so otroci program že poznali, niso imeli večjih težav pri tej nalogi. Hitrejšim in tistim z več znanja sem dodatno pripravil nekoliko kompleksnejše notno gradivo. Če so se jim pri delu pojavili problemi, sem jih pustil, da sami skušajo najti rešitve in na ta način samostojno raziskujejo MuseScore. Podobno kot v prvi uri so tudi tokrat otroci izvajali napisani skladbi, vendar smo se ponovno osredotočili samo na ritem in ne na melodijo.



Slika 5: Skladba, ki so jo morali učenci prepisat

3 ZAKLJUČEK

Učenci so z navdušenjem sprejeli pouk glasbene umetnosti v računalniški učilnici. S pomočjo sodobne tehnologije so se na inovativen način učili ali pa samo preprosto utrjevali že znano snov. Ob delu s programom MuseScore učenci niso imeli večjih težav in so bili pri nalogah uspešni tako učno šibkejši kot tisti z veliko glasbenega znanja. Delo v učilnici računalništva se je obrestovalo, saj so bili otroci kasneje ob podobnih nalogah, v katerih je bilo potrebno skladbo zapisati in jo nato izvajati, bistveno bolj uspešni. Povezava med zapisanim in izvajanim je tako otrokom postala bolj jasna.

Učitelj, ki otrokom predstavlja takšen ali podoben program, se mora najprej sam z njim dobro spoznati, saj se otroci zelo hitro učijo in lahko presežejo načrtovane cilje. Takrat je potrebno otroke voditi v njihovem odkrivanju novega in jim pomagati z lastnimi izkušnjami. Menim, da so MuseScore in drugi sodobni učni pripomočki pomembni pri pedagoškem delu in ga bom v prihodnje uporabljal kot sredstvo za izboljšanje učnih dosežkov.

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Uporaba opreme Vernier v eksperimentih pri pouku fizike

Using Vernier Equipment in Experiments at Physics Lessons

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POVZETEK

Običajno učitelji na konferencah predstavijo eno metodo, eno orodje ali en pristop, ki so ga uporabili pri pouku. Namen tega prispevka je podati širši pregled uporabe računalniško podprtih meritev z opremo podjetja Vernier na podlagi 20 let izkušnje poučevanja fizike v gimnaziji. V prispevku so predstavljeni oprema, primeri demonstracijskih eksperimentov in primeri laboratorijskih vaj. Primerom so dodani komentarji, ki lahko učiteljem pomagajo izbrati primerne poskuse in metode ter se na ta način izognejo marsikateri težavi, na katero naletimo ob prvi uporabi opreme. Čeprav so predstavljeni predvsem primeri iz poučevanja fizike v gimnaziji, lahko zaradi dodanih komentarjev služijo tudi kot dobra osnova za pripravo eksperimentov pri poučevanju vseh naravoslovnih predmetov v osnovni in srednji šoli. Učitelji začetniki lahko v prispevku najdejo veliko idej za zanimive učne ure, zagotovo pa bodo tudi izkušeni učitelji našli uporabne ideje in komentarje glede tega, kateri pristopi so se v praksi izkazali za dobre.

KLJUČNE BESEDE

Pouk fizike, naravoslovje, IKT, eksperiment, Vernier.

ABSTRACT

At conferences, teachers usually present one method, one tool or one approach they have used in class. The aim of this paper is to give a broad overview of the use of computer-based measurements with Vernier equipment, based on 20 years of experience in teaching physics in a secondary school. The paper presents the equipment, examples of demonstration experiments and examples of lab work. The examples are accompanied by comments that can help teachers to choose appropriate experiments and methods and thus avoid many of the problems encountered when using the equipment for the first time. Although the examples are mainly from teaching physics in secondary school, due to the additional comments they can be used as a good base for preparing experiments at all subjects in science education in primary and secondary school. Less experienced teachers will find many ideas for interesting lessons in the paper while experienced teachers will also find useful ideas and comments on which approaches have worked well in practice.

KEYWORDS

Physics lessons, science, ICT, experiment, Vernier.

1 UVOD

Pri pouku fizike v gimnaziji igrata pomembno vlogo motivacija dijakov in razumevanje snovi. IKT lahko učitelju pomaga na obeh področjih. Učitelji se uporabe nove opreme ali novega pristopa k poučevanju pogosto lotimo v želji, da bi dijaki snov razumeli bolje. Veliko dijakov bo bolj motiviranih za delo že v primeru, če vidijo novo opremo. Na drugi strani se mora učitelj zavedati tudi izzivov pri uporabi IKT.

Nekatere dijake ob pogledu na novo opremo skrbi, da je ne bodo znali uporabljati ali da jo bodo uničili. Pomembno je, da take strahove čim prej pomirimo in da dijaki v kratkem času vidijo, da je uporaba opreme (večinoma) enostavna in jim pomaga pri učenju novih vsebin. Pri uporabi IKT pri pouku moramo biti pozorni na to, da uporaba tehnologije ne postane sama sebi namen, temveč jo uporabimo le pri temah, kjer je to smiselno. Praviloma učitelj ob prvi izvedbi novega pristopa kljub dobri pripravi naredi več napak, ki jih potem ob upoštevanju odzivov dijakov pri naslednjih izvedbah odpravi. V nadaljevanju bom predstavil več primerov uporabe računalniško podprtih meritev z opremo Vernier, ob katerih bom dodal tudi svoje ugotovitve, za katere si želim, da bi učiteljem pomagali pri pripravi in izvedbi eksperimentov.

2 PREDSTAVITEV OPREME VERNIER

Pouk fizike lahko popestrimo z računalniško podprtimi eksperimenti. Izvedba eksperimentov je najbolj učinkovita, če imamo na šoli vso opremo istega proizvajalca. V svetovnem merilu sta največji podjetji, ki ponujata senzorje in programsko opremo za šole, Vernier in Pasco. V Sloveniji je zlasti v srednjih šolah najbolj zastopana oprema podjetja Vernier [1]. Slovenski učitelji lahko dobimo več informacij in cenik pri podjetju Romiks, ki zastopa Vernier v Sloveniji [2]. Načeloma lahko na obeh spletnih straneh najdemo vse informacije o opremi, v praksi pa se seveda izkaže, da je veliko podrobnosti, ki jih lahko odkrijemo le sami ali nam jih posredujejo izkušeni učitelji. Vsekakor pa sta obe spletni strani dober vir idej za eksperimente. Na voljo so brezplačni video posnetki in webinarji kot tudi plačljive klasične in elektronske knjige z navodili za izvedbo eksperimentov (v angleščini).

O uporabi opreme Vernier pri pouku je bilo na različnih konferencah in drugih dogodkih predstavljenih veliko prispevkov. V večini primerov je predstavljen le en primer uporabe izbranega senzorja ali prikaz kvečjemu enega eksperimenta z več senzorji. Na ta način sem kot soavtor

sodeloval pri prispevku o uporabi merilnika sile pri analizi skoka, ki ga opisujem kasneje. Ob pripravi tistega prispevka sem se pogovarjal z mnogimi učitelji fizike v osnovni in srednji šoli. Presenetilo me je, kako velike so bile razlike med opremljenostjo in pogostostjo uporabe vmesnikov in senzorjev Vernier, čeprav so vse srednje šole od ministrstva prek razpisa na nivoju Slovenije prejele enako opremo. Med takratno predstavitvijo sem omenil, da bi si lahko tovrstno opremo med seboj posojali učitelji z različnih šol. Po predstavitvi me je ena od učiteljic iz osnovne šole vprašala, ali sem to mislil resno. Dogovorila sva se, da sem ji opremo, ki sem jo predstavil v prispevku, čez nekaj tednov posodil za naravoslovni dan, ki so ga izvedli na šoli. Vsekakor si želim, da bi predstavitve prispevkov na konferencah večkrat imele za posledico take pogovore ter izmenjave opreme in idej.

Ker so se v zadnjih letih reči glede opreme Vernier precej spremenile, je smiselna primerjava opreme v začetku uporabe v slovenskih šolah in danes. Leta 2013, v času pisanja prispevka o merjenju sile pri skoku, so pri podjetju Vernier ponujali en računalniški vmesnik (LabPro), ki smo ga priključili na računalnik. Na vmesnik LabPro smo priključili različne senzorje (za silo, tlak, razdaljo in drugo). Meritve smo izvajali s programom Logger Pro na računalniku. Vmesnik LabPro so kasneje zamenjali z vmesnikom LabQuest Mini, ki ga še vedno prek USB kabla priključimo na računalnik. Na LabQuest Mini lahko prek kablov priključimo 3 analogne in 2 digitalna senzorja. Več o vrstah senzorjev sledi v nadaljevanju.

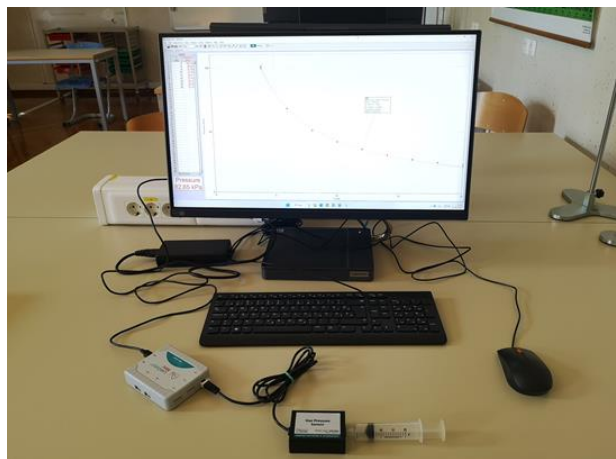
Zlasti za delo na terenu, izven učilnice, je pogosto uporaben vmesnik LabQuest 3, na katerega lahko poleg 3 analognih in 2 digitalnih priključimo senzorje še na druge načine (Go Direct, prek USB, brezžično in vgrajena senzorja). Ena od prednosti LabQuest 3 je, da ne potrebujemo osebnega računalnika, saj vsebuje mini računalnik in zaslon, ki je občutljiv na dotik. Njegova slabost v primerjavi z uporabo vmesnika LabQuest Mini in računalnika je v tem, da je njegov zaslon manjši, programska oprema pa ponuja veliko manj orodij za obdelavo podatkov kot v programu Logger Pro na računalniku. Pri uporabi LabQuest 3 je najbolj smiselno, da podatke shranjujemo direktno na USB ključek, ki ga vstavimo v vmesnik. Kasnejši prenos podatkov iz vmesnika na USB ključek ali računalnik je zaradi nerodnega uporabniškega vmesnika precej težaven.

Obstaja tudi vmesnik Go!Link, ki je manj zmogljiv in nanj lahko naenkrat priključimo le en analogni senzor. Go!Link pa je zaradi nižje cene pogostejša izbira šol, ki kupijo manj senzorjev in imajo bolj omejena finančna sredstva.

Pri senzorjih je ponudba še pestrejša kot pri vmesnikih, saj Vernier ponuja več kot 150 senzorjev. Nekaj senzorjev bo predstavljenih v spodnjih primerih. Kot sem omenil zgoraj, moramo biti posebej pozorni na to, katere senzorje podpira naš vmesnik. Senzorji, ki jih na vmesnik priključimo prek kabla, so lahko analogni ali digitalni. Pri uporabi obeh vrst senzorjev v večini primerov ni razlik, le priključiti jih moramo na ustrezen vhod vmesnika. Pri Vernieru je to odlično rešeno in je uporaba zelo enostavna. Senzor poskusimo vstaviti v en vhod in če ta ni ustrezen, ga preprosto vstavimo v drug vhod. Prav vsi dijaki se to naučijo v manj kot minuti. Prikljop senzorjev s kablom je enak pri vseh vrstah vmesnikov.

V zadnjih letih so postali precej popularni brezžični senzorji Go Direct, ki pa jih na žalost ne moremo priključiti na vmesnik LabQuest Mini in uporabljati s programom Logger Pro. Njihova prednost je, da se lahko z njimi povežemo prek aplikacije

Graphical Analysis na pametnem telefonu ali prek vmesnika LabQuest 3. Mnogo učiteljev je navdušenih nad njihovo uporabo, saj dijaki podatke s senzorjev shranjujejo direktno na svoj telefon, na katerega predhodno namestijo aplikacijo Graphical Analysis. Osnovna verzija te aplikacije je na voljo brezplačno, napredna pa je plačljiva. Po potrebi lahko senzorje GoDirect prek USB kabla povežemo z računalnikom, na katerem uporabljamo aplikacijo Graphical Analysis, a se pri tem izgubi glavni namen teh senzorjev – brezžična povezava.



Slika 1: Primer poskusa z opremo Vernier (Boylov zakon)

Kljub različnim možnostim, ki so danes na voljo, sam zaradi visoke zanesljivosti pri pouku še vedno najraje posežem po senzorjih, ki so na vmesnik in zatem na računalnik povezani s kablom (Slika 1). Pri uporabi bluetootha ali drugih brezžičnih načinov prenosa podatkov se občasno pojavijo težave, zlasti pri povezovanju naprav, na primer pri povezavi pametnega telefona in senzorja. Pri tem je največja težava to, da ne vemo, kdaj in v katerem primeru se bodo pojavile težave. Včasih se zgodi, da se senzor preprosto ne poveže z določenimi vrstami telefonov. Če se težave pojavijo pri več dijakih, to močno zmoti potek učne ure. Pri brezžičnih senzorjih moramo biti pozorni tudi na to, da je baterija dovolj napolnjena. Pri uporabi kablov se težave pojavijo zelo redko in še v tem primeru jih večinoma odpravimo tako, da senzor med uporabo preprosto iztaknemo in ponovno vtaknemo v vmesnik, napajanje pa poteka prek istega USB kabla, ki ga sicer uporabljamo že za prenos podatkov..

Način uporabe opisane opreme pri pouku je močno odvisen od možnosti, ki jih ima učitelj na posamezni šoli. Na Gimnaziji Bežigrad smo poleg opreme, ki so jo vse šole prejele od ministrstva, dokupili veliko dodatne opreme. Opremo lahko uporabljamo v fizikalni učilnici ali jo nesemo v katerokoli drugo učilnico. Poleg tega imamo tudi posebno učilnico, ki je namenjena le uporabi računalniško podprtih eksperimentov pri naravoslovju. Učitelji lahko načrtujemo izvedbo določenih laboratorijskih vaj v tej učilnici. V tem primeru imamo na voljo 8 delovnih postaj za dijake. Na vsaki postaji je namizni računalnik z vmesnikom LabQuest Mini, laborant pa pripravi senzorje in drugo opremo, ki jo dijaki potrebujejo za izvedbo vaje.

3 PROGRAMSKA OPREMA

Pri Vernieru je na voljo več različnih programov za posebne senzorje ali namene, najpomembnejša pa sta Logger Pro in Graphical Analysis. Logger Pro je relativno preprost a zelo zmogljiv program za zajemanje podatkov s senzorji, ki jih s kabli priključimo na vmesnik. Obstajata dve verziji – za Windows in Mac OS. Program je sicer plačljiv, a so precej radodarni pri licenci za šole. Če šola uporablja opremo Vernier, je uporaba programa Logger Pro brezplačna za vse učitelje in dijake, tako na šolskih kot domačih računalnikih. V praksi je torej Logger Pro za slovenske učitelje brezplačen.

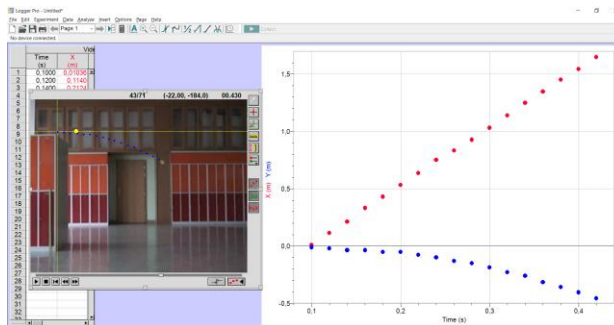
V Logger Proju lahko enostavno nastavimo, koliko časa naj traja meritev, kako pogosto bomo zajemali podatke, kdaj naj se meritev sproži in podobno. Poleg zajemanja podatkov prek senzorjev lahko podatke tudi obdelujemo. Ker je program precej zmogljiv in enostaven za uporabo, ga dijaki včasih uporabijo raje kot Excel ali druge programe tudi za risanje grafov s podatki, ki so jih izmerili na drug način in ne z opremo Vernier. V Logger Proju na enostaven način dodamo novo spremenljivko, katere vrednosti izračunamo s poljubno formulo iz drugih spremenljivk, na več enostavnih načinov lahko povečamo izbrani del grafa, modeliramo podatke z izbrano funkcijo, izračunamo strmino funkcije (odvod), ploščino pod krivuljo (integral). Zahtevnejši uporabnik bo v meniju našel napredne nastavitve in izbral, iz koliko točk naj program vsakokrat izračuna odvod (na primer pri računanju hitrosti iz zaporednih točk lege), natančno nastavi podrobnosti prikazanih točk na grafu in vrsto drugih možnosti. Logger Pro omogoča tudi video analizo, ki je opisana v nadaljevanju.

Aplikacija Graphical Analysis je na voljo za Windows, Mac OS Chrome OS, iOS in Android. Sam sem jo uporabljal na telefonu z Androidom v kombinaciji s senzorji GoDirect. Velja opozoriti, da se pri vseh programih in aplikacijah lahko uporabniška izkušnja na različnih napravah nekoliko razlikuje. Uporaba programa je relativno enostavna, a je možnosti veliko manj kot pri Logger Proju. Enega od senzorjev GoDirect (za merjenje razdalje, tlaka, temperature ali česa drugega) vklopimo s pritiskom na gumb, da začne utripati lučka Bluetooth. Na telefonu zaženemo aplikacijo Graphical Analysis, kliknemo na Sensor Data Collection (ali ustrezen slovenski prevod v slovenski verziji aplikacije) ter s seznama senzorjev izberemo zeleni senzor. Če uporabljamo več senzorjev v istem prostoru, na primer pri laboratorijskih vajah, moramo biti pozorni, da izberemo senzor z ustrežno kodo, ki je zapisana na ohišju vsakega senzorja. Ko se senzor in telefon povežeta, bo svetila zelena lučka. Kliknemo na "Done", glede na senzor izberemo poljubne nastavitve in začnemo z meritvijo.

4 VIDEO ANALIZA

S programom Logger Pro lahko poleg zajemanja podatkov prek senzorjev in obdelave podatkov naredimo tudi video analizo. Pri večini poskusov zadošča, da gibanje teles posnamemo s telefonom. V Logger Proju v meniju kliknemo na Insert, Movie in izberemo datoteko z našim videom. V spodnjem desnem kotu okna z videom kliknemo na Enable/Disable Video Analysis. Odpre se podokno z ikonami, kjer zelo intuitivno uporabimo ikone od vrha navzdol. Na vsaki sličici videa kliknemo na predmet, program pa sproti že riše graf gibanja iz prebrane lege

in časa. Lega je prvotno prikazana v pikslih, za umeritev dolžin pa moramo imeti na posnetku dobro viden predmet, za katerega vemo, kako velik je. Po umeritvi so enote na grafu pravilne, torej izražene v metrih. Poljubno lahko izberemo izhodišče in orientacijo koordinatnega sistema. Sledimo lahko tudi več telesom ali več točkam enega telesa. To je uporabno, če želimo slediti gibanju komolca, boka in kolena tekača.



Slika 2: Video analiza vodoravnega meta

Video analizo običajno predstavim dijakom ob obravnavi vodoravnega meta, kasneje pa jo pogosto uporabijo pri projektnem delu (Slika 2). Vodoravni met je po eni strani preprost za obdelavo, po drugi strani pa lahko vključimo večino orodij, ki jih uporabljamo pri video analizi. Dijaki se ob primeru (vsi obdelujejo isti video posnetek) v eni šolski uri naučijo uporabljati vsa pomembna orodja za video analizo. Med drugim se naučijo narisati grafe za komponente lege in hitrosti v odvisnosti od časa (x , y , v_x in v_y) ter določiti strmino grafa. Med obdelavo vodoravnega meta določijo tudi gravitacijski pospešek.

Čeprav je video analiza v Logger Proju preprosta, dijaki ob prvi uporabi večkrat naletijo na težave, če jih nanje ne opozorimo vnaprej. Pred snemanjem poskusa je potrebno preveriti, ali Logger Pro podpira format videa, ki ga bo shranil naš telefon ali druga naprava. V primeru težav je možna tudi pretvorba v ustrezen format, a se pri tem večkrat pojavijo nove težave. Pazljiv je treba biti tudi pri počasnih posnetkih, saj lahko telefoni čas zapišejo na različne načine (kot pravi ali upočasnjeni čas). Včasih dijaki premikajo kamero, da sledijo predmetu, s čimer dobijo za preprosto video analizo neuporaben posnetek. Telefon mora ob snemanju mirovati, na posnetku pa mora biti tudi dobro viden vsaj en predmet, za katerega vemo, kako velik je, da bomo lahko izvedli umeritev (določimo koliko pikslov ustreza enemu metru). Predmet za umeritev in opazovani predmet morata biti na enaki razdalji. Če je en meter dolga palica od nas oddaljena 20 metrov, z njo ne bomo mogli umeriti gibanja predmeta, ki leti mimo nas na oddaljenosti 5 metrov. Določanje lege predmetov in razdalj med njimi lahko uporabimo tudi na fotografijah.

Pri biologiji lahko tako iz fotografije skozi okular mikroskopa določimo velikost in oddaljenosti mikroorganizmov, če vsaj za en predmet v vidnem polju vemo, kako velik je. Med pogostimi primeri video obdelave pri fiziki so padanje teles (žoge in padala), met žoge in let puščice. Z video analizo lahko sledimo valovanju na vzmeti, kjer so pojavi včasih prehitri, da bi jih lahko opazovali brez upočasnitve. Z nekaj domišljije najdemo tudi druge teme, na primer kako je dolžina koraka tekača odvisna od njegove hitrosti.

Za video analizo lahko uporabimo veliko različnih programov. Med dobre prosto dostopne programe spada Tracker [3], ki ima v primerjavi z Logger Projem več možnosti, med drugim lahko samodejno sledi gibajočemu se predmetu in zato ni potrebno klikniti na predmet na vsaki sličici v videu. Za šolsko delo večinoma zadošča Logger Pro, zato se verjetno večina učiteljev in dijakov ne bo učila uporabe novega programa, če že pozna Logger Pro.

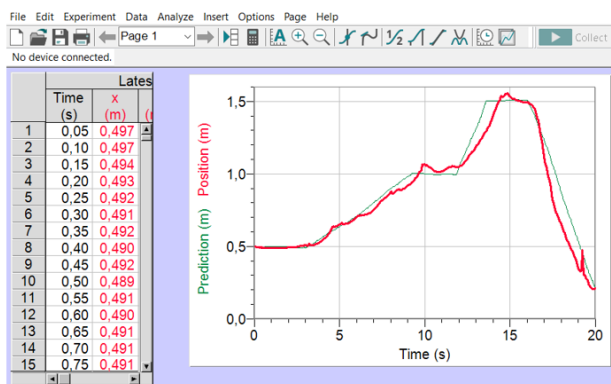
5 DEMONSTRACIJSKI EKSPERIMENTI

Učitelji pri pouku pogosto izvedemo eksperimente, ki jih vidijo vsi dijaki. Največkrat meritve prikazujemo na interaktivnem zaslonu, tabli ali jih projiciramo na steno. Cela vrsta meritev z opremo Vernier dijakom pomaga bolje razumeti predstavljeno snov.

Nekaj primerov demonstracijskih poskusov iz različnih poglavij fizike je navedenih v nadaljevanju (v oklepaju so zaradi lažjega iskanja senzorjev na spletu zapisana angleška imena senzorjev).

5.1 Hoja

Pri obravnavi gibanja imajo dijaki pogosto težave pri predstavi fizikalnega koncepta, da na grafu lege v odvisnosti od časa strmina pove hitrost. Ko dijaki opazujejo svojega sošolca, kako hodi pred tablo in istočasno vidijo graf $x(t)$, se marsikomu zadeve razjasnijo. Ko se sošolec giblje počasneje, je strmina manjša, ob hitrejšem gibanju pa je strmina večja (Slika 3). Pri tem poskusu uporabimo slednik gibanja (motion detector).



Slika 3: Graf $x(t)$ za hojo

5.2 Sunek sile

Pri trku vozička ob sensor sile lahko opazujemo, kako se s časom spreminjata sila in hitrost. Za izvedbo poskusa potrebujemo sensor sile (force sensor) in slednik gibanja (motion detector). Pomembno je, da silo izmerimo več stokrat v sekundi. Opazujemo lahko, kako se sila spreminja, če je hitrost vozička ob trku večja. Še bolj zanimivo je opazovati izid poskusa, če je voziček enkrat trči direktno v senzor, drugič pa trk ublažimo s papirjem. Ob daljšem času trka je sila manjša. Razlago lahko navežemo na varnost v prometu, kjer je ob trku ključna ideja, da podaljšamo čas trka in s tem zmanjšamo silo na potnika. Te eksperimente lahko v enaki ali nadgrajeni obliki uporabimo tudi pri laboratorijskih vajah.

5.3 Sila ob skoku

Dijake vedno pritegne izvedba eksperimenta, pri katerem eden od dijakov ali učitelj skoči na posebnem merilniku sile (force plate), ki je videti kot osebna tehtnica brez številčnice, saj meritve vidimo na zaslonu računalnika. Od navadne tehtnice se razlikuje po možnosti hitrega zajemanja podatkov, tudi več sto meritev v sekundi, kar nam omogoča opazovanje spreminjanja sile med skokom [4]. Merilnik ima dve območji (največja dovoljena sila je 3.500 N), omogoča pa tako merjenje pritiska na merilnik kot vlečenje, ki ga izvedemo ob namestitvi ročajev na merilnik. Ob doskoku lahko opazujemo, kako se spremeni sila na merilnik in s tem obremenitev kosti in sklepov, če pristanemo z iztegnjenimi nogami. Sila lahko doseže več kot trikratno težo. Ob tej temi se lahko navežemo tudi na sile pri doskoku smučarskih skakalcev. Osnovni poskus je zanimiv za vse dijake, lahko pa ga nadgradimo tudi s zahtevnejšimi vprašanji, na katera bodo znali le odgovoriti le najboljši dijaki.

5.4 Absolutna ničla

Ta eksperiment lahko izvajamo demonstracijsko pred razredom ali pa ga dijaki izvajajo kot vajo. Steklo bučko dobro zatesnimo z gumijastim zamaškom, skozi katerega priključimo senzor tlaka (gas pressure sensor). Bučko postavimo v grelnik poln vode (za čaj), s katerim vodo počasi segrevamo. Privzeti smemo, da se prostornina zraka v bučki in cevki do sensorja ne spreminja. Ker gre za izohorno spremembo, bo tlak sorazmeren s temperaturo. Temperaturo vode merimo z Vernierovim termometrom (stainless steel temperature probe). Meritve običajno opravimo na območju od 20 do 80 °C. V Logger Proju na grafu $p(T)$ skozi izmerjene točke potegnemo premico in določimo, kje premica seka abscisno os. To ustreza točki, kjer je tlak enak nič, temperatura pa je najnižja možna (absolutna ničla). Običajno meritev pokaže, da bi bil tlak enak nič pri temperaturi okrog -300 °C. Ker dijaki vedo, da je najnižja možna temperatura 0 kelvinov ali -273 °C, so običajno nekoliko razočarani nad precejšnjim odstopanjem. Ko se pogovorimo o tem, da smo na absolutno ničlo sklepali iz meritev pri temperaturah med 20 in 80 °C ter da glede prave vrednosti nismo imeli nobenega eksperimentalnega podatka (le vsi na pamet vemo, kolikšna je pravilna vrednost), so z meritvijo bolj zadovoljni.

5.5 Nihanje

Pri nihanju lahko opravimo različne meritve. Ob spoznavanju grafov pri nihanju lahko obesimo leseno ali kovinsko kroglo na metrsko vrvico in tako nihalo zanihamo. S slednikom gibanja merimo časovno spreminjanje razdalje krogle od sensorja. Pred poskusom dijaki naredijo svojo napoved grafa $x(t)$. Po opravljenem poskusu se pogovorimo o pravilnosti njihovih napovedi. Po komentarjih nadaljujemo napovedjo grafov $v(t)$ in $a(t)$ ter vsakokrat preverimo pravilnost napovedi s poskusom.

6 LABORATORIJSKE VAJE

Čeprav ob vseprisotni tehnologiji morda kdo pomisli, da bi bilo idealno, če bi dijaki vse laboratorijske vaje pri fiziki dijaki izvedli z računalnikom, sam menim, da moramo najti pravo ravnotežje različnih pristopov. Pomembno je, da znajo dijaki zapisati meritve in narisati grafe tudi "na roko" na milimetrski papir.

Ravno tako je smiselno, da pri vajah pridobivajo različne veščine. Morda bo pri eni vaji večji poudarek na razmisleku, pri drugi na meritvi, pri tretji na obdelavi podatkov in pri četrti na interpretaciji rezultatov. Zagotovo pa računalniško podprte meritve lahko prispevajo k boljšemu razumevanju, hitreje opravljenim meritvam in omogočajo modeliranje (prilagajanje ustreznih funkcij podatkom). Nekaj primerov računalniško podprtih laboratorijskih vaj je navedenih v nadaljevanju.

6.1 Gibanje vozička po klancu

Dijaki napovejo grafe $x(t)$, $v(t)$ in $a(t)$ za gibanje vozička po klancu in s slednikom gibanja te grafe narišejo in komentirajo. Napoved bo zahtevnejša, če se voziček med gibanjem odbije ali če spremenimo lego senzorja.

6.2 Sunek sile

S slednikom gibanja na vrhu klanca merimo hitrost vozička. Na najnižji točki klanca se voziček zaleti v merilnik sile in se zaradi vzmeti na srednjem delu vozička odbije. Dijaki iz mase vozička in spremembe hitrosti določijo spremembo gibalne količine, iz ploščine na grafu sile v odvisnosti od časa pa sunek sile. Na ta način preverijo veljavnost izreka o gibalni količini. Običajno je odstopanje obeh izmerjenih vrednosti okrog 20 %, kar se zdi glede na izzive pri merjenju sprejemljivo. Pri poskusu je pomembno, da povečamo frekvenco zajemanja podatkov vsaj na 200 meritev na sekundo.

6.3 Boylov zakon

Merilnik tlaka privijemo na brizgo. Ko zmanjšamo prostornino brizge, se poveča tlak v njej. Pri večini poskusov opazujemo, kako se izbrana količina spreminja s časom, pri Boylevem zakonu pa uporabimo novo vrsto meritve – Events with entry. Pri tem načinu merjenja merimo eno količino s senzorjem (tlak), drugo količino pa vnašamo ročno (prostornina). Na osnovnem nivoju zadošča, da dijaki z meritvijo izrišejo graf $p(V)$, na katerem prepoznajo obratno sorazmerje. Na višjem nivoju pa lahko ugotovimo, da zveza ne velja natančno zaradi napake pri merjenju prostornine. Podrobnejša analiza pokaže, da je v senzorju okrog 0,5 ml zraka, kar vpliva na nenatančnost izmerjene prostornine. V maturitetni skupini dijaki običajno naredijo še linearizacijo grafa in torej narišejo graf $p(1/V)$.

6.4 Nedušeno in dušeno nihanje

Za nedušeno nihanje običajno uporabimo utež, ki jo obesimo na vrvico. Na ta način se amplituda v nekaj nihajih le malo spremeni in smemo nihanje obravnavati kot nedušeno. Dijaki opazujejo nihanje nihala na grafih $x(t)$, $v(t)$ in $a(t)$. Za prikaz grafa $a(t)$ je potrebno v meniju Logger Proja izbrati Insert, Graph. Običajno vajo izvajajo po obdelani snovi in lahko praktično preverijo, kar so naučili ob demonstracijskem poskusu in teoriji (časovni zamiki grafov, pomen amplitude in nihajnega časa). Glede na predznanje in spretnost dijakov ter čas, ki nam je na voljo, lahko dušeno nihanje prikažemo kot demonstracijski poskus ali pa kot samostojno vajo. Dijaki si po izvedenem poskusu veliko bolje zapomnijo obliko grafa $x(t)$ za dušeno nihanje. Vidijo, da se amplituda zmanjšuje eksponentno s časom, nihajni čas pa se ne spreminja.

6.5 Osvetljenost

To vajo praviloma izvajam v maturitetni skupini za fiziko. Dijaki s svetlobnim senzorjem (light sensor) merijo, koliko svetlobe pade na senzor glede na oddaljenost od svetilke. Na osnovnem nivoju lahko dijaki preverijo, da osvetljenost pada s kvadratom oddaljenosti. Podrobnejša analiza pa pokaže, da odvisnost ne velja natančno, ker svetilka ni točkasto telo, ker prihaja svetloba tudi iz okolice in da svetloba morda ne pade vedno povsem pravokotno na senzor. Vse to pa ponuja priložnost za nadaljnje raziskovanje.

6.6 Dodatni komentarji in projekti

Zaradi omejitve prostora v prispevek ni možno vključiti fotografij vseh navedenih poskusov, ki bi pomagali pri boljši predstavi. Kratek seznam poskusov je namenjen le prikazu nekaterih primerov uporabe in idej za nadgradnjo eksperimentov.

Glede na prostorske kapacitete in opremljenost posamezne šole lahko laboratorijske vaje z računalniško podprtimi meritvami izvajamo v laboratoriju oziroma specialni fizikalni učilnici ali v računalniški učilnici. V primeru, da imamo na šoli na voljo mobilno računalniško opremo (prenosnike prenesemo v različne učilnice), lahko vaje izvajamo v poljubni učilnici.

Poleg laboratorijskih vaj lahko dijakom ponudimo tudi, da izdelajo projekt, pri katerem uporabijo opremo Vernier. Glede na šolska pravila ocenjevanja zainteresirani dijaki tako pridobijo dodatno oceno ali pa projekt izdelajo vsi dijaki in vsi pridobijo oceno na tak način. V začetku so si dijaki teme določili sami, kasneje sem pripravil seznam tem. Večina dijakov si izbere temo s tega seznama, še vedno pa velja, da si lahko izberejo svojo temo. Izvedbo projektov sem že predstavil v prispevku na konferenci [5], kasneje pa sem preskusil še številne druge možnosti. Eno leto so vsi dijaki za izvedbo poskusov uporabljali le mobilne telefone, večino let pa jih veliko uporabi Vernierove senzorje. Sprva sem bil skeptičen glede tega, da bi dijaki precej drago opremo nosili domov. Izkušnje so pokazale, da z opremo ravnavajo zelo skrbno in zelo redko pride do poškodovanja vmesnikov, senzorjev ali druge opreme. Dijaki se sami odločijo, ali bodo meritve izvedli v šoli ali pa bodo opremo nesli domov in poskus izvedli doma.

7 ZAKLJUČEK

Vsak učitelj, ki želi pri pouku uporabiti nove metode ali orodja, naleti na mnoge izzive. Prispevek je namenjen učiteljem naravoslovnih predmetov v osnovni in srednji šoli. Čeprav so primeri iz poučevanja fizike, je poleg splošnega opisa opreme nekaj idej lahko uporabnih tudi kot motivacija za poskuse pri drugih predmetih. Če pri fiziki govorimo o gibanju dijaka pred tablo ali o gibanju avtomobilčka na klancu, bi lahko pri biologiji opazovali gibanje mikroorganizmov pod mikroskopom, ki bi ga potem obdelali z video analizo.

Pregled vmesnikov in senzorjev je lahko v pomoč učiteljem, ki se odločajo za nakup opreme. Osnovnošolski učitelji zagotovo lahko dobijo dragocene komentarje in nasvete pri kolegih iz srednje šole, saj se zdi, da so na splošno srednje šole bolje opremljene z opremo, ki je opisana v prispevku. Tudi primerjava programov (Logger Pro in Graphical Analysis) je lahko v pomoč pri izbiri opreme.

Video analiza je primerno orodje v mnogih primerih in prav presenetljivo je, kako malo se jo uporablja v šolah glede na dostopnost, uporabnost in učinkovitost. Primerom demonstracijskih poskusov so dodani koristni komentarji za uporabo opreme, učitelje pa lahko spodbudijo k drugačnim ali dodatnim poskusom tudi v primeru, ko nimajo opisane opreme. Podobno velja tudi za laboratorijske vaje in projekte, ki učencem in dijakom pomagajo bolje razumeti obravnavano snov.

Za podrobnejši opis vseh vidikov eksperimentalnega dela in večjega števila poskusov bi bilo gradiva dovolj za knjigo, ta prispevek pa je poskušal prikazati različne načine uporabe opreme Vernier, ki lahko koristijo učiteljem pri pripravi eksperimentov z vključevanjem IKT.

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Oblačni rehabilitacijski sistemi za otroke z govorno jezikovno motnjo

Cloud rehabilitation systems for children with speech language disorder

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POVZETEK

Otroku smo dolžni pripraviti ustvarjalno učno okolje, pogoje in prilagoditve, da bo lažje dosegel razvojne cilje.

Otroci z govorno jezikovnimi motnjami potrebujejo namenske prilagoditve. Uporaba oblačnih rehabilitacijskih pripomočkov omogoča mladim bolnikom lažje premagovati ovire verbalnega komuniciranja, učenje in socialne interakcije.

V tem dokumentu želimo opisati primarne naloge oblačnih sistemov za podporo nadomestne govorne komunikacije otrok z govorno jezikovnimi motnjami.

KLJUČNE BESEDE

Govorno jezikovna motnja, govorna rehabilitacija, rehabilitacijski pripomoček, nadomestna komunikacija, oblačni sistem, terapija na daljavo.

ABSTRACT

It is our duty to prepare a creative learning environment, conditions and adaptations for a child so that he can more easily achieve his developmental goals.

Children with speech and language disorders need specific adaptations. The use of cloud-based rehabilitation aids enables young patients to more easily overcome barriers to verbal communication, learning and social interaction.

This paper describes the primary tasks of cloud-based systems to support substitute speech communication for children with speech language disorders.

KEYWORDS

Speech language disorder, speech rehabilitation, rehabilitation aid, alternative communication, cloud system, remote therapy.

1 UVOD

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Otroku smo dolžni pripraviti ustvarjalno učno okolje, pogoje in prilagoditve, da bo v miru lažje dosegel razvojne cilje. Vsak otrok je nekaj posebnega. Vsi potrebujejo dom, sprejetost in toplino. Varna navezanost otroka na uglašeno odraslo osebo, ki je sposobna brezpogojne ljubezni, zagotavlja stabilen in uravnovešen razvoj.

Otroci z govorno jezikovnimi motnjami in otroci z motnjami avtističnega spektra - MAS, ki ne zmorejo izgovoriti določenega glasu, zloga ali besede, potrebujejo namenske prilagoditve, ki jim predstavljajo most v svobodo in bivanjsko samostojnost. Ne moremo sprejeti, da bi postali stigmatizirani in marginalni.

Z uporabo prosto dostopnih oblačnih govornih pripomočkov lahko omogočimo mladim bolnikom lažje premagovati ovire verbalnega komuniciranja, učenje in socialne interakcije. Pričakujemo, da se bodo otroku z uporabo pametnega pripomočka povečevale komunikacijske sposobnosti.

Na osnovi rezultatov anket smo pripravili temeljna izhodišča za zasnovano oblačnega govornega pripomočka v slovenskem jeziku.

2 OPREDELITEV PROBLEMA

Osnovne vzroke za nastanek govorno jezikovne motnje bolnika stroka navaja kot posledice bolezni, nezgod in prirojene motnje. V stikih z bolniki smo počasi prepoznavali in poskušali razumeti njihova stanja, način življenja in dojemanje družbe. Njihove ovire, stiske, nemoč in brezup.

"Ko človek izgubi govor, je to zanj lahko zelo mučno, še posebej tedaj, ko je ohranjeno razumevanje. Zaradi tega je lahko žalosten, včasih je jezen na ves svet, da se mu je to zgodilo, in tudi to je treba razumeti, ko se poskušate pogovarjati z njim. Zato je tako zelo pomembno, da mu daste priložnost, da tisto, kar zna in zmore, tudi pokaže. Na teh majhnih korakih se gradi samozaupanje in samozavest. To je balzam za njegovo dušo." [1] [2] [3]

Cilj rehabilitacije je izboljšati bolnikovo telesno ali kognitivno stanje. Rehabilitacijski proces je sestavljen iz zdravstvene, socialne, izobraževalne in poklicne rehabilitacije. Zdravstvena rehabilitacija je ciljno usmerjen individualni program, ki zahteva tesno sodelovanje specializiranega rehabilitacijskega tima, bolnika, njegove družine in prijateljev. [4] "Diagnostika in obravnava oseb z motnjami požiranja poteka v okviru multidisciplinarnega tima, katerega pomemben član so srednje medicinske sestre oziroma tehniki zdravstvene nege." [5]

Človeška kultura se razvija z izkustvenim učenjem. To je proces skupnosti, ki se z novim znanjem razvija in vzpostavlja vrednote. "Kultura je prenosljiv vzorec vrednot, idej in drugih simboličnih sistemov, ki oblikujejo vedenje." [6] Napredne družbe spodbujajo sposobnosti sočutja in pomoči do bolnih, stigmatiziranih in trpečih. Ob podpori nevladnih humanitarnih organizacij in stroke izvajajo izobraževanja v javnih šolah in medijih. Na več ravneh razvijajo omrežja pomoči in razumevanja.

"Tehnologija, ki je na voljo posamezniku, sooblikuje družbo. Kvalitetna informacija je ključna za uspešno odločanje v post-informacijski družbi. Ljudje, ki nosijo "nalepko" oviranosti, so pri izkustvenem zbiranju podatkov pogosto v težkem položaju; njihove gibalne, vidne, slušne ali druge sposobnosti so zmanjšane." [7]

3 IZHODIŠČA ZA ZASNOVO SISTEMA

Z uporabo napredne tehnologije želimo pomagati osebam z govorno jezikovno motnjo pri vzpostavljanju nadomestne govorne komunikacije. Model rehabilitacijskega pripomočka lahko pričnemo snovati na osnovi diagnoz, ki jih opredeli stroka. Zahtevno diagnostiko in terapijo govorno-jezikovnih motenj izvajajo univerzitetni strokovnjaki logopedi.[8] Bolnike, logopede, družinske člane in delovne terapevte smo vključili v analizo potreb bolnikov. Naše področje dela smo omejili le na oblačni rehabilitacijski sistem v slovenskem jeziku za otroke z govorno jezikovno motnjo. V tem delu ne moremo obravnavati elektronske tehniške pripomočke za govorno komuniciranje.

Rezultate analize anket smo uporabili pri snovanju uporabniško usmerjenega modela spletnega sistema, ki bo generiral nadomestni umetni govor, podpiral govorno terapijo, spremljal biometrične parametre bolnika in komuniciral s člani specializiranega rehabilitacijskega tima.

Podrobni cilji se nanašajo na tehnično strukturo modela oblačnega sistema, ki bo osebam z govorno jezikovno motnjo omogočil nadomestno komunikacijo. S prijaznim grafičnim vmesnikom bo z ukazi na dotik zanesljivo generiral umetni govor v materinem jeziku. Pripomoček bo pretvarjal simbole in znake v umeten govor. Za bolnike načrtujemo prost dostop do uporabe spletnega sistema. Svobodo komuniciranja, rast samopodobe in bivanjsko samostojnost bo bolniku zagotavljal sistem z enostavnim upravljanjem. Zajemal, spremljal, shranjeval in distribuiral bo biometrične parametre bolnika. Sistem bo podpiral govorno rehabilitacijo v slovenskem jeziku z zajemanjem, obdelavo, predvajanjem, grafičnim prikazovanjem in shranjevanjem zvočnih zapisov govornih dosežkov bolnika. Modularna zgradba sistema je pregledna in odprta za razvoj novih rešitev. Potrebujemo tudi hitro komunikacijo s terapevti in družinskimi člani na daljavo. Sistem bo razvit za specifične potrebe otrok in mladostnikov.

Med analizo podatkov ankete smo prišli do novih pomembnih spoznaj. Vsak bolnik ima specifične potrebe. Stroka navaja različne motnje. Pripomoček opredeli samo stroka. Nadomestna komunikacija je pogosto edina rešitev za osebe z govorno jezikovno motnjo. Pomembna je pozitivna naravnost vseh sodelujočih, ključna je podpora družine oziroma skrbnikov. Motivacija in razpoloženje bolnikov se pogosto menja. Pripomoček lahko prilagajamo bolniku. Stroka uči bolnike pravilno prepoznavati pomen simbolov in uporabljati pripomoček. Preproste in jasne rešitve skrajšajo bolniku čas

prilagajanja in učenja uporabe. Brez podpore stroke ne moremo nadaljevati iskanja optimalnih rešitev za bolnike. Industrijsko izdelani govorni pripomočki (komunikatorji) so pogosto dragi in bolnikom težje dostopni.

Za bolnike s težjim potekom bolezni po opisu stroke prilagajamo pripomočke. [9] Prilagajamo vsebino informacij, obliko okolja, razpored, število in velikost gumbov s simboli. Preveč gumbov na zaslonu je lahko moteče. Določenim bolnikom je potrebno postopno dodajati gube. Motijo jih simboli, ki jih ne poznajo. Nekatere oblike simbolov je potrebno prilagajati razumevanju bolnika. V naprej pripravljene grafične podobe simbolov nekaterim bolnikom ne ustrezajo. Nekateri bolniki težko enoznačno prepoznajo določene skupine grafičnih podob oziroma simbolov.

4 UPORABA NAPREDNIH REŠITEV

Računalniško podprta analiza govornih motenj ali računalniško podprto ocenjevanje govora ali tehnologija govorne patologije, vključuje uporabo računalniških metod in tehnologije za ocenjevanje, diagnosticiranje in zdravljenje govornih in jezikovnih motenj.[10] Ključni vidiki analize govornih motenj [11] so pomembni za razumevanje, kako je bolnik sposoben uporabljati jezikovne veščine [12] [13]:

A. Prepoznavanje in analiza govora: napredni algoritmi in tehnike strojnega učenja se uporabljajo za samodejno analizo govornih vzorcev. Orodja pomagajo prepoznati odstopanja od tipičnih govornih vzorcev, kot so napačna izgovorjava, popačenja in druge napake artikulacije.

B. Fonetična analiza: Računalniški algoritmi analizirajo fonetične značilnosti govornih zvokov, prepoznajo napake v tvorbi fonemov in pomagajo pri govornjenju. Jezikovni patologi iščejo področja za poseg.

C. Akustična analiza: Računalniški algoritmi analizirajo akustične lastnosti govora, vključno z višino, glasnostjo, trajanjem in spektralnimi značilnostmi. Te analize lahko zagotovijo vpogled v glasovne motnje in pomagajo pri oceni stanj, kot sta dizartrija ali afazija.

Č. Analiza prozodije: prozodija se nanaša na ritem, intonacijo in naglasne vzorce v govoru. Računalniško podprta analiza pomaga prepoznati prozodične nepravilnosti, ki lahko kažejo na nekatere govorne motnje ali nevrološka stanja.

D. Sinteza govora in povratne informacije: Tehnologijo sinteze govora bolnikov z govornimi motnjami je mogoče uporabiti za zagotavljanje povratnih informacij v realnem času. Pomaga bolnikom pri vajah artikulacije in podpira razvoj boljše govorne sposobnosti.

E. Obdelava jezika: Tehnike obdelave naravnega jezika NLP (NLP je podveja umetne inteligence, ki omogoča povezavo med človekom in računalnikom) se lahko uporabijo za analizo jezikovnih vzorcev, kot so slovnica, sintaksa in semantika. To je še posebej uporabno za posameznike z jezikovnimi motnjami, kot je afazija.

F. Terapevtska orodja: računalniški terapevtski programi in aplikacije zagotovijo interaktivne vaje in igre, namenjene izboljšanju govora in jezikovne spretnosti. Ta orodja je mogoče prilagoditi individualnim potrebam in napredku bolnika.

G. Zbiranje in spremljanje podatkov: velike podatkovne nize vzorcev govora posameznikov z in brez govornih motenj je mogoče uporabiti za razvoj in nadgradnjo računalniških

modelov. Z vzdolžnim zbiranjem podatkov spremljamo napredek in sčasoma prilagodimo načrte zdravljenja.

H. Diagnoza in sledenje napredku: Orodja za računalniško analizo lahko pomagajo logopedom pri postavljanju natančnejših diagnoz in spremljanje napredka zdravljenja. Objektivne meritve lahko dopolnijo subjektivne klinične ocene.

I. Raziskave in inovacije: Računalniška analiza govornih motenj prispeva k iskanju temeljnih vzrokov govornih motenj in razvoju novih metod za zdravljenje. Pomembno je zavedanje, da ne sme nadomestiti strokovnega znanja in kliničnih presoj usposobljenih logopedov. Opisane tehnologije so najučinkovitejše, če se uporabljajo v povezavi s strokovnim vrednotenjem in usmerjanjem.

5 SKLEP IN VIZIJA

Na osnovi proučevanja strokovnih virov, modelov in rezultatov anket smo prišli do novih spoznanj in hibridne rešitve. [14] [15] [16] Sestavljena je iz spodaj opisanih sistemov:

- Prosto dostopni oblaki sistemi za lažje premagovanje ovir verbalnega komuniciranja, učenje in socialne interakcije otrok z govorno jezikovnimi motnjami v slovenskem jeziku.

- Oblaki sistemi za zvezno spremljanje biometričnih parametrov omogočajo zaznavanje ravni stresa mladih bolnikov. Terapevtom in logopedom omogočajo prilagajati obremenitve z delom in učnimi metodami, glede na sposobnosti bolnika. [17] [18]

- Oblaki sistem za vnos besedila z enim gumbom za bolnike s težjim potekom bolezni.

- Sistemi za podporo strokovnemu delu logopedov z uporabo napredne računalniško podprte analize govornih motenj za ocenjevanje, diagnosticiranje in zdravljenje govornih in jezikovnih motenj.

- S spletnimi videokonferenčnimi platformami, lahko v posebnih primerih podpremo terapije na daljavo, logopedске obravnave, nego in varstva na daljavo.

Uporaba opisane tehnologije spreminja bivalno raven mladih bolnikov in vpliva na spremembe rehabilitacijskih procesov, krajša čakalne vrste in ustvarja več vrst različnih prihrankov.

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Avtorji.

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Razvoj spletnega odprtega učnega gradiva za poučevanje računalništva v 2. triletju osnovne šole

Development of Computer Science Online Open Educational Resources for 2nd triad of Primary School

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POVZETEK

Članek predstavlja razvoj spletnega interaktivnega učnega gradiva za poučevanje računalništva v 2. triletju slovenskih osnovnih šol. Učno gradivo vključuje pet vsebinskih sklopov z razlagami, preverjanji znanja in interaktivnimi elementi. Gradivo je javno dostopno kot odprt izobraževalni vir, vsebinsko in oblikovno je prilagojeno ciljni publiki otrok, starih med 8 in 10 let, z upoštevanjem standardov dostopnosti. Članek poudarja pomen odprtokodnih virov in trajnostne naravnosti gradiva ter predlaga nadaljnjo nadgradnjo gradiva, vključno z vključitvijo tematik s področja umetne inteligence.

KLJUČNE BESEDE

Odprti izobraževalni viri, poučevanje računalništva, razvoj gradiv za učenje in poučevanje, spletni interaktivni tečaj

ABSTRACT

The article presents the development of an interactive online learning material for teaching computer science in the second trimester of Slovenian primary schools. The teaching material includes five content areas with explanations, assessments and interactive elements. The material is publicly available as an open educational resource. It has been adapted in terms of content and design to the target group of children aged 8 to 10 years, taking into account accessibility standards. The article underlines the importance of open educational resources and the sustainability of the material and suggests further development of the material, including the inclusion of topics in the field of artificial intelligence.

KEYWORDS

Open Educational Resources, Computer Science Education, Developing Learning and Teaching Material, Online Interactive Course

1 UVOD

Kot učitelji se zavedamo pomembnosti kakovostnega izobraževanja učencev. To je bil povod za začetek projekta, kjer smo razvili spletna odprta učna gradiva za poučevanje

računalništva v 2. triletju osnovne šole, ki so v pomoč tako učiteljem pri snovanju učnih ur kot tudi učencem pri samostojnem raziskovanju teme. Projekt, imenovan *Razvijanje temeljnih računalniških konceptov, perspektiv in praks pri učencih 2. triletja*, je trajal eno leto. Na začetnem srečanju smo identificirali učne teme *Računalniški sistemi, Podatki in analiza, Algoritmi in programiranje, Omrežja in internet* ter *Učinki računalništva in informatike* ter zanje določili učne cilje. Sledilo je ustvarjanje gradiv in spletnega mesta ter testiranje v praksi na štirih osnovnih šolah. S tem smo želeli računalništvo približati mlajšim učencem, saj je danes računalniško znanje eno od temeljnih znanj sodobne družbe. Prav tako spletno mesto ponuja dodaten vir kakovostnih gradiv, ki predstavlja dodano vrednost pri uvedbi predmeta računalništvo, kot obveznega predmeta v kurikulumu slovenskih osnovnih šol. V prispevku najprej predstavimo pregled teoretičnih izhodišč in raziskovalno metodo, v osrednjem delu pa se osredotočimo na predstavitev razvoja gradiv ter izzive pri razvoju le-teh.

2 Pregled literature

V okviru projekta smo se raziskovalci in študentke osredotočili primarno na dve področji: (1) trajnost učnih gradiv in odprti učni viri in (2) analizo različnih pristopov poučevanja računalniških vsebin s primerjavo obstoječih učnih načrtov za poučevanje ter adaptacijo praks na slovenski učni prostor in kontekst.

2.1 Trajnost učnih gradiv in odprti učni viri

Zasnovo spletišče je uporabno kot gradivo za obravnavo določene vsebine ali kot izobraževalni program (ang. Open Educational Program, v nadaljevanju OEP). Eden izmed izzivov, s katerim smo se snovalci spletišča srečali, je načrtovanje in zagotavljanje trajnosti spletišča, kjer se beseda trajnost nanaša na dolgoročno uspešnost in stabilnost odprtega izobraževalnega programa [6]. V našem primeru je spletišče, ki smo ga ustvarili v projektu OEP kot primer odprtega učnega vira (ang. Open Educational Resources; v nadaljevanju OER).

Trajnost učnih gradiv postaja vse bolj prisotna tematika akademskih diskurzov. Nekateri avtorji [6], na primer trdijo, da je trenutno razmišljanje o tej temi pogosto zgolj taktično s preveč pozornosti na "izdelku" in premalo pozornosti na razumevanju,

kaj želi skupnost uporabnikov, ali na izboljšanje vrednosti OER za različne skupnosti uporabnikov. Ti avtorji predlagajo tudi, da "preden razmislijo o različnih prihodkovnih modelih za določen OER in izberejo enega ali kombinacijo le-teh, se morajo ponudniki OER osredotočiti na vprašanje povečanja skupne vrednosti mesta za njegove sestavine v največji možni meri. Z drugimi besedami, razen če je spletno mesto OER sposobno najprej pridobiti in ohraniti kritično maso aktivnih, angažiranih uporabnikov ter jim zagotoviti znatno in diferencirano vrednost v fazi zagona in rasti, potem noben od razpoložljivih in/ali izbranih prihodkovnih modelov verjetno ne bo dolgoročno deloval za OER.«

Odprti učni viri ali OER, kot jih definira UNESCO [2], so učni in raziskovalni materiali v kateri koli obliki in dostopni na katerem koli mediju. Gradiva so v javni domeni ali so zaščitena z avtorskimi pravicami, ki so bila izdana z odprto licenco. Drugim uporabnikom je omogočen brezplačen dostop, ponovna uporaba, sprememba namembnosti, prilagajanje in distribucija gradiva.

Wiley in Hilton [5] ugotavljata, da sama beseda »odprt« v zvezi z OER indicira, da imajo gradiva, ki so sicer zaščitena z avtorskimi pravicami, za druge uporabnike dovoljenje za aktivnosti 5R: obdrži, popravi, predelaj, ponovno uporabi in deli naprej (v ang. retain, reuse, revise, remix, and redistribute). Avtorja z izrazom OER podprta pedagogika označujeta nabor poučevalnih in učnih praks, ki so možne le v kontekstu zgoraj navedenih 5R dovoljenj, značilnih za OER.

2.2 Analiza obstoječih izobraževalnih okvirjev

Pri določitvi vsebinskih sklopov oz. učnih enot ter podenot in učnih ciljev smo si pomagali z analizo obstoječih okvirjev združenj in organizacij (kot so na primer: okvir Mednarodnega združenja za tehnologijo v izobraževanju ISTE, gradiv Code.org in TechComputing, okvir gibanja CS4All, standardov opredeljenih v shemi K-12CS ter okvirja DigComp 2.2 in DigComEdu Evropske komisije) in primerjavo učnih načrtov predmetov z računalniškimi vsebinami, ki so del kurikulov osnovnošolskega izobraževanja v drugih državah.

Okvir gibanja CS4All je osnovan na okvirju K-12 [7], zato je smo se pri analizi osredotočili na slednjega. Okvir K-12 [8] za poučevanje računalniških vsebin predlaga delitev obravnavanih vsebin v 5 vsebinskih sklopov: (1) Računalniški sistemi, (2) Omrežja in internet, (3) Podatki in analiza, (4) Algoritmni in programiranje ter (5) Vplivi računalništva. Obravnavane vsebine dopolnjujejo tudi koncepti abstrakcija, sistemski odnosi, interakcija človek-računalnik, zasebnost in varnost ter komunikacija in koordinacija, ki povezujejo posamezne vsebinske sklope med seboj. Del vsebin je zastavljen kot del medpredmetnega povezovanja s preostalimi STEM predmeti – naravoslovje, tehnika in matematika.[6]

Naša analiza obstoječih okvirjev je pokazala, da večina držav, ki uporablja analizirane okvirje, začne s poučevanjem računalniških vsebin že v predšolskem obdobju. Trenutno se formalen pouk računalništva v slovenskem učnem prostoru začne v 4. razredu kot neobvezni izbirni predmet v drugem (2.) vzgojno-izobraževalnem obdobju, nadaljuje pa kot triletni predmet Računalništvo [10], ki je sestavljen iz predmetov Urejanje besedil v 7. razredu, Multimedija v 8. razredu in Računalniška omrežja v 9. razredu [9]. Predznanje oziroma pomanjkanja le tega pri slovenskih osnovnošolcih v drugem (2.)

vzgojno-izobraževalnem obdobju smo upoštevali pri definiranju vsebinskih sklopov, učnih enot, ciljev in izidov. Kompetenčni okviri in učni načrti iz drugih držav namreč opredeljuje časovnico obravnavanih vsebin, ki ni usklajena s slovenskim okoljem. Npr. v kompetenčnem okviru K12 se obravnava učnih vsebin prične že v predšolskem obdobju. Naslednji pomemben vidik, ki smo ga upoštevali pri odločitvi za izdelavo gradiv je bila ponuditi kvalitetna brezplačna gradiva, ki bodo na voljo vsakemu učitelju v Sloveniji. Vpeljava novih učnih pripomočkov in storitev je namreč velikokrat povezana s stroški, ker pa običajno za te namene ni dovolj sredstev, to v našem prostoru predstavlja veliko oviro. Slovenski kontekst smo upoštevali tudi pri izbiranju primerov, s katerimi smo pojasnjevali računalniške koncepte. Iskali smo jih iz vsebin drugih predmetov 4. in 5. razreda in s tem želeli pripomoči k realizaciji medpredmetnega povezovanja.

Za lažji prehod iz analiziranih kurikularnih okvirjev v slovenski učni prostor, bi bilo potrebno reorganizirati poučevanje računalniških vsebin v slovenskem sistemu. To težavo bi rešili z uveljavitvijo trenutno predlaganega okvirja za poučevanje računalniških vsebin s strani skupine RINOS, ki vključuje računalniške vsebine v predšolskem, osnovnošolskem in srednješolskem izobraževanju [4].

3 METODA

Kot raziskovalno metodo smo v raziskavi uporabili raziskavo načrtovanih novosti pri pouku [1] s kavzalno-neeksperimentalno metodo dela na priložnostnem vzorcu, katere temeljno izhodišče je raziskovanje na pedagoškem področju približati potrebam pedagoške prakse s končnim ciljem izboljšanja pouka (prav tam). Omogoča ustvarjanje in širjenje znanja o razvoju, oblikovanju, sprejemanju in ohranjanju inovativnih učnih okolij. V procesu raziskave smo izvedli štiri stopnje raziskovanja, in sicer: (1) analiza problema ter sodelovanje raziskovalcev in praktikov (študentov, učiteljev in zaposlenih na fakulteti), (2) razvijanje novosti za rešitev problema pri poučevanju (spletnega okolja za učenje in poučevanje računalništva), (3) ponavljajoči se cikli preverjanja in izpopolnjevanja predlagane novosti ter (4) refleksija teoretične izgradnje novosti in njene implementacije pri pouku. V pričujočem prispevku predstavljamo potek razvoja spletnih interaktivnih učnih gradiv za poučevanje računalništva v 4. in 5. razredu ter opisujemo izzive, s katerimi smo se soočili v projektu.

Pomemben del izbrane metode je sodelovanje različnih deležnikov, ki zagotavlja, da so raziskovalni dosežki in ugotovitve relevantne in uporabne v realnem kontekstu. Pri razvoju učnih gradiv in spletnega okolja smo sodelovali trije raziskovalci in pedagogi s Pedagoške fakultete UL, štiri študentke računalništva s Pedagoške fakultete UL, ki imajo znanja s področja sodobnih didaktičnih pristopov in s področja računalništva ter učitelje prakse in njihove učence, ki so pomagali pri izvedbi ur v razredu in podali mnenje o nastalem učnem gradivu. Vzorec so tako predstavljali 3 raziskovalci, 4 študentke, 3 učitelji in 110 učencev.

4 REZULTATI

Rezultat dela v okviru raziskave predstavlja odprt izobraževalni vir z vsebinami, ki so namenjene usvajanju osnovnega znanja s področja RIN. Vključena gradiva so didaktično in vsebinsko

prilagojena učencem 2. triletja in predstavljajo kakovosten izobraževalen vir ter jih je mogoče uporabiti kot osnovno učno sredstvo.

4.1 Razvoj učnih gradiv

4.1.1 Razčlenitev sheme poteka razvoja gradiv

Prvo fazo razvoja gradiv, v katerem smo identificirali učne sklope in opredelili učne vsebine gradiv smo podrobneje predstavili v teoretičnem delu. Za vsak zaključen sklop učnih ciljev smo nato določili načine obravnave učnih vsebin, naredili vsebinski oris in izbrali obliko predstavitve, npr.: video, infografika, besedilo, zvočni posnetek, predstavitev. Sledila je razdelitev dela, pri kateri smo upoštevali osebne preference študentk, mentorji pa so prevzeli področja, s katerimi se sicer ukvarjajo. Pri razvoju gradiv smo izhajali iz predpostavke, da naj bodo ta samostojna, kar pomeni, da učenec za učenje ne potrebuje nujno podpore učitelja, ampak se lahko uči samostojno. Iz tega razloga smo se v večini primerov odločili, da bodo gradiva kombinacija razlagalnega interaktivnega videa in interaktivnih nalog za preverjanje znanja. Z videom učenec pride do razlage in razumevanja učne snovi, interaktivne naloge pa mu omogočajo, da se samo-preveri in prejme takojšnjo povratno informacijo, če snov res razume. Z željo, da bi se čim bolj približali ciljni publiki smo se odločili, da učno vsebino podajamo preko treh likov, sester Klare in Mance ter robota Obre, ki obvlada računalništvo. V nekaterih video posnetkih študentke razlagajo učno snov, medtem ko v drugih glavnim likom posodijo svoj glas. Ta pristop videom daje osebno občutek in ustvarja bolj vključujočo izkušnjo za učence. Pred začetkom razvijanja gradiv smo pripravili grafično zasnovo projekta. S tem smo želeli gradiva grafično poenotiti. Določili smo barvne sheme, ustvarili logotip, izbrali stil grafičnih elementov, naredili predloge za predstavitve in infografike ter izdelali podobe uporabljenih likov. Pri tem smo upoštevali ciljno publiko in načela oblikovanja izobraževalnih gradiv.

Izdelavo gradiv smo začeli tako, da so študentke najprej pripravile osnutke scenarijev in določile interaktivne naloge. Mentorji smo gradiva sprti pregledovali, komentirali, podajali povratne informacije in usmeritve. Za osnovno komunikacijo smo uporabili program MS Teams. V njem smo ustvarili ekipo z več kanali: »Splošno«, »Izvedba učnih ur v razredu«, »Sestava učnih ciljev, učnih dosežkov in učnih vsebin« in »Zbirka uporabnih gradiv«. Za bolj učinkovito delo smo organizirali tudi številne sestanke v živo, kjer smo bili navzoči vsi vključeni v projekt. Določene vidike razvoja učnih gradiv je bilo namreč bolj učinkovito opraviti v živo. Na sestankih smo debatirali o odprtih vprašanjih, iskali nove ideje, popravljali in dopolnjevali scenarije. Na ta način smo prišli do končnih verzij scenarijev. Ti so predstavljali osnovo za snemanje video in zvočnih posnetkov. Materiale smo snemali v prostorih Pedagoške fakultete v improviziranem studiu, študentke pa so jih nato obdelale s pomočjo odprtokodnih programov. Razlagalnim video posnetkom so dodale interaktivne komponente, kot npr. vprašanja z izbiro odgovora, besedilnim vnosom, javnimi besedili, ipd.. Za to smo se odločili, ker so takšni video posnetki za učence bolj zanimivi. Od njih zahtevajo aktivno sodelovanje in pripomorejo k bolj pozornemu spremljanju obravnavane učne snovi ter lahko posledično privedejo do boljšega učnega učinka. Za vsako učno enoto so nato izdelale tudi interaktivne naloge z

orodjem h5p, ki služijo kot dopolnilo razlagalnemu videu in omogočajo, da se učenec preveri in pridobi takojšnjo povratno informacijo o pridobljenem znanju. Izdelana gradiva so dale v vnovičen pregled mentorju, ki je bil zadolžen za njihovo področje. Ta jih je skrbno pregledal in zahteval popravke. Proces popravljanja se je iterativno ponavljal dokler mentor ni gradiva odobril kot končno verzijo. Kljub dorečenim scenarijem, ki so bili osnova za izdelana gradiva je bilo nekatere stvari možno namreč opaziti šele naknadno, ko je bilo gradivo že izdelano. Npr. usklajevanje zvoka in vizualne podobe v posameznem kadru, da je bolje pojasnjevalo učno vsebino. Vse dokončane razlagalne video posnetke smo naložili v kanal »Obvladam računalništvo« na portalu Arnes Video. Video posnetke smo zasnovali tako, da so samostojni in se lahko uporabljajo kot samostojne enote. Nato smo uporabili spletno orodje za izdelavo spletišč Arnes Splet, kjer smo razlagalne video posnetke opremili z interaktivnimi h5p nalogami in jih ustrezno strukturirali po področjih. V zadnji fazi smo intenzivno testirali delovanje spletišča, preverjali smo delovanje povezav, video posnetkov in interaktivnih nalog.

4.1.2 Predstavitve vsebinskega okvira petih področij RIN

V sklopu »Računalniški sistemi« smo predstavili arhitekturo računalnika, delovanje digitalnih naprav ter pojasnili kako strojna in programska oprema sodelujeta pri reševanju nalog. Podrobno smo predstavili obdelavo, pošiljanje in shranjevanje digitalnih podatkov ter delovanje pomnilniških medijev. Osvetlili smo osnovne načine povezovanja računalnikov v omrežja ter podali splošne napotke za reševanje pogostih računalniških težav.

V sklopu »Podatki in analiza« smo obravnavali načine zbiranja, shranjevanja in predstavitve podatkov v računalniku. Pojasnili smo kako lahko podatke preoblikujemo in s tem pridobimo nova spoznanja. Prav tako smo predstavili načine analize podatkov, ki jih lahko uporabimo za sklepanje in napovedovanje.

V sklopu »Algoritmi in programiranje« smo na enostaven način predstavili osnovne koncepte programiranja z uporabo vizualnega programiranja v jeziku Scratch. Na praktičnem primeru programiranja igre »kaca« smo predstavili pojma izraz in ukaz ter programske konstrukte – spremenljivka, pogojni stavek in zanka. Naslovili smo tudi osnovne koncepte objektnega in dogodkovnega programiranja.

V sklopu »Omrežja in internet« smo osvetlili osnovne koncepte povezovanja računalnikov v omrežja. Predstavili smo omrežne naprave: modem, usmerjevalnik in stikalo ter pojasnili njihovo vlogo v omrežju internet. Razložili smo osnovne principe izmenjave informacij, koncepta strežnik-odjemalec in gostovanja spletnih strani. Spodbujali smo odgovorno dodajanje vsebin na internet, spoštovanje avtorskih pravic in ozaveščanje o verodostojnosti informacij.

V sklopu »Učinki računalništva in informatike« smo poudarili pomembnost spoštljivega komuniciranja preko interneta ter ozaveščanje o vplivu tehnologije na družbo, vključno s pravnimi, kulturnimi, okoljskimi in etičnimi vidiki. Spodbujali smo odgovorno ravnanje in razmišljanje o družbenih posledicah naših dejanj v digitalnem prostoru.

4.1.3 Upoštevanje ciljne skupine in slovenskega konteksta

Pri razvoju gradiv smo se želeli čim bolj približati ciljni publiki in upoštevati slovenski kontekst. V Sloveniji nimamo

formalnega izobraževanja na področju računalništva in informatike do 4. razreda osnovne šole, zato smo morali zagotoviti, da gradiva ne predpostavljajo nobenega predznanja. To smo morali upoštevati tudi pri definiranju vsebinskih sklopov, učnih enot, ciljev in izidov. Kompetenčni okvir in učni načrti iz drugih držav namreč opredeljuje časovnico obravnavanih vsebin, ki ni usklajena s slovenskim okoljem. Npr. v kompetenčnem okviru K12 se obravnava učnih vsebin prične že v predšolskem obdobju. Naslednji pomemben vidik, ki smo ga upoštevali pri odločitvi za izdelavo gradiv je bila ponuditi kvalitetna brezplačna gradiva, ki bodo na voljo vsakemu učitelju v Sloveniji. Vpeljava novih učnih pripomočkov in storitev je namreč velikokrat povezana s stroški, ker pa običajno za te namene ni dovolj sredstev, to v našem prostoru predstavlja veliko oviro. Slovenski kontekst smo upoštevali tudi pri izbiranju primerov, s katerimi smo pojasnjevali računalniške koncepte. Iskali smo jih iz vsebin drugih predmetov 4. in 5. razreda in s tem želeli pripomoči k realizaciji medpredmetnega povezovanja.

4.1.4 Ponazoritev primerov učnih gradiv

Slika 1 prikazuje primere gradiv, ki so vključeni v spletišče Obvladam računalništvo. Del slike 1.a prikazuje razlagalni interaktivni video. Na časovnem traku so vidne točke, na katerih se video ustavi, učenec pa mora za nadaljevanje rešiti kratko nalogo. Pri tem pa si lahko pomaga z namigi (klik na znak »i«). Slika 1.b prikazuje infografiko, ki je namenjena razlagi pomnilniške hierarhije na primeru iz realnega življenja. Na sliki 1.c je prikazana animacija, ki razlaga osnovni princip prenašanja binarnih vrednosti po prenosnem mediju. Na sliki 1.d pa so prikazani različni načini preverjanja znanja, ki so realizirani s pomočjo h5p interaktivnosti.



Slika 1: Primeri gradiv: a) razlagalni interaktivni video, b) besedilna razlaga in infografika, c) animacija razlage koncepta prenosa digitalnih vrednosti, d) preverjanje znanja

4.2 Izzivi pri razvoju

Izdelava učnega gradiva nam je predstavljala izjemno priložnost za zagotavljanje strokovno kakovostnih, didaktično ustreznih in prosto dostopnih vsebin iz računalništva in informatike v slovenskem prostoru. Vendar pa smo se soočali tudi s številnimi izzivi, ki smo jih morali nasloviti, da bi gradiva ustrezala zadanim visokim standardom in bila koristna za učence.

4.2.1 Predstavitev konceptov na otroku razumljiv način

Največji izziv nam je predstavljalo iskanje ustreznega načina za predstavitev obravnavanih računalniških vsebin za ciljno publiko. Veliko časa smo posvetili ukvarjanju z vprašanjem kako iz nekega koncepta, ki smo ga želeli predstaviti, abstrahirati bistvo in ga predstaviti na način, ki je primeren za otroka na tej

razvojni stopnji. Otroci v 2. triletju so namreč na konkretni operacijski stopnji, kar pomeni, da še niso na stopnji, ki bi jim omogočala abstraktno razmišljanje, ki je potrebno za poglobljeno razumevanje številnih računalniških konceptov. Zato smo želeli predstaviti bistvo koncepta in ga ponazoriti na realnih primerih, ki bi bili učencem blizu. Pri tem smo morali paziti, da konceptov nismo preveč poenostavili, saj s tem ne bi ustvarili ustreznega temelja, ki bi ga bilo mogoče v 3. triletju nadgrajevati v abstraktno razumevanje konceptov in pojmov. Obenem pa smo morali biti pazljivi pri izbiri primerov, da ti ne bi vodili v napačna razumevanja. Nespretno izbran primer iz realnega življenja lahko namreč vzbuja napačne asociacije, otrok pa lahko konceptu pripiše lastnosti, ki jih je sicer mogoče izpeljati iz podanega primera, pri konceptu, ki ga poučujemo pa na splošno ne veljajo. Izziva smo se lotili tako, da smo proces iskanja ustreznih primerov izvedli iterativno, vanj smo bili vključeni vsi, spodbujali smo odprto komunikacijo, soočanje različnih mnenj in argumentirano debato. Večkrat je bilo potrebnih veliko razmislekov, usklajevanj, zavrženih idej in ponovitev, da smo prišli do končne verzije, s katero smo se vsi strinjali.

4.2.2 Iskanje ustreznih načinov preverjanja znanja

Izziv je predstavljal tudi izbor načinov za preverjanje znanja pri upoštevanju specifičnosti, ki jih prinaša izobraževanje v okviru spletnega okolja. Odločili smo se, da jih naslovimo tako, da izkoristimo zmožnosti vtičnika h5p, ki omogoča implementacijo raznolikih interaktivnih aktivnosti. Pri tem smo si zastavili ključno vprašanje: kako na različnih ravneh preveriti znanje in izbrati ustrezne h5p aktivnosti iz nabora možnosti. Reševanje tega problema je zahtevalo usklajevanje več vidikov, s katerimi bi lahko zagotovili učinkovito in obenem za učence zanimivo preverjanje znanja na različnih nivojih. Prvi korak je bil določiti ključne cilje in vsebine, ki jih želimo preveriti pri učencih. Nato smo za vsako vsebino določili kognitivno stopnjo, na kateri smo jo želeli preverjati, ter oblikovali naloge oz. aktivnosti. Sledil je ključen premislek o tem kako izbran način preverjanja znanja realizirati v spletnem okolju. Pomembno nam je bilo zagotoviti takojšnjo povratno informacijo, ki bi učencem jasno prikazala nivo njihovega pridobljenega znanja. Hkrati pa smo skrbno izbirali naloge in aktivnosti, ki bi ohranjale situacijski interes in vzpodbujale zanimanje učencev. Pri tem smo se zavedali, da mora preverjanje potekati na način, ki učence spodbudi k nadaljnjemu delu.

4.2.3 Iskanje večpredstavnih virov z ustrežno licenco

Vsi, ki smo se kadar koli srečali z iskanjem večpredstavnih virov, na primer slik, animacij, zvočnih posnetkov, razumemo, da je iskanje pogosto zelo zamudno in se večkrat zgodi, da je ustrezne vire zelo težko najti. V slovenskem prostoru smo v času pandemije COVID-19 lahko opazili prakso deljenje virov in gradiv med učitelji, kar je izjemno povezovalno in je učiteljem prihranilo čas ter na drugi strani učencem omogočilo dostop do kakovostnejših gradiv. Vendar pa je bilo ob tem opaziti tudi splošno nepoznavanje avtorskega prava in licenc.

Večina spletnih virov je avtorsko zaščitenih, zato jih ni mogoče uporabiti, predelati in deliti. To so vsi viri, ki so bodisi označeni z licenco @Copyright (©) bodisi niso označeni z nobeno od licenc.

Pri snovanju OER, ki so javno prosto dostopna vsem na spletu je zato velik izziv predstavljalo iskanje vsebinsko in licenčno ustreznih večpredstavnih materialov. V veliko pomoč pri tem so

nam bile prosto-dostopne zbirke virov kot so Pixabay, Pexels, Unsplash ipd. ter Canva za učitelje, s pomočjo katere smo ustvarili večino večpredstavnih virov.

4.2.4 Snovanje preverjanja znanja za spletno učno okolje

Učno gradivo, ki ne omogoča, da pridobimo povratne informacije o pravilnem razumevanju, zahteva zelo dobre samoregulacijske spretnosti, ki pa pri mlajših učencih še niso razvite do te mere, da bi se lahko učinkovito samostojno učili brez povratnih informacij [3]. Da bi bilo spletno učno gradivo kljub temu lahko kakovosten učni pripomoček pri poučevanju in izven prostora šole, smo veliko pozornosti namenili snovanju ustreznega preverjanja znanja. Vtičnik h5p, ki je na voljo v storitvi Arnes splet omogoča ustvarjanje zelo raznolikih aktivnosti in nalog. Pri tem je ključno dobro pedagoško-didaktično in strokovno znanje s področja, za katerega ustvarjamo naloge in aktivnosti ter hkrati dobro tehnično znanje uporabe h5p. S temi znanji je mogoče ustvariti kognitivno pestre, vsebinsko raznolike in za učence zanimive naloge, pri reševanju katerih učenci prejmejo takojšnje povratne informacije.

Vsaka tema vključuje formativno preverjanje znanja, ki je implementirano kot del video posnetka in učencu omogoča, da sproti preveri, kako dobro razume vsebino, koncepte in pojme. Pod vsakim razlagalnim videom pa ima učenec na voljo še dodatne kognitivno in taksonomsko raznovrstne aktivnosti in naloge, s katerimi preveri svoje znanje po zaključku učne teme. V primeru, ko učenec pri reševanju še ne izkaže obvladovanja snovi, ga povratne informacije ob koncu naloge spodbudijo, da nalogo rešuje ponovno. Pri vseh povratnih informacijah smo skrbeli tudi za pozitivno naravnost, saj je Žerovnikova v doktorski raziskavi ugotovila, da slovenski učenci prejemajo bistveno več negativno kot pozitivno naravnanih pisnih povratnih informacij [3]. Po našem mnenju je pozitivna naravnost v podajanju povratnih informacij še toliko bolj ključna v spletnem okolju, kjer nimamo vpogleda v to, kako je učenec sprejel povratne informacije. Cilj pozitivno naravnanih povratnih informacij je ohraniti situacijski interes učencev za vsebine in reševanje nalog ter s tem spodbujati učenje računalniških vsebin.

4.3 Predstavitev spletišča - Alenka

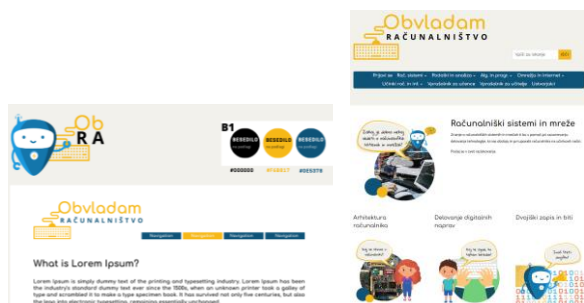
Kot končni rezultat razvojnega projekta je nastalo spletno mesto <https://obvladamracunalnistvo.splet.arnes.si/>. Iz spletnega URL naslova je razvidno, da smo pri vzpostavitvi spletnega mesta uporabili storitev Arnes splet, ki uporablja ogrodje Wordpress. Arnes splet je za učitelje in učence brezplačna storitev, ki omogoča postavitev enega ali več spletnih mest. Pri načrtovanju zgradbe in strukture spletnega mesta smo uporabili zahtevnejšo temo *Divi*, ki nam je omogočala popolno svobodo pri oblikovanju spletnega mesta. Spletno mesto je razdeljeno na 5 vsebinskih sklopov, ki pokrivajo temeljna področja računalništva in informatike (RIN), vsak sklop pa ima v podmeniju svoje podteme. Prva stran služi opisu, slikovni in zvočni predstaviti 5-ih temeljnih področij RIN. Vsaka učna tema vključuje razlago, sprotno preverjanje znanja in končno preverjanje znanja. Za razlago smo uporabili video, predstavitev, besedilo in infografiko, interaktivnost pa smo implementirali s pomočjo vtičnika h5p, ki je dostopen v storitvi Arnes splet. Vsi videoposnetki so visoke resolucije, za gostovanje video vsebin pa smo uporabili portal Arnes video, ki je za učitelje prosto

dostopen, podatki pa se varno hranijo na slovenskih strežnikih. Tako spletno mesto, kot h5p vsebine in video portal podpirajo označevanje gradiv z licencami Creative Commons, ki smo jih uporabili za namen označevanja gradiv kot odprtih izobraževalnih virov. Vsa gradiva so tako dostopna javno in na voljo za uporabo, spremljanje in vnovično deljenje pod licenco CC BY-NC-SA (navedba avtorstva, nekomercialna raba in deljenje pod enakimi pogoji). Tabela 1 predstavlja temeljne gradnike, ki smo jih uporabili pri razvoju spletnih interaktivnih učnih gradiv.

Tabela 1: Temeljni gradniki spletnega učnega gradiva

Gradnik	Opis	Pomen
Besedilna razlaga	Razlaga v obliki besedila ali ključnih besed in poudarkov	Kognitivna obremenitev dveh kanalov za boljše razumevanje.
Slikovna ponazoritev	Slikovni viri, ki pojasnjujejo in oslikujejo razlago in podajajo primere.	Kognitivna obremenitev dveh kanalov za boljše razumevanje.
Infografika	Izobraževalni plakat za ponazoritev pojmov.	Ponazoritev, učni pripomoček
Predstavitev	Predstavitev s ključnimi podatki o temi.	Predstavitev teme, učni pripomoček
Interaktivni video	Razlagalni video posnetek s poudarki, vizualnimi ponazoritvami in interaktivne naloge za formativno preverjanje znanja.	Razlaga, ponazoritev in preverjanje znanja, učni pripomoček
Zvočna razlaga	Posneta zvočna razlaga besedilnih zapisov za učence, ki težje ali slabše berejo.	Dostopnost, učni pripomoček
Interaktivne komponente	Naloge in aktivnosti, ki omogočajo takojšnje povratne informacije v spletnem okolju	Formativno in končno preverjanje znanja
Barvna shema	Barvna shema, ki je uporabljena pri vseh gradnikih in gradivo med seboj povezuje, da deluje enotno.	Enotnost in povezanost
Liki	Glavni lik Obra (OBvlada RAčunalništvo), ki spremlja učenca. Sestrici Manca in Klara, ki si med seboj pomagata in izmenjujeta znanje.	Vključevanje elementov pripovedovanja zgodb
Logo	Logotip spletnega mesta	Prepoznavnost

Pri načrtovanju in implementaciji zgradbe in celostne grafične podobe smo izhajali iz sodobnih smernic spletnega oblikovanja. Barvno shemo smo uskladili s standardom WCAG 2.1 za ustrezen kontrast, ki omogoča boljšo dostopnost uporabnikom s primanjkljajem na področju vida. Pri oblikovanju logotipa in glavnega lika smo naslovili ciljno publiko otrok starih med 8 in 10 let ter ju povezali s temo računalništva (Slika 2 levo).



Slika 2: Celostna grafična podoba spletnega mesta z barvno shemo, logotipom, tipografijo in glavnim likom Obro (levo) in zgradba končnega spletnega mesta (desno).

Celotno zgradbo spletnega mesta smo naredili čim bolj preprosto, da se mlajši uporabniki hitreje in lažje znajdejo po njej. Meni spletnega mesta je zato učečemu vedno dostopen, po vsebini pa lahko išče tudi s pomočjo iskalnika. Vsaka tema ima poleg kratkega opisa teme tudi slikovno ponazoritev, ki skrbi za to, da bi pri učencu vzbudili interes za ogled vsebine teme (Slika 2 desno). Na podlagi pridobljenih odzivov s strani učencem in učiteljev sklepamo, da smo razvili kakovostno, za ciljno publiko ustrezno, spletno učno gradivo.

5 ZAKLJUČEK

Nastalo učno gradivo in spoznanja, ki smo jih pridobili v fazi razvoja učnega gradiva predstavljajo velik doprinos k razvoju stroke in prakse na področju poučevanja računalništva v slovenskih osnovnih šolah. Ker smo ena redkih držav, ki nimam obveznega predmeta s področja računalništva niti v enem razredu osnovne šole, v slovenskem prostoru manjka kakovostnih učnih gradiv, ki bi bila učiteljem v pomoč pri poučevanju in učencem pri učenju. Hkrati nastalo učno gradivo prinaša praktični zgled kakovostnega spletnega učnega okolja, pri razvoju katerega smo raziskovalci in praktiki vnašali in upoštevali spoznanja, ki smo jih pridobili v času šolanja na daljavo, ki je potekalo v COVID-19 obdobju. Doprinos k znanosti predstavlja kombinacija uporabljenih metod, tehnik, pripomočkov in orodij za nastanek učnega gradiva. Učno gradivo je v celoti izdelano kot odprt izobraževalni vir (OER), ki ima v izobraževalnem prostoru poseben prostor tudi zato, ker je na ta način znanje dostopno vsem, vir pa trajnostno naravnano. S tem prispevamo k zmanjševanju razlik, ki nastajajo zaradi socialno-ekonomskega položaja učečih in njihovih družin. Pri nastajanju smo uporabljali odprtokodno in brezplačno dostopno programsko opremo in pripomočke, ki so na voljo vsakemu (na primer mobilni telefon za snemanje) ter storitve, ki so na voljo vsem slovenskim učiteljem, s čimer smo pokazali, da lahko kakovostna učna gradiva pripravijo tudi učitelji sami, potrebno je le znanje.

V okviru nadaljnjega dela bi bilo smiselno nadgrajevati obstoječe učno gradivo ter ga prilagoditi tudi drugim starostnim skupinam in stopnjam poučevanja. Vanj bi bilo koristno vključiti

tematike iz področja umetne inteligence, saj gre za eno od najbolj vplivnih tehnologij v prihodnosti in predstavlja pomemben del digitalne pismenosti. Prav tako bi bilo v nadaljevanju smiselno izvajati poglobljene evalvacije učnega gradiva ter ugotavljati njegovo uporabnost in učinkovitost v učnem procesu. V razvoj gradiva bi lahko vključili tudi učitelje, ki bi na osnovi lastnih izkušenj in potreb prispevali k učnim gradivom in usmerjali njegov nadaljnji razvoj. Naša prizadevanja bi lahko poteka tudi v smeri osveščanja o odprtokodnih virih ter organizaciji rednih izobraževanj in delavnic za učitelje pri uporabi izdelanega gradiva. S tem bi omogočili, da bi lahko bolje izkoristili njegov potencial pri svojem pedagoškem delu in s tem prispevali k izboljšanju digitalne pismenosti v Sloveniji.

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PREDGOVOR

Danes, v dobi razmahajoče digitalizacije, postaja digitalna vključenost ključni steber naše informacijske družbe. S širjenjem dostopa do digitalnih tehnologij in spletnih storitev na vse večje število posameznikov, vključno z osebami z različnimi oblikami oviranosti, se poudarek na zagotavljanju dostopnosti, jasnosti, razumljivosti in uporabnosti tehnologij le še krepi. Vse večje število posameznikov potrebuje prilagojene rešitve, da bi lahko v celoti sodelovali v digitalni dobi in izkoristili njen polni potencial. Hkrati pa se moramo globoko zavedati potreb in zahtev tistih, ki potrebujejo podporo pri komunikaciji ter lažjem vključevanju v družbeno, socialno in delovno okolje.

In prav to je osrednja tematika prve hibridne in obenem dostopne konference "Digitalna vključenost v informacijski družbi – DIGIN 2023", ki se je izvajala v sodelovanju z evropskim centrom virov o dostopnosti – AccessibleEU. Konferenca je združila priznane slovenske raziskovalce in praktike iz različnih področij, ki so delili svoje rešitve, spoznanja in metode za doseg popolne digitalne vključenosti. Cilj konference je bil raziskati in premagati ovire, s katerimi se srečujejo osebe z različnimi oblikami oviranosti ter ustvariti digitalno okolje, ki bo dostopno za vse.

Vsebine, ki so v pričujočem zborniku, so neprecenljiv vir znanja in inspiracije za vse udeležence. Z njimi bomo bolje razumeli, kako lahko podporno tehnologijo izkoristimo za izboljšanje kakovosti življenja posameznikov in omogočimo, da se vsi enakopravno vključijo v digitalno dobo. Prepričani smo, da bomo skupaj ustvarili pomembno premikanje proti bolj vključujoči in dostopni digitalni prihodnosti!

Uredniški odbor

FOREWORD

Today, in the era of digitalization, digital inclusion is becoming a pivotal pillar of our information society. As access to digital technologies and online services continues to expand to an ever-growing number of individuals, including those with various forms of disabilities, the emphasis on ensuring accessibility, clarity, comprehensibility, and usability of technology only strengthens. An increasing number of individuals require tailored solutions to fully participate in the digital age and harness its full potential. At the same time, we must deeply acknowledge the needs and requirements of those who require support in communication and seamless integration into the social, societal, and work environments.

And precisely this is the central theme of the first hybrid and accessible conference, "Digital Inclusion in the Information Society – DIGIN 2023," conducted in collaboration with the European Accessibility Resource Centre – AccessibleEU. The conference brought together esteemed Slovenian researchers and practitioners from various fields who shared their solutions, insights, and methods to achieve complete digital inclusion. The conference's goal was to explore and overcome the barriers faced by individuals with various forms of disabilities and to create a digital environment accessible to all.

The contents within this compendium serve as an invaluable source of knowledge and inspiration for all participants. Through them, we will gain a better understanding of how assistive technology can be leveraged to improve the quality of life for individuals and enable everyone to be equally included in the digital era. We are confident that together, we will make significant strides toward a more inclusive and accessible digital future!

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Online Notes – A Real-Time Speech Recognition and Machine Translation System for Slovene University Lectures

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ABSTRACT

The paper presents Online Notes, a system involving speech recognition and machine translation that provides a real-time transcription of Slovene speech during a lecture and its machine translation into English. It was developed by researchers at the University of Ljubljana to fulfil two principal goals: (1) to allow non-Slovene-speaking university students to attend lectures held in Slovene; and (2) to enable students with disabilities (particularly the hard-of-hearing) to attend lectures that would be otherwise inaccessible to them. We present the motivation behind the development of the system, its functionality, some results and impressions obtained from the pilot lectures conducted in the last two years, and finally, our plans for future work.

KEYWORDS

speech recognition, machine translation, university lectures, Slovene

1 INTRODUCTION

In accordance with the development strategy adopted by the University of Ljubljana for the periods 2012-2020 and 2022-2027, the University has undertaken a series of measures in order to achieve its goals of fostering academic excellence, credibility and autonomy, with a strong focus on internationalization, equal opportunity, solidarity, and inclusiveness [4]. The internationalization of the University has long been a source of heated debates both among experts and in the public, with opponents warning that the introduction of more English lectures would have a negative effect on the development of Slovene, and advocates proposing it as a necessary measure in order for the University to become more active in the international academic sphere, competitive, inclusive and accessible. The strategy of inclusiveness does not refer to only non-Slovene-speaking students, however, but students with disabilities as well: one of the strategic activities of the University (according to its 2022-2027 development plan [5]) focuses on providing systematic support for the accessibility of studies to individuals with special needs. The results of a survey conducted by the University of Ljubljana in February 2021 ([3] show e.g. that approximately 38% of students with disabilities

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are dyslexic, 2% are hearing-impaired, 4% are sight-impaired, and 13% are cognitively impaired.

One of the projects financed by the University to tackle both the issues of internationalization and inclusiveness is Online Notes. We begin the paper by outlining the project, then continue by describing the system (with short descriptions of its components and its interface), the workflow of the pilot lectures used to test the system between 2021 and 2023, and the preliminary results of the testing phase. We conclude by describing our plans for future work.

2 PROJECT DESCRIPTION

The Online Notes project is a collaboration between the Laboratory for Data Technologies at the Faculty of Computer and Information Science of the University of Ljubljana, and the Centre for Language Resources and Technologies of the University of Ljubljana. The project is aimed at developing a system for the real-time speech recognition and automatic translation of Slovene lectures, which will help non-Slovene-speaking students to attend lectures held in Slovene, as well as provide transcriptions and recordings of lectures for students with disabilities.

The project encompasses the following activities: (a) the development of ASR-models for the domain of Slovene university-level lectures; (b) the development of the system back-end and front-end; (c) the organization of pilot lectures at the University of Ljubljana; and (d) collecting user feedback.

3 THE ONLINE NOTES SYSTEM

The Online Notes system (or ON for short) consists of several components presented in the following subsections.

The components of ON can be divided into three groups; (1) client-side applications, (2) back-end services and (3) speech services. Client-side applications consist of (a) an application for audio streaming, (b) a web application for users (students and lecturers; see 3.5 and 3.4), and (c) a web application for administrators (see 3.6). The main back-end component connects the building blocks (i.e. speech services), stores audio, transcripts and translations to a database/file system, provides real-time data using a message broker and exposes functionalities to client-side applications via an API, protected by an identity and access management (IAM) service. The speech services consist of a speech recognition service, a punctuation service and a translation service.

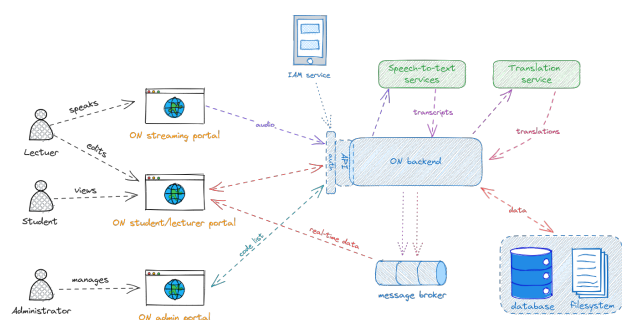


Figure 1: High-level overview of ON system architecture.

3.1 Speech Recognition

The speech recognition model that has been developed within the project is based on the Kaldi toolkit [6] and uses Weighted Finite-State Transducers (WFST) for training and decoding. All steps (including data preprocessing and training) follow the recipe provided by Kaldi. Speech recognition starts with waveform-reading and feature extraction from the audio, which is then presented with a Mel spectrogram. The data is processed by the acoustic model (based on librispeech chain recipes), which returns a probability matrix of subword units (phonemes) over time. The probability matrix is decoded with a language model (a statistical n-gram model in ARPA format, created using the kenlm toolkit), which results in the recognized text. Because this text lacks punctuation, it is sent to the punctuator, which is implemented as a separate service that inserts punctuation into the text.

Currently, two distinct speech recognition models are used within the ON system: one that is tailored to social science lectures (ON-DR) and one for technical science lectures (ON-NT). In the Kaldi framework, the acoustic model and the language model can be built independently, therefore the two speech recognition models share a common acoustic model, but have domain-tuned language models. The acoustic model was trained on approximately 200 hours of orthographically transcribed speech. The language model is being continuously updated and the current training dataset consists of approximately 2M sentences and a lexicon of 1.3M words.

The base for the language model is a corpus of texts pertaining to the field(s) of university lectures. The content of university-level lectures is highly specialized, so it was important to adjust the language model accordingly.

To do so, we contacted all lecturers at the University of Ljubljana through a common mailing list and collected a number of audio- or video-recordings of lectures from previous years (when recordings were more frequent because of the COVID-19 pandemic). The recordings were first automatically converted to text, then manually corrected to get the correct transcriptions. In case no recording material for a specific field was available, we used other materials for the subcorpus, such as theses, journals, and research papers. The process was repeated multiple times during the course of the project for each pilot lecture (more on this in section 4.1): each time the obtained transcriptions were added to either the ON-NT or ON-DR corpus, gradually expanding both language models. Once the text corpus is compiled, a lexicon of tokens and their corresponding pronunciations that match the chosen subword unit while training is prepared.

3.2 Machine Translation

Each final hypothesis (represented as a paragraph, or a block of text with punctuation) returned by the speech recognition service is then translated and displayed parallel to the Slovene text. Each segment is translated separately to minimize the delay in the display of translations. Currently, two machine translators are supported, i.e. an external commercial neural machine translator, as well as a translation service that was developed at the University of Ljubljana within the Development of Slovene in a Digital Environment (RSDO) project for the Slovene-English language pair. It is based on the AAYN model from the NVIDIA NeMo toolkit. The model was trained on a Slovene-English corpus consisting of 40 million aligned sentences. While the system has been tested for the Slovene-English language pair, in the future, the plan is to allow students to choose their preferred target language when using an external machine translator.

3.3 Interface

The ON front-end is designed as a web portal with a single entry site where users can log in with their digital identities provided by the University of Ljubljana. Based on their account type (student or lecturer), the log-in redirects them to one of the two different sites with differing functions. In addition, a separate administrator site is also available, along with a streaming site (where live lectures are recorded). We briefly present all components in the subsections below.

The general workflow of the system is designed in the following manner: (1) lectures are scheduled in the ON system by an administrator, (2) a lecturer runs the ON speech-recognition and machine-translation system during their scheduled lecture through the streaming site; students can access the real-time transcriptions and translations during the lecture through the student site; (3) once the lecture is complete, the lecturer can edit the transcription and translation (if necessary) through the lecturer site; (4) the recording, (edited) transcription and (edited) translation are archived in the system and can be accessed again at a later date through the student or lecturer site; the lecturer also has an option to hide the lecture from further view.

3.4 Lecturer Site

The lecturer site consists of an overview page (Figure 2) with a list of all lectures archived in the ON system by the lecturer so far; and an editing page (Figure 3), where the lecturer can edit the ASR-output (left column) and its machine translation (right column) for a specific lecture. The lecturer can move through the transcription by clicking on the audio progress bar at the bottom of the page. The audio is synchronized with the Slovene transcription and the text is color-highlighted when listening to the audio to facilitate the editing process. The lecturer can also add attachments to the lecture (presentation slides, notes, figures, etc.).

3.5 Student Site

The student site is similar to the lecturer site. The homepage consists of an overview of courses and lectures that the student is subscribed to (Figure 4), while the lecture page (which is accessed by selecting one of the lectures from the list) shows the Slovene transcription and its machine translation in the same way they are displayed to the lecturer (see Figure 3). However, students cannot edit the text. During live lectures, the transcription and

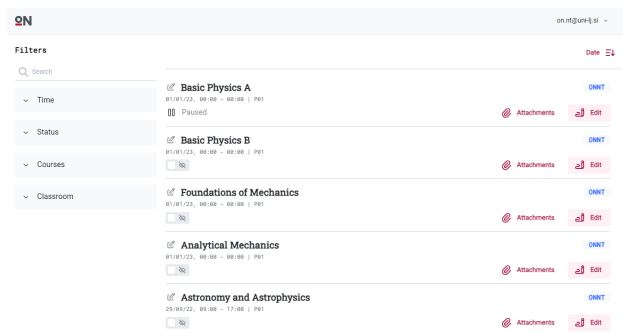


Figure 2: ON lecturer site with an overview of available lectures.

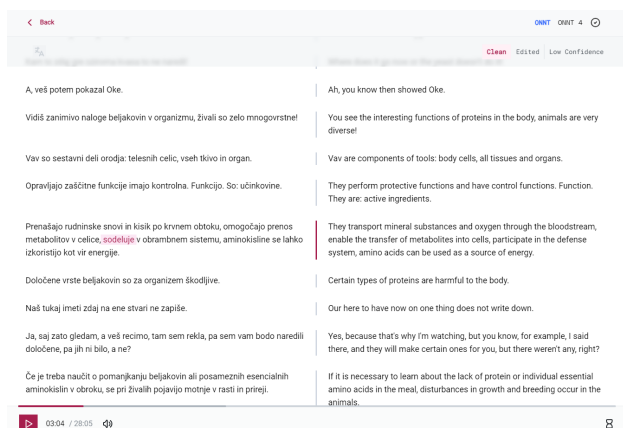


Figure 3: Editing page of the ON lecturer site.

translation are shown in successive blocks of text appearing at the bottom of the page.

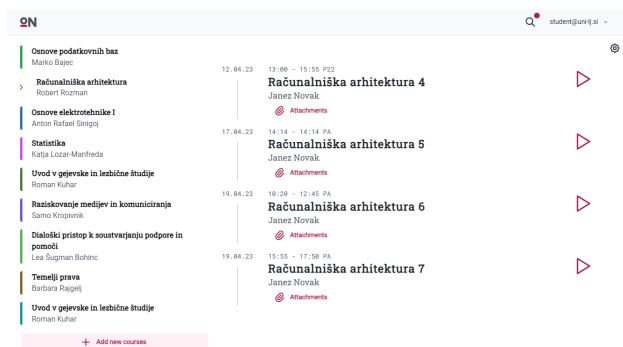


Figure 4: Overview page of the ON student site.

3.6 Administrator Site

The administrator site (Figure 5) is separate from the lecturer and student sites and allows for lectures to be scheduled in the Online Notes system. The administrator can manage the passwords for lecturer accounts, add new courses to their accounts, assign individual lectures to different classrooms, etc.

The administrator site is designed for a designated administrator at the faculty level that is responsible for scheduling lectures

for different lecturers, while lecturers simply run the ON system from the streaming site at the start of their lecture.



Figure 5: The ON administrator site.

4 PILOT LECTURES

4.1 Workflow

To test the Online Notes system in real-life situations, a number of pilot lectures were organized through multiple calls for interested lecturers at the University of Ljubljana. In collaboration with the IT-staff of individual faculties, we first tested the sound equipment available in the relevant lecture room. If the equipment was inadequate, we used our own setup (a laptop and a pin microphone).

Before the lecture, the recordings of previous lectures with the same or similar content that were provided by the lecturers were transcribed and processed (in order to improve the ASR-models, as described in section 3.1).

During the lecture(s), the students were given access to the live transcriptions and translations; in some lectures, the ON output was also projected to the screen. In two cases, the ON system was used for every lecture held in that course in that semester.

4.2 First Impressions and Further Feedback

Since 2021, a total of 29 pilot lectures (with two consisting of multiple lectures) have been held at 8 different faculties of the University of Ljubljana so far, with several more planned for the 2023-2024 scholastic year. The lectures included both the fields of humanities and social sciences (e.g. the Faculty of Arts, the Faculty of Social Sciences) as well as STEM subjects (e.g. the Faculty of Mathematics and Physics, the Faculty of Computer and Information Science).

While the feedback has been predominantly positive, the use of the system has shown several potential problems that need to be addressed before a more widespread implementation. These range from minor bugs and features to be implemented (e.g. the implementation of a sensible profanity filter for machine translations, as these are often unpredictable and sometimes result in unwarranted obscenities in the translated text) to purely technical issues that require action on the part of the faculties themselves, such as outdated operating systems on lecture room computers or insufficient hardware.

Currently, we are working on surveys and interviews to obtain more feedback from lecturers (not just on the live version of Online Notes, but the post-lecture editing phase as well) and students, particularly Erasmus students and students with disabilities. When it comes to students with disabilities, We have already received general feedback on the use of WCAG Guidelines in

terms of the overall interface design, e.g. the use of appropriate contrast ratio for the sight-impaired and the accessibility of different interface elements by keyboard. However, this feedback was not specific to the Online Notes system, but in general. For a more focused test of the user-experience for students with disabilities, we intend to perform a pilot lecture to receive feedback on the actual use of the platform. Unfortunately, setting up such a pilot lecture has not yet been successful because of difficulties finding willing candidates who at the same time attend lectures that are more suitable for the use of the ON system.

The latest evaluations of the ASR-models done on a sample of the transcriptions of pilot lectures at the end of 2022 show that the speech recognition features word-error rates (WER) between approximately 12.6% and 32%, depending on multiple factors, such as the complexity of the topic (e.g. successful ASR is more difficult with non-linguistic elements such as formulae in mathematics and physics) and the lecturer's speech rate, clarity, and degree of standardness (e.g. non-standard and dialectal speech is still insufficiently supported by our current ASR-models). Successful speech segmentation is also a problem, as speech segments do not necessarily coincide with semantically coherent units, which causes additional problems downstream with machine translations. No systematic machine translation evaluation has been conducted yet since our priority is to resolve as many ASR-issues as possible and then tackle machine translation. However, one of the teachers who used the Online Notes system for an entire semester deemed the translations suitable enough to be published as subtitles on their videos (with some corrections), which indicates that automatic translations are reasonably useful; however, this also varies from subject to subject.

5 CONCLUSION AND FUTURE WORK

While the pilot version of Online Notes has been received positively by the lecturer community at the University of Ljubljana (with some lecturers even integrating the use of the system in their own workflows, e.g. using transcriptions for the preparation of subtitles for video-recordings of their lecture on public video platforms) and the students (for instance, two Erasmus students successfully passed an exam in a course held in Slovene by using the ON translations as study aids), the evaluations have shown that there is still room for improvement. Translating transcriptions of spontaneous spoken speech is a difficult task, particularly in Slovene, where spoken language frequently differs significantly from written standard language both in terms of vocabulary and pronunciation. In the future, we intend to adapt our ASR-models to non-standard pronunciations and expanding the pronunciation dictionaries in order to increase ASR-accuracy. We also intend to expand our pronunciation dictionaries by integrating the ON system with other language resources developed at the University of Ljubljana, such as the Sloleks Morphological Lexicon of Slovene [1], the Digital Dictionary Database of Slovene [2], and the Slovenian Terminology Portal [7]. This will reduce the need for processing transcriptions in order to cover the vocabulary required for good ASR-results. Depending on how willing the participating lecturers are to correct the automatic transcriptions, we may implement an incremental training workflow using corrected outputs to provide more improvements to the system.

Additionally, different segmentation methods must be tested in order to avoid segmentation-related problems in machine translation, e.g. speech segments that are either too short or too long

(which also causes problems with translation delay; in some cases, it took more than 30 seconds for a very long segment to be displayed and translated, which made it more difficult to follow the lecture). Uneven and delayed segmentation causes problems for students with disabilities as well and needs to be addressed to increase user-friendliness.

However, several other, non-technical aspects need to be taken into account as well. To a certain extent, the successful use of ON depends on the degree to which the speaker adapts their speech to the limitations of the tool; for instance, by consciously avoiding segmented speech with numerous false starts, filler words and so on. These become particularly evident in the translation, where the frequent Slovene filler word *ne* (which is homonymous with *ne* meaning 'no' or 'not') sometimes causes the translation to be diametrically opposed to what the speaker actually said.

By the end of the project, we intend to develop the Online Notes system so that it can be successfully implemented at the University in order to (1) help increase the accessibility of lectures for people with disabilities; (2) contribute to the internationalization of the University of Ljubljana by allowing non-Slovene-speaking students to attend Slovene lectures; (3) allow teachers to archive their lectures and edit their transcriptions/translations; and (4) contribute to the wider language infrastructure for Slovene.

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Digitalna vključenost študentov s posebnimi potrebami v visokošolskem izobraževanju

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KLJUČNE BESEDE

digitalna dostopnost, IKT, podporna tehnologija, študenti s posebnimi potrebami, visokošolsko izobraževanje

ABSTRACT

In higher education, more and more courses are held online or traditional campus courses involve digital tools to enhance teaching and learning. In some cases, digital environments enable disabled students to access and participate on more equal terms, yet specific groups of disabled people still face barriers in accessing digital learning environments and resources. Barriers are present on different levels, ranging from accessibility of the digital tools themselves, having clear policies and procedures on the level of institutions or academic staff awareness about digital accessibility to the knowledge and skills of disabled students. We will discuss some most common barriers and the way they influence students' academic performance.

KEYWORDS

digital accessibility, ICT, assistive technology, disabled students, higher education

1 UVOD

Raziskava *EVROŠTUDENT* [1] je pokazala, da je v Sloveniji 21 % študentov poročalo o zdravstvenih težavah ali invalidnosti. 56 % sodelujočih v raziskavi meni, da je institucionalna podpora nezadostna ali le delno zadovoljiva. Zagotavljanje digitalne dostopnosti je pomemben del institucionalne podpore študentom. Zaradi vse večje digitalizacije visokega šolstva je treba razmisliti, kako lahko različni ljudje dostopajo do digitalnih informacij, spletnih učnih okolij in študijskega gradiva izbranih študijskih

področij, razmisliti pa je treba tudi o dostopnosti informacijske tehnologije, ki se uporablja na visokošolskih institucijah in med študenti. Predpisi na področju visokega šolstva [6], invalidskega varstva [7] in digitalne dostopnosti [8] nam nalagajo, da se tudi v digitalnem okolju prilagodimo raznolikosti študentske populacije, prav tako pa moramo upoštevati raznolikost zaposlenih. Digitalna dostopnost visokošolskega prostora je večplastna in zahteva načrtno ter usklajeno delovanje različnih deležnikov.

V prvi vrsti gre za poznavanje dostopnosti razvijalcev digitalnih izdelkov in storitev, da so ti zasnovani po kriterijih digitalne dostopnosti. V času pandemije covid-19, ko se je celoten izobraževalni proces preselil na splet in je bilo treba za nadomeščanje nekaterih aktivnosti, ki bi se sicer odvijale v predavalnici, hitro najti digitalna orodja, je imelo veliko študentov težave z nedostopnostjo teh programov oz. aplikacij. Tudi skrbniki IKT-področja na visokošolskih institucijah morajo poznati minimalne standarde dostopnosti, da zakupijo licence programov, ki jih lahko uporabljajo tudi uporabniki s posebnimi potrebami. Ker veliko invalidov za dostop do informacij in storitev v digitalnem okolju uporablja podporno tehnologijo, lahko tudi tukaj prihaja do težav, saj včasih nadgradnja teh pripomočkov ne dohaja hitrosti nadgradnje orodij v splošni uporabi. Naslednji člen v verigi so oblikovalci vsebin in gradiv v spletnih učilnicah: profesorji, asistenti in drugo visokošolsko osebje. Če ne poznajo osnovnih načel oblikovanja dostopnih informacij, tudi dostopni programi niso koristni. Zadnji v tej verigi so študenti s posebnimi potrebami. Njihovo znanje in spretnost pri uporabi IKT-tehnologije ter prilagojenih pripomočkov prav tako vplivata na možnost dostopa do določenih vsebin ter aplikacij. Njihovo znanje je odvisno od več dejavnikov: časa in intenzitete nastale invalidnosti ali bolezni, rehabilitacije, ustreznega usposabljanja za delo s temi pripomočki in pogostosti njihove uporabe.

Tako lahko vidimo, da so na vseh ravneh potrebni ozaveščanje in usposabljanje, povezovanje in sodelovanje vseh deležnikov ter upoštevanje uporabniških izkušenj.

2 DOSTOPNOST ŠTUDIJSKEGA GRADIVA

Za uspešen študij morajo vsi študenti imeti zagotovljene enake možnosti dostopa do študijskega gradiva. Z uporabo digitalnih gradiv in spletnih učilnic so se te možnosti precej izboljšale. Študijski programi uporabljajo raznoliko študijsko gradivo: od spletnih strani, videoposnetkov, besedilnih datotek, predstavitev

in podobno. Za dostopnost študijskih gradiv naj bi bili odgovorni pedagoški delavci, ki nimajo niti vseh potrebnih tehničnih sredstev niti zadostnega znanja o oblikovanju dostopnih gradiv.

Najpogostejša oblika elektronskega študijskega gradiva, ki se pojavlja v spletnih učilnicah, so pdf-datoteke. Če so ti dokumenti ustrezno oblikovani in shranjeni kot besedilo, za večino študentov niso težavni. Velikokrat se zgodi, da so dokumenti shranjeni kot slike – še posebej, kadar gre za skenirane strani brez OCR-ja, ali pa niso ustrezno oblikovani in označeni. V tem primeru jih slepi in slabovidni študenti, ki uporabljajo bralnike zaslona, ne morejo prebrati. Težave predstavljajo tudi študentom s specifičnimi učnimi težavami, ki si za lažje branje, obdelavo in pomnjenje gradivo dodatno prilagajajo svojim potrebam, tako da spremenijo obliko pisave, razmik med vrsticami, barvo ozadja ter besedila in podobno. Ti sicer gradivo lahko preberejo, a jim to vzame precej več časa in napora.

Prav zato na *Društvu študentov invalidov Slovenije* svetujemo, da je gradivo študentom s posebnimi potrebami na voljo v izvornih oblikah, kot so *MS Word*, *PowerPoint* ali *Excel*, vendar je tudi pri uporabi teh programov treba poznati in paziti na dostopno oblikovanje dokumentov. V sklopu projekta *PRAVA SMER*, ki smo ga na *Društvu študentov invalidov Slovenije* izvajali med pandemijo covid-19, smo objavili priporočila za pripravo dostopnih študijskih gradiv; do njih lahko prosto dostopamo na naši spletni strani pod zavihkom *Visokošolsko osebe*.

V nadaljevanju podajamo nekaj konkretnih primerov, ki so bili zbrani na skupinskih spletnih posvetih s študenti in v okviru individualnih svetovanj študentom med študijem na daljavo. Začnimo s primerom slepe študentke, ki pri delu z računalnikom in branju gradiv uporablja bralnik zaslona *JAWS*. Pri predelovanju gradiv, ki jih je prejela v obliki *PowerPoint*-dokumentov, in pri reševanju nalog, ki jih je dobila v *Wordovem* dokumentu, nikakor ni mogla rešiti dela nalog, saj snovi, ki bi obravnavale dotične naloge, ni našla. Drugi študenti s tem niso imeli težav in so povedali, da je na drsnicah vsa snov. Izkazalo se je, da je bila težava v tem, da nosilec predmeta, ki je pripravil *PowerPoint* predstavitev, ni uporabil zgolj prednastavljenih postavitev drsnic, temveč je namesto oblikovanja novih postavitev v obstoječo drsnico vstavil okvirčke z besedilom. Slednji so bralnikom zaslona nedostopni, saj jih zaznavajo kot sliko, ki ji je treba dodati nadomestno besedilo. Tako so bile informacije na drsnici za videče študente vidne, slepa študentka pa jih s pomočjo podporne tehnologije ni mogla prebrati. Profesor je tako, čeprav povsem nenamerno in nezavedno, postavil slepo študentko v neenakovreden položaj.

Študenti velikokrat prejmejo gradivo v obliki pdf-dokumentov. V nekaterih primerih so to delovni listi, ki jih videči študenti natisnejo in izpolnjujejo v papirnati obliki, medtem ko slepi in slabovidni delovne liste raje izpolnjujejo digitalno. Ko takšen dokument ni ustrezno oblikovan in označen z različnimi vrstami zaznamkov (z naslovi, odstavki, s povezavami, tabelami, slikami, polji obrazca, z vrstnim redom branja ipd.) ter ne vsebuje polj za vnos besedila, slep ali slaboviden z njim ne more delati. Enako velja za skenirane knjige, članke, skripte in ostalo obsežnejše študijsko gradivo. Študenti s posebnimi potrebami začnejo zaradi nedostopnosti gradiv in potrebnega časa za

prilagajanje v dostopne oblike pri študijskem delu zaostajati za drugimi študenti.

Velikokrat si študenti sami prilagajajo nedostopno gradivo v dostopne oblike. Nekaterim slepim študentom zdaj pomagajo tudi osebni asistenti, nekaterim priskočimo na pomoč na *Društvu študentov invalidov Slovenije*, vendar so naše kapacitete zaradi pomanjkanja osebja zelo omejene. Z enakimi težavami se srečujejo tudi visokošolske institucije.

Naslednji primer je primer močno slabovidne študentke, ki je prejela gradivo za delo na vajah v pdf-obliki, čeprav je imela v odločbi zapisano, da naj bi študijsko gradivo prejela v njej dostopni obliki, torej v *Word*-formatu. Gradivo ni bilo avtorsko delo nosilca predmeta, temveč eksterno skenirano gradivo, ki so ga uporabljali kot dodatno gradivo za podporo študijskemu procesu. Po pogovoru z nosilcem predmeta ji je bilo svetovano, naj vse pdf-dokumente odpira v *Wordu*, kar pa zanjo še vedno ni rešilo težav z dostopnostjo dokumenta. Pri pretvorbi je namreč prišlo do večjih popačenj strukture dokumenta, ki so vplivala tako na preglednost in logičnost gradiva kot na razumevanje vsebine.

Določene visokošolske institucije v tujini imajo posebne oddelke, zadolžene za področje digitalne dostopnosti; tako sodelujejo s službami za podporo študentov invalidov in z akademskim osebjem. Prav tako imajo interne ali eksterne službe, ki preverjajo dostopnost digitalnih informacij in jo popravljajo oz. izboljšujejo. Od akademskega osebja se pričakuje, da bo gradivo, ki ga pripravljajo sami, na voljo v dostopni obliki, za drugo gradivo pa je odgovornost deljena. Tako na primer učitelj ne povsem dostopen desetstranski članek v pdf-obliki prilagodi sam, medtem ko 100 strani dolgo publikacijo prilagaja posebna služba.

3 DOSTOPNOST SPLETNIH UČILNIC

Tudi spletna učna okolja so lahko le delno dostopna. Težave pri branju lahko povzročata nepravilna struktura strani, ki ne uporablja naslovov ali podnaslovov oz. so ti napačno uporabljeni. Težavni so lahko nezadosten kontrast, uporaba slik v ozadju, uporaba nepravilno strukturiranih tabel, grafični elementi brez dodanih alternativnih opisov ipd. Za vse, ki uporabljajo bralnike zaslona, je pomembno, da vedo, ali je besedilo, ki ga slišijo, naslov, podnaslov, odstavek, seznam, tabela in podobno. Brez ustreznih označb bralnik zaslona celotno besedilo na strani prebere kot enoten odstavek, ki je pomensko težje razumljiv.

Poleg podajanja osnovnih informacij o predmetu, gradiv in navedenih obveznosti lahko v *Moodlu* potekata tudi preverjanje in ocenjevanje znanja. Po eni strani je treba razmisliti o vrsti nalog in o njihovi dostopnosti vsem študentom; morda nekaterim skupinam študentov povzročajo težave. Naloge, ki jih je treba rešiti v omejenem času, ali naloge, ki ne omogočajo vračanja na prejšnji odgovor, lahko določenim študentom povzročajo veliko težav. V tem primeru so to študenti s specifičnimi učnimi težavami, študenti s težavami ohranjanja pozornosti ali z anksioznostjo. Tem časovni pritisk in brezpogojni vrstni red izpolnjevanja vprašanj povzročata nepotreben dodaten stres, kar lahko močno zmanjšuje njihovo učinkovitost. Zanje je priporočljivo, da čas odgovarjanja na posamezno vprašanje ni

omejen in da lahko najprej rešijo vprašanja, ki jih znajo, ter se nato vrnejo na tista, ki jim povzročajo težave.

Pomembno je poznavanje dodatnih orodij, s pomočjo katerih lahko učitelji posameznim študentom s posebnimi potrebami znatno olajšajo delo in jim pri študiju zagotovijo po odločbi dodeljene prilagoditve. Z individualnimi nastavitvami lahko posameznim študentom dodelijo daljši čas oddaje naloge ali jim dovolijo več poskusov reševanja naloge. Nekaj napotkov v zvezi z dostopnim preverjanjem znanja v spletni učilnici Moodle je zbranih v priporočilih za dostopno preverjanje znanja v Moodle, objavljenih na spletni strani Društva študentov invalidov Slovenije pod zavihkom *Visokošolsko osebje*.

4 DOSTOPNOST DIGITALNIH ORODIJ IN KOMPATIBILNOST S PODPORNO TEHNOLOGIJO

Tehnologija zadnja leta zelo hitro napreduje. To mnogokrat pomeni, da dizajn in razvoj podporne tehnologije zaostajata za razvojem tehnologije v splošni rabi. Situacija se zadnje čase sicer izboljšuje, a razvoj dostopne tehnologije v splošni rabi in razvoj podporne tehnologije ne potekata vedno usklajeno. Prav tako so v fazi zasnove digitalnih orodij pogosto premalo poudarjeni vsi potrebni vidiki dostopnosti. Oviro pa predstavlja tudi cena; ne le z vidika finančne dosegljivosti licenčne opreme v splošni rabi, temveč tudi oz. predvsem zaradi visokih stroškov podporne tehnologije, ki je ne krije zdravstvena zavarovalnica in si jo morajo študenti s posebnimi potrebami priskrbeti sami.

Študenti so imeli največ težav z dostopnostjo in rabo podporne tehnologije med študijem na daljavo zaradi covid-19, saj sta hiter prehod na različne platforme videopredavanj in uporaba drugih digitalnih orodij za sodelovanje povzročila, da so bili študenti s posebnimi potrebami preobremenjeni z iskanjem informacij, kako uporabljati ta orodja. Slepici so na primer morali poiskati informacije, kako jih upravljati s pomočjo tipkovnice. Imeli so tudi težave z dostopanjem do deljenega zaslona in s preklapljanjem med orodji znotraj programa, kot so klepet, postavljanje vprašanj ali reševanje anket. Študenti s težavami z osredotočanjem in ohranjanjem pozornosti so iskali rešitve, kako zmanjšati moteče elemente, kot je pojavljanje sporočil, medtem ko so imeli gluhi in naglušni študenti težave s spremljanjem predavanj, saj ta niso bila podnaslovljena ali tolmačena v slovenski znakovni jezik – sledenje predavateljevi sliki in branje z ustnic sta bila pogosto otežena.

Prav tako je predstavljala težavo poplava različnih aplikacij in učnih orodij: od Kahoota, H5P, Mentimeter do različnih orodij v Moodle, saj so študenti, ki uporabljajo podporno tehnologijo, le s težavo dohajali druge študente. Posledično so doživljali dodaten stres in breme pri iskanju rešitev, kako jih uporabljati.

5 ZAKLJUČEK

Študenti na splošno poročajo, da so jim zaposleni v visokošolskih institucijah pripravljene prisluhniti in pomagati, vendar pogosto nimajo dovolj znanja o tem, kako izvesti te prilagoditve. O podobnih ugotovitvah na osnovi nacionalne raziskave v ZDA poročajo tudi Jeannis idr. [2], v kateri 30,8 % študentov meni, da je ena od ovir pri študiju pomanjkanje znanja

o posebnih potrebah in prilagoditvah med visokošolskim osebjem, medtem ko jih kar 66,4 % poroča, da so zaposleni nadvse pripravljeni pomagati in prilagoditi študij njihovim potrebam. Študije, ki jih navajata Langørgen in Magnus [3], kažejo, da je študijska uspešnost študentov s posebnimi potrebami trenutno bolj odvisna od pripravljenosti posameznikov v visokošolskem okolju, da pomagajo tem študentom, kot pa od proaktivnega pristopa visokošolskih institucij, da zagotavljajo vključujoče študijsko okolje za raznolike skupine študentov na sistemski ravni.

Študije iz tujine kažejo [4], da obstaja precejšen razkorak med predpisi in dejansko implementacijo digitalne dostopnosti v visokošolskih institucijah. Ovire dostopanja do učnih okolij in študijskih gradiv študentom s posebnimi potrebami preprečujejo ali močno ovirajo sodelovanje ter vključevanje v vse vidike študijskega procesa, kar vpliva tudi na njihovo (manjšo) študijsko uspešnost [5].

Ukrepi, s katerimi lahko visokošolske institucije izboljšajo digitalno dostopnost [4], so:

- preverjanje obstoječega stanja glede digitalne dostopnosti spletnih strani; sistema za upravljanje učenja (LMS); digitalnih vsebin in gradiv, kamor se vključi tudi študente in zaposlene s posebnimi potrebami.
- Priprava akcijskega načrta izboljšav, ki temelji na predhodnih ugotovitvah obstoječega stanja.
- Upoštevanje standardov dostopnosti že v fazah naročanja in nakupa digitalne opreme, da se že pri naročilu določi, naj ponudniki zagotovijo skladnost orodja s standardom EN 301 549 V3.2.1 oz. s smernicami WCAG 2.1 do nivoja AA, kot narekuje zakonodaja.
- Imenovanje osebja, ki bo na ravneh institucije ali oddelkov odgovorno za digitalno dostopnost.
- Izobraževanje osebja in študentov o standardih digitalne dostopnosti in o težavah z digitalno nedostopnostjo.

Mehanizmi zagotavljanja digitalne dostopnosti na večjih visokošolskih institucijah v tujini vključujejo delovno mesto koordinatorja digitalne dostopnosti, ki povezuje ostale deležnike znotraj institucije; utečen sistem naročanja, ki upošteva vidike dostopnosti; akcijski načrt izboljšanja digitalne dostopnosti in sistem nadzora ter evalvacije napredka.

Zagotavljanje dostopnosti je torej dolgoročna zaveza. Potrebna sta povezovanje in sodelovanje večine služb institucije, da dostopnost postane del vseh vidikov visokošolskega okolja – tako grajenega, informacijskega, pedagoškega in družbenega.

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Exploring Digital Literacy and the Use of ChatGPT among Students with Disabilities

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ABSTRACT

This paper examines the level of digital and algorithm literacy, and the use of ChatGPT as a study aid among students with disabilities. Twenty-seven respondents filled out an online survey questionnaire. The results revealed a high proficiency in digital and sufficient level in algorithm literacy, with participants valuing ChatGPT for studying and problem-solving. While perceived as accessible, participants suggested additional features to enhance their user experience – subtitles, text-to-speech conversion and content summaries, and the integration of voice assistants. The study highlights the potential of chatbots to support students with disabilities in the education process.

KEYWORDS

People with disabilities, chatbots, conversational agents, digital literacy, education, usability

1 INTRODUCTION

Accessibility and usability are, in tight interplay, crucial for people with disabilities (PwD) to participate actively in society and have equal access to educational opportunities. Lower levels of education, followed by lower employment rates, have been recorded consistently among PwD in comparison to people without disabilities [1].

Although Information and Communication Technologies (ICT) can contribute to accessibility improvement, PwD, on the contrary, often face digital divide and digital exclusion [2, 3]. ICT thus works as an additional barrier, instead of being a facilitator of participation [3]. Recently, Artificial Intelligence chatbots, or conversational agents (CAs), have been found to solve some accessibility issues, mostly by providing a personalised experience or enhancing the learning process [4-7].

*Article Title Footnote needs to be captured as Title Note

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In the usage of all assistive technologies the role of digital and algorithmic literacy should not be overlooked, particularly in the context of special requirements of PwD [7]. Prior research has also found that some challenges faced by SwD, such as inadequate social skills, can be solved with AI tools, e.g. social robots [8].

Accordingly, the purpose of this paper is to examine what is the level of digital and algorithm literacy among students with disabilities (SwD), as a part of PwD, and, further, how they use CAs, and to what extent they perceive them as useful and accessible study aids. The study focused primarily on ChatGPT, due to its exponentially increasing user base and previously identified features with high potential for educational use [9].

2 ARTIFICIAL INTELLIGENCE CONVERSATIONAL AGENTS

2.1 Definition of AI Conversational Agents

Chatbots are Artificial Intelligence systems for Human-Computer Interaction [10]. The computer software uses Natural Language Processing, and converses through text or voice in one or more languages [11]. While numerous chatbots are currently available, ChatGPT soon became the fastest growing consumer application with over a million active monthly users [12].

Currently, the free version of ChatGPT provides many functionalities [9] that could be used for educational purposes and SwD. Users can request information via written conversation, which is saved, and can later be recalled for specific topic-related information. The input can be in numerous languages and text complexities (e.g. simple, academic). The same applies to the text generated by the chatbot, along with various speaking styles, such as professional and engaging. As ChatGPT is based on Natural Language Processing, the conversations are highly similar to human communication. The bot can elaborate ideas, recall prior statements, apologise for mistakes, which was not previously possible. Furthermore, user interaction supplies the bot with additional information, which also improves the communication with users by recognising communication patterns. Students could also benefit from receiving prompts and directions for writing assignments, or

detailed feedback on assignments. Another benefit of ChatGPT is its ability to research a wide range of topics, and organise unstructured data into structured information.

2.2 Contextual Use of Conversational Agents

Chatbots have been examined increasingly in the context of education, travel, research, journalism and other uses [7, 9, 13-18]. In recent years, large parts of education have been conducted via digital tools, e.g. homework assignments, class attendance reports, etc. [7, 14], which could be expanded further.

In the travel context, chatbots were found to provide user-centric or personalised recommendations [13] as opposed to general information found through search engines, which could also apply to education. As chatbots emulate human interaction and hold conversations similar to humans, they could suit students who prefer to obtain information through conversation instead of researching various sources independently. Students are able to ask general or specific questions and receive elaborate feedback [9].

Winkler and Söllner [18] recognised chatbots as beneficial for individual student support, such as when the lecturer is unable to respond adequately to large groups of students. These tools also encourage students to be more proactive and seek information on their own, improving their academic performance further.

Although chatbots have been present in general use for several years, their use in education has been expanding in the past five years, ranging from a very limited tool [18, 19] to becoming a valuable study aid both for students and teachers [7].

2.3 Limitations of Artificial Intelligence Conversational Agents

The main challenges of chatbots are related to the limited training data and use of raw text without hyperlinks and citations, which can lead to incorrect responses. They are also unable to comprehend human emotions fully, due to their training for specific tasks. Selection of training data can also contribute to the model's biased output. Lastly, AI tools pose a danger of plagiarism on assignments among students [9] and make identification of human and AI authorship difficult [21].

Haleem et al. [9] proposed development of niche instead of generic models for a more limited set of information. CAs should also be avoided for tasks requiring significant users' input. Among ethical concerns remain the users' difficulty to identify true and false information due to human-like conversations. Some also rely on the CAs' output without proper validation and verification, while the output is often generated randomly statistically [21].

3 DIGITAL AND ALGORITHM LITERACY

Apart from digital accessibility, digital illiteracy is also a major problem of technology implementation [7]. Digital literacy can be defined with six components; (a) Understanding of graphical interfaces in digital devices, (b) Creating new media, (c) Navigation in digital media, (d) Critical thinking, (e) Communication and collaboration, and (f) The ability to process

and evaluate information in real-time [20, 22]. Similarly, Cortina-Pérez et al. [23] defined digital literacy with three dimensions; (a) Information skills (information management and interpretation), (b) Use of digital tools (the skills and competencies to operate digital devices), and (c) Digital transformation (evaluation and production of information, understanding of copyright law).

On one hand, digital illiteracy can be present in educators, who are trained insufficiently in new technologies [23]. On the other, digitally illiterate students are at risk of understanding and creating materials incorrectly, unable to navigate nonlinear information sources, or evaluate the validity of information [24]. The importance of digital literacy has been expanded further with the increasing role of algorithms on the Internet. Algorithm literacy should be perceived as a part of digital literacy, and can be defined as "awareness of the use of algorithms in online applications, platforms, and services, knowing how algorithms work, being able to evaluate algorithm decision-making critically, as well as having the skills to cope with, or even influence, algorithm operations" [25]. Due to its importance, algorithm literacy should be taught as part of digital literacy for SwD [26].

4 METHODS

4.1 Procedure

Data were obtained with an online questionnaire in July 2023. The participants were invited through Slovene local and national associations for PwD, either visual, auditory, mobility or cognitive impairments. The study was conducted with the approval of the IRB at the University of Maribor (038-13-148/2023/5 FFUM), due to collecting health information. Participation was voluntary and anonymous.

4.2 Measuring Instrument

The questionnaire obtained the socio-demographic characteristics of participants (gender, age and current level of schooling). Participants who were currently not students were excluded from the study. Participants were also asked about the field of study they are currently undertaking [27]. Participation was limited to SwD.

The second part of the questionnaire obtained data on participants' purposes and frequency of Internet use [28]. The next part examined participants' digital literacy with questions adapted from Kaeophanuek et al. [29]. Participants were asked about their information abilities, use of digital tools and digital transformation. The fourth part examined algorithm literacy, adapted from [25] with a series of true/false statements.

The fifth part was aimed at ChatGPT use for general and education purposes. Some questions were adapted from [30] and [31]. Lastly, perceived ChatGPT usability was examined with an adapted chatbot usability scale [32]. Participants could also suggest other features they would benefit from.

4.3 Research Questions

Based on the presented theoretical frame, the following research questions were defined:

RQ1: What is the level of digital literacy among SwD?

RQ2: What is the algorithm literacy among SwD?

RQ3: How do SwD use ChatGPT?

RQ4: How SwD perceive the usability of ChatGPT?

4.4 Participants

The questionnaire was completed by a total of 27 participants, of whom 67% were men (n=18) and 33% were women (n=9). Most participants were younger than 18 (26%, n=7) or older than 26 years (37%, n=10). Others were aged 18-20 (15%, n=4), 21-23 (18%, n=5) or 24-26 (4%, n=1). The majority of participants were currently in a 3-year vocational secondary school (44%, n=12), followed by a gymnasium or other 4-year secondary school (15%, n=4), students in Bachelor's (15%, n=4) or Master's programmes (15%, n=4), 2-year lower vocational school (7%, n=2), or a PhD programme (4%, n=1).

Most participants were enrolled in ICT programmes (37%, n=10), engineering programmes (19%, n=5), followed by business and administration (11%, n=3), social sciences, agriculture, tourism, arts and humanities (7%, n=2) or law (4%, n=1). Participants reported visual (35%, n=12), hearing (17%, n=6), movement (20%, n=7), cognitive (20%, n=7) or other disabilities (6%, n=2). Six participants reported having multiple disabilities.

Among the participants with hearing impairments, most reported profound hearing loss (over 90dB) (n=3), and one participant reported severe hearing loss (71-90 dB). Two participants were unsure of the degree of their hearing loss.

5 RESULTS

5.1 Internet use

Participants were asked to assess their Internet use for various activities. Most often (three or more times per day) they used it for studying (37%), browsing social media (33%), listening to music or podcasts (30%) and communication (19%). Other common activities included independent learning (e.g. programming, Photoshop), which was done once per day or less often (37%), the same as searching for information and problem-solving (33%). Most estimated to use between one and three hours per day studying or learning (n=9), or less than an hour (n=7).

5.2 Digital and Algorithm Literacy

Digital literacy was examined with three indicators (information competencies, use of digital tools and digital transformation) to address RQ1 and RQ2. Participants exhibited the highest proficiency in the use of digital tools (M=4,08, SD=0,58), particularly in awareness about the advantages, disadvantages and impact of Internet use (M=4,59, SD=0,63). They also exhibited high willingness to learn and adapt to new technologies (M=4,44, SD=0,64), and awareness on the importance of ethical Internet use and prevention of cyber harassment (M=4,41, SD=0,79).

Furthermore, participants exhibited considerable proficiency in information skills (M=3,82, SD=0,77), with notable strengths in their ability to verify the information's accuracy (M=4,11, SD=1,12). They also reported a high capacity to share data files online (M=4,0, SD=1,33), assess reliable information sources (M=4,0, SD=0,83), and distinguish between facts and opinions (M=4,0, SD=0,96). Lastly, participants also demonstrated an above average level of proficiency in the domain of Digital Transformation (M=3,5, SD=0,83), particularly with regard to awareness on copyrighted videos (M=4,22, SD=1,08) and their ability to create content while avoiding plagiarism (M=3,59, SD=1,18).

Algorithm literacy was assessed with 11 true/false statements. On average, participants recognised 6,52 statements correctly. Most participants were able to discern accurately that algorithms offer both opportunities and risks (89%, n=24). Furthermore, they concurred that user behaviour on the Internet can impact the functioning of algorithms (63%, n=17), and that personalised content aligns with users' pre-existing opinions (63%, n=17). Conversely, it was acknowledged that algorithms are unable to recognise incomplete search results and correct them automatically (59%, n=16). Among the incorrect responses, a considerable number of participants assumed erroneously that algorithms operate independently of human involvement (52%, n=14). No participant identified all statements correctly, two identified 10 statements, three identified 9 statements and four participants identified either 8 or 7 statements. 14 participants identified below the average number of statements.

The results also show a significant difference in recorded digital and algorithm literacy (p=.001), with significantly higher values for digital (M=3,8, SD=0,66) than algorithm literacy (M=1,4, SD=0,18). There was no significant correlation between ChatGPT use and perceived usability.

5.3 ChatGPT use and perceived usability

In response to RQ3, ChatGPT was previously used by most participants (59%, n=16). Most have used it previously for studying or other assignments (85%) and a third uses it often or very often (at least in $\frac{3}{4}$ of cases). The next common use is the developing of creative ideas or problem-solving, used by 74%. Many use it on every occasion necessary (22%). Two thirds of participants use ChatGPT for chatting, many of them very often (19%).

When asked to assess the usefulness of ChatGPT for studying, most participants found it very useful (33%, n=9), useful (29%, n=8), or neither useful nor useless (26%, n=7).

Participants also evaluated the capabilities and constraints of ChatGPT. The predominant consensus was that the tool produces correct responses consistently (M=3,44, SD=1,18), followed by the ability to produce contextually relevant responses (M=3,41, SD=1,3). ChatGPT also generates meaningful responses (3,11, SD=1,42) and credible and correct information (M=2,96, SD=1,48). The features that were least often recognised were to provide relevant sources (M=2,74, SD=1,34) and genuine sources (M=2,78, SD=1,25). Participants also assessed the usability of ChatGPT (RQ4). Most praised its usability, as they found the way to talking to the tool easily (M=3,56, SD=0,84).

They also reported an easy start to the conversation ($M=3,48$, $SD=1,0$), it was clear and easy to understand communication ($M=3,44$, $SD=0,93$) and maintaining of the conversation context consistently ($M=3,33$, $SD=0,92$). Some features were recognised as less accessible, as they had to ask questions several times to receive the correct answer ($M=2,96$, $SD=1,19$).

Participants have provided some recommendations for enhanced usability and accessibility of ChatGPT. Several proposed the implementation of subtitles ($M=2,89$, $SD=1,15$), text-to-speech conversion ($M=2,81$, $SD=1,07$), or the capability to provide content summaries ($M=2,78$, $SD=1,21$). Less frequently mentioned, likely due to the limited sample size, was sign language interpretation ($M=2,52$, $SD=1,08$). Additionally, some participants emphasised the need for different contrast settings for people with visual impairments, and recommended the integration of voice assistants, e.g. Siri.

6 CONCLUSION

This study investigated the use of ChatGPT and its perceived usability for educational purposes among SwD. The results indicate that the participants demonstrated a high level of digital literacy (RQ1). They exhibited the highest proficiency in the use of digital tools. They also showed awareness about the impact of Internet use, the importance of ethical Internet use, and the ability to verify information accuracy. Such a level of digital literacy is tied with the sufficient understanding of the role of algorithm literacy shown by the participants (RQ2). They recognised the opportunities and risks of algorithms, and the alignment of content personalised with users' opinions. Most participants reported using ChatGPT for studying, developing creative ideas, and problem-solving (RQ3). They found ChatGPT to be highly useful for their academic work, and appreciated its ability to produce correct and contextually relevant responses consistently. Participants perceived ChatGPT as highly useful (RQ4), as they engaged in conversations easily, and found the tool's communication clear and easy to understand. The least favourable characteristic was the need to ask questions several times to receive the correct answer. Participants suggested additional usability and accessibility features, such as subtitles, text-to-speech conversion and content summaries, and the integration of voice assistants.

We examined the potential of ChatGPT for educational and other uses among SwD. The findings support the importance of inclusivity of chatbots to facilitate the learning process, but also presents ethical dilemmas, such as biased results and uncritical use of information. The results are limited by the small sample size and limited number of participants with each disability type. While the study did not identify participants' challenges in using ChatGPT, future works should also address this issue.

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General Strategies for Improving Accessibility of E-commerce

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ABSTRACT

This paper focuses on the accessibility challenges in e-commerce and strategies for their remediation on a high level with the main purpose of promoting further in-depth research. It also offers some general applicable guidelines for e-commerce to start improving their accessibility. It highlights the significance of organizational culture, commitment, awareness, training, and collaboration with accessibility specialists and individuals with disabilities. The paper categorizes the challenges based on the main user journeys that are essential for e-commerce, explores potential causes, and provides generalized best practices for implementing accessibility on a strategic level. Solutions include prioritizing accessibility within company culture, allocating resources, implementing change management strategies, raising awareness, defining roles and responsibilities, offering role-based accessibility training, integrating accessibility into project management and reporting, collaborating with external specialists, and actively involving people with disabilities.

KEYWORDS

Accessibility, E-commerce, European Accessibility Act, WCAG, Accessibility culture

1 INTRODUCTION

E-commerce and financial independence are crucial for everyone, but they can have a particularly life-changing impact on individuals with disabilities who have historically faced difficulties in navigating the physical world. Around 87 million people in the EU have some form of disability and around 45 million of them feel discriminated against [1]. This indicates that inaccessible online services discriminate against individuals who typically derive the greatest advantages from them.

Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services (The European Accessibility Act, EAA) [2] covers products and services that have been identified as being the most important for people with disabilities while being the most likely to have diverging accessibility requirements across EU countries.

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The scope of the EAA includes consumer banking services and e-commerce services that will need to be accessible no later than after the transitional period ending on 28 June 2030 [2].

With the revised Payment Services Directive (PSD2) [3] e-commerce and digital banking became even more interconnected [4], therefore they should be analyzed together.

This paper aims to examine common accessibility challenges in e-commerce. We will categorize and analyze them based on typical user journeys that often pose obstacles for people with disabilities.

Furthermore, we will discuss their probable causes. Finally, we will examine possible practical measures on an organizational level that can either avert these challenges from arising in the first place or remediate the existing ones.

2 METHODS

Firstly, we conducted a review of existing articles and research papers on accessibility to gather insights and perspectives. Additionally, we examined publicly available accessibility audits to gain a broader understanding of common accessibility issues and challenges.

Furthermore, we leveraged our own extensive experience in conducting accessibility audits and counselling for different organizations and platforms, allowing us to provide firsthand insights and recommendations. To ensure a user-centric approach, we actively sought direct feedback from individuals with disabilities [5], who shared their experiences and highlighted areas for improvement.

Moreover, we relied on statistical data obtained from both automated and manual accessibility testing studies. This quantitative information enabled us to identify trends and patterns in accessibility issues, as well as providing a more data-driven analysis.

By combining these various sources and methods, this paper should provide a robust and generalized foundation for the observations and recommendations presented in this article and encourage further, more detailed, research and discussions.

3 PARTS OF THE USER JOURNEY WITH ACCESSIBILITY CHALLENGES AND SUGGESTED SOLUTIONS

3.1 Presales and advertising

Digital advertisements are frequently displayed through various platforms such as search engine result pages, social media, inside mobile applications, and anywhere on the internet. Unfortunately, accessibility is often overlooked during the creation and serving of these ads [6].

Home pages that utilize the common Google AdSense system had 17.7 more errors on average [7], as a relevant example. Typical issues include low text contrasts, blinking animations, videos missing captions, missing keyboard support, total invisibility to screen readers, and so on.

To ensure accessibility of presales and advertising, it is important to select creative agencies and advertising platforms that adhere to accessibility standards. Verification of their compliance should be a part of systematic responsible procurement processes.

For in-house advertisements, creators should ensure compliance with accessibility standards before publishing them on advertising platforms. It is also important to recognize the varying accessibility support capabilities of different social media platforms and provide necessary workarounds when required [8].

3.2 Public-facing websites or native mobile applications

The 2023 report on the accessibility of the top 1,000,000 home pages, WebAIM's Million project [7] reports that 96.3% of home pages had detected WCAG 2 failures, discovered with automatic accessibility testing. Automatic accessibility testing can only discover up to 30% of all WCAG failures (16 out of the 50 Success Criteria under WCAG 2.1 Level AA [9]), so these numbers are often even higher.

Evaluating accessibility of native mobile applications is usually a manual approach, which is difficult to scale and therefore mass evaluation studies comparable to website studies do not yet exist. In a study of 479 Android apps in 23 business categories, 94.8% of them had automatically detectable accessibility issues [10]. Based also on our experience and available reports from the public sector applications [11], the accessibility of native mobile applications seems to be similar to the web with most of them being inaccessible.

In the past four years, the number of webpages with detectable WCAG (Web Content Accessibility Guidelines) failures has decreased by only 1.5%, from 97.8% [7]. It also appears that some e-commerce platforms have more accessibility issues compared to the previous year [7]. This could suggest a worsening of awareness and concern for accessibility.

Experts recommend that the management of organizations take the necessary steps to assess of the current accessibility

situation. They also propose conducting accessibility audits to determine the state of accessibility. These audits also serve to track progress during improvement cycles and provide content for accessibility statements, which also need to be created and maintained.

Additionally, it is important to clearly define roles and responsibilities related to accessibility within the organization [12]. The individuals in these roles should receive appropriate role-based training on accessibility to effectively address issues they are (co)responsible for.

Project management should provide the necessary support to ensure that proper processes are in place and respected. This includes prioritizing accessibility alongside other planned activities, monitoring and reporting progress and allocating resources accordingly. This will allow for both the development of new functionalities with integrated accessibility from the start and the fixing of existing inaccessible functionalities. Organizational policy on accessibility is strongly suggested [13].

3.3 Customer onboarding

Customer onboarding typically involves multi-step online forms that may require users to provide additional documentation manually or through digital authorization and signing. More than 45% of webpages tested in WebAIM Million still have basic form accessibility issues, for example missing form input labels [7].

Complex forms and components tend to come with more accessibility challenges. While reusable web components and design systems are the recommended best practice when they integrate accessibility [14], it is important to exercise caution and not solely rely on self-declared statements in their documentation [15], as they can be incorrectly reporting conformance.

Advanced custom-made components that can compromise accessibility require input from accessibility specialists and users with disabilities before they can be used [16]. Neglecting this due to lack of awareness or prioritization leaving accessibility to the end is a common cause of accessibility challenges and barriers. Using native components and simplifying where possible is advised instead of re-creating custom components [17].

Automatically generated documents such as contracts and invoices, usually made as Portable Document Format (PDF) documents [18], are another potential accessibility challenge when not tested for accessibility.

Communication channels such as email also need attention or quickly become potential sources of accessibility challenges as well [19].

Once again, a systematic approach works best. All roles involved need to be properly trained, aware of their responsibilities, and continuously cooperate to reach sustainable accessibility.

3.4 Customer Self-Service

Self-Service refers to a protected part of an online portal or a mobile application where customers authenticate so that they can manage their accounts, such as tracking deliveries, handling banking transactions, exporting transactional data, managing credit cards, and similar. Most customers (73%) want to be able to solve issues on their own [20] before contacting support. Forty-five per cent of people with disabilities in a Deloitte survey [21] believe that banks can elevate their experience by making digital banking channels more accessible.

Sixty-seven per cent of accessibility issues originate before coding, in wireframes and design specifications [22], so it is vital to implement accessibility earliest. As product details solidify, fixing problems becomes harder and more expensive [23].

With authentication and authorization services, complex dynamic components, rich visualizations, report generation, data exports, third-party components, and all other parts that are needed for efficient customer self-service products and services need proper and early planning, implementation, and maximum coverage of automatic and manual testing to be able to satisfy accessibility requirements, acceptance criteria, and conformance to standards.

Different roles with support from accessibility specialists and people with disabilities need to plan, cooperate, and test, particularly during the early stages, so that efforts yield the best results with accessibility implementation.

3.5 Customer support

Customer support in e-commerce involves assisting customers with their online purchases, financial transactions, and resolving a variety of other queries.

Accessibility is crucial for customer satisfaction and retention [24]. It involves providing an inclusive experience through diverse contact options and staff need to have training and solutions to offer alternatives when requested. Customers may prefer utilizing customer support through various channels such as phone calls, SMS, email, ticketing systems, video calls, and chat, so best practice is to offer them multiple channels and especially respect their preferences for communication.

Awareness and training of support staff around accessibility is decisive in customer satisfaction and in preventing legal consequences when dealing with accessibility complaints.

3.6 Third parties

Third-party solutions are pre-built tools provided by external companies for web and mobile platforms. They offer components or even full features such as authentication, authorization, chats, polls, forms, and so on. Overall, these solutions save time and resources and outsource parts of products or services.

Such solutions are also often a source of accessibility challenges [25]. Therefore, it is vital to ensure their accessibility before integration, otherwise the product or service risks inheritance of accessibility challenges. It is also recommended to create a vendor accessibility policy [26] that requires conformance of all third-party solutions before they can even be considered.

Providing possibilities of user-generated content is another potential source of accessibility challenges [27] and needs to be planned for as well.

Again, all involved roles need to be aware of their responsibilities and follow procurement and integration processes that consider accessibility beside other priorities.

DISCUSSION

Sustainable accessibility efforts require more than mere technical conformance. It is essential for companies to cultivate a culture that comprehends, supports, and integrates accessibility [28]. This practice not only aligns with moral obligations but also offers various benefits to businesses, such as enhanced branding, increased customer retention, and broader market reach. Accessibility expands market reach by attracting and retaining customers with disabilities, but calculating the economical return on investment is challenging [29]. Accessibility not only enhances the online experience for all users but also improves brand reputation and reduces legal liabilities [30].

To ensure accessibility is prioritized, it must be integrated into the executive strategy. In large organizations, the appointment of a Chief Accessibility Officer can be advantageous, overseeing the accessibility programme [31]. Nonetheless, executives themselves need to demonstrate effective change management and allocate adequate resources to constantly enhance processes and integrate accessibility within company roles and responsibilities. Evaluating products and services for accessibility is crucial, and the Web Content Accessibility Guidelines [32], along with their Evaluation Methodology [33], serve as a solid foundation for establishing key performance indicators, useful for continuous monitoring and managing progress.

Furthermore, it is imperative for all employees to receive awareness and role-based training to effectively improve and maintain accessibility. Collaboration with experienced external accessibility specialists and early involvement of individuals with disabilities are vital components, especially when internal resources are still building competence [34].

In the light of the upcoming European Accessibility Act, organizations without an existing executive strategy for accessibility are strongly advised to begin implementing the suggested activities promptly or risk falling behind. Complex systems often result in technical and procedural debt, necessitating even more required resources. These complexities can also impact the integration of third-party solutions, thereby prolonging accessibility efforts.

The paper provides a concise overview of complex subjects, encouraging further research and hopefully inspiring others in this important area.

CONCLUSION

In conclusion, sustainable accessibility efforts require cultivating a culture of accessibility, beyond technical compliance. Accessibility offers benefits to businesses, including enhanced

branding, increased customer retention, and broader market reach. Prioritizing accessibility requires integration into the executive strategy and ideally appointing a Chief Accessibility Officer to lead the programme of larger organizations. Evaluating products and services for accessibility using the Web Content Accessibility Guidelines is crucial but only a baseline. All employees should receive awareness and role-based training on accessibility. Collaboration with external accessibility specialists and early involvement of individuals with disabilities are key for long-term accessibility efforts. Integration of third-party solutions impacts overall accessibility and should also be taken into consideration. Organizations without an existing executive strategy for accessibility must start implementing suggested activities rapidly and the insights offered in this paper offer an introductory overview with quality sources that can be used for detailed research.

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Dostopnost informacijskih rešitev – ključ za opolnomočenje oseb z invalidnostmi

IT solutions accessibility – the key to empowering people with disabilities

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POVZETEK

V zadnjih desetletjih je razvoj tehnologije povsem spremenil naša življenja. Digitalni svet je postal pomemben del posameznikovega življenja. Omogoča medsebojno komunikacijo, izboljša priložnosti za izobraževanje in zaposlitev ter ponuja različne možnosti sprostitve.

Digitalizacija je pripeljala do velikih sprememb tudi v poslovnem svetu. Hiter in enostaven dostop do podatkov ter možnost oddaje digitalnih podatkov, za katere je skladno s pooblastili odgovoren vsak pooblaščen posameznik, omogočata samostojno opravljanje del.

Vendar to žal ne velja za vse. Programske rešitve v veliki večini namreč niso narejene z mislijo na to, da morajo omogočati enako uporabnost za vse uporabnike, ne glede na njihove morebitne oviranosti.

Zato se v realnem svetu osebe z invalidnostmi, v članku smo se osredotočili na področje vida, slepoto in slabovidnost, srečujejo s številnimi ovirami ter omejitvami pri uporabi rešitev, kar jih postavlja v neenakovreden položaj.

KLJUČNE BESEDE

Programske rešitve, dostopnost, opolnomočenje, diskriminacija.

OPTIONAL: ABSTRACT

Over the last decades, the development of technology has completely transformed our lives. The digital world has become an essential part of people's lives. It enables us to communicate with each other, improves education and employment opportunities and offers a variety of ways to relax.

Digitalization has also led to major changes in the business world. Fast and easy access to data, the possibility of submitting digital data for which each authorized individual is responsible in accordance with the mandate, allows independent work to be carried out.

However, this is unfortunately not the case for all. Most software solutions are not designed with the idea that they should be

equally usable by all users, regardless of any handicaps they may have.

Therefore, in the real world, people with disabilities - in this article we have focused on vision, blindness, and visual impairment - face many barriers and limitations in using solutions, which puts them in an unequal position.

KEYWORDS

IT solutions, accessibility, empowerment, discrimination.

1 Pomen dostopnosti produktov in storitev IKT

Produkte in storitve IKT uporabljamo na vseh področjih življenja. Na delovnem mestu uporabljamo raznovrstno programsko opremo, ki nam omogoča komunikacijo, vpogled v evidence in dokumente, načrtovanje ter izvedbo delovnih nalog. Z iskanjem informacij na spletu in uporabo sistemov načrtujemo izrabo prostega časa, obenem tudi rezerviramo in plačujemo nastanitvene zmožljivosti. Za vsakodnevno življenje opravljamo nakupe prek spleta, spremljamo procese dostave, uporabljamo elektronsko bančništvo, oddajamo elektronske vloge in prejemo elektronske odločbe.

Lahko rečemo, da je v zadnjih letih IKT za veliko večino oseb postal ključni element vsakodnevnega življenja – tako v zasebnem in poslovnem življenju kot tudi za opravljanje večine vsakodnevnih opravil. Nedostopni produkti in storitve pa določenemu delu oseb vendarle preprečujejo enakovredno uporabo ter s tem enake možnosti, kot jih imajo drugi.

Ko gledamo službeni del časa, nedostopnost IKT produktov zmanjšuje ali celo onemogoča njihove zmožnosti, ne pa sposobnosti, samostojnega opravljanja nalog, kar smatramo kot neposredno diskriminacijo [1]. To je v neskladju tako z nacionalno kot tudi evropsko ustavo in zakonodajo. Enako velja, ko gre za naša opravila, ki jih imamo z javno upravo in širše javnim sektorjem.

Pri preživljanju prostega časa so tovrstne omejitve enako problematične, osebam z invalidnostmi in oviranostmi povzročajo težave ter ovirajo njihovo samostojnost. Žal se v EU zakonodaja tega področja še ne dotika, zaradi česar je zelo malo rešitev sploh dostopnih. Odločitve so prepuščene etičnim in ekonomskim interesom ponudnikov.

Evropska komisija je vse prej omenjeno že prepoznala in tako ob zaključku tisočletja začela pripravljati ukrepe. Tako je od leta 1999 na tem področju sprejela kar nekaj direktiv in standardov, katerih namen je predvsem preprečevanje diskriminacije pri uporabi produktov in storitev IKT.

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Osnova za to je 19. člen Pogodbe o delovanju Evropske unije [2], pozneje prenesen v Ustavo EU, ki določa ukrepe proti diskriminaciji, med drugim na podlagi invalidnosti. Prav na podlagi tega člena je Evropska komisija novembra 1999 sprejela protidiskriminacijski sveženj [3], ki je privedel do direktive na področju zaposlovanja in poklica, ki prepoveduje diskriminacijo iz vseh razlogov iz 13. člena prej omenjene pogodbe.

Leta 2005 je Evropska komisija Evropskemu inštitutu za telekomunikacijske standarde (European Telecommunications Standards Institute – ETSI) in Evropskemu odboru za elektrotehnično standardizacijo (European Committee for Standardization – CEN-CENELEC) podala mandat, imenovan M 376 [4], s katerim je organizacijam naložila pripravo standarda za dostopnost produktov in storitev IKT.

Med cilji uvedbe standarda je bilo navedeno: »Izdelki IKT morajo biti zasnovani na dostopen način, da jih lahko invalidi in starejše osebe uporabljajo ter imajo od njih enake koristi kot vsi drugi. S tem se ne bo le olajšalo dela industrije, temveč bo tudi povečalo trge ter potencialnim kupcem zagotovilo boljše izdelke in storitve. Vključitev zahtev glede dostopnosti v javna naročila bo predstavljala spodbudo za proizvajalce, da razvijajo in ponujajo dostopne naprave, aplikacije in storitve, kar bo koristilo invalidom in starejšim, hkrati pa tudi drugim uporabnikom.«[4]

Na tej osnovi je bil, sicer z zamudo, leta 2014 objavljen standard EN 301 549 [5], ki opredeljuje zahteve za dostopnost in storitev IKT. Standard, ki se redno dopolnjuje in sledi trendom na področju digitalne dostopnosti, je dosegljiv tudi v slovenskem prevodu SIST EN 301 549.

Eno od pričakovanj predlagateljev je bilo, da bo uvedba zahtev po dostopnih IKT rešitvah v procesih javnih naročil spodbudila razvoj dostopnih rešitev, ki bodo dostopne tudi zasebnemu sektorju; prav takšne izkušnje so imeli v ZDA ob uvedbi zahtev glede dostopnosti v okviru »Section 508« [6].

Evropska komisija je torej že več kot pred dvajsetimi leti prepoznala pomen dostopnosti produktov in storitev IKT za preprečevanje diskriminacije v vsakdanjem življenju ter pri zaposlovanju.

V ta namen je sprejela vse potrebne standarde in direktive, ki organizacijam javnega sektorja zapovedujejo uporabo teh standardov tako v procesih javnega naročanja (Zakon o javnem naročanju – ZJN-3, ki velja od leta 2016) kot tudi pri razvoju in vzdrževanju spletišč ter mobilnih aplikacij (Zakon o dostopnosti spletišč in mobilnih aplikacij – ZDSMA, ki velja od leta 2018).

Podjetja s področja IKT v Evropi in Sloveniji bi morala torej vse od leta 2016 poznati področje digitalne dostopnosti, pri tem pa imeti osnovno zavedanje in strokovno znanje za razvoj kot tudi implementacijo dostopnih rešitev.

Toda kakšno je trenutno stanje?

2 Stanje dostopnosti v Sloveniji

Petnajst let izkušenj na področju digitalne dostopnosti, sodelovanje z invalidskimi organizacijami in končnimi uporabniki z oviranostmi ter vsakodnevno delo na tem področju nam omogočajo vpogled v stanje dostopnosti informacijskih rešitev v Sloveniji.

Šele zadnja leta se o dostopnosti vedno več govori in piše. Lahko rečemo, da je tudi vedno več zavedanja in naporov, usmerjenih v zagotavljanje dostopnih spletnih strani. Pomembna novost je, da se **zaznavajo pozitivne spremembe le na**

področju spletnih strani organizacij javnega sektorja, ki so zavezanci po Zakonu o dostopnosti spletišč in mobilnih aplikacij (ZDSMA).

Več kot dve leti pred ZDSMA je začel veljati Zakon o javnem naročanju (ZJN-3), ki je v 3. točki 68. člena, kjer so podane tehnične specifikacije, natančno opredelil naslednje:

»(3) Pri vseh predmetih naročanja, ki jih bodo uporabljale fizične osebe, bodisi splošna javnost bodisi uslužbenci naročnika, naročnik pri pripravi tehničnih specifikacij upošteva merila dostopnosti za invalide ali zahteve za oblikovanje, prilagojeno vsem uporabnikom, razen v ustrezno utemeljenih izjemnih primerih. Kadar zahteve v zvezi z obvezno dostopnostjo določa neposredno veljaven pravni akt Evropske unije, naročnik tehnične specifikacije glede kriterijev dostopnosti za invalide ali zahtev za oblikovanje, prilagojeno vsem uporabnikom, določi s sklicevanjem na ta akt.«[7]

Vendar se po naših izkušnjah prav to ključno določilo v Sloveniji ni nikoli uveljavljalo, če gledamo z vidika omogočanja enakosti pri uporabi IKT storitev in rešitev. Morda obstajajo izjeme, a stanje dostopnosti rešitev, spletnih strani in slabo stanje poznavanja tega področja kot tudi primanjkljaj strokovnosti razvijalcev na tem področju potrjujejo naše prepričanje.

Navsezadnje pa imajo posledice nespoštovanja in neizpolnjevanja zahtev glede dostopnosti v okviru javnega naročanja daljnosežne posledice, torej takšne, ki podaljšujejo in razširjajo diskriminacijo oseb z invalidnostmi na več področjih – od zaposlovanja, samostojnosti, urejanja upravnih zadev do marsičesa drugega.

3 Posledice dosedanjega neizpolnjevanja zahtev glede dostopnosti

Še leta 2023 se soočamo z dejstvom, da IT podjetja nimajo niti ustreznega zavedanja o pomenu digitalne dostopnosti niti ustreznih strokovnih znanj s področja digitalne dostopnosti. Posledično tudi njihove rešitve niso ustrezno dostopne – žal niti tiste, ki jih prodajo ali oddajo organizacijam javnega sektorja, čeprav bi, glede na zakonske zahteve, brez dvoma, morale biti. Tako imajo tudi vsi zavezanci po ZDSMA velike težave z izpolnjevanjem zahtev zakona.

Z zelo veliko stopnjo verjetnosti lahko trdimo, da bi bila raven zavedanja in strokovnih znanj s področja digitalne dostopnosti, v primeru doslednega upoštevanja zahtev ZJN-3 od 1. 4. 2016, torej več, kot sedem let, v tem trenutku na ustreznih ravni ali vsaj občutno višji, kot je zdaj. **To je dobesedno sedem nepovratno izgubljenih let razvoja. Táko poimenovanje lahko tudi ustrezno argumentiramo.**

Digitalizacija javnega in zasebnega sektorja je bila v zadnjih sedmih letih zelo aktivna. Aktivnosti se nadaljujejo in celo intenzivirajo. Ob tem se tudi leta 2023 rešitve razvijajo na enako nedostopen ali celo bolj nedostopen način, kot so se vse predhodne.

Namesto da bi po sedmih letih razvoja imeli v Sloveniji na voljo skupek rešitev, ki bi bile enako dostopne vsem, se je razširil in se razširja skupek nedostopnih rešitev. Enako velja za naslednje – namesto da bi v Sloveniji imeli širok krog strokovnjakov na vseh področjih razvoja, ki standarde digitalne dostopnosti obvladajo, obstaja le peščica strokovnjakov s tega področja. Teh sedem let je izgubljenih tako z vidika razvoja dostopnih rešitev, razvoja kompetenc kot tudi najosnovnejšega

razširjanja zavedanja o pomenu digitalne dostopnosti za ciljne skupine in družbo kot celoto.

Upoštevaajoč dejstvo, da se še dandanes skoraj nihče ne drži zahtev ZJN-3, raven zavedanja in strokovnih znanj s področja digitalne dostopnosti še vedno ne raste dovolj hitro. Prepričani smo, da se bo brez hitrega ukrepanja vseh deležnikov razvoj nedostopnih rešitev nadaljeval vsaj še nekaj let. S tem se bo nadaljevala in poglobljala tudi diskriminacija, saj se vse digitalizira.

Dejstvo je, da bi se diskriminacija nadaljevala tudi, če bi se jutri začel razvoj nove generacije informacijskih rešitev. Tak razvoj traja dolgo, upoštevaajoč primanjkljaj strokovnosti na tem področju, pa odpira vprašanje, koliko bi bile razvite rešitve v resnici dostopne.

4 Težave oseb z invalidnostmi in organizacij, ki jih zaposlujejo

Težave in diskriminacija, ki jo omenjamo, seveda ne izvirajo iz hipotetičnih situacij, temveč iz izkušenj in rednega sodelovanja z osebami z invalidnostmi ter invalidskimi organizacijami. Poglejmo primer ene take organizacije in težave, s katerimi se soočajo.

Pred leti smo imeli na projektu Zveze društev slepih in slabovidnih Slovenije (v nadaljevanju Zveza), ki je reprezentativna invalidska organizacija in tudi delodajalec osebami z invalidnostmi, precejšnje težave z iskanjem dostopnega sistema za evidenco delovnega časa, saj smo imeli zaposlene tako slabovidne kot tudi slepe. Izziv je bil že najti regulator na fizične tipke, saj so bile rešitve z zasloni na dotik namreč vse po vrsti popolnoma nedostopne.

Ob iskanju nove rešitve nekaj let pozneje stanje ni bilo veliko boljše. Registratorjev s tipkami ni več, rešitve na mobilnih telefonih in osebnih računalnikih niso ustrezno oziroma popolnoma dostopne. Še manj so dostopne rešitve za urejanje in administracijo evidenc.

Leta 2022 je Zveza začela izvajati projekt Informatizacija Zveze. Za izvedbo projekta je od Ministrstva za javno upravo, tako kot mnoge druge nevladne organizacije, prejela tudi sredstva. Poglavitna razlika med Zvezo in večino ostalih organizacij je, da so ostali lahko kupili in po potrebi delno prilagodili rešitve, ki so že na voljo na trgu. Zveza je zaradi nedostopnosti rešitev morala v razvoj lastne rešitve, saj so le tako lahko zagotovili, da so njihovi zaposleni na delovnem mestu ustrezno opolnomočeni.

Ob upoštevanju načel univerzalnega oblikovanja in ustreznih tehnoloških rešitev je v današnjem času mogoče zagotoviti informacijske rešitve, ki zagotavljajo skoraj popolno samostojnost pri delu oseb z različnimi vrstami invalidnostmi in oviranostmi.

Samostojen vpogled v podatke, samostojna oddaja in podpisovanje vlog, samostojno potrjevanje vlog ter samostojen pregled skoraj vseh vrst dokumentov je v primerjavi s časi papirnatega poslovanja še pred desetletjem nepredstavljen korak naprej.

Prek sodobnih rešitev lahko zaposleni dandanes dostopajo do digitalnih evidenc organizacije, na primer: do potnih nalogov, naročilnic, raznih poročil in obračunov. Vsi podatki so shranjeni v besedilni obliki, kar pomeni, da je njihova predstavitev lahko pripravljena na vsem dostopen način. Slepim prek bralnikov zaslona in govorne sinteze ali brajeve vrstice, slabovidnim v

obliki povečanega teksta v ustreznih kontrastih, kognitivno oviranim v obliki predstavitve ključnih poenostavljenih podatkov.

A tudi tu je bila Zveza v neenakem položaju. Digitalizirali so lahko le del postopkov, tudi te ne nujno optimalno oziroma v podrobnosti, sam proces je bil kompleksnejši, čaka jih še veliko razvoja, da bodo lahko v enakem položaju kot neka organizacija, ki (nedostopno) rešitev kupi ali najame na trgu. Tudi strošek vzdrževanja in nadaljnega razvoja aplikacije na ključ je v vsakem primeru višji od stroška vzdrževanja in nadgrajen programskega paketa.

Hkrati pa mora Zveza za poročanje po programih uporabljati tudi rešitve, ki so bile v preteklih letih razvite s strani ministrstev in niso popolnoma dostopne. Te rešitve uporabljajo tudi uporabniki z invalidnostmi, kar jih postavlja v neenak položaj z ostalimi zaposlenimi.

Namesto da bi se organizacija lahko ukvarjala s svojo osnovno dejavnostjo in poslanstvom, se mora ukvarjati tudi z iskanjem in razvojem rešitev, ki jih bodo lahko uporabljali njihovi zaposleni.

5 Kako izboljšati stanje

Da bi čim prej izšli iz tega, za mnoge nevzdržnega, stanja, je potreben precejšen in usklajen napor različnih deležnikov.

- Spremljati in preverjati je treba 68. člen Zakona o javnem naročanju (ZJN-3), opozarjati organizacije na neskladnosti ter doseči, da se začnejo določbe dosledno upoštevati.
- Spremljati in preverjati je treba primopredaje rešitev, razvitih na podlagi javnih naročil. So te rešitve res ustrezno dostopne? Primopredaja nedostopnih rešitev ne sme biti opravljena oziroma se morajo podati in po potrebi uveljavljati ustrezne garancije glede dobre izvedbe posla tudi na tem področju.
- Za izvedljivost predhodnih točk je treba začeti z aktivnim informiranjem vseh deležnikov, naročnikov v okviru javnega sektorja ter njihovih dobaviteljev storitev in opreme glede področja digitalne dostopnosti, zakonskih ter tehničnih zahtev in standardov s tega področja.
- Organizacije je treba spodbuditi, da začnejo z razvojem dostopnih rešitev. V okviru rešitev, financiranih iz nacionalnega ali evropskega proračuna, bi moral biti omogočen le razvoj rešitev, dostopnih vsem, brez izjem. Nedostopne rešitve ne bi smele biti upravičen strošek.
- Invalidskim organizacijam in organizacijam, ki zaposlujejo osebe z invalidnostmi, bi morali s finančnimi spodbudami in strokovnimi pomočmi omogočiti vzpostavitev primerov dobrih praks – tako na primerih spletišč organizacij kot tudi razvoja ali prilagoditev informacijskih rešitev.
- Omogočiti in spodbujati je treba usposabljanje vseh deležnikov, vpletenih v produkcijo storitev ali produktov, ter s tem zagotoviti celostno izvajanje dostopnosti, kjer vsak deležnik dobro pozna svoje odgovornosti ter kako se te medsebojno prepletajo z odgovornostmi ostalih deležnikov.

Seveda bi bilo za vse do zdaj našete točke potrebno sodelovanje vseh deležnikov s tega področja. Naj omenimo le

delodajalce, ponudnike rešitev, ministrstva, reprezentativne invalidske organizacije, strokovne organizacije, višje šole in univerze, ponudnike certificiranj in druge.

Za doseg celostne dostopnosti in upoštevanje dobrih praks je tako nujno treba spodbuditi dvig kompetenc s področja digitalne dostopnosti pri vseh deležnikih in na vseh ravneh. Zahteve dostopnosti je treba upoštevati že v prvih korakih snovanja razvoja ali prenove informacijskega sistema (premik na levo), ne pa šele na koncu, ko je produkt končan, kakršna je dandanašnja praksa. Dokler izvajalci, prav tako pa tudi naročniki, nimajo dovolj internih kompetenc, da lahko presodijo dostopnost, je nujno vključevanje zunanjih specialistov dostopnosti ter reprezentativnih invalidskih organizacij. Trajnostna dostopnost, ki se mora prilagajati novim tehnologijam in standardom, pa priporoča, da se sodelovanje ohranja tudi takrat, ko so interne kompetence že precej samostojne.

Podjetja, ki se ukvarjajo z načrtovanjem in razvojem informacijskih rešitev ter načrtovanjem in razvojem spletnih strani, bodo morala ustrezno usposobiti:

- projektne vodje, ki bodo morali skrbeti za skladnost skozi celoten proces razvoja in ustrezno usklajevati deležnike, vključene v proces, ter po potrebi vključevati tako strokovnjake s področja digitalne dostopnosti kot tudi uporabnike z invalidnostmi;
- sistemske analitike, ki morajo v svoje zahteve vključiti tudi zahteve s področja digitalne dostopnosti, in morajo to ustrezno tudi upoštevati;
- raziskovalce in oblikovalce uporabniške izkušnje (UX), ki je ključna komponenta univerzalnega oblikovanja in zagotavljanja enako dostopnih rešitev za vse;
- oblikovalce, ki morajo upoštevati načrtovano uporabniško izkušnjo in jo v fazi oblikovanja dosledno udejanjiti ter pri tem upoštevati vse zahteve in dobre prakse standardov dostopnosti;
- programerje, ki morajo zagotoviti dostopnost končnih rešitev in ob tem tudi opozoriti na morebitne nedoslednosti ali pomanjkljivosti opredelitev glede dostopnosti v predhodnih korakih;
- testerje, ki morajo poleg funkcionalnih testiranj glede na zahteve sistemskih analitikov upoštevati tudi zahteve glede dostopnosti;
- osebe, ki skrbijo za vsebino in uredniški del strani, ker je dostopnost možna le s sodelovanjem oblikovanja, programiranja in vsebin, ki upoštevajo standarde dostopnosti.

Ob hitrem ukrepanju, ustreznem financiranju in usklajenem delovanju vseh deležnikov je preboj mogoče doseči že v nekaj letih. Tovrsten preboj je po našem mnenju nujen, da se začne stanje na področju dostopnosti IKT rešitev vendarle izboljševati.

Hitro ukrepanje, ki je po našem mnenju nujno, je lahko le začasne narave in je morda vzdržno v nekem srednjeročnem obdobju treh do petih let. Za zagotavljanje teh srednjeročnih ukrepov bi se morala zagotoviti tako notranja sredstva organizacij kot tudi sredstva nacionalnega in evropskega proračuna. Za namen digitalizacije je v prihajajočem obdobju namenjeno precej sredstev.

6 Dolgoročno zagotavljanje kakovosti in kontinuiran razvoj

Povsem na mestu je vprašanje, ali obstajata ustrezno zavedanje in politična volja za usklajen pristop ter financiranje spodbude preskoka v srednjeročnem obdobju. Brez tega se bo namreč uvajanje digitalne dostopnosti občutno zavleklo.

Dolgoročno bodo morale vse organizacije najti ustrezne interne rešitve. V tujini se to rešuje predvsem s specializiranimi delovnimi mesti, kot so direktor dostopnosti oziroma koordinator dostopnosti ali skrbnik dostopnosti, ki imajo širšo odgovornost glede dostopnosti, kot so aplikacije in/ali spletne strani, ter omogočajo dostopnost celotne organizacije. Na univerzah na primer skrbijo tudi za dostopnost učnih gradiv in učnega procesa za vse študente.

Za zagotavljanje ustreznih internih rešitev bo potrebno zavedanje glede dostopnosti na vseh ravneh, ki se dolgoročno najlažje in najceneje doseže z uvedbo ustreznih predmetov v programe srednješolskega in visokošolskega izobraževanja.

Podobni ukrepi bodo zaradi Zakona o dostopnosti produktov in storitev za invalide (ZDPSI) potrebni tudi na strani zasebnih delodajalcev, kot so banke, spletne trgovine, prevozniki in drugi, ki jih bodo zaobjele zahteve zakona.

Prvi korak na tem področju se sicer že izvaja. Center za poklicno izobraževanje (CPI) pripravlja NPK »Menedžer digitalne dostopnosti«, ki v dobri meri pokriva kompetence in delovne obveze profilov, ki jih omenjamo v tem poglavju.

Kako hitro bodo organizacije prepoznale potrebe po tovrstnih kadrih oziroma tovrstnem pristopu k celovitemu reševanju digitalne dostopnosti ali dostopnosti na splošno, je odvisno od uspešnosti širitve zavedanja in ponotrnanja realnih potreb v širšem krogu javnih in zasebnih organizacij v Sloveniji.

Seveda upamo, da se bo dolgoročno zakonodaja razširila na širši krog deležnikov, za katere pa bo samo zagotavljanje dostopnosti, zlasti zaradi širšega poznavanja v družbi in stroki, veliko lažje.

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Bridging Communication Gaps through the Talking Hands Project: An In-depth Analysis

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ABSTRACT

Talking Hands project, operating under the Erasmus+ KA220-YOU cooperation partnerships in adult education, seeks to change the landscape of sign language learning. This article presents a comprehensive overview of the project's goals, research rationale of the Inception Workshops that was made by each project partner, its findings and implications for bridging communication barriers between deaf individuals and their associates. The project's multi-faceted approach aims to enhance inclusivity and digital transformation within European society. Each partner conducted an Inception workshop with target groups, which included friends, family members, and experts from organizations that work with deaf people, in order to identify the thematic areas that interested them the most and come to a consensus. Local particularities, patterns, and variations were documented.

KEYWORDS

Talking Hands project, Erasmus+ KA220-YOU, Inceptions Workshop, adult education, sign language learning, Deaf Culture, Children of deaf adults, Family members, Support Workers, Educational Path, multi-faceted approach, inclusivity, digital transformation, European society, open online platform.

INTRODUCTION

Sign language plays a crucial role in enabling effective communication for the deaf community. However, communication barriers persist due to limited sign language proficiency among the hearing population. The Talking Hands project addresses this challenge by leveraging the potential of digital education.

This article delves into the project's inception, research objectives for Inception Workshop, its findings, and implications for promoting inclusivity and digital preparedness.

To comprehend the challenges faced by the deaf community and the dynamics of interactions between deaf and hearing individuals, the Talking Hands project initiated a comprehensive research phase. This research aimed to identify communication barriers and foster awareness about the challenges within the community. By conducting Inception Workshops, the project

engaged with 120 participants, including deaf individuals, family members, support workers, and educators. The research employed a structured questionnaire to explore personal and professional data, challenges faced, educational paths, and topics for online sign language lessons. This research approach offered multifaceted insights into the complexities of communication barriers.

1 ABOUT TALKING HANDS PROJECT

Talking Hands project endeavors to develop an open online platform for learning sign language. Aligned with the Erasmus+ KA220-YOU cooperation partnerships in adult education, the project aims to offer high-quality learning opportunities to adults while addressing digital transformation and inclusion priorities set by the European Union. There are 7 Partners organizations that come from 6 different countries: Slovenia, Italy, Greece, Sweden, Poland and Croatia[3].

Project addresses digital transformation through the development of digital readiness, resilience, and capacity, as well as inclusion and diversity in all fields of education, training, youth and sport. It focuses on improving the availability of high-quality learning opportunities for adults and on facilitating communication between deaf individuals, their relatives, friends, and colleagues who wish to learn the fundamentals of sign language.

Project's open online platform offers a flexible and adaptable approach to learning, allowing learners to choose thematic topics non-sequentially. This approach enhances digital access and flexibility, catering to various learning needs and mitigating physical constraints

Objectives of the Talking hands project are [1]:

- To develop a methodology, to collect and record sign language lessons from the languages of the participating countries, including the international sign language.
- To provide these lessons freely online in a non-formal and flexible educational context, along with other useful learning materials related to sign language lessons and Deaf Culture.

- To offer learning opportunities to family members and friends of deaf individuals who wish to enhance their competences, as well as to deaf individuals who wish to access supplementary learning.

Foreseen Results of the project [1]:

- Inception workshops by each partner.
- Methodology Guide: A methodology guide was created based on the outputs of the Inception Workshops, which were provided by each partner in the form of reports. It included 28 lessons recorded in all sign languages, divided into 7 topics, matching the number of partner organizations. This methodology guide was designed for "non-experts" and encompassed sign languages from all partner organizations. Each session required students to engage for approximately 60 minutes.
- Recording of lessons: Consequently, following the aforementioned methodology guide, the recording of lessons was organized by each partner in their own country's sign language, based on the collectively agreed-upon structure.
- Creating a web platform.
- Dissemination.

2 INITIAL RESEARCH PURPOSE

Based on initial research, the Talking Hands project intends to assess the existing status of both hearing and deaf individuals in terms of their approach and attitude toward this Culture. The goal is to comprehend how Deaf and Hearing people currently interact in daily life, emphasizing the difficulties they encounter and the support they eventually receive.

Thanks to the Inceptions Workshops created by the 7 Partner Organizations, 120 answers from participants were collected through questionnaires. All the Partners agreed that there is a need to spread awareness of the present problems facing Europe.

The questionnaire was designed to examine four key topics, including [1]:

- Personal and Professional data (age, country, profession, interaction description with the Deaf Culture)
- Identification of Problems & Support received (encountered issues in any circumstances of social life and eventually support received)
- Education Path (This section investigates the educational path of the TG)
- Topics suggested for the online lessons (the most requested thematic that experts would like to learn through online Sign Language course).

Primary data was collected through field research conducted by all partners. The research was built based on the involvement of the target group at the local/regional/national level.

According to the project application, the questionnaire had to be handed out to at least 20 participants in each country. Analysis

of the comments and recommendations gathered by the target groups and stakeholders who participated came next. The ultimate distribution of the subjects, classes, and associated educational material is set in the Methodology guide. All partners engaged in internal fine-tuning to ensure the maximum integration of the findings from their regional reports and to create a common structure for the lessons that is generated, in order to offer a variety of learning opportunities [1].

The participants answered a total of 8 open questions belonging to one common Google Form Questionnaire, translated into the 6 partnership languages (Slovenian, Italian, Greek, Swedish, Polish, Croatian).

3 RESEARCH RESULTS

The European analysis of expert feedback provided a nuanced understanding of the interactions between target groups and sign language within the Deaf Culture. The analysis revealed distinct participant categories, each with varying levels of sign language proficiency. Communication barriers emerged as a central theme, impacting essential areas such as medical contexts, public services, and education. This analysis underscored the urgency of addressing communication challenges to foster inclusivity.

The European analysis acquired 120 expert answers in all, ranging in age from 20 to 60+, with the following Deaf Culture identifications and interactions [1]:

- Deaf individuals, Deafblind
- Coda (Children of Deaf Adults) and family members
- Support personnel, teachers, and sign language interpreters
- Hearing people (friends or coworkers) to deaf or hard of hearing people.

The EU analysis reveals one characteristic of the target group: all participants have interacted with deaf culture for a long time—some from birth, others for more than 30 years—and all have some level of sign language proficiency.

Deaf individuals and deafblind persons who regularly communicate with other deaf people, signers, oralists, and hearing people are all active members of the deaf community and engage in familial and friendly exchanges. While some of them learned sign language later in life because they were born into hearing households without sign language knowledge, others were born into deaf homes and are fluent sign language communicators.

A significant difference between the analyzed countries can be seen when looking at the profile segment of family members at the European level from the perspective of sign language proficiency; in some of them, communication between the parties is limited and is implemented through written communication. Other family members claimed that they gradually lost a large portion of their sign language proficiency due to life events like moving, switching jobs, or changing schools. However, in the long run, they were able to participate in a learning platform remotely in order to practice and reinforce concepts that they had forgotten. The Children of Deaf Adults

who have emerged and are actively participating in this culture on a daily basis, according to Coda profiles, all have a solid command of Sign Language. Some of them have also gained expertise and have become interpreters in a variety of employment settings[1].

Regarding the profile category, the majority of support workers interviewed interact regularly with members of this culture through their work environments; some of them work for the National Deaf Authority as interpreters and have more than 25 years of experience; others train school teachers in workshops on sensory disabilities; and still others are employed by local organizations of the deafblind to create educational programs for these individuals and their families. Others have experience teaching family members who are not proficient in sign language, working with them to improve their skills.

The field research also allowed for the depiction of the exchanges from the viewpoint of a friend, coworker, or a hearing person. Overall, we can say that most of them have excellent relationships with persons who are hard of hearing yet struggle to communicate because of their poor sign language proficiency. They treat someone who has hearing loss the same as any other hearing person, showing that they have grown accustomed to the mode of communication. They take care to talk clearly and avoid covering their mouths with their hands.

4 DIFFICULTIES ENCOUNTERED

Communication difficulties were identified as pervasive issues, affecting both deaf and hearing individuals. The prevalence of auditory stimuli in public spaces created challenges for deaf individuals. The lack of sign language knowledge among hearing individuals further exacerbated communication breakdowns. The study illuminated regional dialects within sign language, adding complexity to communication. The research emphasized the need for institutional preparedness and robust support mechanisms to ensure inclusivity and accessibility [1].

The research phase progressed to analyzing the communication experiences of the Target Group during the communication phase, considering both the perspectives of deaf and hearing individuals.

Participants universally reported past communication difficulties, with common challenges arising in various aspects of life such as public services, hospitals, personal interactions, and professional settings.

Deaf individuals highlighted the impact of living in predominantly hearing environments, where auditory cues overshadow visual ones. This disparity, evident in places like stations and airports, posed obstacles due to predominantly auditory announcements.

The inability of most hearing individuals to use sign language created a significant communication barrier. Deaf respondents expressed a desire for hearing people to learn basic phrases and overcome the fear of interacting with them. Lip reading and

written communication were fallbacks, but their limitations became evident, especially for congenitally deaf individuals dealing with complex vocabulary, abstract concepts, and synonyms.

The variable nature of sign language, influenced by local dialects, posed challenges, particularly among self-taught learners compared to formal courses.

In healthcare settings, including the pandemic, communication breakdowns were rampant due to a lack of knowledge about sign language among medical professionals and the barrier posed by masks. Restrictions on deaf relatives as mediators further hindered effective communication.

Similar issues arose in public offices, educational institutions, and areas where hearing individuals had guaranteed access to information. Learning sign language proved difficult, leading many to prefer professional interpreters in critical scenarios.

European hearing individuals acknowledged struggles in communicating with deaf acquaintances, especially before learning sign language. Making initial contact with deaf individuals and comprehending them posed difficulties. Adjusting speaking pace for lip reading was common.

Access to sign language courses was inadequate, exacerbated by the shift to online learning after Covid-19. Existing resources mostly offered vocabulary without grammar, limiting independent learning opportunities.

In education, schools often lacked preparation to accommodate deaf students, resulting in communication gaps and dependence on peers for assistance.

The experiences of Children of Deaf Adults (CODAs) emphasized their pivotal role as interpreters. Some hearing individuals claimed no communication issues with the deaf, possibly influenced by biases.

Across EU countries, participants faced a dearth of support in dismantling communication barriers. Institutional unpreparedness led to interpreter shortages in public spaces and legal contexts. Private services filled the void but at a cost. Deaf individuals primarily relied on family support, despite its limitations in nuanced deaf communication.

5 EDUCATION PATH OF TARGET GROUP

The educational paths of target group members showcased diversity, with deaf individuals learning from birth or formal education. Family members and friends varied in their sign language proficiency. Codas, as children of deaf adults, played a pivotal role in bridging communication gaps. The inclusion of sign language in schools and workplaces was recommended to enhance communication and promote inclusivity.

5.1. Lesson's Topics

Participants presented their ideas for content that would greatly facilitate communication with the deaf and hard of hearing, described in the graphic:

Table 1: Most popular topics

Topics	Percentage
Let's get to know each other (Greetings, Introduce yourself, Daily life, Weather, Work)	17,4%
Leisure time (Hobbies, Sport, Culture)	15,1%
Health care, Emotional feeling, Medical Terms	14%
Living at home (List of grocery, Kitchen, Bathroom)	7%
Alphabets / Numbers	7,1%
Family & Friends	5,8%
How to approach to Deaf	5,8%
Character traits	3,5%
Science	2,3%
COS	2,3%
Children's activities	2,3%

Source:[1]

The majority of those surveyed expressed a desire to improve their daily interactions with the deaf, as well as a desire to learn sign language and communicate in it in order to participate in and share the most significant aspects of their lives. Participants' strong interest in learning sign language highlighted the importance of meaningful communication with deaf individuals. The most popular lesson topics included greetings, introductions, daily life, leisure activities, medical terms, and alphabets/numbers. These preferences reflected a desire to address fundamental aspects of communication and foster deeper connections.

CONCLUSION

The Talking Hands project's inception workshop laid a strong foundation for addressing communication challenges faced by the deaf community and their associates. By offering accessible and flexible sign language lessons, the project aims to empower individuals, foster inclusivity, and embrace digital transformation. The project's multi-faceted approach holds promise for bridging communication gaps and enhancing social cohesion within European society.

Learning Sign Language (SL) is a complex journey that mirrors acquiring any foreign spoken language. This visual language presents captivating challenges, particularly when pursued through online platforms. A fundamental approach recommends engaging with the deaf community and practicing daily for effective learning. Each National Sign Language exhibits unique characteristics, encompassing distinct vocabulary and grammar, setting them apart from spoken languages and even international sign language. For instance, Italy's SL displays diverse dialects

corresponding to regions, whereas Europe typically experiences greater uniformity.

Facial expressions play a significant role in the Mediterranean-rooted Greek sign language, while the Japanese version employs fewer expressions. Specific gestures exclusive to regions, further underscore the individuality of sign languages. Online platforms were reviewed by a Polish participants who emphasized the importance of clarity, convenience, and intuitive usability for effective learning.

To ensure the success of SL projects, complete involvement of the deaf community is essential. Cultural appropriation by the hearing community must be avoided, and projects should emphasize the recognition of the deaf community as a linguistic minority rather than mere integration. Encouraging SL courses in schools and workplaces was also advocated.

The positive aspects of a web-based SL course were highlighted, enabling learning from home or work while fostering family involvement. A crucial recommendation pertained to communication changes for hearing individuals: comprehending that sign language is visual-spatial, with eyes and hands as the primary communication channels, necessitating a shift from verbal-sound communication.

In summary, learning Sign Language involves a challenging yet fascinating journey comparable to acquiring spoken languages. National Sign Languages possess unique characteristics, and online platforms must prioritize clarity and ease of use. Ensuring the involvement of the deaf community, avoiding cultural appropriation, and encouraging SL courses were emphasized. The adoption of a web-based course was welcomed, and a crucial recommendation urged hearing individuals to adapt to the visual-spatial nature of sign language.

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Tehnična izvedba tolmačenja znakovnega jezika na televiziji

The Technical Execution of Sign Language Interpretation on Television

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(Oče treh gluhih otrok, certificirani tolmač slovenskega znakovnega jezika in prvi gluhi sodni tolmač v Sloveniji, uporabnik mednarodnega znakovnega jezika. Z več kot 20 leti izkušenj učitelj strokovno-teoretičnih in praktičnih predmetov grafične in medijske smeri z nazivom svetnika v šolskem sistemu. Zaposlen na Zavodu za gluhe in naglušne Ljubljana. Direktor neprofitnega Zavoda Hiša slovenskega znakovnega jezika, Zavoda za sodobno dostopnost za gluhe, naglušne in osebe s polževim vsadkom. V svoji 25-letni karieri je deloval kot presojevalec in svetovalec na področju dostopnosti za televizijo in splet. Član strokovnega sveta, kjer zastopa interese oseb za gluhe in naglušne v Zavodu A11Y.si. Glavni in odgovorni urednik klasične televizije TIPK TV, specializirane za ciljno občinstvo za gluhe in naglušne. S svojim strokovnim znanjem pomaga pri prilagoditvah spletnih portalov, namenjenih gluhim. Prejemnik priznanja jabolko navdiha RS v letu 2022 za navdihujoča dejanja za skupnost gluhih in krepitev solidarnosti v družbi.)

POVZETEK

Članek raziskuje izzive in smernice glede dostopnosti tolmačev znakovnega jezika (ZJ) na televiziji in spletnih platformah. Poudarja pomembnost prisotnosti tolmačev ZJ na televiziji za gluhe in naglušne gledalce, obenem pa se osredotoča na vprašanja, kot so velikost, pozicioniranje, ozadje in naloge tolmačev ZJ ter njihov vpliv na dostopnost in razumevanje vsebin. Znakovni jezik je ključno komunikacijsko orodje, za učinkovito tolmačenje pa je potrebno izpopolnjeno znanje in spoštovanje etičnih standardov.

Poleg tega članek obravnava tehnične vidike, kot so velikost in pozicioniranje tolmača ZJ na televiziji, poudarjajoč pomembnost enakomerne osvetlitve, ozadja, kontrasta ter razmerja med velikostjo tolmača in drugimi elementi na zaslonu. Predstavlja praktične smernice za optimalno vidnost tolmača ZJ na zaslonu.

Sklep članka izpostavlja pomanjkljivosti v trenutnih tehničnih rešitvah za vključevanje tolmačev ZJ na televiziji in poziva k večji pozornosti do tehničnih in vsebinskih izzivov. Poleg tega avtor predstavi namen in cilj Zavoda Hiša slovenskega znakovnega jezika, ki se ukvarja z dostopnostjo za gluhe in naglušne ter ponuja rešitve za izboljšanje kakovosti storitev dostopnosti za to skupino uporabnikov.

KLJUČNE BESEDE

dostopnost, tolmači znakovnega jezika, televizija, spletna platforma, medijske vsebine.

ABSTRACT

The Technical Execution of Sign Language Interpretation on Television

The article explores the challenges and guidelines regarding the accessibility of sign language interpreters on television and online platforms. It underscores the significance of the presence of sign language interpreters on television for deaf and hard of hearing viewers, focusing on issues such as size, positioning, background, and roles of sign language interpreters, and their impact on accessibility and comprehension of content. Sign language is a crucial communication tool, and effective interpretation requires advanced knowledge and adherence to ethical standards.

Furthermore, the article addresses technical aspects, such as the size and positioning of the sign language interpreter on television, emphasizing the importance of uniform lighting, background, contrast, and the relationship between the interpreter's size and other elements on the screen. It presents practical guidelines for optimal visibility of the sign language interpreter on the screen.

The conclusion of the article highlights shortcomings in current technical solutions for integrating sign language interpreters on television and calls for increased attention to technical and content-related challenges. Additionally, the author introduces the mission and objectives of the Institute for Slovenian Sign Language, which focuses on accessibility for the deaf and hard of hearing and offers solutions to enhance the quality of accessibility services for this user group.

KEYWORDS

accessibility, sign language interpreters, television, online platform, media content.

1 OPREDELITEV ZNAKOVNEGA JEZIKA IN POKLICA TOLMAČ ZNAKOVNEGA JEZIKA

Tolmači za znakovni jezik se vključujejo v televizijske programe. To je postalo opazneje med pandemijo covid-19, ko je družba postala še bolj ozaveščena o prisotnosti gluhih, naglušnih in uporabnikov znakovnega jezika v našem okolju. Izkušnje vključevanja tolmačev ZJ na televiziji segajo v osemdeseta leta 20. stoletja, čeprav se v nekaterih virih omenjajo tudi sedemdeseta in celo šestdeseta leta 20. stoletja.

Tolmači ZJ so najopaznejši, ko so na televiziji postavljeni v spodnji desni ali zgornji desni kot ekrana. Uporabljajo se različni okviri, vključno s krogi in kvadrati, danes pa sodobna tehnologija omogoča tudi postavitev tolmača ZJ v formatu slika v sliki (angl. »picture in picture«).

Dostopnost medijskih vsebin se razširja v spletno okolje, vključno s spletnimi pretočnimi predvajanji v živo, kar je izjemno pozitivno. Pomembno je, da so nacionalni mediji na televiziji vse bolj pozorni na vključevanje tolmačev ZJ. Tehnologija je napredovala do te mere, da ni več tehničnih ovir za umeščanje tolmačev ZJ na televizijo. Zagotoviti je treba zadostno kadrovske znanje in strokovnost za to posebno področje, ki ga srečujemo tako v Sloveniji kot tudi v tujini.

Predstavil bom tehnične smernice za umestitev tolmačev ZJ, pred tem pa še kriterije dela tolmačev ZJ, specifičnosti znakovnega jezika ter pričakovanja gledalcev za ustrezno in kakovostno televizijsko vsebino v znakovnem jeziku.

Znakovni jezik gluhih izhaja iz uporabe rok, mimike obraza, oči, ustnic in gibanja telesa, da se lahko izražajo ideje, čustva in sporočilnost. Uporablja se tudi prstno abecedo. Je vizualni jezik za gluhe in njihovo ključno komunikacijsko sredstvo. Razlikuje se po izrazih, gibanju in celo strukturi stavkov. Vsak znakovni jezik je dinamičen in se razvija znotraj gluhe skupnosti, nanj pa vplivata tudi lokalna kultura in zgodovina. Nima enake slovnice kot govorni jezik, niti na istem geografskem, kulturnem in zgodovinskem območju ne, saj je neodvisen od govorenja in se oblikuje znotraj gluhe skupnosti.

Prejemanje informacij in znanja s pomočjo znakovnega jezika gluhih je omejeno, informacijska vrednost je majhna, nujno je potrebna standardizacija jezika. Pomembno je poudariti, da slovenski znakovni jezik ni enak drugim znakovnim jezikom. Vsak znakovni jezik na svetu je edinstven in razlike so že znotraj iste države.

POMEMBNO: uporaba rok, mimike obraza, oči, ustnic ter gibanja telesa, da se lahko izražajo ideje, čustva in sporočila.

2 ZNAČILNOSTI DELA IN VLOGA TOLMAČA ZNAKOVNEGA JEZIKA NA TELEVIZIJI

Tolmač ZJ v Sloveniji lahko postane vsak, ki opravi NPK-certifikat za tolmače slovenskega ZJ. Od julija 2019 dalje so vrata odprta tudi za gluhe osebe, ki lahko tolmačijo slovenski ZJ. tej spremembi je pomembno prispevalo Društvo učiteljev gluhih Slovenije.*¹

Tolmač za znakovni jezik na televiziji mora zelo dobro poznati znakovni jezik in razumeti procese načina komunikacije. Prav tako mora obvladati specifičnosti prenosa sporočil v televizijskem okolju, kjer je podajanje informacij izjemno posebno. Zagotavlja nenehno visoko kakovost tolmačenja in ohranja izjemno raven koncentracije, medtem ko posreduje sporočila na razumljiv način.

2.1 Ključne veščine, ki jih mora tolmač znakovnega jezika obvladati za delo na televiziji:

- Poskrbeti mora za tekoče simultano (sinhronizirano) tolmačenje, pri čemer mora hitrost tolmačenja in podajanje izrazov (čustev) biti usklajena z izrečenimi besedami.
- Izvajati mora tolmačenje s temeljitim obvladovanjem gibanja rok, prstov, oči, ustnic, dosledna uporaba gest, mimike in telesnega gibanja mora biti skladna in jasna.
- Prenašati globoke pomene in odtenke je bistvenega pomena, prenesti morajo polni pomen besedila, vključno z razumevanjem konteksta, namena govora in čustvenih nians.
- Prilagoditi se tako informativnim oddajam kot tudi zabavnim in izobraževalnim vsebinam, glede na žanr in naravo televizijske vsebine morajo prilagoditi svoj slog komunikacije.
- Delovati v skladu z etičnimi standardi, spoštovati zasebnost gledalcev ter vzdrževati profesionalen odnos do svojega dela in občinstva.

Delo tolmača je sestavljeno iz zgoraj naštetih veščin. Poudariti je treba, da tolmač ni tehnik, zato ni njegova pristojnost, ali se ga dobro vidi, ali je pravilno umeščen oziroma postavljen v kader. Njegova prvenstvena naloga je, da se pred prenosom in med njim dobro počuti, da ima stalen dovod svežega zraka in možnost, da dobi predčasen vpogled v vsebino oddaje (besedila voditeljev, besedila avtorjev skladbe, kateri gost se bo predvidoma oglasil s terena in podobno).*²

2.2 Napotki za razumevanje vloge tolmačev v televizijskem okolju

Postavitev tolmača na zaslonu mora omogočati nemoteno spremljanje tako tolmača kot tudi drugih vizualnih elementov, ki se morajo medsebojno izključevati. Upoštevati je treba optimalno razmerje med velikostjo tolmača in preostalimi vsebinami. Zelo preudarno je treba zagotoviti sodelovanje med vsemi tolmači, ki sodelujejo na televiziji, tako za slišče kot gluhe certificirane tolmače ZJ, tudi s kamermani, svetlobnimi tehnikami, tonskim tehniko, scenografom, producenti, urednikom, odgovornim za dostopnost vsebin v znakovnem jeziku, ter presojevalcem in svetovalcem za dostopnost uporabnikom znakovnega jezika. To so ključni člani ekipe, ki omogočajo kakovostno medijsko posredovanje informacij.

Velik poudarek je na izobraževanju in evalviranju opravljenega dela tolmačenja na televiziji. Ohranjanje visoke ravnosti strokovnosti in motivacije vključuje stalno sodelovanje tako na internih kot eksternih izobraževanjih. Priporoča se vzpostavitev uredništva za znakovni jezik, ki naj ga vodijo izkušeni strokovnjaki s področja znakovnega jezika in poznavalci gluhe skupnosti, za uvajanje znakovnega jezika za potrebe televizije.

Tolmači morajo skrbeti, da na sebi nimajo nakita, ure, visečih uhanov, vidnih motečih tetovaž, bleščečih predmetov, premočno obarvanih nohtov, podaljšane trepalnice in nohti niso zaželeni. Priporočajo se speti lasje (tolmači niso fotomodeli) in minimalistično ličenje. Zaželeni so tri četrt rokavi. Preživahne barve ali bleščice na oblačilih so prepovedane, enako velja za prekomerna vzorčasta oblačila, ki lahko motijo gledalce pri prepoznavanju znakov in gibanja tolmača. Preohlapna oblačila ovirajo delo tolmača pri gibanju in gibljivost rok ter izrazov. Oblačila z vzorci niso priporočljiva, prav tako ne globoki V-izrezi.

Pomembno je zagotoviti redno prisotnost tolmačev ZJ na televiziji, da se vzpostavi zaupanje in pričakovanje med gledalci. Za oddaje v živo se običajno uporablja slišče tolmače, so pa tudi redke izjeme, kjer delajo tudi gluhi tolmači. Za oddaje, ki so vnaprej posnete, se priporoča, da vključijo gluhe tolmače. Pri dnevnoinformativnih oddajah naj se zagotovi desetminutna oddaja, prilagojena potrebam gluhih v znakovnem jeziku, za katero tolmačijo gluhi tolmači. Zavedati se je treba, da so gluhi in slišči tolmači enakovredni in so drug drugemu podpora ter tim za kakovostno izvajanje storitev, še posebej na televiziji in v pretočnih spletnih vsebinah.

Svetovna zveza gluhih (WFD) piše, da so gluhi tolmači v nekaterih primerih bolj zaželeni. V Evropi in po svetu zelo podpirajo tolmačenje gluhih tolmačev, saj so izsledki njihovih raziskav pokazali, da so gluhi tolmači boljši tolmači za gluhe kot slišči tolmači.*³

2.3 Omejitve in naloge, ki jih tolmač ZJ na televiziji ne izvaja:

- Ne izbira vsebin, ki bodo predvajane na televiziji. Njegova naloga je tolmačenje že pripravljenih vsebin, ne pa odločanje o tem, kaj se bo predvajalo.
- Ne sodeluje pri urejanju videoposnetkov ali montaži oddaj. Njegova vloga je izključno tolmačenje med predvajanjem.
- Ne piše scenarijev za oddaje ali pripravlja vsebin za televizijo. Njegovo delo je tolmačenje in prenos že obstoječih vsebin.
- Ne nastopa v vlogah igralcev ali voditeljev. Njegova naloga je omogočiti razumevanje govornega jezika za gluhe in naglušne gledalce.

- Med televizijsko oddajo tolmač ne prevaja dokumentov ali pisnih grafično opremljenih besedil na zaslonu. Omejen je na tolmačenje govornega jezika in branje podnapisov v znakovni jezik.

- Ne izraža svojih mnenj, komentarjev ali sodb o vsebinah, ki jih tolmači. Njegova naloga je objektivno prenašanje informacij.

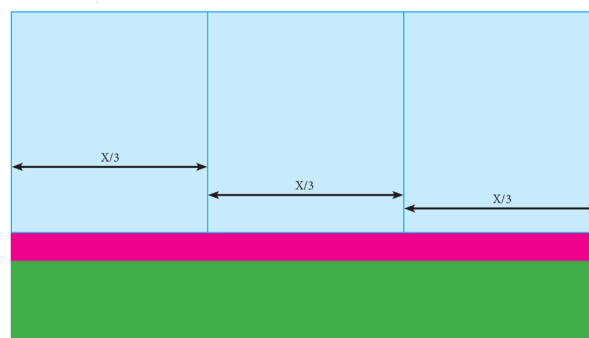
Pomembno je razumeti, da je delo tolmača na televiziji osredotočeno na prenos sporočil iz enega jezika v drugega, tako da se zagotovi dostopnost in razumevanje medijskih vsebin za gluhe in naglušne gledalce.

3 DIMENZIONIRANJE IN POZICIONIRANJE TOLMAČA ZJ NA TELEVIZIJI

Podano razumevanje znakovnega jezika in njegovih značilnosti daje vpogled, ki razkriva kompleksnost te komunikacijske oblike. Ključno je razumeti, da gledalci pred televizijskimi zasloni za celovito in razumljivo informacijo spremljajo uporabo rok, mimike obraza, oči, ustnic in gibanje telesa. S temi elementi se izražajo ideje, čustva in sporočilnost. Pri neposrednih novicah, zlasti v informativnih oddajah, je besedna vsebina zgoščena v čim krajšem času. Tolmači znakovnega jezika morajo simultano in izjemno natančno prevesti vsebino, pri čemer je pomembno, da se vsi odtenki in drobne kretnje, ki prispevajo k razumevanju sporočil, jasno vidijo in razumejo. Zmanjšanje prostora za tolmača na televiziji zmanjšuje prostor za prenos informacij, kar vpliva na kakovost razumevanja.

Pri ustrezni dimenzioniranosti tolmača znakovnega jezika je ključno, da je razmerje med njegovo velikostjo in velikostjo drugih prisotnih oseb na televiziji enako. Tako kot prikaz voditelja ali izvajalca naj bo tudi velikost tolmača znakovnega jezika enako nastavljena. Pozicioniranje tolmača na levi ali desni strani je odvisno od medijske hiše, pogosto je pozicioniranje na desni strani. Prostor za tolmača naj bo ločen in neodvisen od drugih elementov na zaslonu.

Spodnja slika ponazarja priporočeno dimenzioniranje tolmača znakovnega jezika v modrem polju. Širino prostora za tolmača se določi z razdelitvijo na tretjine, kar prispeva k optimalni vidnosti in razumevanju.



Slika 1: Shematski/grafični prikaz razdelitve prostora pri umeščanju velikosti prostora za tolmače znakovnega jezika.
Vir: osebni arhiv avtorja

Določitev pozicije tolmača – centrirano, pustiti ob komolcu nekaj prostora (slika spodaj).



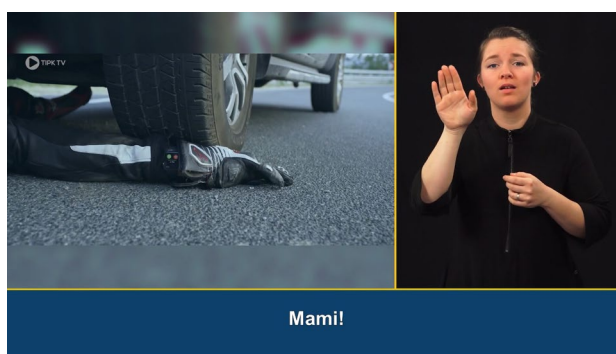
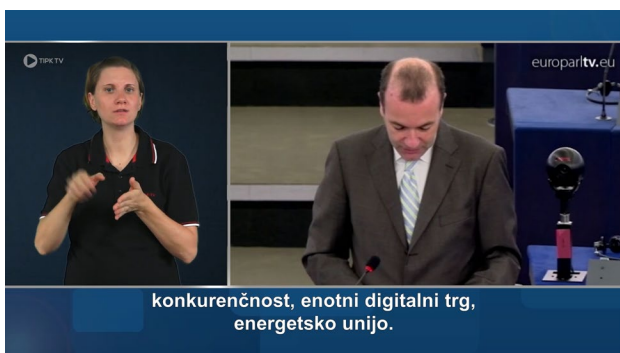
Slika 2: Pri določanju pozicije tolmača je pomembno, da ga postavimo v centriran položaj, hkrati pa zagotovimo dovolj prostora ob komolcu.

Spodnji rez naj se začne nad pasom, pri tem moramo skrbno paziti, da glava ni preblizu zgornjemu robu.

Obe prikazani rešitvi sta ustrezni.

Vir: <https://tipk.si/oddaje>

Slikovni prikaz pravilne umeščenosti in velikosti tolmača ZJ in njegovo pozicioniranje praktičnih primerov na klasični televiziji TIPK TV za gluhe in naglušne **Vir: <https://tipk.si/oddaje>**



V nadaljevanju je prikaz nekaterih različnih praks umestitve tolmača za znakovni jezik v **PRILOGI A**.

4 OZADJE TOLMAČA ZJ NA TELEVIZIJI

V vsaki medijski ustanovi se oblikujejo načini postavitve tolmačev ZJ pred kamero. Kljub temu se le redko pomisli, kakšno ozadje bi bilo primerno. Pomembno je, da scenografi sodelujejo s strokovnjaki za dostopnost in presojevalci, ki poznajo potrebe uporabnikov znakovnega jezika. Izbor ozadja mora biti premišljen, da bo omogočalo jasno vidnost tolmača.

Ozadje naj bo preprosto, umirjeno in nevtravno. Priporočljiv je enobarvni vzorec, ki usmerja pozornost na tolmača. Kontrast ima izjemno pomembno vlogo. Skupaj s stilisti in tolmači ZJ je treba določiti barvno paletu oblačil za določeno oddajo, kar omogoča, da roke in izrazi obraza izstopajo in so jasno vidni. Barvna ozadja naj se skladajo s celotno grafično podobo oddaje, pri tem je treba paziti na pravilno kontrastno razmerje in se izogibati motečim intenzivnim barvam.

Pravilna osvetlitev ima ključno vlogo, da se preprečijo sence in zamegljenost. Tudi manj opazni deli, na primer podbradki, morajo biti ustrezno osvetljeni. Jasna in enakomerna osvetlitev omogoča gledalcem boljšo vidnost tolmača ZJ. V ozadju ne smejo biti moteči elementi, kot so deli videa, grafični napisi, premikajoči se predmeti ali bleščeče površine. To je pogosto izraženo pri delu z zelenim ozadjem, kjer lahko tolmač ZJ prehaja med videom, kar ni priporočljivo. Položaj tolmača ZJ mora biti takšen, da ne prekriva pomembnih vizualnih elementov na zaslonu.

Velikost tolmača ZJ mora biti dovoljšna, da gledalci jasno vidijo njegove izrazne geste in mimiko, kar omogoča učinkovito spremljanje sporočil v znakovnem jeziku.

Zaključna beseda

V svoji karieri, ki traja že več kot 25 let, sem se posvetil zagotavljanju dostopnosti za gluhe in naglušne osebe, ki uporabljajo znakovni jezik. Kljub dolgoletnemu spremljanju tega področja tako doma kot v tujini sem razočaran nad pomanjkljivostmi, ki še vedno obstajajo pri tehnični izvedbi spremljanja tolmača ZJ na televizijskem zaslonu. Vztrajno se namreč soočamo s problemi, kjer vložen trud, energija, delo tolmačev ZJ in finančna sredstva izgubijo svoj pomen zaradi pomanjkljive celostne obravnave problema.

Prvotna uvedba tolmačev na televizijskih zaslonih je razveselila in osrečila gluhe osebe. Kljub temu ne upajo izraziti zaskrbljenosti, da je bil ves trud zaman, saj obstajajo strahovi pred morebitno ukinitvijo oddaj, opremljenih z ZJ. Ko skuša skupina gluhih oseb glasno opozoriti na te težave, se pri sogovornikih pojavi »tehnični izziv«, kajti trdijo, da povečanje velikosti tolmača ZJ in zmanjšanje velikosti preostalega videa ni izvedljivo. Te tehnične omejitve so pogosto povezane z mešalnimi mizami za video, licenciranimi matričnimi postavitvami in drugimi izgovori.

Današnja tehnologija dokazuje, da je vse mogoče doseči in izpolniti tehnične ter vsebinske kriterije. Z nekaj truda in volje bi se lahko izognili tehničnim težavam, ker jih ni, in razvijali obliko v polni meri. V prispevku sem se osredotočil predvsem na velikost tolmača ZJ, ustrezno ozadje, optimalno pozicioniranje in naloge tolmača na televiziji.

Spregovoriti je treba tudi o nekaterih **ključnih področjih**, povezanih z dostopnostjo za gluhe, naglušne in uporabnike znakovnega jezika:

- tehnično urejanje podnapisov, kjer se predvajajo za televizijo, pretočne vsebine, spletne portale ...;
- vsebinsko delo tolmača ZJ, evalvacija, razvoj tehnike, vrsta strategije, pristopi in načini za posamezno področje;
- urednikovanje in priprava vsebin ZJ za televizijo ter splet;
- oddaje za gluhe in informativnih vsebin, prilagojenih za gluhe, v Sloveniji na ravni RTVSLO še nimamo;
- monitoring in kontrola kakovosti dela za tolmače ZJ na vseh nivojih, še posebej na izpostavljenih mestih tolmačenja, kot so televizija, konference in javni nastopi;
- šola za tolmače za obstoječe NPK-tolmače za tiste, ki delajo (delo na televiziji, spletu – pretočne vsebine, konference, javni nastopi);

- uvedba kategorizacije in ovrednotenje dela tolmačev ZJ, pobuda za nov NPK II tolmač/tolmačica slovenskega znakovnega jezika za televizijo, konference in javne nastope (delo na televiziji, spletu – pretočne vsebine, konference, javni nastopi);

- permanentno izobraževanje je vseživljenjsko učenje za vse druge ZJ.

Vse strokovno znanje in pridobljene izkušnje tako v Sloveniji kot tudi v tujini so rezultati več kot 25-letnih izkušenj. V okviru neprofitnega Zavoda Hiša slovenskega znakovnega jezika in Zavoda za sodobno dostopnost gluhih, naglušnih in oseb s polževim vsadkom bomo v prihodnje z zgoraj naštetih področij ponujali tako individualne kot skupinske storitve. Naš skupni cilj je dvigniti kakovost storitev dostopnosti za gluhe, naglušne in uporabnike znakovnega jezika tako v Sloveniji kot tudi v tujini.

VIRI/REFERENCES

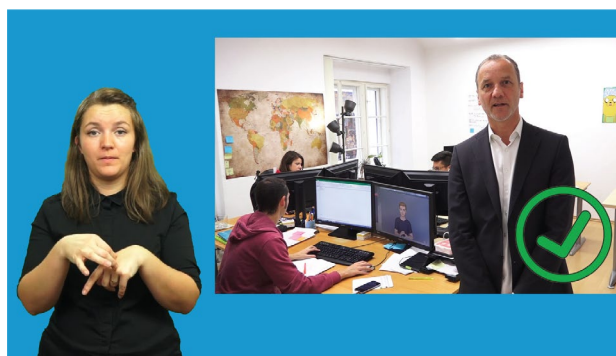
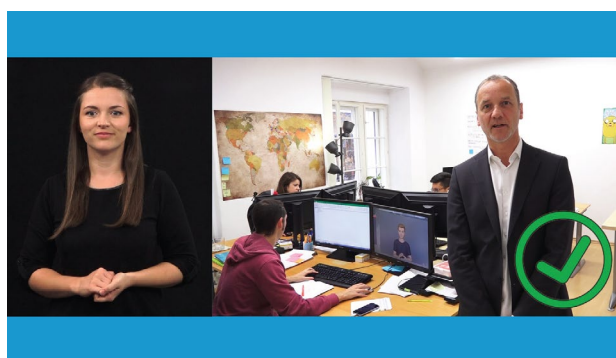
^{*1} Tolmač/ica slovenskega znakovnega jezika (0613188011): <https://npk.si/katalogi/0613188/>

^{*2} Konferenčno tolmačenje znakovnega jezika: <https://knowledge-centre-interpretation.education.ec.europa.eu/sl/node/153>

^{*3} Sign Language Interpreting and translation and technological developments Approved by WFD Board on 7 February 2019: https://wfdeaf.org/wp-content/uploads/2019/07/WFD-Postion-Paper-on-Accessibility-12-Feb-2019-Updated.pdf?fbclid=IwAR0JYP4FsQfyhAQm9Ala3z_Yq-0a0auKOOICTOJa0Gqp60w4kyJtfQ8rSY8

PRILOGA A

Prikaz nekaterih različnih praks umestitve tolmačev ZJ



Uporaba tehnik za samodejno podnaslavljanje avdiovizualnih vsebin

Using auto-subtitle system methods in audiovisual content

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ABSTRACT / POVZETEK

Vse več je ljudi z okvaro sluha, kar otežuje tako medsebojno sporazumevanje kot tudi razumevanje dialogov avdiovizualnih vsebin. Podnaslavljanje poveča razumljivost in zmanjša potrebni napor prizadetih pri spremljanju vsebin. Ker je ročno podnaslavljanje dolgotrajni proces in drago opravilo, ga želimo avtomatizirati s pomočjo orodij za avtomatsko razpoznavanje dialogov v zvoku in s podnaslavljanjem. Nekatera komercialna in prostodostopna orodja so že vključena v programih za video montažo. V času pandemije Covid-19 smo posneli več učnih gradiv, ki smo jih s pomočjo omenjenih orodij tudi podnaslovili. Na primeru izobraževalnega filma predstavimo postopke samodejnega podnaslavljanja video gradiv.

KLJUČNE BESEDE

Samodejno razpoznavanje govora, podnaslavljanje, video.

ABSTRACT

More and more people have hearing impairment, making it challenging to communicate with each other and understand dialogs of audiovisual content. Subtitling increases comprehensibility and reduces the effort required by people with disabilities to follow the content. Since manual subtitling is a time-consuming and expensive task, we want to automate it with the help of tools for automatic speech recognition and auto-subtitling. Some commercial and open-source tools are already available in video editing tools. During the Covid-19 pandemic, we recorded several educational materials and subtitled it with the help of the mentioned tools. Using the example of an educational film, we present the procedure for automatic subtitling video materials.

KEYWORDS

Automatic speech recognition, subtitling, video.

Uporaba tehnik za samodejno podnaslavljanja avdiovizualnih vsebin
Bogdan Dugonik

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1 Uvod

Delež ljudi, ki ima težavo s sluhom se nenehno povečuje. Razlogov za slabši sluh je mnogo, nekateri so prirojeni kot posledica obolenj, ali poškodb nastalih zaradi povečane dolgotrajne ali kratkotrajne izpostavljenosti hrupu. Podaljšuje se tudi življenjska doba, s tem pa je povezana tudi starostna izguba sluha (naglušnostjo). Odmiranje čutnic za zaznavanje tonov se začne že po dvajsetem letu, v starosti pa odmirajo tudi tiste za sprejemanje nizkih frekvenc, ki so pomembne za sporazumevanje [1]. Vse bolj izrazita je izguba sluha že v najstniških letih. Vzroki za veliko število najstnikov s težavami sluha je lahko povečana izpostavljenost hrupu na zabavah, preglasnem gledanju filmov in poslušanju glasbe preko slušalk. Ko se izguba sluha enkrat pojavi, le-te ni mogoče več povrniti v prvotno stanje [1].

Osebe s slabšim sluhom imajo pri medsebojnem sporazumevanju težave, kajti to od njih zahteva dodatni psihofizični napor, posebej še v hrupnem okolju. Tudi spremljanje avdiovizualnih vsebin (AV vsebin) je težavno, pogosto pa teh niti ne razumejo. Posebej še, kadar so avdiovizualna dela slabše tonske kakovosti ali nepravilno uglasena [2]. Tudi kakovost predvajalnih naprav, neprimerna prostorska akustika in hrup iz okolja dodatno otežujejo razumevanje vsebin [2]. Avdiovizualne vsebine niso namenjena le za zabavo in sprostitev, temveč so pomembno orodje za informiranje. Uporabljamo jih pri neformalnem in formalnem izobraževanju za širše interesne skupine. Kadar je izobraževanje namenjeno osebam s slabšim sluhom, je pomembno, da so vsebine zaradi boljše razumljivosti tudi podnaslovljene.

Podnaslavljanje filmov in videa v slovenskem prostoru ni novost, saj se tujejezična dela prevajajo s pomočjo podnaslavljanja, pri tem pa originalni ton ostane nespremenjen [3]. Podnaslavljanje AV vsebin je časovno zelo zamudno opravilo, če se izvaja ročno, vendar pa današnje tehnologije s strojnimi razpoznavanjem dialogov ASR (angl. Automatic Speech Recognition) že omogočajo samodejno podnaslavljanje vsebin, v ta namen so na voljo različna orodja in tehnike [4]. Za večino svetovnih jezikov so orodja ASR s funkcijo podnaslavljanja že dobro izpopolnjena. Intenzivne raziskave s področja avtomatskega razpoznavanja

potekajo tudi za slovenski jezik. Rezultat teh raziskav so orodja, ki so v okrnjeni obliki tudi dostopna za uporabo širšim uporabnikom [5]. Ker umetna inteligenca na področju strojnega razpoznavanja govora vse bolj prispeva k razvoju teh orodij, lahko v bližnji prihodnosti pričakujemo, da bodo postopki v prihodnje vsaj deloma avtomatizirani, omogočali pa tudi sprotno podnaslavljanje AV vsebin [6]. Trenutno še nimamo orodja, ki bi omogočalo celostno strojno samodejno in sprotno razpoznavanje govora v slovenskem jeziku s tvorbo samodejnega podpisovanja [5].

V prispevku predstavimo orodja za avtomatsko govorno razpoznavanje v kombinaciji s plačljivimi in prostodostopnimi orodji za urejanje videa ter izvedbo podnaslavljanja na primeru učnih videovsebin. Učne AV vsebine smo začeli intenzivno producirati v času pandemije Covid-19, ko je bil osebni stik s študenti močno okrnjen ali povsem onemogočen. Rezultati samodejnega razpoznavanja in deljenja teksta na ustrezne bralne odseke so še nepopolni in še zahtevajo ročno popravljanje, kar od urednika vsebin zahteva še dodaten čas in napor.

2 Video s podnapisi kot pripomoček za učenje

Video je kot pripomoček pri formalnem in neformalnem učenju pridobival veljavo vse od začetka tega stoletja, potem ko so spletne tehnologije omogočile pretočnost video vsebin preko spleta. Prvi model izobraževalnih video vsebin namenjenim gluhih in naglušnim osebam je bil v okviru Centra za študij na daljavo na UM Maribor predstavljen leta 2001. Raziskovali smo način vključevanja tolmača znakovnega jezika s tehniko slike v sliki (angl. Picture in Picture). V okviru projekta VISOCOM je bilo izdelano tutorsko orodje, za učenje gluhih uporabe sodobnih tehnologij za komunikacijo na daljavo [7]. Omenjen projekt še ni predvideval podnaslavljanja tolmača znakovnega jezika, saj bi bilo podnaslavljanje s takratno tehnologijo težko izvesti. Kasneje so avtorji s študijo ugotovili [8], da podnapisi skupaj s tolmačem znakovnega jezika bistveno prispevajo k boljšemu razumevanju vsebine učnega gradiva gluhih in naglušnih gledalcev [8]. Tudi številne druge raziskave poročajo o pozitivni uporabi podnapisov za izboljšanje besedišča in veščin razumevanja [9]. Evropska organizacija združenja gluhih in naglušnih EFHOH je z direktivo tudi zahtevala, da se vse AV vsebine v evropskem medijskem prostoru opremijo s podnapisi, da slušno prizadetim osebam omogočimo boljšo vključitev v medijski prostor in njihovo lažje razumevanje [10].

Čeprav primarno obravnavamo težave z razumevanjem AV vsebin slušno prizadete populacije oseb, pa so pogosto težave z razumevanjem tudi za starejšo populacijo in tudi pri osebah, ki sicer nimajo težav s sluhom [1]. Razlogi so lahko tudi povsem tehnični:

- hrupno okolje (sejmi, prireditve, muzeji),
- akustično neustrezen prostor,
- neakovostna oprema za predvajanje zvoka,
- slabo uravnan in posnet zvok,
- dolg odmev zaradi lastnosti prostor.

Javna radiotelevizija Slovenija zato preko svojega spletnega portala že omogoča spremljanje več od 700 oddaj s pomočjo podnaslavljanja prek tehnologije teleteksta. Trenutno so pri javni radioteleviziji podnaslovljene le oddaje, ki so posnete vnaprej. Razvoj orodij za podnaslavljanje živih oddaj že teče, trenutno pa tehnologije za tekoče podnaslavljanje vsebin v živo še ne omogočajo. Predstavljen pilotni projekt za samodejno podnaslavljanje televizijskih programov za sprotno ustvarjanje podnapisov informativnih, kulturnih, športnih in drugih televizijskih oddaj z uporabo samodejne razpoznave slovenskega govora v realnem času je trenutno še v razvojni fazi. Razvoj orodij za razpoznavanje govora ASR iz slovenskega jezika poteka na obeh večjih slovenskih univerzah. Orodja za razpoznavo so v razvojni fazi, zato jih še ni mogoče integrirati z drugimi orodji. Zadnji rezultati kažejo na 71 % uspešnost razpoznavanja [11].

Iz zgoraj navedenih razlogov vse več ponudnikov avdiovizualnih vsebin omogoča samodejno razpoznavanje govora s podnaslavljanjem. Načinov izvedbe podnaslavljanja in umeščanja teksta v video je bilo izvedenih več raziskav [10]. Pokazale so, da klasično nameščanje teksta v spodnji srednji del slike na zaslonu ni edini možni način za podnaslavljanje, ampak da lahko namestitev teksta v okvir slike tudi dinamično prilagodimo glede na vsebino in želje uporabnika. Pomembnih elementov slike s tekstom nikakor ne želimo prekriti, saj v videu lahko vključeni tudi teksti in podnaslovi kot prevodi drugih jezikov. Prekrivanje teksta s tekstom je za gledalca moteče, zato mesto za podnaslavljanje določimo tako, da predhodno vnesenega teksta ne prekrivamo. Spletne tehnologije razen integriranega načina (angl. closed-caption) predvidevajo tudi predvajanje teksta le v primeru, kadar je predvajanje aktivirano s strani uporabnika (angl. closed-caption). Urednik vsebin lahko tekst izvozi v zunanjo datoteko in ga uporabi kot pripomoček iskalkniku določenega mesta v AV vsebini s pomočjo preko ključnih besed. Pri urejanju tekstov za podnaslavljanje je treba upoštevati še vrsto smernic, kot je število znakov v vrstici in število vrstic podnapisa, razmerje med dolžino podnapisa v znakih in njegovim trajanjem, obliko in barvo črk ter vrsto podlage.

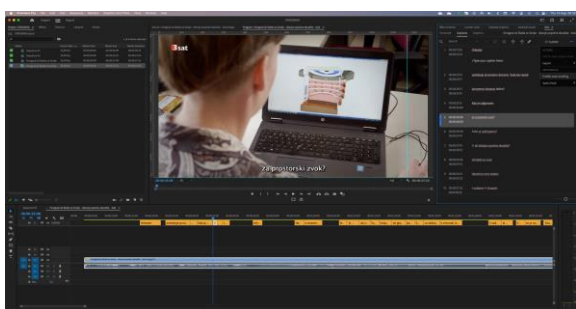
3 Podnaslavljanje AV vsebin

Poznamo več tehnik za podnaslavljanje AV vsebin. Pri prvem se v podnaslovljen tekst vključujejo izključno dialogi govorcev, lahko pa vključujejo tudi opisi spremnega zvoka, za opis vrste glasbe, šumov in drugega spremljajočega zvoka. Podnaslavljanje je v slovenskem prostoru že dolgo prisotno, saj so vse tujejezične AV vsebine prevedene in podnaslovljene [3]. Ker je ročno podnaslavljanje dolgotrajno in drago opravilo. Ker je AV vsebin vse več, je lahko rešitev tudi uporaba orodij za samodejno prepoznavanje govora ASR. Za dober rezultat branja mora besedilo biti dopolnjeno tudi z ločili, primerno razdvojeno, in postavljeno na ustreznih mestih [3]. Ponudniki nekaterih spletnih portalov za pretočno predvajanje AV vsebin omogočajo kreatorjem vsebin integrirana orodja ASR za samodejno podnaslavljanje. Ta uspešno prepoznajo dialog več različnih svetovnih jezikov, hkrati pa omogočajo tudi sproti prevod besedil. Hiter razvoj na področju umetne inteligence, botruje mu

predvsem tehnološki napredek na področju velikih podatkov in uporabe akustičnih modelov globokih nevronske mreže ima velik vpliv na razvoj orodij ASR [11]. Z umetno inteligenco je opremljeno orodje portala Vimeo, namenjeno uporabnikom za snemanje preko spletne kamere in urejanje videoposnetkov. Vgrajen ima bralnik besedil (angl. Teleprompter) in funkcijo pametnega odstranjevanje neželenih vsebin, na primer besednih mašil. Orodje je namenjeno predavateljem, ki jim je neprijetno ustvarjati lastne videoposnetke. Slovenski jezik zaradi specifičnosti njegove zgradbe trenutno še ni na voljo. Avtomatsko razpoznavanje slovenskega jezika za podnaslavljanje je problematično, predvsem v primeru kratkih besed, in kadar so ob govornih besedi prisotni tudi drugi zvoki (šum), ali kadar je v posnetek opremljeno z glasbenim ozadjem [12]. Težave z razpoznavanjem nastanejo tudi v akustično problematičnih prostorih, to so prostori z daljšim odmevnim časom RT60 (angl. Reverb Time 60) [13].

4 Tehnike nameščanja teksta v video

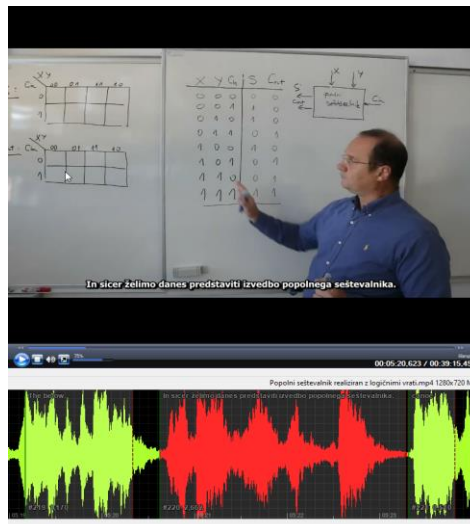
Montaža videa velja za kreativni in ustvarjalni proces, hkrati pa je časovno dolgotrajno in ponavljajoče se opravilo. Vse več video urejevalnikov že vključuje umetno inteligenco, ki delovni proces poenostavlja z avtomatizacijo dolgočasnih opravil. Raziskave so pokazale, katera pogosto izvajana opravila pri urejanju videa bodo z uvedbo umetne inteligence najbolj poenostavila proces montaže za ustvarjanje video vsebin [14]. Podnaslavljanje AV vsebin je zagotovo eno od opravil, ki ga želimo avtomatizirati. Je precej specifično delo, saj ga poleg tehničnega vidika prikazovanja podnapisov, vsebinske natančnosti in preverjenosti objavljenih podatkov pogosto spremljajo tudi kratki časovni roki. Strojno prepoznavanje dialogov montažerjem bistveno zmanjšajo obseg dela. Na Sliki 1 je prikazano okno orodja za montažo videa Adobe Premiere Pro z vgrajenim modulom za strojno razpoznavanje dialogov in možnostjo samodejnega podnaslavljanja. Čeprav z uporabo omenjenih orodij prihranimo na času, pa trenutno še veliko montažerjev ta postopek še zmeraj izvajajo ročno [15].



Slika 1: Razpoznavnik dialogov v Adobe PremierePro prepozna govor in samodejno namešča tekste po časovnici videa

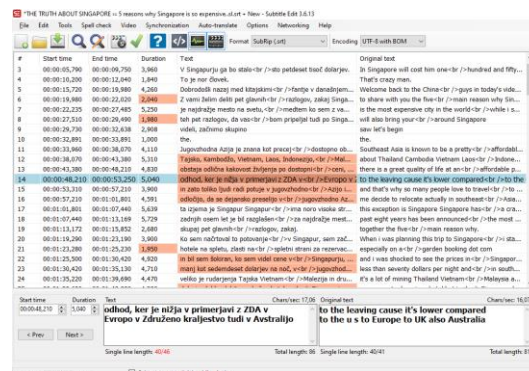
Na voljo so tudi prostodostopna orodja za strojno prepoznavanje dialogov in podnaslavljanje, na Sliki 2 je prikazan vmesnik orodja Subtitle Edit SE. Program tekst s pomočjo umetne inteligence za tekoče branje samodejno in smiselno razdeli na krajše odseke. Omogoča tudi večjezično podnaslavljanje, saj se ustvarjeni podnapisi lahko samodejno prevedejo tudi v druge

jezike. Na Sliki 3 je prikazan primer za podnaslavljanje s tekstom v angleškem in slovenskem jeziku. Integracija podnapisov v video je samodejna, vendar so potrebni še ročni popravki. Največkrat gre za smiselne popravke prevodov, nastavitve trenutka začetka in konca prikaza tekstovne vrstice v časovnici, in prilagajanje trajanja posameznega podnapisa. Vgrajena je tudi funkcija za samodejno odpravljanje tipkarskih napak. Podnapise lahko v video integriramo ali izvozimo v tekstovno datoteko za predvajanje na zahtevo gledalca.



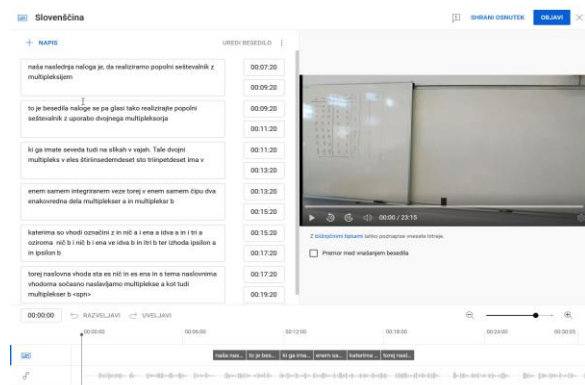
Slika 2: Orodje za strojno prepoznavanje dialogov s funkcijo samodejnega podnaslavljanja

V času pandemije Covid-19 smo zaradi okrnjenih osebnih stikov predavanja in vaje snemali za namen predvajanja kot video na zahtevo. Učne video vsebine so se lahko predvajale kadarkoli, v celoti ali po delih. Iz analize in statistike ogledov lahko predavatelj ugotovi, kateri del snovi je za študenta še posebej zanimiv, kajti določeni odseki v videu se lahko predvajajo pogosteje od drugih. Video vsebine so dostopne tudi po končanih omejitvah, ko se predavanja in vaje v celoti izvajajo v predavalnicah. Iz pogovora s študenti smo ugotovili, da je kombiniran način podajanja snovi dobrodošla in zaželena dopolnitev predavanjem v živo.



Slika 2: Okno s teksti za podnaslavljanje in prevodom v drug jezik

Video posnetke predavanj smo namestili na video strežnik v okolje Moodle in na spletni portal YouTube. Tam smo uporabili orodje Studio, namenjeno za urejanje in samodejno podnaslavljanje videa. Ker slovenskih dialogov Studio še ne prepozna, je tekst za podnaslavljanje treba vnesti ročno, kar je časovno zamudno opravilo. Postopek smo pohitрили tako, da dialog iz zvočne datoteke prepoznali z orodjem za strojno prepoznavanje jezika v spletnem portalu slovenscina.eu [5]. Ker orodje ne omogoča branja video datotek, je treba zvok pretvoriti v zvočno datoteko.



Slika 3: Okno za urejanje podnapisov v programu Studio na spletnem portalu YouTube

Razpoznani tekst prenesemo v okno tekstovnega urejevalnika programa Studio, prikazan na Sliki 3, ga razdelimo na ustrezne krajše razdelke in uskladimo s časovnico slike. Portal YouTube omogoča tudi večjezično strojno prevajanje, vendar so prevodi še nepopolni in potrebujejo nekaj dodatnih ročnih popravkov. Gledalec lahko v predvajalniku poljubno aktivira podnaslavljanje in izbere jezik. Učna gradiva s podnapisi zagotovo olajšajo razumevanje snovi, posebej še na delih, kjer morda govor predavatelja ni povsem razumljiv. Dialoge smo prevedli in jih za tuje študente opremili še z angleškimi podnapisi.

5 Zaključek

Dodajanje podnapisov v AV vsebine je pomembno za lažje in boljše razumevanje ne gluhih in naglušnih, temveč tudi širši populaciji. Dodatno se stara tudi prebivalstvo, s starostjo pa nastopijo tudi težave poslabšanega sluha. Razloge za slabše razumevanje AV vsebin lahko pripisujemo tudi neustrezni tehnični opremljenosti pri predvajanju, akustično neurejenega prostora in visokim nivojem hrupa iz ozadja. Pomembno je tudi, da zagotovimo visoko produkcijska kakovost zvoka avdiovizualnih vsebin. Ker je pogosto ta problematična, je za lažje spremljanje pomembno, da so videoposnetki ustrezno dodatno opremljeni s podnapisi. Podnapisi v videoposnetkih vsekakor bistveno zmanjšajo napor pri spremljanju vsebin tako gluhih in naglušnih kot tudi osebam, ki sicer s sluhom nimajo težav. Javne radiotelevizije zato večino AV vsebin, bodisi so te predvajane v živo ali na zahtevo, podnaslovijo. Tudi vsebine, ki se predvajajo iz drugih virov, na primer spletnih portalov, se morajo zato podnasloviti. Podnaslavljanje AV vsebin je specializirana

strokovna dejavnost in velja za zahtevno, predvsem pa časovno dolgotrajno opravilo. Ker je omenjenih vsebin vse več, je pomembno, da za podnaslavljanje uporabimo orodja, ki bi opravilo podnaslavljanje lahko kakovostno samodejno izvedla. Umetna inteligenca tehnologijam ASR danes že omogoča samodejno razpoznavanje dialogov in podnaslavljanje. Imamo orodja za urejanje videa z vgrajeno tehnologijo ASR. Dialoge nekaterih svetovnih jezikov orodja že razpoznajo z visoko zanesljivostjo in točnostjo. V podnapisih so lahko še prisotne napake, ki so posledica slabše produkcijske kakovosti posnetka ali šumov iz ozadja.

V članku smo predstavili postopke in možnosti orodij na primeru produkcije videa namenjen izobraževanju. V času pandemije Covid-19 je bil stik s študenti otežen, zato smo predavanja in vaje posneli in jih opremili s slovenskimi in angleškimi podnapisi. Samodejno razpoznavanje, deljenje teksta na ustrezne bralne odseke in podnaslavljanje z razpoložljivimi orodji je za slovenski jezik zaenkrat še težje izvedljivo, kajti orodja zahtevajo še nekaj dodatnega ročnega dela. Popolna avtomatizacija postopkov za samodejno podnaslavljanje v slovenskem jeziku bo zagotovo velika pridobitev. Umetna inteligenca na področju strojnega razpoznavanja govora vse bolj prispeva k razvoju teh orodij, zato lahko v bližnji prihodnosti pričakujemo, da bodo postopki v prihodnje ne le avtomatizirani, ampak omogočali tudi sprotno podnaslavljanje AV vsebin tudi v slovenskem jeziku.

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Accessible Multimodal Journey Planner: Prioritizing Inclusive UI Design

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ABSTRACT

This paper presents the planned approach for the design of a mobile application that incorporates multimodal journey planning with a strong emphasis on accessibility and user interface design (UI). The app aims to seamlessly integrate various modes of transport and focus on equal access for all users, regardless of their physical abilities. UI Design approach prioritises user-centred principles and provides an intuitive and visually appealing platform, using real-time data integration, interactive maps and multi-modal route recommendations to enhance the user experience. Accessibility is taking place at the beginning of the design planning process, ensuring that people with disabilities can navigate the platform effortlessly. Screen readers, voice control, colour contrast and inclusive design practises should be integral components. As part of the iterative process of UI design, qualitative and quantitative methods are used to measure user experience (UX) and accessibility, using feedback, surveys, usability testing, and accessibility audits. This iterative approach ensures continuous improvement and a truly inclusive transport solution.

KEYWORDS

multi-modal route planning, accessibility, interactive map, responsive design, cross-device accessibility

1 INTRODUCTION

In a time when web and mobile applications have seamlessly integrated into our daily lives, their importance cannot be overstated. As these technologies advance and gain wider adoption, it becomes imperative to embrace the principles of universal design and digital accessibility. These principles ensure that products can be utilized by individuals across a wide range of abilities and in various operational contexts. The concept of digital accessibility, primarily focused on designing for individuals with disabilities, considers a wide range of impairments, spanning auditory, speech, visual, physical, cognitive, and neurological disabilities [1]. It is crucial to

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recognize that many of the strategies and solutions developed for accessibility directly benefit users with situational limitations, such as individuals with a broken arm or lost glasses. Additionally, the aging process brings changes in abilities for older individuals, often leading to challenges like impaired hearing and weakened vision [1][2]. Furthermore, situational limitations such as intense sunlight or noisy surroundings can also hinder interactions [2]. Embracing comprehensive accessibility measures therefore enables application designers and developers to address these various challenges and create a digital landscape that is fully accommodating.

From a business perspective, the design of accessible software offers substantial benefits to organisations [3]. These advantages encompass enhanced application usability, broader market research resulting from an improved user experience that caters to a wider range of users, mitigation of accessibility-related legal actions (especially relevant for public sector organisations), fostering a positive brand perception and providing a better environment for driving innovation [2][3]. Therefore, developing accessible applications extends beyond the ethical aspects. It is a strategic move for organisations to showcase digital inclusivity and tap into an overlooked market.

This paper discusses the initial phase of designing an accessible journey planning application, addressing relevant aspects such as application requirements and the approaches to solving various case-specific accessibility challenges.

2 MULTI-MODAL ROUTE PLANNING APPLICATION

In response to the growing need for efficient and user-friendly travel solutions, multimodal journey planning applications have proven to be valuable tools that simplify the organisation of trips using different modes of transport. These applications, available both on the Web and on mobile platforms, provide users with a convenient and comprehensive approach to journey planning that includes public transport, walking, cycling and other modes of transport.

At both national and international levels, the importance of robust journey planner applications is undeniable. These applications serve as key tools for effective transportation management, fostering seamless travel experience for citizens and tourists. By encouraging the use of public transport and sustainable travel methods, they help optimise transport networks as well as reduce environmental impact.

The key objectives of the presented use case presented are to redesign the existing web-based multimodal journey planner

"AtoB" and the development of a mobile version of the journey planner for mobile devices, also taking into account accessibility of these solutions. By integrating various diverse data sources provided by different governmental and other institutions, the system will effectively plan and present trips and thus positively contribute to user-oriented journey planning experience.

Despite the existence of widely used route planning solutions like Google Maps and Apple Maps, these applications do exhibit some accessibility shortcomings [4][5]. This includes problems with focus order, keyboard navigation, colour contrast, labelling and other usability issues, which can pose challenges for users with disabilities [5][6]. Moreover, global route planning applications often lack the diverse data sources necessary for comprehensive local route planning, presenting a notable disadvantage.

2.1 Functional Requirements

The design of the multimodal route planning application will implement a conventional client-server architecture that enables efficient communication and data exchange between users' devices and the application's backend system. The following functional requirements, defined from a front-end and user experience perspective, describe the main features of the application.

3.1.1 Route Planning

The functionalities of the application extend to advanced route planning, allowing users to define start, end and intermediate points via an address, location, a point of interest or a direct map selection. In addition, preferred modes of transport (walking, cycling, rental bikes, bus, train, or boat) can be selected, along with route alternatives if available. Users should be able to set departure and arrival times or access the current departure and arrival times for convenience, underlining the app's commitment to comprehensive, adaptable journey planning. The application must allow users to view timetables for their chosen location and time, which should be available for all possible stops. Furthermore, the application must also facilitate the display of rental bike stops and provide important data on the number of bikes and parking spaces available. The design of the application should incorporate wheelchair accessibility, allowing the user to select this option when calculating the route and displaying a warning message if the route is partially or completely inaccessible. Finally, users should be able to set a maximum walking time and a slow walking pace option, which will be considered when calculating the estimated time of arrival.

3.1.2 Interactive map

The application must have an interactive map that allows the user to effortlessly navigate, view their current location, and select points of interest. The client recommends the use of OpenStreetMap as the underlying map data layer, chosen for its openness, wide coverage, and customisable attributes. In addition, the map should allow for the interactive display of key transport hubs, including public transport stops, bicycle, and car rentals, as well as P+R (Park + Ride) parking. Users should be provided with comprehensive information including identification, location, operating hours, rental options, booking systems, directions, accessibility features and additional services to ensure an informative navigation experience.

3.1.3 Real-Time Location Tracking

The application shall include real-time location tracking features to enhance the user experience during route planning, using technologies such as GPS and network-based methods for accurate data. The collection of user location data must comply with data protection regulations, with clear information and user consent for data use.

3.1.4 Additional (Nice-to-Have) Requirements

In addition to the basic requirements, several desirable features can be provided to further enhance the user experience of the application. These features include real-time integration of public transport information, bus and train tracking for enhanced travel visibility, real-time locations of shared vehicles, fare information and ticket purchase, as well as the ability to store and use tickets. Together, these optional features could contribute to an enhanced, user-centered travel experience.

2.2 Supported Platforms and Devices

The web application should be fully responsive and adhere to responsive design principles to ensure compatibility with different screen sizes. The mobile application is a crucial component that should be compatible with Android, iOS and HarmonyOS operating systems and must be accessible via Google Play, the Apple App Store, and the Huawei AppGallery. To meet these criteria, the Microsoft.NET Maui cross-platform framework will be used, ensuring efficient and consistent application deployment.

2.3 Variety of Content Types

The application will prominently feature textual information along with the interactive map. The map will incorporate various graphic elements, including typical map elements as well as additional lines, icons, and other visual components. The use of icons is anticipated to be substantial, contributing to visual clarity. Small animations will be used strategically to support user guidance and notifications and enhance the overall experience. Visual content will also include images, e.g. logos of transport providers and images of places. The incorporation of videos within the application is expected to be limited or non-existent.

3 APPROACHES TO ENSURING MULTI PLATFORM ACCESSIBILITY

In the design phase, consideration of accessibility is crucial as it lays the foundation for a product that is both inclusive and easy to use. Considering accessibility early in the design process not only reduces costs, but also prevents the need for extensive retroactive work. While a significant portion of accessibility-related efforts is expected to occur during the development phase, it's vital to thoughtfully outline necessary accessibility measures during the design phase. Therefore, while the design phase includes typical design work such as colour selection, application layout design, icon selection, etc., adherence to accessibility requirements should also be considered [7]. Addressing accessibility for this specific use case combines established best practises with unique considerations, mainly related to the interactive map functionality. The design of the

application is based on the foundation of the WCAG guidelines [8], ensuring the application is perceivable, operable, understandable, and robust. This section delves into essential accessibility implementations and challenges in designing an inclusive web and mobile application for our route planning use-case.

3.1 Web-Specific Challenges

In terms of web browser accessibility features, we can expect certain functions to be readily available through both the browser itself and the device's operating system. Commonly encompassed within these browser features are screen readers, high contrast options, zoom capabilities, and the ability to customise font settings, including font type, size and style [9]. However, as these features are somewhat limited and vary greatly between different browsers and devices (particularly features related to visual aspects such as different contrast modes and text adjustments), additional in-app measures need to be implemented to ensure proper cross-device accessibility of the web application.

Therefore, an accessibility menu should be integrated into the web application, which will provide users with the ability to customize the application's settings according to their preferences and needs. The accessibility menu should be readily visible, easily accessible, and offer several key options. The menu should offer settings for high contrast modes and various colour enhancements to accommodate people with visual impairments. In addition, users should be able to adjust text-related settings, such as the font type, size, style, text spacing, line height settings, and link appearances. The menu should also offer the possibility to change the size of icons and other graphical elements (including elements within the interactive map interface, such as route lines).

The interactive map, one of the most important features of the application, presents some unique challenges regarding accessibility. Keyboard-only navigation and proper focus management are particularly important for ensuring operability of the map. The order of focus must be as consistent and predictable as possible. This consistency not only promotes smooth keyboard navigation, but also ensures compatibility with screen readers, which need access to all webpage components to read essential information. Crucially, screen readers should also alert the user when important events related to the interactive map occur, such as the appearance of pop-ups or map movement [10]. Any additional elements placed on the map should have corresponding textual information for screen reader users. Accessible Rich Internet Applications (ARIA), alt, and title attributes should be added to these elements where appropriate, and they must be short and descriptive [11]. Furthermore, the interactive map should also support keyboard-only operation for navigating the map – this includes zooming, panning, and rotating the map [8][11].

In terms of the visual aspects of the interactive map, adherence to established principles of accessible map design is crucial. Key considerations when designing accessible maps include refraining from relying solely on colour to convey information, but instead using text, icons, or subtle, yet recognisable patterns to complement the colour-based information. Furthermore, it is essential to avoid excessively

small or illegible labels, prevent overlapping of different elements, ensure appropriate size of graphic components, and provide intuitive icons [12].

3.2 Mobile-Specific Challenges

Solving accessibility challenges when designing for mobile devices will involve building upon earlier discussed measures, while also considering specific aspects of mobile applications. In general, mobile devices offer a broader and more uniform range of accessibility features for applications compared to web browsers. As a result, mobile applications often extensively rely on operating system features to provide accessibility. While these features differ slightly between operating systems, the major platforms all include core elements such as screen readers, magnification and zoom options, voice command capabilities, closed captioning, contrast and colour differentiation modes, haptic feedback through vibration, simplified gesture-based interaction, and font adjustments [13]. Thus, to make the mobile application accessible, it is first necessary to enable the effective utilization of the provided accessibility features. Furthermore, some supplementary accessibility measures need to be implemented to bridge the gaps left by the built-in functions of the operating system.

Perhaps most importantly, the application's user interface elements, including buttons, labels, and navigation, have to be coded with correct semantic information and labelling, while also arranged in an intuitive semantic order. This enables screen readers to accurately convey the content to users with visual impairments. Additionally, the application must fully support key accessibility options such as platform zoom, text resizing, providing haptic feedback instead of audio or visual feedback, and high contrast modes. Although in most cases these features are automatically available due to the built-in support of development frameworks, it remains imperative to test and validate their correct functionality.

Aside from ensuring the proper functioning of assistive technologies, additional measures should be taken to ensure accessibility. This entails adopting accessible interactive map design principles, as well as applying general design principles for accessible mobile design. It is crucial that the touch targets are sufficiently large and appropriately spaced. Since the application is expected to include various input fields, it should offer simple data entry with various input methods such as predefined drop-down lists and autocomplete functions, while also supporting voice input. Furthermore, the application should facilitate the use of key functionalities — such as navigating the interactive map — through simplified gestures instead of complex ones [14].

3.3 Cross-platform Development Frameworks

The development of the mobile application will be based on the cross-platform framework .NET MAUI, necessitating a thorough assessment of the potential for creating accessible user interfaces within this framework.

Development framework suppliers usually provide documentation detailing the accessibility features they offer, as is the case with Microsoft's .NET MAUI, which presents accessibility documentation and offers robust accessibility tools

[15]. Nonetheless, comprehensive testing remains imperative to ensure effective implementation of accessibility measures across all platforms and devices.

In the context of the .NET MAUI framework, the preferred method involves utilizing "semantic properties". These properties provide information about controls that need to be made accessible and text that should be read aloud to the user. Semantic properties can be added to any element, utilizing the platform's accessibility APIs. A key advantage is the ability to accommodate distinct platform-specific accessibility experiences, rather than enforcing a uniform behaviour across all platforms. UI Elements can possess properties such as description, hint, and heading level, tailoring platform-specific accessibility values for improved interaction with screen readers. Furthermore, the framework provides tools to prompt the platform's screen reader to automatically articulate specific elements. Additional "automation properties" can also be applied to elements to define how they are conveyed to the platform's accessibility framework [15][16].

Nonetheless, the behaviour of these functionalities across various platforms remains somewhat uncertain. Therefore, performing comprehensive accessibility testing on each platform is a mandatory part of the development process.

3.4 Accessibility testing

The evaluation of appropriately integrated accessibility features includes both automated tools and non-technical assessments. This holistic approach aims to ensure that content and functionalities are universally accessible.

Automated tools play a pivotal role in analysing application code and content, identifying accessibility issues and even providing guidance on how to resolve them. These tools streamline development by uncovering intricate code errors that may elude human evaluators [17]. However, they cannot fully understand the subtle details of context or thoroughly evaluate the quality of content [18].

Even though automated testing is necessary for accessibility, it will be reinforced by manual inspection. Manual testing entails proficient evaluators navigating the application using assistive technologies such as screen readers and keyboard-only interactions, mimicking the experiences of users with disabilities [18]. This thorough approach includes assessing content, testing keyboard-only use, and evaluating the use of screen readers and other assistive tools on various devices for both web and mobile applications. To comprehensively validate accessibility, the testing process should include a variety of mobile devices of all three required operating systems. Furthermore, the inclusion of real users with disabilities in the testing process would provide invaluable insights by uncovering additional accessibility issues and gathering feedback on user experience [18].

4 CONCLUSION

Diverse applications pose distinct challenges when it comes to ensuring accessibility. Throughout this paper preliminary research was conducted to identify these challenges and explore possible solutions to ensure accessibility across the entire journey planning application. The focus was on exploring specific features where accessibility integration is not

particularly intuitive and not yet widespread. The focus on the interactive map and journey planning functionality revealed several potential hurdles in the design of both the mobile and web application that require a thorough application of accessibility guidelines. The use of cross-platform frameworks was also identified and explored as a potential challenge for ensuring accessibility. In addition, new ideas emerged during the research that could help improve accessibility in the next versions of the application. For example, one of these suggestions includes the implementation of an animated sign language interpreter to assist deaf or hard of hearing users.

The initial research is expected to be of great value in the design and development phase of the application, providing a solid set of design principles and enabling effective resolution of accessibility issues. Despite the additional resources dedicated to ensure accessibility, the significant business and ethical benefits of an inclusive app are likely to outweigh the initial investment. With this foundation, the stage is set for the efficient development of an accessible journey planning application.

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Towards a Self-Assessment Tool for Enabling Inclusive Digital Education *

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ABSTRACT

In the ever-changing field of education, facing various challenges, developing a self-evaluation tool is crucial. Striving for excellence and inclusivity demands continuous assessment, adaptability, and the development of student-friendly settings. This necessity is emphasised by tools like Self-Reflection on Effective Learning by Fostering Innovation through Educational technology (SELFIE) and the Index for Inclusion, advocating inclusive education practices and fostering collaboration among all participants. Their goal is to boost digital learning and professional growth, however, not all factors, important for inclusive digital education, are included in the existing tools. Our proposed self-evaluation tool model builds on these foundations, integrating practical insights and best practices while also addressing potential obstacles and best practices connected to digital education. It aims to deepen understanding of factors sustaining successful inclusion and enriching the educational landscape for students, educators, and institutions. Our research aims to develop a tool that will have the potential to redefine education's future.

KEYWORDS

Inclusion, self-evaluation, supporting tools, digital education.

1. INTRODUCTION

Inclusive education has been defined by the United Nations Educational, Scientific and Cultural Organization (UNESCO) as “a process of addressing and responding to the diversity of needs of all learners through increasing participation in learning, cultures and communities, and reducing exclusion within and from education” [1].

Digital inclusion (DI) „is the ability of individuals and groups to access information and communication technologies (ICT)” [2]. DI in education aims to provide students with disabilities the opportunity to learn alongside their non-disabled peers and

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encompasses not only access to the Internet but also the availability of hardware and software, relevant content and services, and training for the digital literacy skills required for effective use of ICT.

A significant step forward in advancing DI in education was the United Nations' adoption of the Convention on the Rights of Persons with Disabilities [3]. This international commitment underscores the importance of ensuring equal access to inclusive and high-quality primary and secondary education for individuals with disabilities within their communities [4]. Today, many countries have legislation or policies that support the inclusion of students with special needs [5].

Self-evaluation of school leadership and teachers regarding the goals of inclusive digital teaching and learning is crucial for improving the quality of education and ensuring that all students have equal learning opportunities. The use of self-evaluation tools is essential for several reasons:

- **Measuring progress:** Self-evaluation tools allow school leadership and teachers to assess their current position in terms of inclusive digital teaching and learning. This helps them determine where they are and how they have progressed in their efforts to include all students.
- **Identifying strengths and weaknesses:** Self-evaluation helps identify strong points where successful practices are in place and weaknesses where improvement is needed. This enables the allocation of resources and efforts to areas where they are most needed.
- **Guiding approach development:** Based on the results of self-evaluation, school leadership, and teachers can develop approaches and strategies to enhance inclusive digital teaching. This contributes to better adaptation to the diverse needs of students.
- **Providing evidence:** With the data and analyses obtained through self-evaluation, schools and teachers can justify their approaches and decisions, including those involving school leadership, parents, and the broader community.

The goal of this study is to provide a framework for developing a tool that will help understand the specific needs of educational environments and support schools and teachers in achieving inclusive digital teaching and learning. Through the use of self-evaluation tools, we aim to achieve the following objectives: (1) *Enhancing inclusivity:* Ensure that all students, including those with special needs and different learning styles, have equal access to digital learning resources and tools; (2) *Increasing*

digital literacy: Enable teachers and students to develop digital skills and competencies necessary for success in the modern world; (3) *Improving learning outcomes*: Increase students' success and their understanding of school subjects by promoting inclusive digital teaching; and (4) *Fostering Collaboration*: Encourage collaboration among teachers, school leadership, parents, and the community to achieve common goals in inclusive digital education. With self-evaluation tools, we can achieve this goal and contribute to enhancing inclusivity, digital literacy, and the quality of teaching and learning in our schools. In the existing literature, we can find tools that enable assessing specific aspects of inclusive digital education. Most tools have been developed to evaluate the readiness to use digital technologies in primary schools or to evaluate inclusion in general schools. However, we have yet to find any studies dealing specifically with evaluating readiness to ensure effective inclusion in education based on digital technologies. There is a lack of such tools, especially in the field of tertiary education. For this reason, this work is one of the first steps towards building such a tool.

This paper is structured into four sections. Following the introduction in Section 1, Section 2 investigates the background of inclusive education. This Section focuses on digital inclusion within education, followed by an examination of accessible learning content designed to facilitate inclusive digital education. In Section 3, we explore the development of self-evaluation tools, discuss existing frameworks, and introduce a novel framework concept. Finally, Section 4 offers the conclusion and outlines future prospects for our work.

2. BACKGROUNDS

In the ever-changing landscape of education, the principles of inclusivity, digitalization, and accessibility have emerged as critical bases of progress. As we navigate the 21st century, the concept of inclusive education has evolved from being a noble aspiration to a fundamental necessity, emphasizing equitable opportunities for all learners, regardless of their diverse needs and backgrounds.

In this section, we embark on a comprehensive exploration of three interconnected facets: Inclusive Education, Digital Inclusion in Education, and Accessible Learning Content for Enabling Inclusive Digital Education.

2.1 Inclusive education

Inclusive education, as defined by UNESCO, focuses on addressing the diverse needs of all learners, fostering increased participation in learning, culture, and communities while reducing exclusion in education. This approach emphasizes the inclusion of both students with and without disabilities in the same classroom, enabling them to learn and participate together [6]. This inclusive model not only provides significant educational benefits to students with disabilities but also contributes to greater social acceptance of differences and impairments among all students [7]. Curriculum, pedagogy, assessment, student classification, and stratification are all important in determining the quality and inclusiveness of educational experiences [8].

Inclusion involves more than the placement of students with disabilities in mainstream classes and requires structural changes in organization, curriculum and teaching, and learning strategies [9]. Improving inclusivity may require substantial change not only to the teaching practices occurring inside and outside of the classroom but also within staffrooms and the school's relationships with parents, caregivers, and the community [10]. Figure 1 shows the dimensions of the Index for Inclusion, developed by Booth and Ainscow [10] that can assist schools in turning the philosophy of inclusion into inclusive educational actions. Inclusive school policy provides the foundation for enabling schools to be accessible to all students and staff. An inclusive school culture is one in which diversity is embraced, and all members are treated fairly, respectfully, and equitably. Inclusive practice means that learning and teaching activities are responsive to student diversity. Learning experiences are designed with students' individual strengths and needs in mind, and consideration is given to how all students can actively and meaningfully participate in their learning and be appropriately challenged.

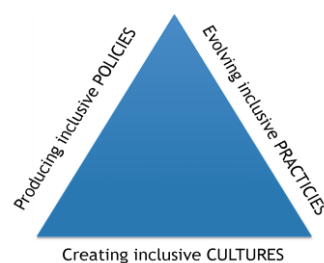


Figure 1. Index for Inclusion – dimensions [6]

2.2 Digital inclusion in education

DI should adapt to technological progress but also aim for digital equity by actively removing barriers that perpetuate disadvantages in individuals and communities [11]. Educators are actively seeking innovative approaches to address the complexities presented by diverse modern classrooms. Universal Design for Learning (UDL) for example offers a philosophy, framework, and a set of principles that enable the creation and implementation of adaptable teaching and learning strategies, effectively catering to the diverse needs of students within the classroom environment. UDL is an educational framework based on the idea that all students can benefit from learning when they are provided with choices that are suited to their individual needs. UDL encourages educators to create flexible and adaptable learning environments in which students of all abilities and backgrounds can succeed [12][13].

At the core of the European Union's Digital Education Action Plan (2021-2027), the policy initiative offers a long-term strategic vision for high-quality, inclusive, and accessible European digital education [14]. Digital transformation goes beyond applying suitably designed digital technologies in education and involves several education system levels [14]:

- **Technology Level** - The development of inclusive technology should consider technology-driven approaches and the primacy of pedagogy in a balanced way. Assistive technology (AT) should be used as a compensatory means only where universally designed technology does not (yet) sufficiently satisfy all users' needs.

- Learners level - Inclusion in digital education is multi-dimensional, affected by society, technical equipment, the educational institution, the learning situation, and the individual learners. Learners' digital competencies play an important role in inclusive digital education communication, collaboration and safety, respectful and appreciative social interaction, the development of a digital person, critical reflection on digital media and self-protection against violence in digital environments, etc.
- Teachers level - Teachers need support in selecting inclusive teaching materials that present no or few barriers and are suitable for all learners. Competencies like media literacy, data literacy, and data-based decision-making are important in the context of inclusive digital teaching.
- Educational institution level - Educational organizations that embrace the digitalization process in terms of content and funding can help to reduce social exclusion. Teacher empowerment is key and must be accompanied by organizational support measures, further training, and consideration of teachers' individual needs.
- National/regional level.

2.3 Accessible learning content for enabling inclusive digital education

In addition to ensuring equal access for all students, content accessibility in digital education can also improve the overall quality of education. Digital content accessibility is the practice of designing digital materials to be inclusive to all individuals, regardless of their abilities. In digital education, it's vital to ensure that all students can access educational resources equitably, accommodating diverse needs, including visual, hearing or other impairments. Failing to prioritize accessibility can lead to unequal educational outcomes, as students with disabilities may struggle to fully engage in online learning, highlighting the importance of inclusive content design in the digital education landscape.

Students with different types of disabilities can face barriers when accessing digital content in the context of digital education. Students with visual impairments can have difficulty accessing digital content that is not designed with accessibility in mind. For example, images, videos, and other visual content may not be described in a way that is meaningful to individuals who are blind or have low vision. Additionally, text may be too small or too low contrast to be readable for individuals with certain types of visual impairments. Next, students with hearing impairments can face barriers when accessing digital content that includes audio content, such as lectures or videos. Without proper captions or transcripts, students who are deaf or hard of hearing may not be able to fully engage with this content. Students with cognitive disabilities can have difficulty navigating and understanding digital content that is not designed with accessibility in mind. This can include content that is overly complex or difficult to navigate, as well as content that does not provide clear instructions or feedback. Students with motor impairments may have difficulty interacting with digital content that requires precise movements, such as using a mouse or keyboard. This can make it difficult for these students to navigate websites or complete assignments that require specific types of input.

There are several solutions that can be implemented to make digital content accessible for each group of students with disabilities. To make digital content accessible for students with visual impairments, content creators can use alternative text (alt text) to describe images and graphics. This alt text should be detailed enough to convey the meaning of the image or graphic to students who cannot see it. Additionally, designers can use high-contrast colors and font sizes that are easy to read for individuals with visual impairments. To make digital content accessible for students with hearing impairments, content creators can include captions and transcripts for audio content such as videos and lectures. This will allow students who are deaf or hard of hearing to access the audio content and participate fully in the learning experience. To make digital content accessible for students with cognitive disabilities, content creators can use clear and simple language and provide clear instructions and feedback. Additionally, designers can use layout and formatting techniques that make content easy to navigate and understand, such as bullet points and headings. To make digital content accessible for students with motor impairments, content creators can design content that can be accessed using a range of input methods, such as keyboard-only navigation or voice recognition software. Additionally, designers can use a clear and consistent interface design that allows for easy navigation.

Overall, creating accessible digital content in digital education benefits all students by improving usability, enhancing the learning experience, and promoting inclusion and diversity. By making content accessible to everyone, educators and content creators can help all students reach their full potential and succeed in their education.

3. DEVELOPMENT OF SELF-EVALUATION TOOL

In the dynamic landscape of education, the pursuit of excellence and inclusivity is important. To achieve these goals, educators and institutions must continually assess their practices, adapt to developing trends, and foster an environment where all learners can thrive. It is within this context that the development of a self-evaluation tool becomes indispensable. In the following sections, some existing solutions are presented as well as our proposed model.

3.1 Existing frameworks and tools for the design of the self-evaluation tool

To promote the integration and effective use of digital technologies in schools across Europe, the European Commission's Joint Research Centre (JRC) developed a conceptual framework for Digitally-Competent Educational Organizations (DigCompOrg), which encompasses key aspects of systematically integrating digital technology in educational organisations [15]. The DigCompOrg framework consists of following seven domains: (1) Leadership & Governance Practices, (2) Teaching and Learning Practices, (3) Professional Development, (4) Assessment Practices, (5) Content and Curricula, (6) Collaboration and Networking, and (7) Infrastructure.

Based on the DigCompOrg framework, the Commission designed and implemented the self-reflection tool SELFIE (Self-

reflection on Effective Learning by Fostering Innovation through Educational Technology), which helps schools exploit the opportunities digital technologies offer [15]. SELFIE can help schools and educational institutions assess their digital readiness and competence in integrating technology for effective teaching and learning [16]. SELFIE data can be used for assessing how the utilization of digital technologies in education influences students' development of digital skills and teachers' engagement in continuous professional development. SELFIE aims to: (1) Assess digital readiness: Evaluate how well educational institutions are prepared for digital integration, (2) Encourage self-reflection: Prompt educators, administrators, and students to reflect on their digital practices, and (3) Enhance digital learning: Identify areas for improvement in technology use for better teaching and learning outcomes.

SELFIE tool supports schools to plan their digital strategies, by highlighting what is working well, where improvement is needed and what the priorities should be [17]. Key features include user-friendliness, as SELFIE provides an easy-to-use interface for all stakeholders. It is customizable, and institutions can tailor the questionnaire to their specific needs and goals. It also has data-driven insights since it generates comprehensive reports and recommendations based on responses. SELFIE also promotes professional development and helps educators identify areas for skill improvement.

SELFIE provides an extensive questionnaires that cover areas, specific to utilization of digital technologies in education, impact of the use of digital technologies in education on students' development of digital skills, teachers' engagement in continuous professional development, etc. [17]. The questionnaire defines indicators, that cover following key areas [18]: Teaching and Learning Practices; Assessment Practices; Content and Curricula; Networking and Collaboration; Professional Development; Leadership and Governance Practices; and Infrastructure. These seven areas are expanded into fifteen sub-elements and 74 descriptors. The tool provides questions that can be used for collecting data from school's leaders, teachers, and students, to assess these areas from different points of view.

The "Index for Inclusion" is another important concept that must be considered and included in the development of the tool for self-assessment of inclusive digital education. The index for inclusion was designed to support inclusive education practices within schools and educational institutions. It provides a framework for assessing, developing, and promoting inclusive practices to ensure that all students, regardless of their abilities, backgrounds, or characteristics, can access high-quality education [19]. It aims to: (1) Promote inclusive education: Encourage schools and institutions to create environments where every student can participate, learn, and thrive. (2) Evaluate and improve inclusion: Provide a structured approach for self-assessment and continuous improvement in inclusive practices. (3) Empower participants: Engage educators, students, families, and the community in collaborative efforts to enhance inclusivity. Key features include the comprehensive framework for evaluating and enhancing inclusive education practices. It is user-friendly and designed to be accessible and usable by educators, administrators, and other stakeholders. It provides practical guidance, tools, and resources for implementing inclusive practices. It also presents a collaborative approach,

encouraging the involvement of all stakeholders and fostering a sense of ownership and commitment to inclusion.

3.2 Proposal for the model for self-evaluation tool for assessment of inclusive digital education

Self-evaluation is a process for helping schools improve autonomously, a practice that should be integrated routinely into their management systems [20]. The proposed model for self-evaluation of inclusive digital education will incorporate existing awareness of inclusion drawn from the SELFIE tool and the Index of Inclusion. However, our primary objective is to enhance this foundation with insights collected from the practical experiences of researchers, pedagogical professionals, and other experts in this field. We will integrate best practices as well as address obstacles within the existing self-evaluation tool to gain a more comprehensive understanding of their impact on successful inclusion. This approach allows to identify potential challenges and difficulties that may not have been encompassed by existing frameworks, as shown in Figure 2.

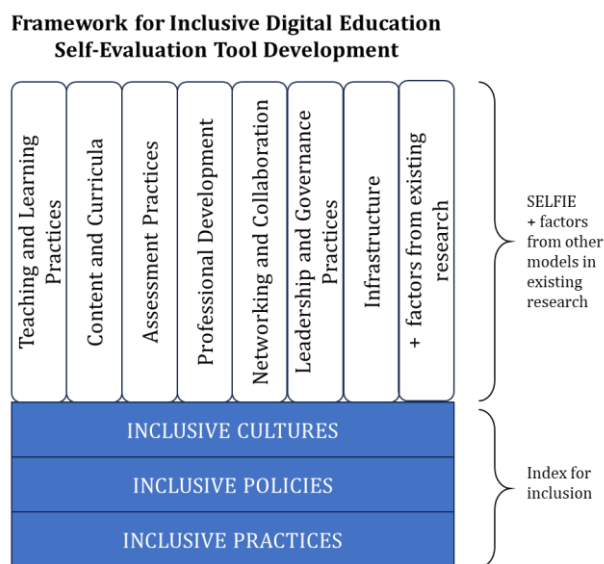


Figure 2 Framework for integration of dimensions and factors from existing frameworks and existing research

The following inclusion domains are planned to be addressed: leadership, collaboration and networking, infrastructure, equipment and technology, continuous professional development, resources for pedagogical activities and assessment practices, as well as student digital competence. Each domain will be subdivided into factors strongly associated with the content of that particular domain. The resulting self-evaluation tool will be designed with the assistance of a questionnaire, enabling users to assess statements related to factors within each domain using a 5-point Likert scale. The self-assessment results will be presented in the form of separate scores for each domain, representing the current state of DI within each domain. Based on the obtained assessments, recommendations will also be provided for improving DI in specific, critically assessed areas. Through this comprehensive approach, the self-evaluation tool aims to empower educational institutions not only to measure

their current state but also to chart a course for continuous improvement. Inclusive digital education is an ongoing journey, and our tool will serve as a compass, guiding institutions toward a future where every stakeholder can thrive in a digitally enhanced educational environment.

4. CONCLUSIONS AND FUTURE WORK

In conclusion, the development of a self-evaluation tool holds significant importance in the dynamic setting of education. Excellence and inclusivity are central goals, requiring continuous assessment, adaptation, and the creation of environments encouraging to the success of all learners. This necessity is underlined by the existence of different frameworks and tools such as SELFIE and the Index for Inclusion.

SELFIE, serves as a user-friendly, customizable, and data-driven tool for assessing digital readiness and promoting self-reflection among educational institutions. It aims to enhance digital learning and professional development by identifying areas for improvement. The Index for Inclusion, on the other hand, is a comprehensive resource that advocates for inclusive education practices. It offers an inclusive framework and encourages collaboration among stakeholders, ensuring that all students have access to quality education.

Our proposed model for a self-evaluation tool represents a step forward in this direction. By building upon the knowledge from established tools like SELFIE and the Index of Inclusion, our model strives to integrate practical insights and experiences, incorporating best practices and addressing potential obstacles. This holistic approach seeks to provide a more comprehensive understanding of the factors that influence successful inclusion, enriching the educational landscape with a tool designed to meet the evolving needs of students, educators, and institutions.

In our upcoming research activities, we plan to conduct a comprehensive literature review to survey the existing body of research conducted by scholars in this field. Furthermore, as we are interested to gather insights from individuals within the realm of higher education, we will also administer a survey among them. This approach will help us gain a well-rounded perspective and enrich our study with valuable opinions and data from relevant stakeholders.

ACKNOWLEDGMENTS

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Konferenca o zdravi dolgoživosti
Conference on Healthy Longevity

Urednika / Editors

Martin Lipovšek, Boštjan Petrič

<http://is.ijs.si>

10. oktober 2023 / 10 October 2023
Ljubljana, Slovenia

PREDGOVOR

Nekatera področja znanosti in tehnologije se razvijajo daleč od oči javnosti, povečini zato, ker se javnosti njihov vpliv na družbo ne zdi dovolj pomemben, da bi zaslužil kako posebno javno debato ali pa nasprotovanje. Področje raziskav o dolgoživosti ne deli te usode. Posamezni pristopi, kot so npr. celične terapije, restrikcija kalorij ali pa reaktivacija telomeraze, znajo pritegniti precej medijske pozornosti, pri čemer dobijo prostor za izražanje svojega mnenja tako zagovorniki kot nasprotniki posameznega pristopa. Največji kamen spotike pri podaljševanju življenja pa je še vedno osnovna ideja sama. Naj znanost stremi k temu, da podaljša človeško življenjsko dobo preko trenutnih bioloških meja? Ali naj se omeji na zdravljenje bolezni in lajšanje bolečin?

V javnosti je še vedno veliko nesporazumov glede podaljševanja življenja, kljub desetletjem naporov, da bi jih zatrli. Največji od nesporazumov je ta, da raziskovalci na področju dolgoživosti poskušajo podaljšati starost, se pravi senilen, dementen in k boleznim nagnjen del človeškega življenja. Resnica je seveda ravno nasprotna: cilj podaljševanja življenja je drastično podaljšati zdrav del človeškega življenja – v angleščini t. i. “healthspan” – do in preko meja, pri katerih ljudje trenutno umirajo zaradi bolezni. To je seveda ambiciozen projekt, zato pa je tudi razumljivo, da od znanstvenikov samih ne moremo pričakovati, da bodo polovico svojega časa namenili za bojevanje javnih debat.

Da bi promovirale raziskave na področju dolgoživosti, obenem pa pomagale gojiti informirano debato o namenih in ciljih podaljševanja življenja, so nastale številne nevladne organizacije v različnih državah. Mednarodno združenje, ki jih povezuje med seboj, se imenuje ILA oz. “International Longevity Alliance;” od leta 2021 je včlanjeno v združenje ILA tudi Društvo za vitalno podaljševanje življenja Slovenije, ki sicer obstaja od leta 2017. Eden glavnih ciljev društva je povezovati slovenske raziskovalce, podjetnike in državne uslužbence, ki so aktivni na področju podaljševanja življenja. V ta namen je društvo že leta 2020 organiziralo konferenco v sodelovanju s Filozofsko fakulteto, pri tem pa povezalo številne ključne svetovne osebnosti z omenjenega področja. Konferenca, naslov katere je bil “Biti mlad sto let,” je bila zaradi koronskih omejitev izvedena preko interneta.

Pričujočo konferenco organiziramo skupaj z Inštitutom Jožef Stefan in bo potekala v živo v prostorih inštituta. Tokrat je naš partner LongevityForum, češka sestrška organizacija, ki se ukvarja s promocijo ideje podaljševanja življenja. Poleg vodilnih slovenskih in čeških raziskovalcev s tega področja bomo ponovno slišali tudi predavanja glavnih svetovnih zagovornikov podaljševanja življenja, med drugim ikono področja Aubreya de Greya. Ker namen združenja ILA in njenih članic ni predavati ex cathedra, temveč promovirati diskusijo o vrednotah za podaljševanjem življenja, se bo konferenca zaključila z okroglo mizo, na kateri bo prisoten po en predstavnik iz sfer javne uprave, znanosti, ter podjetništva.

FOREWORD

Some fields of science and technology develop in obscurity and far from the public eye, mostly because their impact on society is not considered big enough to merit particular debate or opposition. The field of longevity research does not share this fate. Individual approaches, such as cell therapy, calorie restriction, or telomerase reactivation, might receive considerable media attention, with proponents and opponents of each approach both getting substantial coverage. However, the most contested part of life extension is the basic idea itself. Should science strive to extend the human lifespan beyond present biological limits? Or should it limit itself to treating diseases and suppressing pain?

Several misconceptions about life extension are still rife among the public, despite decades of effort to stamp them out. The most important of these misconceptions is that longevity researchers strive to prolong old age, i.e. to extend the senile, illness-prone and demented part of human life. The truth, of course, is exactly the opposite: longevity researchers aim to dramatically extend the healthy part of the human lifespan – “the healthspan” – up to and beyond the age that people currently die of disease. This is itself a tall order, so it makes sense that the scientists themselves cannot be expected to spend half of their time fighting public debates.

To promote longevity research among the public and foster a well-informed debate about the whys and hows of extending lifespan, several advocacy groups have been formed in different countries. The umbrella organization that joins them together is called ILA, or International Longevity Alliance; as of 2021, one of ILA’s members is the Slovenian Society for Vital Life Extension, based in Ljubljana, which has itself been in business since 2017. One of the Society’s main aims is to connect Slovenian researchers, entrepreneurs and governmental employees who are working in the field of life extension, as well as establishing ties between the Slovenians and their colleagues abroad. To this end, the Society has already co-organized a conference in 2020 together with the Faculty of Arts in Ljubljana, bringing together several key global figures from the field of life extension. The conference, titled “Being Young for a Hundred Years,” was held online due to Covid restrictions.

The present conference is being co-organized with the Jožef Stefan Institute and will be held live at the Institute’s premises. This time, one of our partners is LongevityForum, the Czech sister organization working on promoting the idea of lifespan extension. Apart from leading Slovenian and Czech voices from the field, we will once again hear from key global advocates of longevity research, including the doyen of life extensionism Aubrey de Grey. As the aim of ILA members is not just to speak ex cathedra, but to promote discussion about the values behind extending lifespan, this conference will conclude with a round table featuring one representative of each from the spheres of government, research, and business.

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Evidence-Based Interventions to Prolong Healthspan and Lifespan

In recent years, longevity science has emerged as one of the most captivating and pivotal areas of research, capturing the imagination of scientists, healthcare professionals, and the general public alike. The quest to extend human lifespan and, more importantly, enhance the quality of human healthspan, is a challenge that has intrigued humanity for centuries. Now, with remarkable advancements in science and technology, this aspiration is becoming increasingly achievable.

This presentation will shed light on the dynamic field of longevity science and latest insights into the biological processes of aging. It will explore evidence-based precision interventions based on systems biology and multi-omics data to optimise health and improve vitality. The fusion of machine learning and AI-powered personalized recommendations opens up new horizons for proactive health management.

In this era of longevity science, the boundaries of what's possible are constantly expanding, offering the tantalizing prospect of a future where not only do we live longer, but we also thrive throughout our extended years. This presentation will aim to explore the frontiers of evidence-based interventions that hold the promise of a healthier, longer, and more fulfilling life for all.

Aleš Kenda

Dolgoživost in družba; odzivi politik, opravljeno delo in aktivnosti pred nami

Spadamo v generacijo, ki se ji v veliki meri uresničujejo davne želje človeštva po daljšem življenju. Konec leta 2022 je v Sloveniji živelo desetkrat več stoletnikov kot ob osamosvojitvi. Daljše trajanje življenja se torej že dogaja in je posledica napredka v zdravstvu in znanosti, boljših delovnih pogojev, bolj raznovrstne in kakovostne prehrane, izboljšane higijene itd.. Zaradi daljšega trajanja življenja narašča število starejših, narašča pa tudi njihov delež v celotnem prebivalstvu, saj so mlade generacije maloštevilne. Pravimo, da se prebivalstvo stara, pogosto ta pojav opišemo z besedo dolgoživost. Staranje prebivalstva pa je več kot le demografija, tudi več kot le biologija. Je velik izziv za celotno družbo in tudi posameznike. Tovrstne spremembe namreč temeljito spreminjajo družbo.

Po začetnem pesimizmu ob napovedani "demografski katastrofi" se je začelo iskati rešitve, kako družbene sisteme in podsisteme prilagoditi novim demografskim pogojem. Posebej aktivni na tem področju so že vrsto let Združeni narodi. Do sedaj je bilo največ pozornosti po državah posvečeno prilagoditvam pokojninskih sistemov, zaposlovanju starejših in dolgotrajni oskrbi.

Tudi starejši niso več takšni, kot so bili nekoč; so bolj aktivni, bolj zdravi, zavedajo se svoje vloge in tudi pravic v družbi. Niso več zadovoljni zgolj z dodanimi leti življenja, ta leta želijo zapolniti z vsebino. Ni jim vseeno, v kakšnem okolju živijo, niti kakšen je odnos družbe do njih.

V Evropski kulturi besedi star in staranje še vedno povezujemo z upadom, počasnostjo, nepotrebno, boleznimi, odvisnostjo, in smrtjo. Realnost je drugačna, saj je starost samo eno obdobje v življenju človeka, ki je enakopravno z drugimi obdobji; lahko ti veliko da, pa tudi nekaj vzame. Človek lahko osebno raste do zadnjega diha. Na tem področju je še veliko izzivov, pogosto ugotavljamo, da sta staranje in starost v precejšnji meri še neodkrita kontinenta. Šele v zadnjem času, npr. podrobneje spoznavamo škodljiv vpliv osamljenosti in starizma na zdravje ljudi. Pomembno vlogo pri našem doživljanju starosti imajo tudi prepričanja, ki jih o starosti in starejših gojimo v sebi.

Namen prispevka je prikazati, da dolgoživost, ki se že dogaja, odpira vrsto izzivov, tako za celotno družbo kakor za posameznike. Pri odzivih je treba iskati rešitve, ki upoštevajo interese, koristi in obveznosti ljudi vseh generacij, tudi še nerojenih.

—

Longevity and society; policy responses, work done and activities ahead

We belong to a generation in which humanity's ancient wishes for a longer life are largely being realized. At the end of 2022, there were ten times more centenarians living in Slovenia than at the time of independence. Longer life expectancy is therefore already happening and is a result of progress in health care and science, better working conditions, more varied and high-quality nutrition, improved hygiene, etc. Due to longer life expectancy, the number of elderly people is increasing, and their share in the entire population is also increasing, as the young generation is few in number. We say that the population is aging, and we often describe this phenomenon with the word longevity. Population aging is more than just demography, but also more than just biology. It is a big challenge for the whole society and also for individuals. Such changes fundamentally change society.

After the initial pessimism at the predicted "demographic catastrophe", the search for solutions to adapt social systems and subsystems to the new demographic conditions began. The United Nations have been particularly active in this field for many years. Until now, the most attention

by country has been devoted to adjustments of pension systems, employment of the elderly and long-term care.

Even the elderly are not what they used to be; they are more active, healthier, aware of their role and rights in society. They are no longer satisfied with just the added years of life, they want to fill these years with content. They don't care what kind of environment they live in, nor what society's attitude towards them is.

In European culture, the words old and aging are still associated with decline, slowness, unnecessariness, disease, addiction, and death. The reality is different, because old age is only one period in a person's life, which is equal to other periods; it can give you a lot, but also take something away. A person can grow personally until his last breath. There are still many challenges in this area; we often find that aging and old age are still largely undiscovered continents. For example, we only recently learned more about the harmful impact of loneliness and old age on people's health. The beliefs we hold about age and the elderly also play an important role in our experience of age.

The purpose of the paper is to show that longevity, which is already happening, opens up a series of challenges, both for society as a whole and for individuals. When responding, it is necessary to find solutions that take into account the interests, benefits and obligations of people of all generations, even the unborn.

Stephen Minger

Futuristic possibilities of personalized medicine

There has been significant interest in the therapeutic and scientific potential of stem cells since reconstitution of the haematopoietic system was first realized by bone marrow transplantation in the 1960s. The isolation of tissue-specific, multipotent stem cells from adult organs and the derivation of pluripotent human embryonic stem cells and more recently induced pluripotent stem cells offer the potential for regeneration of several different tissues and organs susceptible to age-related degenerative conditions and traumatic injury. In the not-too-distant future, it will be possible to repair heart tissue damaged by myocardial infarction, to replace neuronal cells lost in Parkinson's disease and traumatic brain injuries, to transplant new insulin producing cells for diabetics and myelinating cells for individuals afflicted with multiple sclerosis, and to replace bone and cartilage lost through aging and inflammatory disease. In addition, the generation of specific populations of defined subtypes of human cells has tremendous potential to revolutionize the fields of drug discovery and investigation into the cellular bases of human disease. The newly emerging field of Regenerative Medicine will fundamentally alter clinical medicine and significantly influence our perceptions of aging, health and disease, with a myriad of consequences for society at large.

Lucie Vidovičová

Five (or so) questions that the pre-longevity society should be asking, but it is not...

Health and longevity are important topics for medicine and biology, but they do not exist in a social vacuum. On the contrary, recent studies suggest that social networks, socio-environmental factors, population structures and socio-demographic characteristics play a key role in health and longevity efforts and outcomes. Moreover, any major breakthrough in the field of longevity will inevitably trigger an urgent need to rethink our individual life trajectories as well as social structures and institutions.

In this presentation, I will offer eclectic points based on a sociological perspective and an understanding of how societies are (un)prepared for the next big step(s) towards longevity. Using surveys of attitudes towards how we (including lay actors, professionals, policy makers...) think about life, education, knowledge or the labour market today, I will present specific challenges for longevity societies. I will reflect on whether "hatred of old age" and "preference to stay young" are "sufficient ". Last but not least, I would like to engage in a conversation about who are the (un)expected proponents of anti-ageing and how this may affect longevity as a concept.

Petr Sramek

Healthy Longevity solutions landscape and the sector outlook

Expanding our healthspan is a complex problem requiring complex solutions and an interdisciplinary approach. We need to support the translation of scientific advances, allow regulatory approvals related to aging itself, and build business infrastructure for a full democratization of access.

My lecture will frame the main problems and opportunities and also describe promising solution examples from the LongevityTech.fund portfolio, including diagnostics methods and therapeutic solutions. We will see advanced solutions addressing mitochondria function, DNA repair, telomere shortening, senescent cells, protein deregulation, tissue engineering, and signalling molecules in the blood. Diagnostic methods will include novel biomarkers based on single-cell sequencing, brain analysis and cheap proteomics.

The main part will focus on estimating the most successful solution trajectory, including various options on how to affect the broader worldwide population.

Didier Couernelle

Steps to implement Open Longevity GPT

In the realm of data, where a staggering 30% of big data is comprised of invaluable health-related information, the processes of sharing and curating these vast resources have been characterized by a sluggish and intricate nature. Addressing this issue, a promising avenue emerges: the development of a tool akin to ChatGPT, armed with a substantial repository of scientific articles and extensive health data. Such a tool holds the potential not only to facilitate but also to actively engage in theoretical research pertaining to longevity therapies. Crucially, this tool's deployment should align with principles of openness, manifesting as both an "open source" platform and one that promotes accessible results. The upcoming presentation will delve into several key facets of this proposal, including the current challenges associated with insufficient data accessibility and the prevailing trend of privatization in health data. Additionally, it will explore the perspectives within the European Health Data Space and delve into specific projects led by open AI initiatives aimed at advancing longevity research. Lastly, the presentation will consider the potential costs and benefits inherent to this transformative approach.

Patrick Linden

The ethics of longevity and how to change pro-death attitudes

The general public is often quite hesitant to support radical life extension and the notion of biological immortality seems to frighten many. The resistance is often seemingly morally motivated. People worry about adverse social consequences of living longer, and see the search for a longer life as selfish and morally suspect. There is, as I have argued in my book *The Case against Death*, in fact a perennial philosophy of death-acceptance and even celebration of death, running alongside the human wish to transcend the naturally given limit to our life. In this talk I will describe this death-ist ideology and argue that morality is on the side of those who seek to expand the human life span by curing aging.

Aubrey de Grey

Taking rejuvenation research to escape velocity

People are living longer - no longer because of reduced child mortality, but because we are postponing the ill-health of old age. But we've seen nothing yet: regenerative medicine and other new therapies will eventually be so comprehensive that people will stay truly youthful however long they live, which means they may mostly live very long indeed. Advances in this direction by my research teams and others have sharply accelerated in recent years, and at LEV Foundation we are combining them to identify a panel of interventions that promise to deliver the ultimate goal of biomedical gerontology: longevity escape velocity.

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INFORMACIJSKA DRUŽBA – IS 2023
Zvezek J

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Legende računalništva in informatike
Legends of Computing and Informatics

Urednika / Editors

Tone Stanovnik, Matjaž Gams

<http://is.ijs.si>

10. oktober 2023 / 10 October 2023
Ljubljana, Slovenia

PREDGOVOR

V 2023 nadaljujemo z novim konceptom promovirati slovensko računalništvo in informatiko. To so »Legende računalništva in informatike« (Krajše »Legende RI« ali kar »legende«) s podnaslovom »Galerija slavnih slovenskega računalništva in informatike«, angleško »Hall of fame of Slovenian computer science and informatics«.

Motiv je, da stroka sama da priznanja pomembnim raziskovalcem, razvojnikom in inženirjem na področju RI, hkrati pa zberemo pomembne avtobiografske prispevke v obliki zapisa slovenske zgodovine RI, torej sledimo dvema ciljema hkrati. Strokovnost brez politike in ideologije, demokratičnost in transparentnost so dominantne komponente postopka Legend RI. Škoda bi bila tudi, da ne bi nekateri pomembni posamezniki nikjer zbrano predstavili svojega dela. Po drugi strani pa pogledjmo samo Alana Turinga, ki je eden najpomembnejših računalničarjev vseh časov, a je bil namesto nagrade obsojen in kaznovan zaradi svoje usmerjenosti, ne da bi komurkoli storil kaj žalega. Pričakujemo, da bo programski odbor nagradil vse pomembne računalničarje s priznanjem "Legenda" glede na njihov dejanski prispevek.

Vsak začetek je težak, zato je bilo tudi nekaj začetniških spodrseljajev, a sedaj imamo programski odbor, ki odloča z glasovanjem o vseh pomembnih točkah. Tako je bilo izglasovano ime dogodka, da so dobitniki nagrade Michie-Turing brez glasovanja sprejeti po poslanem referatu na konferenco, ki hkrati služi kot avtobiografska zgodovina. Podobno naj bi veljalo za zelo pomembne mednarodne nagrade (o zadostni pomembnosti glasuje programski odbor) ne pa tudi za nacionalne nagrade. Nagrad naj bi bilo prvo leto med 10 in 20. Absolutna zgornja meja naj bi bila okoli 50. Ker naj bi preprečili, da kdorkoli glasuje zase, bo volilna komisija multikonference Informacijska družba (IS) preverila vsako volilnico posebej.

Pošiljanje predlogov je odprto, pričakovano pa predvsem s strani društev ACM Slovenija in SLAIS. Volilna komisija legend je kar standardna IS komisija. Rezultati so predani naprej samo v zbirni obliki, to je v številu glasov. Predlog je potrjen, ko je zanj več kot pol oddanih glasovnic z ZA in ne presega dogovorjene letne ali absolutne meje – v tem primeru odloča vrstni red. V letu 2023 imamo le 4 povsem nove predloge.

Predlog za legendo mora biti v obliki 2-4 stranskega prispevka za konferenco IS v pravem formatu, podkrepljen z literaturo. Predlog lahko poda vsak zase, kandidira pa lahko tudi koga drugega. Vsak lahko hkrati napiše več predlogov. Pri posthumni kandidaturi je potrebno pridobiti soglasje najbližjih svojcev. Prispevek velja urediti podobno kot življenjepis oz. CVI, s tem da izpostavljamose dosežke in ne osebne lastnosti. Dosežke velja strukturirati, recimo znanstveno, prenosi v prakso, pedagoško, organizacijsko, a zaenkrat je tu precej svobode.

S tem novim mehanizmom skušamo dodatno promovirati slovensko računalništvo in informatiko ter informacijsko družbo. Prosiva za sodelovanje, podporo, ali vsaj za strpnost in razumevanje. In seveda, iskrena hvala vsem sodelujočim in čestitke sedanjim in bodočim nagrajencem!

Tone Stanovnik in Matjaž Gams

PROGRAMSKI ODBOR / PROGRAMME COMMITTEE

Gams Matjaž
Stanovnik Tone
Batagelj Marjan
Bavec Cene
Bohanec Marko
Bratko Ivan
Bric Rudi
Brodnik Andrej
Džeroski Sašo
Gornik Tomaž
Grad Janez
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Hafner Izidor
Horvat Bogomir
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Leskovar Robert
Luštrek Mitja
Mernik Marjan
Mongus Domen
Petkovšek Marko
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Škedelj Franc
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Trampuž Cveto
Trček Denis
Turk Žiga
Virant Jernej
Volk Mira
Zakrajšek Egon
Zimic Niko
Zupan Blaž
Žalik Borut
Železnikar Anton
Žerko Miha

Dosežki kandidata A. P. Železnikarja

Achievements of the Candidate A. P. Železnikar

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POVZETEK

Prispevek obravnava znanstveno raziskovalno in pedagoško delo pionirja računalniških znanosti v Sloveniji in bivši Jugoslaviji, prof. dr. Antona P. Železnikarja, njegovo vlogo na Inštitutu Jožef Stefan, v Iskri Delti in v akademskem okolju.

KLJUČNE BESEDE

Doživljenjski dosežki, znanost, gospodarstvo, družbeno delo

ABSTRACT

The paper deals with the scientific research and pedagogical work of the pioneer of computer science in Slovenia and the former Yugoslavia, prof. dr. Anton P. Železnikar, his role at the Jožef Stefan Institute, in Iskra Delta and in the academic environment.

KEYWORDS

Lifetime achievements, science, economy, social work

1 UVOD

Anton Pavel Železnikar (slika 1) se je rodil v družini kirurga Vinka Železnikarja. Po končani gimnaziji v Mariboru, kjer je maturiral leta 1948, je postal študent Tehniške fakultete in kasneje Fakultete za elektrotehniko Univerze v Ljubljani.

Njegovi ugledni učitelji v tistem času so bili J. Plemelj (matematika), A. Peterlin (fizika) in V. Koželj (teoretična elektrotehnika). Diplomsko delo je zagovarjal leta 1956 z naslovom "Magnetostriksijska spominska zanka", ki je del amplitudnega analizatorja. Magisterij je opravil leta 1966, nato pa je leta 1967 doktoriral z disertacijo z naslovom "Splošna teorija substitucijskih algoritmov in njena povezava z digitalnimi avtomati".

Od leta 1955 do 1980 je bil zaposlen na Inštitutu Jožef Stefan, na Oddelku za elektroniko. Njegovo delo je bilo usmerjeno v takrat nastajajočo digitalno tehniko z uporabo vakuumskih cevi in tranzistorjev. Na tej poti se je zavedel pomena sodobne tehnologije, ki sega globoko v sofisticirano računalniško in programsko opremo, inženiring in raziskave. Od leta 1961 do 1978 je bil vodja Odseka za digitalno tehniko in od 1968 do 1978 tudi načelnik Oddelka za elektroniko Inštituta Jožef Stefan. V letu 1968 je postal docent in 1972 izredni profesor na Univerzi v Ljubljani ter bil leta 1982 izvoljen za rednega profesorja za predmet Prevajalniki. Na Tehniški fakulteti Univerze v Mariboru je predaval filozofijo in teorijo informatike.



Slika 1: Prof. dr. A. P. Železnikar ob 80-letnici rojstva.

Leta 1980 se je preselil v hitro rastoče slovensko podjetje Iskra-Delta Computers, kjer je ostal do svoje upokojitve leta 1990. V podjetju je med leti 1980 opravljal funkcijo vodje mikroročalnškega laboratorija.

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Slika 2: dr Železnikar v Razvojnem centru Iskra Delte

Bil je avtor koncepta paralelnega procesiranja iz česar je nastal inovativen računalnik Triglav - Trident, ki je imel 3 procesorje. Leta 1982 je napredoval v svetovalca generalnega direktorja Iskra-Delta Computers in postal član uprave za strategijo raziskav in razvoja korporacije Iskra, kjer je ostal do konca svoje delovne kariere.

Med letoma 1967 in 1975 je bil prof. dr. Anton Pavel Železnikar predstavnik v Mednarodnem združenju za informatiko (International Federation for Information Processing - IFIP) in leta 1971 je organiziral svetovni kongres IFIP v Ljubljani.



Slika 3: svetovni kongres IFIP v Ljubljani 1971

V zgodnjih 70 letih je bil član programskega odbora jugoslovanskega mednarodnega simpozija o obravnavanju podatkov FCIP, ki je vsako leto potekal na Bledu. Od leta 1976 do 1981 je bil predsednik Slovenskega društva INFORMATIKA, nato pa je od leta 1977 naprej prevzel tudi vlogo urednika časopisa Informatica.



Slika 4: dr Železnikar na konferenci Mipro 1983

V svojem raziskovalnem delu se je prof. dr. Železnikar osredotočil na teorijo preklopnih vezij, funkcijo algebralne logike, avtomatiko, algoritme, informacijsko logiko, paralelne računalniške sisteme, pa tudi strategijo računalniške industrije. Od leta 1980 se je predvsem posvečal področju umetne inteligence in zavesti. Ob njegovi sedemdesetletnici so na univerzi Charleton v Illinoisu, ZDA, priredili konferenco o filozofiji in znanosti, na kateri je imel pomembne referate. Za svoje delovanje je prejel več priznanj.

2 RAZISKOVALNO DELO

Prof. dr. Anton Pavel Železnikar je večino svojega življenja posvetil raziskovanju informacijske teorije, vključno s filozofijo informacijskega fenomenalizma, teorijo informacijskih pojavov, informacijskimi stroji in informacijskimi operacijskimi sistemi, informacijskimi raziskavami v literaturi, medijih, komunikaciji s pomočjo teorije in strojev, informacijsko teorijo zavesti ter programiranjem informacijskih entitet [2].

V svoji dolgi in plodni znanstveni karieri je objavil več kot 100 znanstvenih in raziskovalnih člankov v štirih jezikih ter 2 knjigi.

Objavil je razprave v različnih časopisih, med drugim:

Telefunken-Zg (Frankfurt, 1954: Die geometrische Transformation von Impedanzdiagrammen), EV (1957: Magnetostriksijski vod), Glasnik matematično fizički i astronomski (Zgb, 1960: Problemi rešljivosti propozicijskih

enačb; 1962: Nekateri aritmetični normalni algoritmi, Behandlung logistischer Probleme mit Ziffernrechner), Elektrotehnika (1964: Opombe o programiranih abstraktnih avtomatih), Mathematical systems theory (New York, 1967: Prekrivajoči se algoritmi), Automatika (Zgb, 1975: Uvod v normalne informacijske sisteme), Informatica (1987: Na poti do informacij; 1988/9: Informacijska logika; 1989: Informacijski principi in formalizacija), Cybernetica (Namur, Belgija, 1988:

Načela informacij; 1988, 1989: Določitve informacij I, II) in druge. Poleg tega je napisal več priročnikov za visokošolski študij, med njimi: Some algorithm theory and its applicability (1963), Splošna teorija substitucijskih algoritmov in njena povezava z digitalnimi avtomati (1966), Formalni jeziki in problemi analize (1968), A parsing concept for a high-level programming language (1968), Prekrivni jeziki I, II (1968, 1969), Linear overlapping algorithms (1969), Linear overplanning languages (1969), Jezik in jezikovno prevajanje I, II (1970, 1971), Prevajalniki (1977).

3 ZAKLJUČEK

Dr. Anton P. Železnikar je bil eden od vizionarjev slovenske informatike. Videl je več korakov naprej. Za svoje delo je bil večkrat nagrajen s strani Nacionalne znanstvene ustanove in drugih strokovnih združenj iz bivše Jugoslavije med leti 1968 – 1990. Je član Mednarodne akademije znanosti San Marino, Kibernetske akademije Stefan Odobleja, Lugano in Mednarodnega združenja za kibernetiko, Belgija.

VIRI

- [1] Wikipedija https://sl.wikipedia.org/wiki/Anton_%C5%BDeleznikar
- [2] Sitar Sandi. »Železnikar Anton«. Slovenski biografski leksikon. Slovenska biografija. Ljubljana: ZRC SAZU, 2013.
- [3] <https://www.dlib.si/stream/URN:NBN:SI:doc-IZ841WKS/b6063f65-a43c-43ed-aa70-d96f83cfbec/PDF>

Dosežki kandidata Saše Divjaka

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POVZETEK

Prispevek govori predvsem o delovanju Saše Divjaka na področju pedagoške dejavnosti, se pa prepleta z razvojno raziskovalnim delom, vezanim na nacionalne in mednarodne projekte s področja računalniške avtomatizacije, simulacije procesov in uporabe računalnikov v izobraževalnih procesih

KLJUČNE BESEDE

Saša Divjak, Doživljenjski dosežki, pedagoška in razvojno raziskovalna dejavnost

ABSTRACT

The paper mainly talks about the achievements of Saša Divjak in the field of pedagogical activity, but it is intertwined with development research work related to national and international projects in the field of computer automation, process simulation and the use of computers in co-educational processes.

KEYWORDS

Saša Divjak, Lifetime achievements, pedagogical and developmental research activity

1 UVOD

Pred pisanjem tega sestavka sem vprašal ChatGPT, kdo je legenda. In dobil naslednji odgovor:

“Legenda je oseba, ki je pridobila izjemen ugled zaradi svojih dosežkov, vpliva, izjemnih sposobnosti ali kvalitet, ki so priznane in cenjene v določenem področju ali skupnosti. Legende so navadno znane osebnosti, ki so presegle običajne meje in postale ikone v svojem polju.

Na splošno je težko določiti eno samo osebo kot legendo, saj se pojmovanje legende lahko razlikuje glede na kontekst. Legende se lahko pojavijo v različnih področjih, kot so znanost, umetnost, šport, glasba, literatura, politika in še mnoga druga.

Na univerzi se lahko legenda nanaša na osebo, ki ima izjemen ugled in je priznana zaradi svojih dosežkov, prispevkov ali vpliva na univerzitetno skupnost. To je lahko profesor, raziskovalec,

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administrator ali celo študent, ki je izstopal in pustil trajen pečat na univerzi.”

In potem sem dodatno vprašal, ali je lahko legenda tudi učitelj. ChatGPT nato razloži, da legenda na univerzi lahko vključuje tudi učitelja. Učitelj, ki ima izjemen ugled, je priznan zaradi svoje predanosti poučevanju, navdušenja študentov, inovativnih pristopov k poučevanju ali pa ima dolgoletno zapuščino, ki je zaznamovala generacije študentov.

Glede na to, da je Saša Divjak deloval kot pedagog več kot 43 let, še pred začetkom študija računalništva in informatike na ljubljanski Univerzi, je tak pečat verjetno zapustil. Preko njegovih predavanj je šlo na tisoče študentov in več kot 400 diplomantov in še danes ga mnogi ogovarjajo na srečanjih na kakšni konferenci, pa tudi na cesti.

2 PRVI KORAKI

Saša Divjak je bil skoraj celotno obdobje zaposlen na Fakulteti za elektrotehniko, kasneje na Fakulteti za računalništvo in informatiko. Ljubljanske Univerze. In skoraj ves čas je to delo združeval z dodatno zaposlitvijo, najprej na Inštitutu Jožef Stefan, kasneje pa 10 let v Iskri Delti.

Dejavnost S. Divjaka bi lahko razdelili v dve obdobji: V prvem se je strokovno ukvarjal predvsem s področjem računalniške avtomatizacije in robotizacije, drug del pa je bil bolj posvečen multimedijijskim tehnologijam s poudarkom na izobraževanju.

Vse se je začelo v letu 1967 s prvimi stiki z računalnikom Zuse, posebej pa zaznamovalo z diplomom pri profesorju Gyergyeku in prof. Bremšaku. Tematika diplome je bila računalniška simulacija regulacije nuklearnega reaktorja, motene z naključnimi šumi. Delo je potekalo na računalniku IBM1130, ki pa ga takrat v Ljubljani še nismo imeli, torej na Univerzi v Zagrebu. Ta simulacija s programom CSMP (Continuous System Modelling Program) je vplivala na večino kasnejšega razvojno raziskovalnega dela Saše Divjaka vse do današnjih dni. Tako bi lahko ta sestavek imel tudi naslov “Računalniške simulacije - od luknjanih kartic do spletnih tehnologij”. Simulacija nuklearnega reaktorja je bila predstavljena na konferenci ETAN 1969. Predstavitev je bila nagrajena.

Ko smo na ljubljanski Univerzi dobili prva računalnika IBM 1130 (najprej na FMF, nato še na Fakulteti za elektrotehniko) je

Saša Divjak izpopolnil takrat popularen in obsežen simulacijski paket ECAP, ki je bil namenjen simulaciji električnih vezij. Programiranje je potekalo v jeziku Fortran in seveda še vedno z luknjanimi karticami. Ena od posledic diplome je bila zaposlitev na Inštitutu Jožef Stefan in nosilstvo naloge "Računalniški nadzor nuklearnega reaktorja Triga". Uporabljeni računalnik je bil CDC1700, programiranje je potekalo v zbirnem jeziku in seveda z luknjanimi trakovi. Na IJS je Saša Divjak takrat prevzel vodstvo Odseka za avtomatiko, čez nekaj let pa je za prof. Železnikarjem postal načelnik Oddelka za elektroniko. Sočasno je nastopil svoje redno delovno razmerje kot asistent pri programerskih predmetih (Fortran in zbirni jezik) pri prof. Hodžarju na Fakulteti za elektrotehniko. Tako se je dejavnost na IJS in na fakulteti prepletala in medsebojno vplivala.

3 PRVA DESETLETJA

Saša Divjak je v tem času razvil več programov za simulacijo dinamičnih procesov in simulacijo elektronskih vezij. Največjo uspešnico je predstavljal HYSIM (Hybrid Simulation), ki so ga kot orodje več let na Fakulteti za elektrotehniko uporabljali tudi pri nekaterih magisterijih in diplomah. Omogočal je združeno simulacijo zveznih sistemov in diskretnih dogodkov in je v tem smislu predstavljal novost. Razvoj tega simulacijskega sistema je bil tudi rezultat njegovega magistrskega in doktorskega dela. Tekel je na IBM1130 in seveda še vedno s pomočjo luknjanih kartic. HYSIM so namestili tudi na eni od francoskih fakultet.

V letih delovanja na IJS je S. Divjak sodeloval pri različnih projektih industrijske avtomatizacije in na koncu bil soavtor programske opreme prvih jugoslovanskih (industrijskih) robotov. Njegovo področje je bilo tedaj predvsem nizkonivojsko programiranje v zbirnem jeziku za krmiljenje različnih računalniških periferij, torej gonilnikov. V primeru uspešnega in nagrajenega projekta računalniške avtomatizacije spektrometra za firmo Carl Zeiss je tako razvil originalen programski jezik in z njim programsko aplikacijo za ta spektrometer. Sama računalniška zasnova pa je bila prav tako inovativna in je bil njen avtor ter nosilec projekta prof.dr. Jurij Tasič.

Za potrebe razvoja programske opreme je tudi razvil univerzalni križni zbirnik za različne vrste mikroprocesorjev, ki je bistveno olajšal programiranje namenskih aplikacij.

V zadnjih letih tega obdobja je S. Divjak sodeloval kot soavtor programske opreme pri projektih prvih industrijskih robotov v Jugoslaviji. Zanje je razvil tudi večprocesni operacijski sistem, pa računalniški simulator robota, podprt z računalniško grafiko. Te izkušnje so prišle prav, ko je koncem 80tih let nekaj let predaval robotiko na Univerzi v Vidmu, pa tudi v sklopu projekta "Tovarne prihodnosti" v Furlaniji Julijski krajini.

V 80 letih je namesto IJS prejel vzporedno zaposlitev (poleg rednega razmerja na fakulteti) v Iskri Delti, kjer je nekaj let vodil izobraževalni center in nato prevzel mesto pomočnika direktorja. Iskra Delta je med drugim vsako leto prirajala zelo obiskane letne šole, posvečene najnovejšim tehnologijam. To je še bilo obdobje klasičnih diapozitivov in grafoskopov. Uspešno rešen izziv so bila sočasna, sinhronizirana predavanja v več vzporednih predavalnicah (takrat Interneta še ni bilo).

V času, ko je kot gostujoči profesor predaval na Univerzi v Vidmu, je v Italiji tudi sodeloval z razvojem programske opreme nekaterih gospodarskih in industrijskih avtomatizacij.

V tem času je (tudi zaradi svoje dejavnosti v Italiji) za slovensko RTV posnel serijo izobraževalnih oddaj na temo "Tovarne prihodnosti" in kasneje na temo "Profil računalniškega tehnika". Saša Divjak se je udeležil tudi delavnice British Council v Edinburghu z naslovom "Education for Engineering". Ta mednarodna delavnica je bistveno vplivala na njegovo bodoče pedagoško delo s tezo, da je bistvo poučevanja proces, ki se dogaja v glavi študenta in ne učitelja. Ta proces ni enkraten dogodek, upoštevati je potrebno tudi raznolikosti profilov študentov in dvigovati njihovo motivacijo.

V programerskem smislu se je takrat spoznal s programiranjem v jeziku C in ga kot prvi uvedel na takratni Fakulteti za elektrotehniko in računalništvo. Glede na to, da je bil ta predmet v prvem letniku, so skozi ta predavanja šli skoraj vsi študenti računalništva in informatike. Pri predmetih Systemska programska oprema in Operacijski sistemi pa je uvedel Unix, predhodnik današnjega Linuxa. Saša Divjak je bil predstojnik Laboratorija za računalniško grafiko in multimedije. Imeli so več nacionalnih in mednarodnih projektov, usmerjenih v uporabo multimedijskih in spletnih tehnologij v izobraževanju.

Zaradi dobrih povezav z vodstvi največjih računalniških hiš (HP, Microsoft, IBM, Marand, Sun,...) so se takrat na fakulteti pojavile dodatne računalniške učilnice s takrat cenjenimi delovnimi postajami za katere pa je bilo potrebno tudi skrbeti. Del denarja iz različnih projektov laboratorija je tako usmeril v posodabljanje in vzdrževanje te opreme. Danes je vzdrževanje vseh računalniških učilnic sistemsko rešeno na nivoju fakultete, računalniške delove postaje pa so praktično izumrle.

Za študente višjih letnikov je uvedel program SRP (Student Research Program, študentski raziskovalni program), katerega bistvo je bilo uvajanje študentov v razvojne dejavnosti in navezovanje stikov teh študentov z večjimi računalniškimi hišami v Sloveniji. Danes bi temu rekli inkubatorske delavnice, valilnice, takrat pa je to pomenilo večjo odprtost laboratorija in njegove opreme študentom, ki so razvijali različne projekte na področju multimedijskih tehnologij vse do prvih korakov v navidezno resničnost. Na koncu vsakega leta je sledila predstavitev študentskih projektov vodstvom IBM, Microsoft, Marand, Oracle in drugim pomembnim hišam. Tak pristop je večal motivacijo študentov, vplival na opremljenost študentskih laboratorijev in ne nazadnje omogočal navezave med računalniškimi hišami in dobrimi študenti.

4 NASLEDNJA DESETLETJA

V sredini 90 let se je kot programski jezik pojavila Java in Saša Divjak jo je prvi uvedel tudi pri svojih predmetih. Kar precej projektov laboratorija je bilo usmerjenih v spletne in multimedijske tehnologije v izobraževanju. Posledično so sodelavci laboratorija vsako leto organizirali poletne šole za srednješolske in osnovnošolske učitelje, pa tudi (v sodelovanju z ZOTKS) poletne šole za dijake. Vsebina so bile seveda multimedijske in spletne tehnologije v izobraževanju. Leta 2000

(torej daleč pred danes uveljavljenimi videokonferencami) smo uvedli (s pomočjo Arnes, TSE Trade in Telekom) videokonferenčne poletne šole, ki so povezale tudi več kot 190 udeležencev iz 11 slovenskih mest v enotno skupnost. Danes to ni nič posebnega, takrat pa so to bili pionirski koraki.

V tem času je Saša Divjak za popularizacijo programiranja tudi posnel serijo 10 predavanj o programskem jeziku Java, ki so jo predvajali po takratni televiziji TevePika.

Saša Divjak je bil tudi član Programskega odbora nacionalnega projekta Ro (Računalniško opismenjevanje). V sklopu tega projekta je bil tudi aktiven pri organizaciji vsakoletnih izobraževalnih konferenc, tudi s plenarnimi predavanji, posvečenimi multimedijским inovacijam na področju izobraževanja.

V letu 2006 bil S.Divjak nosilec projekta e-gradiv za računalništvo in informatiko, ki je povezoval več 10 sodelavcev, tudi iz različnih srednjih šol. V sklopu teh gradiv je bilo razvito tudi spletišče, katerega del Saša Divjak še sedaj stalno posodablja (z leti se stvari na področju IKT hitro spreminjajo in tudi zastarajo). Seveda je bilo v času projekta izvedenih več seminarjev za srednješolske učitelje računalništva in informatike iz vse Slovenije.

V letih 2008 - 2018 je Zavod za šolstvo RS organiziral konferenco SirIKT, ki je bila priložnost za izmenjavo izkušenj med vsemi pedagoškimi delavci, učenci in dijaki, ki pri svojem delu uporabljajo sodobna orodja digitalne dobe, v kateri živimo, in drugimi uporabniki omrežja Arnes na vseh ravneh ter področjih izobraževanja in raziskovanja. Konference se je udeleževalo tudi več kot 1200 udeležencev, na plenarnih predavanjih pa jih je bilo 400-600. Uvedli so novost, da naj bi bila tudi tako obsežna predavanja čimbolj interaktivna. Saša Divjak je v ta namen razvil glasovalni sistem Kliker, ki ga še danes najdemo med spletnimi aplikacijami Arnes. V današnjem času je seveda takšnih glasovalnih sistemov več, takrat pa so to bili pionirski koraki. Za potrebe konference je tudi poslovenil oziroma lokaliziral obsežno spletno aplikacijo za upravljanje konferenc.

Kliker je Saša Divjak uporabljal tudi v okviru svojih rednih predavanj na Fakulteti za računalništvo in informatiko in vzpodbujal študente za uporabo prenosnih naprav (večinoma notesnikov) pri predavanjih. Taka predavanja so bila kljub populaciji cca 180 študentov bolj interaktivna, so pa se zato posledično bolj zavlekla. Rešitev je S. Divjak našel v dodatnih, neobveznih večernih videokonferenčnih predavanjih, ki se jih je udeleževalo cca 80 študentov. Ker so bila snemana, so doživela, kljub strokovni specifičnosti vsebine, tudi več kot 1000 obiskov.

Ob zaključku svoje delovne kariere je Saša Divjak imel tudi več predavanj o sodobnih računalniških tehnologijah za slovenske srednješolske učitelje v Furlaniji Julijski krajini.

Pa se povrnimo k simulacijam: Sodelovanje v mednarodnih projektih je pomenilo tudi sodelovanje v različnih združenjih (predvsem CoLoS (Conceptual Learning of Science) in HSci

(Hands on Science)), ki je povezovalo pedagoge in raziskovalce iz več kot 20 univerz. Zlasti prvo od obeh združenj je bilo usmerjeno v razvoj interaktivnih računalniških simulacij, večinoma na področju fizike, pa tudi drugih naravoslovnih ved. V okviru tega mednarodnega sodelovanja je Saša Divjak razvil vrsto lastnih simulacijskih programov predvsem s področja fizike, seveda pisanih v Javi, v zadnjih letih pa v JavaScript. Istočasno pa je tudi poslovenil vrsto izobraževalnih aplikacij tujih avtorjev (seveda v sodelovanju z njimi) in jih tako približal uporabi v slovenskih šolah.

Saša Divjak je bil član različnih programskih odborov domačih in mednarodnih konferenc. V IEEE je bil predsednik slovenske sekcije, v združenju HSci (Hands on Science) je bil izvoljen predsednik skupščine, v združenju CoLoS (Conceptual Learning of Science) je bil izvoljen za predsednika združenja, v Evropski akademiji znanosti s sedežem v Liegu (Evropskih akademij znanosti je več) je bil več let izvoljen v Presidium in en mandat tudi izvoljen predsednik te akademije)

5 ZAKLJUČEK

Preklop na prvo osebo ednine:

Še vedno predavam na univerzitetnem nivoju in še vedno programiram. Sedaj na nivoju spletnih tehnologij in trenutno predvsem simulacije s področja kibernetike varnosti. In občasno srečujem svoje bivše študente, ki si jih vseh niti nisem mogel zapomniti, pa me to vseeno prijetno pogreje. In kdaj pa kdaj tudi čujem pripombo "legenda". Tako pripombo zasledim tudi na spletnih straneh, ki so jih študentje pisali pri komentiranju svojih profesorjev. In pomislim: No če študentje tako pravijo, pa sem verjetno res tudi sam s kakšnim kamenčkom v razburkano morje računalništva in informatike povzročil kakšen koristen val.

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POVZETEK

V prispevku so povzeti kratki opisi razvojno-raziskovalnega, pedagoškega in vodstvenega delovanja ter dosežki prof. dr. Janez Grada v okviru Instituta Jožef Stefan, Univerze v Ljubljani, Univerze v Mariboru in pedagoških ter znanstveno-raziskovalnih institucij v tujini, kjer je delal več let. Delo je spadalo na področja računalniško usmerjene aplikativne matematike, računalništva in poslovne informatike.

KLJUČNE BESEDE

Pedagoška dejavnost, raziskovalna dejavnost, vodstvena dejavnost, uporabniška matematika, računalništvo, poslovna informatika, lastne vrednosti matrik, baze podatkov, operacijsko raziskovanje

ABSTRACT

The paper presents some information of prof. dr. Janez Grad engagements and achievements in the fields of developmental research, pedagogical process and management that he has carried out at the Institute Jožef Stefan, Ljubljana, the Universities of Ljubljana and Maribor and foreign universities and research institutions. His work took place within computer oriented applied mathematics, computer science and business informatics.

KEYWORDS

Teaching, research, management, applied mathematics, computer science, business informatics, matrix eigenvalues, data bases, operational research

1 UVOD

Janez Grad se je rodil 13.8.1933 v vasi Petelinje, v občini Dol pri Ljubljani. Diplomiral je 1958. leta iz matematike na Naravoslovni fakulteti Univerze v Ljubljani. Med njegovimi univerzitetnimi učitelji so bili tudi profesorji dr. J. Plemelj, dr. I. Vidav in dr. A. Peterlin. Leta 1968 je magistriral iz matematične

fizike na Univerzi v Birminghamu, Anglija, leta 1973 pa doktoriral iz matematičnih znanosti na Vseučilišču v Zagrebu, somentor je bil prof. dr. Z. Bohte.

2 RAZISKOVALNO IN VODSTVENO DELO NA NIJS OZIROMA IJS

Leta 1957 se je zaposlil na Institutu "Jožef Stefan"(IJS), takrat imenovanim Nuklearni institut "Jožef Stefan"(NIJS), kot strokovni sodelavec in kasneje kot operativni vodja Republiškega računskega centra(RRC), formalno enote NIJS. Njegova naloga je bila prevedba fizikalnih problemov v matematični zapis in njihovo reševanje, najprej s pomočjo kalkulatorja FACIT, nato pa s pomočjo računalnikov IBM 705, ZUSE Z-23 in CDC 3300, ko je tudi skrbel za delovanje računalnika ZUSE Z-23 in kasneje, kot operativni vodja RRC, za računalnik CDC 3300. Partnerji v RRC so bili Univerza v Ljubljani, Izvršni svet RS in ZP Iskra.

Za izučitev za programerja na IBM 705 ga je NIJS leta 1961 poslal na 4-mesečno izpopolnjevanje na Zvezni zavod za statistiko v Beogradu, skupaj s kolegom Cvetom Trampužem. S pomočjo programov za IBM 705 so bili kasneje izračunani določeni parametri v okviru raziskovalnega projekta "FIZIKALNI PRORAČUNI ZA YEGGR", Ljubljana,1962, (študija: nuklearna centrala z grafitnim, plinsko hlajenim reaktorjem na obogačeni uran), nosilec naloge je bil dr. ing. M. Osredkar, načelnik reaktorskega oddelka pa dr. M. Čopič. J.

Grad je kot soavtor sodeloval tudi pri dveh referatih v okviru "Simpozija reaktorske fizike", NIJS, 20.-22. 3. 1963.

IJS je dr. Gradu omogočil uspešno znanstveno-strokovno dejavnost s tem, da mu je že v jeseni leta 1961 omogočil 8-mesečno strokovno izpopolnjevanje na Institut fuer Strahlen und Kerphysik v Bonnu, Nemčija, kjer je na računalnikih ER-56 in IBM-1410, v lasti Institut fuer Instrumentelle Mathematik v Bonnu, reševal probleme, povezane z delovanjem ciklotrona (Laplace-jeve transformacije integralno-diferencialnih enačb). Nadalje je IJS dr. Gradu omogočil 2-letno specializacijo v Računalniškem centru Univerze v Birminghamu, Anglija, kjer je na Oddelku za matematiko in fiziko tudi magistriral z delom "Some Topics in the Numerical Solution of the Algebraic Eigenvalue Problem" in imel več predavanj s področja uporabniške matematike.

*Article Title Footnote needs to be captured as Title Note

†Author Footnote to be captured as Author Note

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3 PEDAGOŠKO, RAZISKOVALNO IN VODSTVENO DELO NA UNIVERZAH V LJUBLJANI IN MARIBORU

Leta 1972 se je J. Grad zaposlil na Univerzi v Ljubljani kot predstojnik Računalniškega centra Univerze v Ljubljani(RCU); predstojnik je bil nato vse do konca leta 1981. V obdobju okrog leta 1977 je RCU izvajal tudi strokovna in tehnična dela za Raziskovalno skupnost Slovenije, ki je bila v okviru Jugoslavije izbrana za zveznega koordinatorskega mednarodnega projekta COST 12 – Evropska programska knjižnica(COST – Cooperation scientifique et technique). Od leta 1973 do leta 1999 je sodeloval kot učitelj za informatiko na Ekonomski fakulteti v Ljubljani, najprej kot docent, od leta 1979 dalje kot izredni profesor, od 1985 pa kot redni profesor, kasneje, do upokojitve leta 2007 je poučeval informatiko še na Fakulteti za upravo v Ljubljani. Poleg pedagoškega in raziskovalnega dela je na Ekonomski fakulteti opravljal še druga dela in naloge, tako je bil na primer, med drugim, prodekan za gospodarske zadeve, vodja Podiplomskega programa informacijsko upravljavskih ved, predstojnik Katedre za informatiko, delegat v delavskem svetu ISKRE DELTA(1988), član in kasneje tudi predsednik Strokovnega sveta za računalništvo na univerzi v Ljubljani(1986-1989). Na Fakulteti za upravo pa je oblikoval dodiplomski in podiplomski študijski program v skladu z Bolonjsko deklaracijo. Računalništvo je predaval tudi na Višji upravni šoli v Ljubljani, Filozofski in Medicinski fakulteti ter FSPN Univerze v Ljubljani, in še na podiplomskem študiju Ekonomsko poslovne fakultete Univerze v Mariboru; na Tehniški fakulteti v Mariboru je bil tudi somentor pri doktorskih disertacijah.

V letu 1973 je 6 tednov raziskoval v Department of Mathematics, Statistics and Computing Science, the University of Calgary, Kanada, v jeseni 1986 pa je bil gostujoči profesor na Univerzi v Indiani, Graduate School of Business, Bloomington, ZDA, kjer je predaval računalništvo in informatiko. Rezultat tega obiska je bila tudi iniciacija kasnejšega dogovora med to šolo in Ekonomsko fakulteto Univerze v Ljubljani o izvajanju eno-semesterkega študija na Ekonomski fakulteti za tiste ameriške študente, ki jih je zanimala jugoslovanska ekonomija in v okviru le-te samoupravljanje. Predavanja so se tudi realizirala, vendar so bila prekinjena z razpadom Jugoslavije. V okviru medsebojne izmenjave obiskov učiteljev med pobratenima univerzama v Ljubljani in v Regensburgu, Nemčija je bil 2-krat po en teden gost nemške univerze. Skupaj z znanstveniki z univerz Brunel iz Londona, Aten, Bukarešte in Gdanska je leta 1994 sodeloval pri prijavi mednarodnih projektov v okviru Evropske skupnosti.

Kot učitelj na Ekonomski fakulteti v Ljubljani in kasneje, do upokojitve, na Fakulteti za upravo Univerze v Ljubljani, je s pomočjo numerične matematike raziskoval problem lastnih vrednosti in lastnih vektorjev matrik ter probleme s področja operacijskega raziskovanja in baz podatkov. Pomembno za razvoj in uporabo računalništva in informatike v slovenski družbi je njegovo sodelovanje in soavtorstvo

Pri izdaji knjige “ELEKTRONSKI RAČUNALNIKI”, Elektrotehniška zveza Slovenije v času mednarodnega kongresa IFIP leta 1971 v Ljubljani;

Pri izdaji učnega gradiva “RAČUNALNIŠTVO Gradivo s tečaja za srednješolske profesorje”, ki ga je izdal Zavod za šolstvo SR Slovenije, Ljubljana, 1972, in pri izvedbi tečaja. Avtorji gradiva

so bili: I. Bratko, J. Grad, M. Kac, J. Lesjak, V. Rajkovič, J. Virant in E. Zakrajšek; uredil B. Roblek.

Pomemben pa je tudi njegov doprinos v “POJMOVNIK POSLOVNE INFORMATIKE”, avtorji dr. Ivan Turk in 37 strokovnih sodelavcev, izdalo Društvo ekonomistov Ljubljana, 1987.

Dr. Grad [1] je soavtor 16 monografij, učbenikov in knjig, preko 100 člankov in referatov v strokovnih revijah ter zbornikih strokovnih srečanj doma in v tujini, ter 38 poročil raziskovalnih nalog in projektov. Opravil je več recenzij člankov za domače in tuje revije, bil je član Slovenskega društva Informatika, Društva matematikov, fizikov in astronomov ter mednarodnega društva Association for Information Systems. Bil je član uredniških odborov revij Informatica, Uporabna informatika in Uprava, ter član Australian Research Council Assessors, za katerega je recenziral raziskovalni projekt. Bil je član programskih odborov več simpozijev v organizaciji Društva ekonomistov Ljubljana, in Slovenskega društva Informatika. Bil je mentor pri 12 doktorskih disertacijah, več-deset magisterijih in univerzitetnih diplomah na Ekonomski fakulteti v Ljubljani. Njegova osebna bibliografija je podana v bibliografski bazi COBISS pod postavko 00032 JANEZ GRAD.

4 PRIZNANJA

Slovensko društvo INFORMATIKA mu je 12. 4. 1995 podelilo »Priznanje za življenjsko delo na področju razvoja in uveljavitve informatike v Sloveniji«.

Slovensko društvo INFORMATIKA, SOR, 24. 9. 2003: Priznanje SOR03, Mednarodni simpozij, Atomske toplice.

Univerza v Ljubljani mu je za njegovo delo leta 1997 podelila zlato plaketo in 4. decembra 2008, po upokojitvi, še naziv zaslužni profesor.

Programski in organizacijski odbor 17. mednarodne multikonference Informacijska družba 2014, 6. - 10. oktober 2014, Institut Jožef Stefan, Ljubljana, sta prof. Gradu podelila nagrado Nagrada »Donald Michie and Alan Turing« za življenjsko delo.

IS Information Society 2021 Conference, Institut Jožef Stefan Ljubljana, 8. oktober 2021, je ob 50-letnici poučevanja računalništva v slovenskih srednjih šolah prof. dr. Janezu Gradu podelila naziv PIONIR RAČUNALNIŠTVA V SREDNJIH ŠOLAH.

Občina Dol pri Ljubljani mu je 25. 3. 2022 podelila naziv ČASTNI OBČAN občine Dol..

5 ZAKLJUČEK

Prof. dr. Janez Grad spada med pionirje uvajanja računalništva v raziskovalne in pedagoške procese v okviru slovenskih raziskovalnih inštitutov, fakultet in srednjega šolstva. Začetki njegovega dela segajo nazaj v leto 1962 in se formalno končajo z upokojitvijo leta 2007. Neformalno pa raziskuje še sedaj optimizacijo proizvodnih procesov v ekološkem kmetijstvu.

VIRI

- [1] https://bib.cobiss.net/bibliographies/si/webBiblio/bib20120231002_140459_00032.html

Moja hoja po poti računalništva in informatike

My Journey in Computing and Informatics

Vladislav Rajkovič[†]
Fakulteta za organizacijske vede
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POVZETEK

Prispevek govori o življenjski poti Vladislava Rajkoviča na področju računalništva in informatike. Prepletajo se njegove izobraževalne in razvojno-raziskovalne dejavnosti doma in na tujem.

KLJUČNE BESEDE

Vladislav Rajkovič, računalništvo, informatika, pedagoška in razvojno-raziskovalna dejavnost

ABSTRACT

This paper is about Vladislav Rajkovič's life journey in the field of computing and informatics. His educational as well as research and development activities at home and abroad are intertwined.

KEYWORDS

Vladislav Rajkovič, computer science, informatics, pedagogical and research and development activity

1 UVOD

Uvodoma naj omenim, da sem na svoji strokovni življenjski poti imel srečo spoznati ljudi, ki so pomembno prispevali k mojemu osebnemu razvoju in tudi oprijemljivim rezultatom. Nekateri od teh rezultatov so predstavljeni v tem prispevku. Pomembno mesto v mojem strokovnem življenjepisu pripada mojim študentom. Med njimi je preko 1000 diplomantov od prvostopenjskih diplom do doktoratov. Posebej me veselijo njihove uspešne življenjske zgodbe.

2 ŠTUDENSKA LETA

V začetku druge polovice šestdesetih let prejšnjega stoletja nas je v drugem letniku študija na Fakulteti za elektrotehniko (FE) prof. dr. Tomislav Skubic, ki nam je predaval matematiko, povabil na »krožek« programiranja z besedami: »Matematiko se

*Article Title Footnote needs to be captured as Title Note

†Author Footnote to be captured as Author Note

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boste naučili v vsakem primeru, programiranje računalnikov pa vidim kot novo priložnost«. Naši prvi programi v jeziku algol 60 so stekli na računalniku Zuse Z-23 na računskem centru IMFM v Ljubljani.

Naslednji pomembni mejnik v znanju programiranja je bil tečaj podjetja IBM Intertrade za programiranje v zbirnem jeziku za sisteme IBM/360, ki je potekal od 1. do 19. julija 1968. Izbrano skupino okoli 25 fantov in deklet iz različnih fakultet je poučeval gospod Janko Čičen-Šajn, univ. dipl. ing. Po zaključku tečaja smo dobili preprosto potrdilo in namizno tablico z napisom THINK, da nas opominja na to, kar je res potrebno. Temu je sledil tečaj programskega jezika fortran, ki ga je vodila gospa Mira Volk, univ. dipl. mat. Za tem smo nekateri izmed nas kot študentje programirali rešitve za neposredne naročnike pod okriljem Odseka za uporabno matematiko na Institutu Jožef Stefan (IJS). Sprva smo uporabljali računalnik IBM 1130, za tem pa CDC 3300.

V letu 1969 sva se s kolegom Borutom Bedjaničem, s pomočjo tovarne Iskra, odpravila na dvomesečno študentsko prakso v podjetje Standard Radio & Telefon AB na Švedskem, kjer so naju vključevali v reševanje konkretnih elektrotehničnih izzivov. Znanje fortrana mi je še posebej koristilo pri načrtovanju vezij izenačevalcev na prenosnih linijah.

Profesorja Anton P. Železnikar in Silvin Leskovar sta nas v času študija uvedla v teorijo jezikov, avtomatov in rekurzivnih funkcij. To je pomembno vplivalo na naše dokončanje študija (diplomiranje), zaposlitev in nadaljnji strokovni razvoj. [1]

3 ZAPOSILITEV NA INSTITUTU JOŽEF STEFAN

Po diplomi iz prevajalnikov programskih jezikov v letu 1970 [2] sem se zaposlil na IJS na oddelku, ki ga je vodil prof. dr. Anton P. Železnikar. Istega leta sta se na tem odseku zaposlila tudi kolega Ivan Bratko in Iztok Lajovic. Skupaj smo si delili podstrešno sobico brez oken. Naravna svetloba je prihajala skozi ozko strešno odprtino. Izhodišče našega dela v teoretičnem in praktičnem pogledu je bila teorija jezikov in avtomatov. Sodelovanje med nami pa tudi drugimi kolegi na oddelku je bilo plodno in raznoliko. [3]

Ni nam bil tuj niti spajkalnik. Razvijali smo krmilna električna vezja za neposredne naročnike. V tem okviru naj omenim

podjetje Unis-Rog in razvoj večkanalnega regulatorja ter elektroniko krmilne postaje transportnih trakov, ki so dolga leta predstavljali pomemben izvozni produkt tega podjetja. S strani mehanskih delavnic na IJS, ki jih je vodil gospod Savo Ivanković, univ. dipl. ing., smo bili deležni pomembnih vzpodbud in pomoči.

Kongres mednarodnega računalniškega združenja IFIP, ki je potekal od 23. do 28. avgusta 1971 v Ljubljani, je pomenil veliko vzpodbudo za področje računalništva in informatike pri nas. Bilo je okoli 2500 udeležencev iz 49 držav. Kongres sta k nam pripeljala profesorja Leskovar in Železnikar. Mladi z IJS in FE smo bili tehnični sekretarji. Nama s kolegom Bratkom je pripadla hala Tivoli, kjer so potekala vabljen predavanja. Srečala sva se z vodilnimi strokovnjaki, kot je prof. Donald E. Knuth, ki je znan po svoji zbirki *The Art of Computer Programming*.

Posebej želim omeniti naše sodelovanje z Zavodom za šolstvo pri uvajanju predmeta računalništvo v slovenske srednje šole, ki se je pričelo že leta 1971. O tem smo izčrpno spregovorili na multi-konferenci Informacijska družba 2022. Prispevek je bil objavljen tudi v reviji *Uporabna informatika* [4].

Predmet računalništvo sem več let poučeval na Gimnaziji Bežigrad in »Šubičevi«, sedaj Gimnaziji Jožeta Plečnika. S kolegom Ivanom Bratkom sva napisala učbenik *Uvod v računalništvo* [6] in kasneje tudi učbenik *Računalništvo s programskim jezikom pascal* [7]. Sodelovanje je med drugim potekalo tudi v okviru triletnega projekta na Računalniškem centru za programirano učenje, Fakultete za naravoslovje in tehnologijo, ki je bil zaključen leta 1980. [8]

Jeseni leta 1973 sem odšel k vojakom. Med stažiranjem sem programiral na Tehnični akademiji v Zagrebu. Dne 8.7.1976 je potekal na IJS ustanovni občni zbor Slovenskega društva INFORMATIKA (SDI). Bilo je 25 udeležencev iz različnih akademskih in gospodarskih okolij. Sledila je uradna registracija na sodišču, kjer je bilo potrebno prispevati svoje podpise. Predsednik je postal prof. dr. Železnikar. Temu dejanju lahko pripišemo osamosvojitveni značaj, glede na Jugoslovansko društvo informatika.

S področja obravnavanja podatkov je SDI organiziralo na Bledu vsakoletne jugoslovanske mednarodne simpozije v sodelovanju z IJS in FE. To je bil prostor za srečevanje s kolegi iz ostalih delov Jugoslavije in povabljenimi tujimi strokovnjaki. Simpozije so spremljali tudi zborniki prispevkov. [9]

Januarja 1978 sem odšel za pol leta na strokovno izpopolnjevanje na Univerzo v Durhamu v Angliji. Poleg štipendije Velike Britanije sta k temu pomembno prispevala tudi Republiška raziskovalna skupnost in IJS pa tudi moja družina. Moje delo je bilo osredotočeno na razvoj in implementacijo večparametrskega modela za skupinsko odločanje. Skupaj z gospo Janet Efstathiou, univ. dipl. ing., sva razvila in uspešno preizkusila originalen tovrstni model. Originalnost je v predstavitvi in uporabi odločitvenega znanja, ki omogoča predstavitev s pravili in s tem podajanje spremenljivih uteži odločitvenih parametrov v odvisnosti od njihove vrednosti. S tem se izognemo zahtevi po ortogonalnosti parametrov. Razlaga vpliva posameznih

parametrov na končno oceno postane enostavnejša in razumljivejša. Najino objavo v reviji *IEEE Transactions on System, Man and Cybernetics* [10] sta recenzirala prof. L. Zadeh in F. Land. Slednji naju je povabil tudi na predstavitev na London School of Economics (LSE). To je bil tudi začetek sodelovanja s to ustanovo in tehničnim komitejem IFIP TC 8, ki se ukvarja s tematiko informacijskih sistemov, vključno s sistemi za podporo odločanju. Na LSE sem imel vabljen predavanje z naslovom »Razvoj informacijskih sistemov v samoupravnem okolju« [11], ki mu je sledila izjemno zanimiva razprava.

Poleg sodelovanja v tehničnih komitejih IFIP za informacijske sisteme in izobraževanje (TC 3) me je prof. dr. Jože Gričar povabil v ameriško združenje »Association for Information Systems«, kjer naju prištevajo med ustanovne člane (charter members). V tem razdelku naj omenim številna članstva v uredniških in recenzentskih odborih domačih in tujih strokovnih revij in združenj.

Po vrnitvi iz Anglije sva na nadaljnjem razvoju nove metode večparametrskega odločanja sodelovala s kolegom Markom Bohancem, ki sem ga spoznal že kot mojega dijaka pri predmetu računalništvo na Gimnaziji Bežigrad. Po diplomu iz računalništva na FE se je zaposlil na IJS. Metodo sva najprej poimenovala DECMAK, nato DEX (Decision EXpert) [13]. Kolega Bohanec je poskrbel za računalniško implementacijo, ki jo nenehno dopolnjuje in razvija: <http://dex.ijs.si>. Metoda je bila uporabljena v številnih konkretnih odločitvenih situacijah za neposredne naročnike [13], [14], [15], [16]. Leta 1990 sva prejela Nagrado sklada Borisa Kidriča za pomembne dosežke na področju računalniško podprtega odločanja z uporabo metod umetne inteligence.

Z našo metodo večparametrskega odločanja skupaj s programsko rešitvijo smo skušali prodreti tudi v tujino. Ni bilo posebnega uspeha. Eden od odgovorov na našo ponudbo je bil tudi: »Zadeva je dobra in uporabna, ampak, ko bi avtorji prihajali vsaj iz južne Italije, ne pa iz Jugoslavije«. Prof. dr. Tomaž Kalin je metodo priporočil tudi British Telecomu. S kolegom Bohancem sva odšla v London na dvodnevno predstavitev. Za tem so nam sporočili, da je zadeva zanimiva, vendar za njihovo rabo nekaj let pred časom.

4 ZAPOSILITEV NA FAKULTETI ZA ORGANIZACIJSKE VEDE UNIVERZE V MARIBORU

Leta 1980 sem se zaposlil na tedanji Visoki šoli za organizacijske vede v Kranju, sedaj Fakulteti za organizacijske vede (FOV), Univerza v Mariboru, kot predavatelj računalniških predmetov: programiranje, baze podatkov in računalniške komunikacije. V dopolnilnem delovnem razmerju sem ostal na IJS, kjer sem tudi več let urejal letno poročilo IJS; raziskovalno sem večinoma sodeloval z Odsekom za inteligentne sisteme. Predmete s področja računalništva, informatike in odločanja sem občasno predaval na Fakulteti za računalništvo in informatiko, Ekonomski fakulteti in Fakulteti za šport na UL ter Fakulteti za elektrotehniko, računalništvo in informatiko na UM. Predmet

odločitvenega modeliranja sem predaval tudi na Univerzi v Amsterdamu.

V nadaljevanju bom omenil nekatere pomembnejše projekte, pri katerih sem sodeloval. Večina projektov se je nanašala na pomoč pri odločanju in vrednotenju na področjih npr. računalniške opreme, projektov, podjetij, tehnologij, lokacij, dodeljevanja posojil, športne nadarjenosti otrok, kadrovskega odločanja pa tudi v zdravstvu.

Eden prvih projektov je bilo ocenjevanje prošelj za sprejem otrok v vrtece. Kot član sveta staršev vrtca sem bil soočen s problemom, kako izmed sto in več prošelj za sprejem v vrtec izbrati le nekaj deset otrok za zasedbo prostih mest. V komisiji, ki ji je bil zaupan izbor, so bili pediater, patronažna medicinska sestra, socialni delavec, predstavniki staršev in zaposlenih. Ocenjevanje prošelj je potekalo z branjem prošelj in navajanjem argumentov. Po obravnavi nekaj prošelj je stvar postala nekonsistentna, izbor pa bolj ali manj kaotičen. V sodelovanju s komisijo smo razvili večparametrski model za rangiranje prošelj. Predvsem zaradi transparentnosti ocenjevanja je bil model dobro sprejet tako s strani staršev, kot tudi zaposlenih v vrtcu. Omogočena je bila razlaga, zakaj je nek otrok sprejet v vrtec, drugi pa ne. [17]

Precej modelov vrednotenja in ocenjevanja je bilo razvitih za kadrovske področje, npr. za podjetja Iskra, Yulon, Famos Sarajevo. V slednjem je bil naš kompetenčni model uporabljen na več kot 6000 zaposlenih. [18]

Sodelovanje s Stanovanjskim skladom Republike Slovenije se je pričelo na pobudo Zveze potrošnikov, ki jo je vodila gospa Breda Kutin, univ. dipl. oec. Potrebno je bilo oceniti prošnje za pomoč pri vračilu stanovanjskih kreditov komercialnih bank. Sodelovanje se je nadaljevalo z ocenjevanjem prijav v okviru različnih razpisov sklada. Posebnost tega sodelovanja je predstavljal razvoj modelov ob upoštevanju različnih interesov deležnikov in ocenjevanje na tisoče prošelj [19, 20].

V okviru sodelovanja s Fakulteto za računalništvo in informatiko velja omeniti sodelovanje v nekaterih projektih informatizacije, ki jih je za potrebe javne in državne uprave vodil prof. dr. Marjan Krisper. Sodelovali smo predvsem v segmentih vrednotenja in ocenjevanja. V tem kontekstu je potekalo tudi sodelovanje s kolegi iz Razvojnega centa Celje. Ti so uporabljali metodo analize portfelja F. F. Neubauerja [21]. Pri tej metodi jih je motilo, da le s težavo razložijo, od kod izvirajo pridobljeni številski rezultati. Skupaj smo dopolnili metodo z našim pristopom ekspertnih sistemov, kjer je bilo ocenitveno znanje predstavljeno s pravili. [22]

Na področju uporabe odločitvenih modelov v zdravstvu je pomembno prispevala raziskovalna skupina, ki jo je vodil prof. dr. Miroslav Kljajič in je povezovala FOV in Fakulteto za zdravstvene vede UL. Razvili smo modele za oceno rizičnosti za obolenja rakov dojke, prostate in kože. Timi so bili interdisciplinarni. V njih so poleg zdravnikov sodelovali medicinske sestre, radiološki inženirji in odločitveni analitiki kot sva midva s kolegom prof. dr. Bohancem. [23]

Projekt informacijskega sistema patronažne zdravstvene nege je bil financiran s strani Evropske skupnosti in Ministrstva za zdravje. Razvita je bila programska rešitev, ki je vsebovala sprotno oceno in spremljanje zdravstvenega stanja varovanca oz. družine. Pri tem je ključno vlogo odigrala prof. dr. Olga Šušteršič. Prevedena je bila tudi mednarodna klasifikacija zdravstvene nege – International Classification for Nursing Practice. [24, 25, 26, 27]

Z uvedbo t.i. šolskega tolarja v devetdesetih letih je nastal projekt Računalniško opismenjevanje (RO), ki je bil zaupan Zavodu za šolstvo RS. Ta je organiziral razvojno raziskovalna jedra na štirih fakultetah v Sloveniji za spremljanje in razvoj informatizacije šol. V Laboratoriju za odločitvene procese in ekspertne sisteme na FOV je bila razvita šolska inačica ekspertnega sistema za pomoč pri odločanju DEXi z ustreznim priročnikom [28]. V tem času je nastal tudi priročnik za Tehnologije znanja, ki je bil namenjen učiteljem [29].

V okviru projekta RO je nastal tudi sistem TALENT. Na pobudo prof. dr. Jožeta Šturma s Fakultete za šport (FŠ) je bil nadgrajen športno-vzgojni karton tako, da je bilo poleg splošne nadarjenosti otrok možno ugotavljati tudi nadarjenost za 23 športnih panog. Rešitev je vsebinsko slonela na izsledkih športne znanosti, ki so jih posredovali kolegi s FŠ. Program so uporabljali profesorji športa na šolah za svetovanje otrokom in staršem, kateri šport je zanje verjetno najprimernejši. Ni šlo za selekcijo le vrhunskih bodočih športnikov, ampak za priporočila tudi manj športno nadarjenim otrokom, v katerih športih bodo lažje našli sebe in s tem obogatili svoje življenje in delo. [30, 31] S programom TALENT smo se prijavi tudi na razpis vlade Velike Britanije za usmerjanje otrok v športe. Prijava je potekala preko podjetja Oxford Computer Consultant. Žal smo v mednarodni konkurenci dosegli najbolj nevhvaležno mesto - bili smo drugo uvrščeni. Zmagala je ponudba iz Avstralije.

Metoda DEX je bila in se uporabljana v številnih projektih doma in na tujem, tudi brez sodelovanja prof. dr. Marka Bohanca in mene. Posebej lahko izpostavim področje kmetijstva [32, 33, 34].

5 ZAKLJUČEK

Po upokojitvi leta 2010 sem se vpisal v razvid zasebnih visokošolskih učiteljev pri Ministrstvu za visoko šolstvo, znanost in tehnologijo RS. Na podiplomskem študiju nekaterih javnih in zasebnih institucij predavam predmete managementa informacijskih in odločitvenih procesov ter poslovne inteligence. Poseben poudarek dajem izdelavi seminarskih nalog pri predmetih ob uporabi razpoložljivih orodij, kot so npr. DEX, Orange in druga.

Leta 2018 je izšla knjiga Slovenija na poti digitalne preobrazbe. Avtorji te knjige smo peterica upokojenih profesorjev s petih slovenskih fakultet. Knjiga je izšla pri Založbi UL FRI. Brezplačno je dosegljiva spletna verzija te knjige. [35]

Ob podelitvi naziva zaslužni profesor na Univerzi v Mariboru so me presenetili s povabilom na oder, da spregovorim nekaj besed. Dejal sem, da sem vse življenje hodil v službo z veseljem, za kar se zahvaljujem kolegom, študentom in družini.

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Dosežki kandidata, prof. dr. Boruta Žalika

Achievements of the Candidate prof. dr. Borut Žalik

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POVZETEK

Red. prof. dr. Borut Žalik je vodilni akademik in raziskovalec na Fakulteti za elektrotehniko, računalništvo in informatiko Univerze v Mariboru (UM FERI). Ustanovil je Laboratorij za geoprostorsko modeliranje, multimedijo in umetno inteligenco (GeMMA) in je aktiven član Evropske Akademije Znanosti in Umetnosti. Pod njegovim vodstvom je UM FERI doživela izjemen razvoj, postala ena izmed vodilnih fakultet na univerzi. S svojo predanostjo raziskovalnemu delu je pridobil in uspešno izpeljal številne projekte, objavil bogato bibliografijo in bil mentor številnim študentom in doktorskim kandidatom. Poleg tega je aktivno sodeloval v različnih nacionalnih in mednarodnih odborih ter organizacijah, kot je ACM Slovenija.

KLJUČNE BESEDE

Red. prof. dr. Borut Žalik, Računalniška grafika, računalniška animacija, geometrijsko modeliranje, računalniško modeliranje in simulacije, računalniško podprto geometrijsko načrtovanje, računalniška geometrija, navidezna resničnost, multimedia.

ABSTRACT

Assoc. Prof. Dr. Borut Žalik is a leading academic and researcher at the Faculty of Electrical Engineering, Computer Science, and Informatics at the University of Maribor (UM FERI). He founded the Laboratory for Geospatial Modelling, Multimedia, and Artificial Intelligence (GeMMA) and is an active member of the European Academy of Sciences and Arts. Under his leadership, UM FERI has experienced remarkable growth, establishing itself as one of the leading faculties at the university. With his dedication to research, he has secured and successfully executed numerous projects, published an extensive bibliography, and mentored many students and doctoral candidates. Additionally, he has actively participated in various national and international committees and organizations, such as ACM Slovenia.

KEYWORDS

Assoc. Prof. Dr. Borut Žalik, Computer Graphics, Computer Animation, Geometric Modeling, Computer Modeling and

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Simulations, Computer-Aided Geometric Design, Computational Geometry, Virtual Reality, Multimedia.

1 UVOD

Red. prof. dr. Borut Žalik je **ustanovitelj in vodja** Laboratorij za geoprostorsko modeliranje, multimedijo in umetno inteligenco (GeMMA) na Fakulteti za elektrotehniko, računalništvo in informatiko univerze v Mariboru (UM FERI) ter **član Evropske Akademije Znanosti in Umetnosti**. Kot **prodekan za raziskovalno dejavnost** med leti 2003 in 2011 in **dekan** med leti 2011 in 2019 je s svojim delom izjemo prispeval k razvoju UM FERI, ki je v tem obdobju postala najprodnostnejša fakulteta na UM s preko 300 zaposlenimi in več kot 2000 študenti. Laboratorij GeMMA pa se je iz skromnih začetkov v minimalne kadrovske sestave razvil v močno raziskovalno enoto, ki **trenutno vključuje več kot 30 članov**. Pod vodstvom red. prof. dr. Boruta Žalika, so člani laboratorija zgolj v zadnjih petih letih pridobili in izvedli:

- 13 nacionalnih projektov ARRS,
- 3 bilateralne projekte ARRS,
- 6 projektov Horizon 2020,
- 4 projekte Horizon Europe,
- 1 projekt EDF (European Defence Fund),
- 2 projekta Interreg,
- 9 EU podprtih projektov iz področij pametne specializacije in
- 15 industrijskih/neproračunskih projektov

v skupnem znesku preko 1,5 M€/leto. Prof. dr. Borut Žalik **trenutno vodi dva temeljna projekta** ARRS, in sicer: Paradigma stiskanja podatkov z odstranjevanjem obnovljivih informacij in Posplošene simetrije in ekvivalence v geometrijskih podatkih in nekaj industrijskih projektov. V letih 2009 do 2023 je **bil vodja programske skupine** Računalniški sistemi, metodologije in inteligentne storitve, ki vključuje večino članov oddelka za računalništvo na UM FERI (39 raziskovalcev).

Navedeno izkazuje tudi **izjemen prispevek red. prof. dr. Boruta Žalika k razvoju računalništva in informatike v širšem nacionalnem in mednarodnem okolju**. Slednjega zaznamuje predvsem njegova predanost prenosu raziskovalnih dosežkov v prakso, z dolgoročno strateško vizijo razvoja in usmeritvijo v nastajajoče tehnološke trende. Rezultat slednjega je **več kot 80 izdelanih elaboratov, študij, poročil o rezultatih**

raziskav ter izvedenskih mnenj [1,2,3,4,5]. Red. prof. dr. Borut Žalik prav tako že več kot desetletje bistveno presega najvišje možno število pridobljen točk iz kategorije A3 po vrednotenju ARRS, pri čemer je zgolj iz podkategorije A32 - sredstva po pogodbah z gospodarstvom v zadnjem desetletju redno dobil maksimalnih število točk, to je 10 točk. Leta 2008 je bil red. prof. dr. Borut Žalik na predlog Predsednika vlade Republike Slovenije imenovan tudi za člana Sveta Republike Slovenije za konkurenčnost. V letih 2010-2012 je bil član Upravnega odbora ARRS. Med 2015 in 2016 je bil podpredsednik, nato pa v letih 2017 in 2018 **predsednik ACM Slovenija**. Bil je **pobudnik ustanovitve prve Študentske sekcije ACM v Sloveniji**. V letih 2019 do 2020 je bil član nadzornega odbora ACM Slovenija. Leta 2020 je za svoje zasluge pri delu organizacije ACM postal **ACM Senior member**.

Raziskovalno delo prof. dr. Boruta Žalika se osredotoča na geometrijsko modeliranje, obdelavo geoprostorskih podatkov in računalniško multimedijo, predvsem stiskanje podatkov. Iz teh področij je tudi intenzivno objavljaj. V njegovi bibliografiji najdemo **159 člankov, objavljenih v znanstvenih revijah**, od katerih jih je 51 v kategoriji 1A1, 46 v 1A2, 14 v 1A3 in 18 v 1A4. Google scholar navaja **4250 njegovih citatov s h-indeksom 34**, kar ga je prejšnje leto uvrstilo **med prvih 2 % najboljših znanstvenikov iz področja računalništva in informatike**. Kot avtor ali soavtor je objavil preko 180 člankov na znanstvenih konferencah. Podeljenih mu je bilo **11 patentov**, od tega dva ameriška. Je avtor algoritma za konstrukcijo Delunayeve triangulacije s prebimo premico, ki še danes velja za najhitrejšega. Pri tem je še posebej očitno dejstvo, da pedagoško delo prof. dr. Boruta Žalika močno prepleteno z njegovim raziskovalnim delom. Izdal je znanstveno monografijo in štiri univerzitetne učbenike, zadnjega leta 2023. Bil je **mentor preko sto študentom** tako na prvi kot na drugi stopnji študija. Pod njegovim mentorstvom so trije študentje prejeli Perlachovo nagrado, najvišjo nagrado UM za raziskovalno delo študentov. Bil je mentor **22-tim doktorskim študentov**, od katerih je bilo **11 mladih raziskovalcev**.

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Delovanje na področju računalništva

Working in the Field of Computer Science

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POVZETEK

Delovanje na področju računalništva se nanaša na uvajanje računalništva v srednje šole od 1970-1978, poučevanja na univerzitetni stopnji od 1985-1991 in uporabe računalnika za generiranje nalog iz logike in matematike za različna tekmovanja.

KLJUČNE BESEDE

Računalništvo, izobraževanje, programi

ABSTRACT

Work in computing refers to the introduction of computing in high school from 1970-1978, teaching at the university level from 1985-1991 and the use of computers to generate problems and logic and mathematics for various competitions.

KEYWORDS

Computer science, education, programs

1 EDUCATION

Izidor Hafner se je po maturi l. 1968 vpisal na študij tehnične matematike, ki ga je končal l. 1972, magistriral je le l. 1974 in doktoriral l. 1984 s področja računalništva. Njegovo glavno področje delovanja je bila matematika, posebej matematična logika, vendar pa je veliko prispeval za uvedbo računalništva, predvsem v srednje šole.

Takoj po vpisu na univerzo je poslušal tečaj programiranja na Inštitutu Jožef Stefan, ki ga je vodila matematičarka Mira Volk. Po tečaju se je delno zaposlil na inštitutu v skupini za uporabno matematiko. Večja naloga s tega časa je bil program za izračun gradbenih elementov za hladilne stolpe termocentral za podjetje Elektroprojekt. Po teh izračunih je bil narejen hladilni stolp za TEŠ 4.

Leta 1968 je bilo programiranje še vedno domena visoko izobraženih strokovnjakov, sam pa je kmalu ugotovil, da tak posel ne zahteva nobenih "bazičnih znanj", temveč predvsem logično mišljenje. Zato je v prvem polletju šolskega leta 1969/70 organiziral in vodil pouk računalništva v okviru praktičnih znanj

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na Drugi gimnaziji v Ljubljani. Enako je ponovil še l. 1970/71. Januarja 1970 se je oglašil na Zavodu za šolstvo z namenom, da se organizira podoben pouk tudi na drugih gimnazijah. Stvar je bila izpeljana l. 1971 kot celoleten predmet. Imenovan je bil tudi v komisijo za spremljanje pouka računalništva.

Priprave za izvedbo tekmovanja računalništva so se začele l. 1975. Komisijo je vodil Saša Divjak. Pripravljeno je bilo gradivo z nalogami, nato pa je delo komisije nikoli zastalo. Po vrnitvi z vojaškega roka je Divjak delo predal Hafnerju, ki je kot tajnik komisije za popularizacijo računalništva pri društvu Informatika vodil organizacijo prvega republiškega tekmovanja iz računalništva za srednje šole. Tajništvo je nato l. 1978 prevzel Roman Dorn.

S smernicami o usmerjenem izobraževanju se je pojavila možnost za izobraževanje poklicev iz računalniške stroke na srednji stopnji. Vključil se je v komisijo za kadre na področju računalništva pri komiteju za družbeno planiranje in proti koncu leta 1977 izdelal (na osnovi že zbranih podatkov) dva predloga profilov za poklice računalniške stroke in kmalu za tem še predlog predmetnika za to izobraževanje v skladu z navodili za uvajanje usmerjenega izobraževanja. Jeseni 1978 je vodil seminar za učitelje računalništva. Leta 1981 je dejansko stekel pouk na štirih računalniških srednjih šolah.

Leta 1987 je bil imenovan za predsednika komisije pri Zavodu za šolstvo za izvajanje dvoletnega projekta „krožki robotike“ v srednjih šolah. V prvem letu je sodelovalo 10 srednjih šol, pri čemer se je oprema selila z ene šole na drugo.

Po diplomi l. 1972 se je zaposlil na Fakulteti za elektrotehniko kot asistent za matematiko, nato pa od l. 1985 kot docent za računalništvo in matematiko. V letih od 1985-1991 je predaval predmet Programiranje I in matematiko, pozneje pa samo matematične predmete. V tem času je organiziral tudi poletno šole IBM za najboljše študente računalništva. Dve leti je predaval tudi osnove računalništva za študente Pedagoške fakultete. Na tretji stopnji je bil nosilec izbirnega predmeta logika. Bil je mentor trem študentom tretje stopnje.

Programje je pisal v fortranu, basicu, pascalu in prologu. Zaradi zadnjega se je še posebej dodatno zanimal za logiko.

Leta 1982 je predlagal, da bi prevedli nekaj knjig ameriškega profesorja logike R. Smullyana v slovenščino, izšle pa naj bi v

zbirki Sigma. Odgovornost odklonili vse predloge. Zato je izdelal podroben program za zbirko Z logiko v leto 2000, ki ga je sprejela Državna založba Slovenije in ga določila za zunanjega urednika. Obvezal pa se je, da bo knjige populariziral preko tekmovanja iz logike. Prvo tekmovanje je bilo l. 1986, danes pa na šolskih tekmovanjih sodeluje okoli 30000 učencev. Leta 1991 je DZS zbirko ukinila, Hafner pa je delo nadaljeval z zbirko „Univerza za 21. stoletje“. Zato je l. 1991 ustanovil založniško podjetje Logika d.o.o. ter revijo Logika in razvedrilna matematika.

Leta 1997 je izdelal program za sestavljanje logičnih nalog t.i. tabelarične oblike. Program je nato razširil tako, da omogoča tudi reševanje in dokazovanje. Po zgledu programa „svet Tarskega“ je izdelal test za ocenjevanje znanja osnov logike, ki sta ga nato s T. Žitkom realizirala kot šolska, državna in mednarodno tekmovanje v matematični logiki prek medmrežja. Stavki se generirajo v simbolnem jeziku in izračunajo v modelu. Nato se prevedejo v slovenski ali angleški jezik (lahko bi se v katerikoli jezik). Ko izberemo svet, se na zaslonu prikaže slučajno stavek. Treba je ugotoviti njegovo resničnostno vrednost. Logiki je sledilo še spletno tekmovanje iz prostorske predstavljenosti. Spletna tekmovanja so se izvajala od 1999 do l. 2016, potem pa niso več dobila subvencije.

Po letu 1997 je programiral le še v sistemu mathematica, predvsem za potrebe pri predavanjih iz matematike in tekmovanj iz logike in razvedrilna matematike. Ko se je pojavila možnost s projektom Wolfram Demonstration okoli l. 2010, da se lahko programi v mathematici izvajajo z programom „CDF Player“ je do 2023 izdelal več kot 1300 t.i. demonstracij, ki so prosto dostopne na strani podjetja Wolfram. Hafner deluje tudi v skupini, ki preverja nove verzije programa mathematica. V dobrih 10 letih si je Hafnerjeve demonstracije ogledalo skoraj 4 milijonov, naložilo pa je izvorno kodo okoli 100000 obiskovalcev [4].

2 PRIZNANJA

Leta 1990 dobi priznanje DMFA Slovenije za delo z mladimi. Leta 2000 je za uvajanje računalništva in logike v srednjem izobraževanju prejel častni znak svobode Republike Slovenije. Častni znak ZOTKS dobi l. 2004.

Prometej znanosti za odličnost v komuniciranju za l. 2007.

Leta 2009 je za uvajanje računalništva in logike v srednjem izobraževanju prejel nagrado Republike Slovenije za področje izobraževanja.

L. 2021 je prejel naziv pionir računalniškega izobraževanja v srednjih šolah.

3 ČLANSTVO V ORGANIZACIJAH

Član komisije za uvajanje računalništva v srednjih šolah (1971) Od 1976 do 1977 je bil tajnik komisije za popularizacijo računalništva pri društvu Informatika.

Od 1986 do 2001 je predsednik komisije za logiko pri ZOTKS. Predsednik komisije projekta krožkov robotike v srednjih šolah pri Zavodu za šolstvo (1987-88).

Zunanji urednik zbirke Z logiko v leto 2000 pri DZS (1986-1992) Od l.1990 do l. 2017 tajnik komisije za razvedrilno matematiko pri DMFA Slovenije.

Urednik zbirke Univerza za 21. stoletje (1991-2000) Ustanovitelj in glavni urednik revije Logika in razvedrilna matematika (1991-2023)

VIRI

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- [3] HAFNER, Izidor, ŽITKO, Tomislav. Competitions in knowledge via world wide web as a way of teaching and learning science. V: DIVJAK, Saša (ur.). HSci 2004 : Proceedings of the 1st International Conference on Hands on Science "Teaching and learning in the XXI Century", 5th-9th July 2004, Ljubljana, Slovenia. Ljubljana: Fakulteta za računalništvo in informatiko, 2004. Str. 215-219, ilustr. ISBN 961-6209-45-0. [COBISS.SI-ID 13632089], <http://www.ijhsci.info/hsci2004/PROCEEDINGS/FinalPapers/E00-503886605.pdf> (22.5.2023)
- [4] <https://demonstrations.wolfram.com/author.html?author=Izidor+Hafner> (22.5.2023)
- [5] http://logika.si/subpages/sklop_logika/index.html
- [6] <http://logika.si/revija/index.htm>

Dosežki kandidata zasl. prof. dr. Ceneta Bavec

Achievements of the Candidate Emeritus prof. dr. Cene Bavec

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POVZETEK

Zasl. prof. dr. Cene Bavec je začel svojo profesionalno pot leta 1972, ko je informacijska tehnologija začela spreminjati naša življenja. Spremembe so prihajale v valovih, od katerih je vsak prinašal nove izzive. Zato je tudi on v bistvu živel tri zelo različna profesionalna življenja. V prvem obdobju je večinoma programiral in operativno vodil izrazito tehnološke projekte, predvsem kot IBM sistemski inženir. V drugem obdobju, ki ga je začel kot namestnik direktorja republiške statistike in končal kot državni sekretar za tehnologijo, se je ukvarjal s strateškimi vidiki informatizacije. V to je vključeno njegovo večletno delo za Evropsko komisijo in Bangemannov forum za informacijsko družbo. V tretjem obdobju pa se je umiril kot univerzitetni predavatelj v Sloveniji in tujini.

KLJUČNE BESEDE

Informacijska tehnologija, strokovne aktivnosti, državna uprava, Evropska komisija

ABSTRACT

Emeritus Professor Dr. Cene Bavec began his professional journey in 1972 when information technology started to transform our lives. Changes came in waves, each bringing new challenges. Consequently, he essentially lived three very different professional lives. In the first period, he mostly programmed and operationally led technological projects, primarily as an IBM systems engineer. In the second period, which he began as the deputy director of national statistics and ended as the state secretary for technology, he dealt with the strategic aspects of informatization. This included his years of work for the European Commission and the Bangemann Forum for the Information Society. In the third period, he settled down as a university lecturer in Slovenia and abroad.

KEYWORDS

Information Technology, professional activities, state government, European Commission

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1 UVOD

1.1 Nekaj osebnih podatkov

Rojen je bil leta 1946 v Ljubljani.

Izobrazba

Diploma iz tehnične fizike na Fakulteti za naravoslovje in tehnologijo

Magisterij iz operacijskih raziskovanj na Ekonomski fakulteti
Doktorat iz informacijsko-upravljalnih znanosti na Ekonomski fakulteti Univerze v Ljubljani

Redne zaposlitve

1972–1975: Intertrade IBM (sistemski inženir)

1975–1978: Inštitut Jožef Stefan (svetovalec za računalništvo)

1978–1980: Višja upravna šola Univerze v Ljubljani

1980–1982: Republiški center za DSI in informatiko (v.d. direktorja)

1982–1986: Zavod RS za statistiko (namestnik direktorja)

1986–1991: RS za pravosodje in upravo (svetovalec Izvršnega sveta RS)

1991–1992: Višja upravna šola Univerze v Ljubljani

1992–2000: Ministrstvo za znanost in tehnologijo (od leta 1998 do 2000 kot državni sekretar za tehnologijo)

2001–2012: Univerza na Primorskem

Priznanja

Poleg vrste akademskih je leta 2006 prejel tudi slovensko Donald Michie and Alan Turing priznanje za življenjsko delo.

2 STROKOVNE AKTIVNOSTI V SLOVENIJI

2.1 Programiranje in vodenje projektov

Še v študentskih letih je leta 1969 opravil izpit iz programiranja na računalniku Zuse Z-23 pod vodstvom prof. dr. Egona Zakrajška. Zaposlil se je leta 1972 na Intertradeu IBM, ki je takrat še pokrival celotno Vzhodno Evropo. Najprej je kot IBM sistemski inženir in kasneje kot samostojni svetovalec za računalništvo razvijal programsko opremo in vodil projekte večinoma za posamezne državne organe, kot je, na primer, programska oprema za prvo vzpostavitev centralnega registra prebivalstva in prvo podeljevanje matičnih števil. Nekaj časa je bil tudi vodja programerjev na Intertradu IBM in inštruktor v IBM šoli v Radovljici.

Kot zanimivost omenimo, da je povsem samostojno razvil in programiral sistem za obdelavo besedil na računalniku IBM1130, ki je v veliki meri upošteval slovensko slovnico, kar je bil takrat zelo inovativen pristop. Ker osebni računalniki s komercialnimi programi še niso bili dostopni, je bil to način za centralno vodenje vladnih in ministrskih gradiv. Kasneje se je, seveda, celoten sistem z uporabo osebnih računalnikov decentraliziral.

2.2 Delo na strateških projektih

Leta 1980 je postal namestnik direktorja Republiškega centra za družbeni sistem informiranja, ki je pripravljal prve uradne zametke nacionalnega in vladnega koncepta informatizacije. Ker je bil tudi nacionalni koordinator sodelovanja med OECD in Jugoslavijo na področju javne uprave pa je uspešno prenašal izkušnje zahodnih držav v slovensko okolje. Kot namestnik direktorja Zavoda RS za statistiko je bil v glavnem zadolžen za informatizacijo statističnih raziskav ter organizacijske in tehnične vidike delovanja takrat izjemno močnega centralnega računalnika na statističnem uradu.

Leta je 1986 pripravil prve smernice za slovensko vlado o informatizaciji centralnih registrov prebivalstva, prostora in organizacij. Kot podpredsednik (predsednik je bil podpredsednik vlade prof. dr. Boris Frlec) in kasneje kot predsednik vladne komisije za informatizacijo je pripravil organizacijski in tehnološki koncept pozneje ustanovljenega Centra Vlade za informatiko, vključno s celotnim postopkom izbora in nakupa centralnega računalnika državnih organov.

Po letu 1986 se je njegova strokovna dejavnost usmerila predvsem v strateške vidike informatizacije družbe kot celote. Do osamosvojitve Slovenije je delal kot svetovalec Izvršnega sveta RS za informatiko. Bil je tudi član zveznega (jugoslovanskega) sveta za družbeni sistem informiranja. Ob razpadanju zvezne države je bila njegova osrednja naloga, da prepreči razsutje temeljnih slovenskih državnih evidenc in da ohrani njihovo samostojnost in operativnost, kar je po osamosvojitvi bistveno olajšalo vzpostavitev učinkovite slovenske državne in lokalne uprave.

Od leta 1992 do 2000 je bil zaposlen na Ministrstvu za znanost in tehnologijo, zadnja leta kot državni sekretar za tehnologijo. Čeprav so njegove takratne naloge presegale področje informatike, saj je formalno pokrival celoten tehnološki razvoj, je bila informacijska tehnologija še vedno v centru njegovega strokovnega dela. V letih 1992 in 1993 je bil tudi predsednik upravnih odborov IZUM-a in ARNES-a. V času pogajanj za vstop v EU pa je bil namestnik dveh vodij delovnih skupin, ki so delale na pogajalskih poglavjih povezanih z informacijsko tehnologijo (tehnologija in varovanje osebnih podatkov).

3 STROKOVNE AKTIVNOSTI V TUJINI

3.1 Projekti Evropske unije

Ker je postalo njegovo strokovno delo vidno tudi v mednarodnem okolju, je leta 1997 postal član Evropskega (Bangemannovega) foruma o informacijski družbi in član ožjega

vodstvenega odbora tega foruma, v katerem je zastopal vseh deset bodočih članic EU. Sodeloval je tudi pri pripravi takrat izjemno odmevnega Bangemannovega poročila o evropskem prehodu v informacijsko družbo. Omeniti kaže tudi njegovo sodelovanje v projektu »G7 - Globalni trg za mala in srednja podjetja« (pod vodstvom Kanade).

Izrazito strokovne narave pa je bilo njegovo sodelovanje in vodenje evropskih delovnih skupin povezanih z državami Srednje in Vzhodne Evrope, ki so se pripravljale za članstvo v EU. Kot sopredsednik delovne skupine, ki jo je imenovala Evropska komisija, je vodil projekt »Pot v informacijsko družbo držav Srednje in Vzhodne Evrope« ter pripravo zaključnega poročila predstavljenega na »Panelu o uvajanju informacijske družbe v države Srednje in Vzhodne Evrope«. Gradivo je postalo uradna dokument Evropske komisije.

Strokovno posebej zanimivo pa je bilo njegovo članstvo v redakcijski skupini za pripravo ministrske Bonnske deklaracije, ki je opredelila načela za uporabo informacijskih omrežij in smernice za globalno informacijsko povezovanje Evrope.

Po letu 1993 je imel preko trideset vabljenih predavanj na strokovnih konferencah in delovnih srečanjih v organizaciji Evropske komisije in slovenskih ministrstev (ta predavanja praviloma niso bila objavljena v zbornikih).

3.2 Sodelovanja v evropskih projektih

1986-1991: koordinator sodelovanja med OECD in Jugoslavijo na področju informatike v javni upravi

1994-1999: predstavnik vseh kandidatk za vstop v EU v G7 projektu o informacijski družbi "Globalni trg za mala in srednja podjetja".

1996: Sopredsednik delovne skupine za pripravo EU-CEEC akcijskega programa: »Towards the Information Society in the Central and Eastern European countries« (projekt Evropske komisije)

1996: Sopredsednik delovne skupine za pripravo poročila »The Path to the Information Society in the Central and Eastern European Countries: The Role of Research & Development and Experimentation« (projekt Evropske komisije)

1997: Predsednik delovne skupine »EU-CEEC Panel on the Implementation of the Information Society Action Plan« (projekt Evropske komisije)

1997: član redakcijske skupine, ki je pripravila ministrsko Bonnsko deklaracijo o globalnih informacijskih mrežah, ki so jo sprejele vse članice EU

1998-1999: član skupnega odbora visokih predstavnikov kandidatk za vstop v EU za informacijsko družbo (Joint High Level Information Society Committee)

1997-2001: član Izvršilnega odbora Evropskega foruma za informacijsko družbo (kot predstavnik desetih kandidatk za EU)

4 AKADEMSKO DELO

4.1 Akademske aktivnosti v Sloveniji

Leta 2001 se je zaposlil na Univerzi na Primorskem, kjer je delal do upokojitve. V razmeroma kratki univerzitetni karieri je bil predavatelj na vseh študijskih ravneh s področij teorije organizacije in managementa informacijskih tehnologij. Večino predavanj je imel na Fakulteti za management ter na Fakulteti za matematiko, naravoslovje in informacijske tehnologije Univerze na Primorskem. Precej je predaval tudi na tujih univerzah.

V tem času objavil 61 izvernih znanstvenih člankov in znanstvenih prispevkov na konferencah ter več monografij. Uspešen je bil tudi kot pedagog, saj je dobil vrsto priznanj za najboljšega učitelja na diplomskih in doktorskih smereh ter za prispevke k razvoju fakultete. Leta 2014 je postal tudi zaslužni profesor Univerze na Primorskem.

Članstvo v akademskih in upravnih organih

2001-2003: član Vlade delovne skupine za ustanovitev univerze na Primorskem

2000-2002: dekan Visoke šole za management Koper

2000-2004: član Sveta za tehnologijo pri Ministrstvu za gospodarstvo

2001-2003: član Senata Fakultete za management Koper

2003-2010: član Senata Univerze na Primorskem

2008-2018: član Izvršilnega odbora Slovenske akademije za management

4.2 Nosilec predmetov na tujih univerzah

Poleg rednih predavanj na slovenskih univerzah je imel kot nosilec predmetov preko 200 ur predavanj tudi na New York State University Plattsburgh v ZDA (dodiplomski in podiplomski program) in več let na Mikkeli University of Applied Sciences na Finskem (mednarodna dodiplomska šola).

ZAHVALA

Čeprav tega prispevka verjetno ne bodo brali, se avtor vseeno zahvaljuje vsem bivšim sodelavkam in sodelavcem v preteklih letih za uspešno in pogosto težko sodelovanje. To je bilo obdobje, ki je bilo samo po sebi legendarno in precej utrgano, zato so tudi oni del te legende.

VIRI

[1] https://sl.wikipedia.org/wiki/Cene_Bavec

[2] <https://www2.ames.si/~bavec/index.htm>

55 let dela z informacijsko tehnologijo

55 Years of Work with Information Technology

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POVZETEK

Prof. dr. Jože Gričar [1] je priznan strokovnjak na področju informacijskih sistemov in je zaslužni profesor Univerze v Mariboru. Njegovo izobraževalno pot je začel na Ekonomski fakulteti Univerze v Ljubljani. Ima bogato pedagoško kariero, saj je predaval na Fakulteti za organizacijske vede v Mariboru ter drugih fakultetah v Sloveniji in tujini. S številnimi objavami je postal prepoznaven v Sloveniji in tujini kot pionir elektronskega poslovanja. Organiziral je številne mednarodne konference, med najbolj znanimi je Blejska e-konferenca. Sodeloval je s številnimi univerzami po svetu, posebej izpostavljena je bila sodelovanje z prof. Miltonom A. Jenkinsom iz Univerze v Baltimoru. Bil je tudi pobudnik e-regij in vzpostavitve čezmejnega omrežja ALADIN ter Evropskega omrežja živih laboratorijev. Po upokojitvi je aktiven član Sveta za tretje življenjsko obdobje pri Statističnem uradu RS in koordinira e-storitve za seniorje. Zaradi njegovih prispevkov na področju informatike in računalništva, predvsem v raziskavah, razvoju in pedagoškem delu, je predlagan za podelitev Zlatega častnega znaka Slovenskega društva INFORMATIKA.

KLJUČNE BESEDE

Prof. dr. Jože Gričar, informacijski sistemi, zaslužni profesor, Univerza v Mariboru, Univerza v Ljubljani, elektronsko poslovanje, Blejska e-konferenca, ALADIN, e-regije, Statistični urad RS, seniorji, Central European Seniors 55+ eServices Guide, priznanja, Zlati častni znak, Slovensko društvo INFORMATIKA.

ABSTRACT

Prof. Dr. Jože Gričar [1] is a recognized expert in the field of information systems and is an Emeritus Professor at the University of Maribor. He began his educational journey at the Faculty of Economics of the University of Ljubljana. He has had an extensive teaching career, having lectured at the Faculty of Organizational Sciences in Maribor and other faculties in Slovenia and abroad. With numerous publications, he has become well-known both in Slovenia and internationally as a pioneer in electronic business. He has organized many international conferences, with the Bled e-Conference being one

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of the most renowned. He has collaborated with numerous universities worldwide, particularly highlighting his collaboration with Prof. Milton A. Jenkins from the University of Baltimore. He was also the initiator of e-regions and the establishment of the cross-border ALADIN network and the European Network of Living Labs. After retirement, he remains an active member of the Council for the Third Age at the Statistical Office of the Republic of Slovenia and coordinates e-services for seniors. Due to his contributions in the field of informatics and computing, especially in research, development, and pedagogical work, he is nominated for the Golden Honorary Badge of the Slovenian Association of INFORMATICS.

KEYWORDS

Prof. Dr. Jože Gričar, information systems, Emeritus Professor, University of Maribor, Faculty of Economics of the University of Ljubljana, electronic business, Bled e-Conference, ALADIN, e-regions, Statistical Office of the Republic of Slovenia, seniors, Central European Seniors 55+ eServices Guide, awards, Golden Honorary Badge, Slovenian Association of INFORMATICS.

1 UVOD

Z računalnikom sem se prvič srečal v letu 1968 na dvomesečnem tečaju programiranja računalnikov Siemag (kasneje Philips) Data 8000 v simboličnem strojnem jeziku (assemblerju) na sedežu proizvajalca v mestu Eiserfeld v tedanji Zahodni Nemčiji. Največja zmogljivost računalnikovega pomnilnika je bila 16K, ki jo je bilo mogoče povezovati z magnetnimi kontnimi karticami v zmogljivostjo 512 znakov kot zunanjim pomnilnikom. Cena računalnika je bila visoka: 130.000 nemških mark. Podjetje Commerce Ljubljana je že nekaj let zastopalo podjetje Siemag za knjigovodske stroje na jugoslovanskem trgu, področje računalništva pa je bilo tako za proizvajalca kot za zastopnika novo. Ko me je direktor podjetja vprašal, ali bi se lotil tega področja, sem potrdil, čeprav nisem vedel, kaj vse to pomeni. Do tedaj sem samo od daleč videl računalnik Zuse Z23 na Inštitutu za matematiko v Ljubljani, kamor nas je spomladi 1963 peljal profesor Alojzij Vadnal v okviru predmeta linearno programiranje. Tedaj nam je rekel: Bil sem eno leto v ZDA in spoznal sem, da so računalniki pomembna stvar. To mi je za zmeraj ostalo v spominu.

Nekaj let sem bil v podjetju Commerce programer in vodja službe za izdelavo programov ter kasneje vodja službe za obdelavo podatkov. Za mene je bilo nekaj novega, da je mogoče s spreminjanjem programa po vnaprej določenem pravilu (modificiranje) poenostaviti program, da je zasedal manj

prostora v pomnilniku ter deloval hitreje z izrabljanjem logike programiranja (algoritem) skladno z danimi pogoji, ki jih je bilo mogoče programirano spreminjati. Odprl se mi je nov svet.

Pri delu smo se usmerjali v izdelavo programov, s katerimi je bilo mogoče reševati neki problem kupca računalnika. Gradbeno podjetje Nova Gorica je nakup pogojevalo s programom, ki jim bo rešil probleme izdelave predkalkulacij in mesečni obračun gradbenih situacij. Ko je bil program uspešno uveden, je to spodbudilo še šest gradbenih in eno cestno podjetje v Sloveniji, da so kupili program z računalnikom. Tekstilna tovarna Novoteks Novo mesto je želela rešitev problema terminiranja proizvodnje skladno z naročili kupcev. Ko je program deloval, je računalnik kupila tudi Tekstilna tovarna Svila Maribor. Podjetje Commerce Ljubljana je želelo carinsko označevanje (tarifiranje) konsignacijskega blaga kot podlage za izdelavo carinske deklaracije. Ko je program deloval, sta računalnik kupili tudi zastopniški podjetji Autocommerce in Tehnunion v Ljubljani. Za nakup v vrsti trgovskih in proizvodnih podjetij je bilo odločilno, ko so videli, kako je mogoče povezati blagovno knjigovodstvo s knjigovodstvom kupcev in sočasnim izdelovanjem računa. Vsak kupec računalnika je napotil vsaj eno osebo na 2-tedenski tečaj programiranja na sedežu podjetja Commerce v Ljubljani. Po tečaju je vsaj ena oseba prevzela vzdrževanje kupljenih programov in razvijanje novih; te osebe so bile kasneje vodje nastajajočih računalniških centrov podjetij. Temeljni spoznanji tistih let sta bili: Programi, ki so narejeni za rešitev problemov kupcev, prodajajo računalnike. Več kot je bilo usposobljenih programerjev, boljša je bila promocija prodaje računalnikov.

Po enajstih letih dela v Commercu sem dobil vabilo, da se pridružim računalniški katedri Fakultete za organizacijske vede Univerze v Mariboru. Začel sem pri predmetih Osnove AOP – Avtomatska obdelava podatkov in Analiza in projektiranje organizacijskih sistemov. V okviru Centra za svetovanje fakultete sem veliko sodeloval z vrsto organizacij. Med drugimi v projektu Informacijski sistem izvoznega procesa – ISIP štirih podjetij različnih dejavnosti: Iskra Commerce Ljubljana, Krka Novo mesto, Gorenje Velenje in Slovenijales Ljubljana. V treh letih smo naredili poenoteno organizacijsko zasnovo, da so programerji lahko naredili programe za računalnike Digital VAX in IBM. V programih smo razmejili podatke od postopkov obdelave podatkov; vzpostavili smo bazo podatkov. To je poenostavilo prilagajanje programa spreminjajočim se navodilom, katerim je bilo podvrženo izvozno poslovanje. Potrdili smo domnevo, da je potrebno gradnjo informacijskega sistema nasloniti na procese in ne na organizacijske enote, kar je bila dotedanja praksa v podjetjih. Na primeru izvoznega procesa smo pokazali, da je smiselno oblikovati poenotene organizacijske podlage informacijskega sistema nekega procesa več podjetij hkrati ne glede na vrste računalnikov, ki jih v podjetjih uporabljajo.

S to izkušnjo smo se lotili novega projekta za poenotenje poslovnih listin, da bi jih lahko izmenjavali računalniško in se izognili prepisovanju podatkov iz prejetih papirnih listin. V projektu so sodelovala podjetja Commerce Ljubljana, Elan Begunje, Emona Ljubljana, Gorenje Velenje in Merkur Kranj. Na podlagi obstoječih listin v podjetjih smo naredili predlog dveh

poenoteni listin: naročila in računa. V obeh so bili zajeti vsi podatki, ki smo jih našli, da bi poenotene listine kot model lahko ustrezale vsem. Na sestanku predstavnikov organizacij pa predlog ni bil sprejet, ker nobena organizacija ni bila pripravljena menjati oblike svojih listin. Projekt se je končal s spoznanjem, da listin ni mogoče poenotiti. Šele leto kasneje smo spoznali, da stvar ni v poenotenju papirnih listin, ampak v poenotenju računalniških zapisov podatkov listin. Na primer, naročilo, dobavnica, prevzemnica, račun, plačilo, reklamacija. Pogoj za to pa je dogovor vseh zainteresiranih o zapisu – dogovor o standardu. Ko je možno izmenjati računalniške zapise listin, papirne listine lahko odpadejo.

V okviru podoktorskega študija sem bil v Oddelku za informacijske sisteme Fakultete za management Univerze v Minnesoti v ZDA v času november-december leta 1985 in avgust-december leta 1987. S pridobljenimi izkušnjami sem razvil predmet Informacijski sistem, ki sem ga dvajset let predaval tudi na podiplomskem študiju Ekonomske fakultete Univerze v Ljubljani.

V letu 1985 je bila Univerza v Minnesoti ena izmed desetih univerz v ZDA, ki jih je firma IBM izbrala za podporo programom doktorskega študija informacijskih sistemov na univerzah, ker je manjkalo profesorjev za to hitro rastoče področje. Vsaki univerzi je podarila dva milijona dolarjev: pol v opremi in pol v denarju. V tem sklopu je bila tudi elektronska pošta, ki se je tedaj imenovala bitnet. V začetku decembra mi je en izmed profesorjev pokazal, kaj je elektronska pošta in kako deluje. Navdušen je bil nad tem, da je na prejetu sporočilo mogoče odgovoriti samo s tipko reply, zadošča celo, da vpiše samo črko r. Dal mi je potrebne podatke za prijavo, iz katerih je bilo razvidno, da je bila možnost uporabe bitneta tudi za Jugoslavijo. Prijavil sem se, dobil elektronski naslov in poslal sporočilo na edini naslovu v Jugoslaviji, ki sem ga našel – Zveznemu uradu za statistiko v Beogradu. Odgovora kljub večkratnemu pošiljanju nisem nikoli dobil.

V januarju 1986 sem na Fakulteti za organizacijske vede v Kranju organiziral sestanek direktorjev računalniških centrov treh univerz: Ljubljane, Maribora in Zagreba. Z velikim navdušenjem sem jim povedal o elektronski pošti in predlagal, da sprožimo akcijo, da bi jo dobili tudi za naše univerze. Dva od treh direktorjev sta rekla, da je to brez pomena, ker da na njihovi univerzi tega še nihče ni predlagal. Ker pa je en izmed direktorjev rekel, da se mu stvar zdi zanimiva, smo akcijo vendarle sprožili. Dolgo je trajalo, da smo elektronsko pošto na univerzo le dobili. Po daljšem času nam je nekdo povedal, da imajo na Telekomu Slovenije že vse pripravljeno, da pa generali ne dovolijo, da bi jo odprli za uporabnike.

V jesenskem semestru leta 1987 sem bil v skupini desetih doktorskih študentov informacijskih sistemov Univerze v Minnesoti. Bil sem doktorski študent z vsemi obveznostmi 1. letnika brez možnosti opravljanja izpitov. Kadar ni bilo obveznosti na fakulteti, sem lahko obiskoval podjetja v mestih Minneapolis in St. Paul. Med drugim sem spraševal, kako rešuje problem neenotnosti poslovnih listin kupcev in dobaviteljev. Splošen odgovor v podjetjih in na univerzi je bil, da tako pač je, da se nič ne da narediti in da je treba s tem pač

živeti. Nekateri so sicer omenili, da se menda nekaj na tem dela, da pa njihovo podjetje ne sodeluje. Iskal sem v univerzitetni knjižnici, a ničesar nisem našel. V strokovni reviji sem prebral članek, da nekatera podjetja začenejo izmenjevati računalniška sporočila, da bi se izognili prepisovanju podatkov iz prejetih papirnih listin. Nato pa sem v novembru v specializirani poslovni knjižnici v St. Paulu izvedel, da so pred kratkim prejeli škatlo nekkih dokumentov, za katere ne vedo, kaj z njimi početi. Vse so mi dali na voljo in imel sem kaj videti. To so bili dogovorjeni standardi vseh poslovnih listih procesov transportnih in trgovskih podjetij v ZDA, ki so nastali v dolgoletnih prizadevanjih Ameriškega inštituta za nacionalne standarde v New Yorku (American National Standards Institute – ANSI, Committee ASC X12). Vse dokumente sem lahko kopiral. Takoj sem jih poslal organizacijam v Sloveniji, s katerimi smo sodelovali v projektu, ki se je ustavil, ker se nič ni dalo narediti. Ti standardi so v naslednjih letih sprožili razvoj standardov tudi izven ZDA. EDI Council of Canada v Torontu je zaprosil ANSI, da jim dovoli uporabiti gotove ameriške standarde. Dobili so dovoljenje, da jih brezplačno lahko uporabljajo, saj so imela podjetja v obeh državah interes, da uporabljajo enake standarde. V okviru OZN se je za trgovino in upravo v naslednjih letih uveljavil standard EDIFACT, za avtomobilsko industrijo pa standard Odette. Na trgu so se pojavili računalniški programi za pretvarjanje standardov. Tehnologija računalniškega izmenjavanja podatkov se je izkazala kot inovativna in zelo koristna: omogočila je avtomatiziranje oskrbovalnih verig in spodbudila razvoj medorganizacijskih sistemov.

V maju 1988 smo organizirali sestanek na Gospodarski zbornici Slovenije, kjer sem 25 udeležencem povedal o prizadevanjih v ZDA za računalniško izmenjavanje podatkov z uporabo standardov (Electronic Data Interchange – EDI). V juniju 1989 smo organizirali drugi sestanek v dvorani Kazina na Bledu, ki se ga je udeležilo 120 oseb. Tretjega sestanka v juniju 1989 v Festivalni dvorani na Bledu se je udeležilo 250 oseb, med drugimi predstavniki Francije, Švice in ZDA, zato smo dogodek poimenovali 3. konferenca o računalniškem izmenjavanju podatkov. V juniju 1991 je bila 4. konferenca v Festivalni dvorani na Bledu. Udeležencev je bilo 450 iz vse Jugoslavije. Udeležili so se je tudi člani Svetovnega inštituta za računalniško izmenjevanje podatkov s sedežem v Montrealu. Deset dni po konferenci pa so na Slovenijo pričele padati bombe. Štirinajst dni je bila ena izmed dveh linij interneta edina povezava s svetom, da smo lahko sproti sporočali, kaj se v Slovenji zares dogaja. Pete konference v juniju 1992 se je udeležilo malo ljudi, saj zainteresirani udeleženci iz drugih držav v Slovenijo niso mogli priti. V naslednjih letih je junijska konferenca spet postopno rasla. Preimenovali smo jo v Konferenco o e-poslovanju in kasneje v Blejsko e-konferenco. Značilnost teh konferenc je bilo sodelovanje predstavnikov podjetij in vladnih organizacij ter raziskovalcev na univerzah. Udeleženci konference so zasnovali vrsto odmevnih projektov, ki jih je financirala Evropska komisija. Slovenija je bila med prvimi državami v Evropi, ki so sprejele zakon o elektronskem poslovanju in elektronskem podpisu. V juniju 2023 je bila že 36. konferenca.

V letih 1993-1998 so v okviru vzpostavljenega Laboratorija za e-poslovanje Fakultete za organizacijske vede nastajale diplome, magisteriji in doktorati s področja e-poslovanja. Vsako delo je

vključevalo delujoč prototip izmenjavanja podatkov med dvema organizacijama, ki so kasneje prešli v delujoče sisteme organizacij. Na primer, e-plačilni nalog (Služba družbenega knjigovodstva), e-carinska deklaracija (Carinska uprava Republike Slovenije in osem špedicijskih podjetij), e-naročilo in e-dobavnica (Mercator Ljubljana in Kolinska Ljubljana), e-račun (Železniški zdravstveni dom Ljubljana in Zavod za zdravstveno zavarovanje), e-prijava avtomobilske nesreče (Prometna policija in Združenje zavarovalstva), e-ladijski tovorni list (Splošna plovba Piran). To so bili razlogi, da je bil Laboratorij za e-poslovanje povabljen v prvo skupino Evropskega omrežja živih laboratorijev (The Helsinki Manifesto 20.11.2006). V teh letih sem razvil predmet E-poslovanje, ki sem ga deset let predaval tudi na Fakulteti za družbene vede Univerze v Ljubljani.

V letih 2001-2010 smo raziskovali čezmejne makro e-regije. V Sloveniji smo organizirali številne mednarodne dogodke (Cross-border eCollaboration in the eRegion – Panels & Meetings). Na Bledu je bilo v juniju 2005 vzpostavljeno omrežje univerz v regiji za čezmejno e-sodelovanje ALpine Adria Danube Initiative – ALADIN, v katerem so bile univerze Graz, Maribor, Reka in Trst. To omrežje je v juniju 2010 objavilo stališča glede razvoja Podonavske regije (Position Paper of the Alpe Adria Danube universities Initiative - ALADIN), pri katerem je sodelovalo 14 univerz. V raziskovalnih programih (Framework Programme) Evropske komisije V, VI in VII sem bil 11 let član slovenske delegacije v Komiteju IKT (ICT Committee), Generalni direktorat informacijska družba.

V okviru omrežja Inter-Municipality Initiative: Cross-border eCollaboration in the eRegion, ki je bilo vzpostavljeno 10. februarja 2011, smo v letih 2011-2018 raziskovali priložnosti čezmejnega e-sodelovanja z izrabljanjem interneta. Številni sestanki, paneli in posvetovanja so bili usmerjeni v naslednja področja; eInclusion in Active Aging & Silver Economy, Cultural Heritage ePromotion, eLearning & eEducation, Heathy Food eProcurement, Cross-border eCollaboration.

V letih 2019-2022 smo vzpostavili vrsto omrežij, ki so usmerjena v izrabljanje interneta za podporo aktivnemu staranju in razvoju srebrne ekonomije: eSeniors 55+ Network (2019), Active Aging Networks (2019), Professors Emeriti Network (2020), Global Network of Associations & Networks: Retirees Developing Silver Economy (2022), Network of eCollaborating Retired eAcademics (2022). Za izmenjavanje dobrih praks se kažejo priložnosti v povezovanju spletnih strani omrežij.

Bolj kot druge starostne skupine je pandemija Covid zadela seniorje. Na trd način je v nekaj mesecih pokazala, kako nujno je uporabljati e-storitve. Za nakupovanje, bančno poslovanje, obisk zdravstvenega doma, izobraževanje, urejanje zadev na občini ali upravni enoti in podobno. Dinamika potrebnih akcij se je spremenila, e-sodelovanje se je pokazalo kot nujno. Velika stvar, ki se je zgodila, je bila masovna osvojitve tehnologije za sestanke in delo na daljavo, ki je za vedno spremenila način, kako delamo. Iz vrste razlogov se za mnogo stvari v celoti nikoli ne bomo vrnili na stare načine. Tu se odpirajo vprašanja o potrebnih in želenih akcijah za aktivno e-vključevanje seniorjev.

Po novembru 2022 je na internetu zakipelo objavljane člankov o uporabi orodij umetne inteligence. Razlog za to je bila objava orodja ChatGPT firme OpenAI. Ta tehnologija je koristna za vse generacije, tudi za seniorje, ki pa jih je potrebno spodbuditi, da jo bodo začeli uporabljati. Pri tem velja opozarjati na doslej neznane možnosti uporabe tehnologije za iskanje odgovorov na vprašanja. Ta tehnologija je draga in zahtevna, da jo bo lahko nudilo le nekaj podjetij na svetu. Potrebno pa je odpravljati predsodke, ki ovirajo njeno pospešeno uporabo. Na nas je, da smo zadosti modri, da jo uporabimo vsakokrat, ko se srečamo s širšim problemom. Seniorjem je treba pomagati, da jo začno uporabljati, da spoznajo, kako koristna lahko je.

Delati z informacijsko tehnologijo 55 let je bilo veselje. Imel sem priložnost sodelovati z mnogimi študenti, kolegi profesorji in predstavniki podjetij ter vladnih organizacij, od katerih sem se lahko veliko naučil, za kar sem jim hvaležen. Imel sem srečo, da mi je to bilo dano.

VIRI

- [1] Jože Gričar https://sl.wikipedia.org/wiki/Uporabnik:Joze_Gricar

A Journey Through Life and Operations Research Career by Lidija Zadnik Stirn

Potovanje skozi življenje in kariera operacijske raziskovalke Lidije Zadnik Stirn

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ABSTRACT

The article presents the teaching, research, and service activities of Lidija Zadnik Stirn in the field of operations research, computer science and environment in Slovenia and abroad. Zadnik Stirn, Lidija (1950) is a mathematician and computer scientist. She graduated from FNT in 1974 and received her PhD from EF in Ljubljana in 1986. Since 1977 she has been working at the Biotechnical Faculty in Ljubljana, since 1996 as a full professor of mathematical methods and methods of operations research. She deals with optimization methods and the development of mathematical models for optimal decisions in the management of various systems, considering economic, social, environmental, and technological objectives (Slovenska nacionalna enciklopedija, 2011). Her activities at IS are also reflected in her publications and her work for the Slovenian Society INFORMATIKA - SSI (Vice President) and the Section for Operations Research -SOR (President), including the organization of international symposia.

KEYWORDS

Lidija Zadnik Stirn, mathematician, computer scientist, university teacher, researcher, mentor, editor, reviewer, operations research, quantitative methods, systems, management, environment, decision support, publications, Slovenian Society INFORMATIKA (SSI), Slovenian Section of Operations Research (SOR)

POVZETEK

Članek predstavlja pedagoško, raziskovalno in strokovno delovanje Lidije Zadnik Stirn na področju operacijskih raziskav, računalništva in okolja v Sloveniji in v tujini. Zadnik Stirn, Lidija (1950) je matematičarka in računalničarka.

*Article Title Footnote needs to be captured as Title Note

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Diplomirala je na FNT leta 1974 in doktorirala na EF v Ljubljani leta 1986. Od leta 1977 dela na Biotehniški fakulteti v Ljubljani, od leta 1996 kot redna profesorica za matematične metode in metode operacijskih raziskav. Ukvarja se z optimizacijskimi metodami in razvojem matematičnih modelov za optimalne odločitve v upravljanju različnih sistemov, upoštevajoč ekonomske, socialne, okoljske in tehnološke cilje (Slovenska nacionalna enciklopedija, 2011). Njene aktivnosti pri IS so odražene tudi v njenih publikacijah in njenem delu za Slovensko društvo INFORMATIKA - SSI (podpredsednica) in Sekcijo za operacijske raziskave - SOR (predsednica), vključno z organizacijo mednarodnih simpozijev.

KLJUČNE BESEDE

Lidija Zadnik Stirn, matematičarka, računalničarka, univerzitetna učiteljica, raziskovalka, mentorica, urednica, recenzentka, operacijske raziskave, kvantitativne metode, sistemi, upravljanje, okolje, podpora odločanju, publikacije, Slovensko društvo INFORMATIKA (SSI), Slovenska sekcija za operacijske raziskave (SOR)

1 INTRODUCTION – GENERAL FACTS

Lidija Zadnik Stirn has been as a professor at the Biotechnical Faculty of the University Ljubljana and Adjunct Professor at the University of Tennessee, USA active in various ways in the field IS for 50 years. As an established professor in the field of Operations Research her work as a lecturer and researcher at universities in Slovenia and abroad is of greatest importance for IS. Only some facts are mentioned here, detailed information can be found in continuation:

- she teaches operations research and related computer science courses at the University of Ljubljana and has given guest lectures at numerous universities in Europe and the USA. She has been a visiting professor at the University of Washington, USA, BOKU, Austria, the university of Trier, and the University of Munich, Germany. She has authored numerous syllabi, mentored master's and doctoral students in Slovenia and abroad; and presented papers (several keynotes) at conferences at Slovenian and foreign universities in the United States

of America, Austria, Italy, Greece, Czech Republic, Poland, Croatia, Germany and more

- she has actively participated in national and international projects. Her research is interdisciplinary, related to different systems, and based on dynamic, stochastic, hierarchical, and multi-objective decision analysis. She has developed several models for the practical use of OR methods in environment and industry. She focuses on optimization models applicable to natural resource management and deals with forests and forestry, land use and wood technology in Slovenia and internationally. She has demonstrated the ability to combine operations research, management, computer science, and environment. With her knowledge of business administration, she plays a leading role in researching new developments in bioeconomy, circular economy, climate change and life cycle. She was (is) coordinator of several projects (e.g., EU 5th FP, FORESTERRA, ERANET, H2020, COST) <https://cris.cobiss.net/ecris/si/en/researcher/6073>
- as an established scientist involved in national and international research projects, she is author, co-author and editor of more than 600 titles/units (https://bib.cobiss.net/bibliographies/si/webBiblio/bi_b201_20230913_114834_a2789475.html or https://bib.cobiss.net/bibliographies/si/webBiblio/bi_b201_20230913_115041_a2789475.html)
- the results of her research have been well received as a scientific achievement in advancing regional and global land use (forest managers use it as a theoretical basis for new forestry planning approaches). She discussed the research results with US Forest Service researchers. Her bibliography includes over 50 peer-reviewed articles in high-impact journals (e.g., Journal of Env. Management, Forest Policy and Economics, Journal of Decision Systems, Biomass and Energy, Expert Systems with Applications, European Journal of Operations Research), monographs, conference papers, reports, reviews, and teaching materials and is (co)editor of high impact journals, 23 conference proceedings and (co)organizer of more than 25 conferences. She was IBM Fellow in Germany, Visiting Professor in Austria and Germany for Research in Environmental (Pollution Modeling), Fulbright Fellow for Research and Teaching in USA. She was deputy coordinator of IUFRO D4 (Forest Assessment, Modelling and Management) and is currently coordinator of IUFRO RG 4.05.00 (Managerial Economics, Social Innovations and Entrepreneurship, Forest-based Value Chains)
- she has succeeded in making the nationally organized International Symposia at Operations Research (SOR) internationally visible and important (17 to date). She was one of the founders of OR section at SSI (Slovenian Society INFORMATIKA and is its president since 1997. It is also to her credit that the SSI section of OR was willingly accepted into the international OR associations IFORS and EURO, thus significantly increasing the visibility of Slovenian science, IS. This resulted also that she was in 2018 bestowed the honorary member of

OEGOR (Austrian Society for OR). finally, it is worth mentioning that she was elected vice president of the Slovenian society INFORMATIKA, and held the position for 20 years, which is a testament to her work for and support of the IS. Her other IS activities also include membership in the program committee of the annual national Days of Slovenian Informatics conference, as well as writing papers for the conference and chairing its various themes. For her merits, she was awarded the Golden Badge of the Slovenian Society INFORMATIKA (2019) for her achievements in the field of IS. In 2020, she received the Donald Michie and Alan Turing Prize for Life Achievements in the Slovenian Information Society for her outstanding contribution to the development and promotion of the IS. She is an established professor, for which she was elected Professor Emeritus.

2 EARLY LIFE AND EDUCATIONAL JOURNEY

She was born in Ljubljana, Slovenia, which was then part of Yugoslavia. From an early age she was curious about the world around her. She spent a lot of time reading books and exploring the natural and cultural environment near her home and abroad - as much as it was possible at that time (other parts of Yugoslavia, Italy, Austria). She considered studying management, but her final choice after graduating from high school was mathematics at the University of Ljubljana. During her studies, she became interested in issues related to mathematics education at various levels, especially applied mathematics, which at the time was used to solve real-world problems in economics, social sciences, technology, and the environment based on computer knowledge (informatics). This interest earned her a scholarship at IBM in Germany. During her BSc studies, in the summer semesters (1972, 1973, 1974), she attended computer courses for students and worked as a young research fellow in modeling and statistics in business administration and accounting at IBM Stuttgart, Germany. After graduating in mathematics in 1974, she began teaching mathematics and a new subject, computer science, at the High School Poljane, Ljubljana. Computer science curricula were just being developed, and the first textbooks in Slovenia were in the works (for example Bratko, I, Rajkovič, V. 1974). Her text notes, based on material from IBM for the students' summer classes, and her innovative approaches, which consisted also of taking the classes to various fairs where advances in hardware were shown, and to the new Slovenian Computer Center, where they could solve their simple mathematical calculations using "punch cards," gave the subject much appeal and popularity. Several students expressed their desire to study computer science later. An anecdote on the side: her best student in computer science became a well-known theater actor.

The fame that she can attract students for the subject resulted in the invitation to join the University of Ljubljana, Biotechnical Faculty as a seminar assistant in 1977. She imparted her knowledge in the field of cross-sectoral

analysis and stochastic processes to colleagues within the national project Mathematical modeling in forestry. In 1978 she started her MSc in Operations Research at the Faculty of Economics, University of Ljubljana under the mentorship of Prof. A. Vadnal. Many other outstanding professors from theoretical and applied fields (Prof. V. Rupnik for Systems Theory, Prof. M. Blejec for Statistics, Prof. Z. Bohte for Numerical Analysis, Prof. J. Grad for Computer Science, Prof. F. Garperšič for Renewable Resources Management, and others) provided her with an excellent foundation and support for her future research and teaching activities.

During her master studies she began working with operations research as a mathematical-informational-organizational science with application to environmental systems. She found that the efficient use of renewable natural resources (e.g., forests) and raw materials (wood) was becoming more important from the research and social perspective, both in Slovenia and internationally, with implementing new economic, ecological, and social paradigms. She found that two fundamental factors come to the fore in forest production, i.e., space and time, which appear in exceptional dimensions, and devoted this concept to her master's thesis with the title "Discrete dynamic programming applied to forest management planning", which she defended in 1982 at the University of Ljubljana, Faculty of Economics. In years 1983-1986 she was a researcher on the national project Growth and yield. She analyzed and tested more than 100 mathematical functions on forest sites in Slovenia and proposed a new one. This research was later included in her PhD thesis and in some publications. She received her PhD from the University of Ljubljana, Faculty of Economics in Information and Management Sciences (mentor Prof. A. Vadnal). In her PhD thesis (1986) she generated a deterministic dynamic model with one criterion for optimal forest management. In spring semester 1987 she joined BOKU, Vienna, research group of Prof. H. Joebstl, studying managerial economics and accounting and disseminated her research giving lectures. In fall semester 1987 she joined the University of Munich and focused her research and lectures on modeling pollution damages to forests emphasizing Markov chain methodology. In spring semester 1988 she was researching and teaching mathematical programming and decision analysis at the University of Trier, Germany. In 1995/96 she was Fulbright visiting professor (research and teaching) in the field of Operations Research and Forest Management at the University of Washington, School of Environmental and Forest Sciences, Seattle, Washington, USA. She also was asked by C. D. Oliver to mentor his PhD student on landscape management, integrating growth models, decision systems and optimization models into a computer visualization system that allow to investigate and optimize forest silviculture and utilization treatments according to multiple use of the landscape. The interdisciplinary study of operations research and information/management sciences based on informatics/computer science and statistics, and her ability to blend decision support models with

understanding environmental and social concepts enabled her to receive a full professorship in the field of Operations research, Quantitative methods, and Decision Support Systems at the University of Ljubljana.

Her teaching activities at the University of Ljubljana, Biotechnical Faculty, as well as at other faculties and institutions in Slovenia and abroad are extensive and innovative. She has promoted and successfully developed many new subjects in the field of modeling, quantitative methods, decision making, i.e., operations research, as a new postdoctoral subject at the BF. Her teaching activities include subjects related to quantitative decision-making methods and modeling at all levels of study, such as Mathematical Methods, Quantitative Methods, Mathematical Programming and Statistical Techniques, Modeling Methods in Life Sciences, Decision Making Methods. She has written study programs for all these subjects, most of which are original because she has placed them on new, modern content and methodological foundations and prepared teaching materials/textbooks for them (Zadnik Stirn 1983, 2001).

She was a mentor/co-mentor for young researchers, many graduate and master students, PhD students in various environmental fields and beyond, reviewer and member of dissertation defense. Of particular note, she was the mentor to the first doctoral student in the newly created Natural Resource Economics program. Outside the Biotechnical Faculty, she accepted invitations to teach courses and give lectures in operations research, mathematical methods, financial mathematics and statistical methods, and decision-making methods in marketing at several faculties and institutions in Slovenia and abroad. At most of them she also wrote syllabi, and textbooks, was member of PhD thesis defense committees, habilitation committees. Further she gave more than 20 invited lectures at universities in the USA (Oregon, Madison, Fort Collins, Boulder) and Europe (Vienna, Trieste, Prague, Göttingen, Munich, Thessaloniki, Kavala, Osijek, Zagreb, Nancy, Gdansk, ...).

3 RESEARCH ACTIVITIES

Her research that achieved broader applicability and notoriety dates back to 1986, when she developed a mathematical model based on dynamic programming. This contribution to decision models used to support the choice of strategies/scenarios in the management of environmental systems subject to multiple, sustained, long-term objectives and to unpredictable influences led to: (i) the publication (Zadnik Stirn 1986) which is a pioneering the field of practical applicability of operational research in environmental systems (renewable resources), and (ii) the invitation to give invited lectures at BOKU, Vienna and to do research and teach at the Department of Computer Science, University of Trier, ZRN. Later, she extended her research area to include multicriteria, stochastic, fuzzy models and group decision making in the natural systems domain. She used these findings in the context of numerous national and

especially European projects, which she led and transferred to her teaching activities, especially for Master students, PhD students and young researchers.

She participated in interdisciplinary research and was the leader of basic and applied projects. For example, she led basic research projects: Quantitative Approaches for Optimal Decisions in Forestry Planning, Stochastic and Heuristic Methods to Support Forestry Planning, Introduction of Decision-Making Methods for Optimal Ecosystem Management, Mathematical Models for Optimal Management of Timber Industry Enterprises. She also led the methodological area in the projects: Development of Marketing Strategies for Agricultural Products and Modeling of Marketing and Management Strategies for Increasing the Competitiveness of Fruit Production. Under the Fulbright program (1 year), she participated in the following projects at Seattle College, USA: Development and Improvement of a Mathematical Model for Optimal Decision Making in Forestry, Landscape Management System, Hierarchical Planning in Forestry, Stumpage Valuation for State Excise Tax Purposes. He also had two bilateral projects (Greece, Poland) and participates in COST projects. He also actively participated in GIS projects, especially in Forestry Program Group (among the best - in internal evaluation system). Among the more important international projects, it is worth highlighting that from 2000-2005 she led the project Tools for evaluating investment in the Mediterranean mountain areas - An integrated framework for sustainable development - MEDMONT from the 5th EU Framework Program, one of the first European projects in the field of forestry. In 2012-2014 she was the leader of the project COOL (COMpeting uses Of forest Land) in ERA-NET WoodWisdom-Net 2, where together with her colleagues at BF UL and abroad she solved the current problem of how to deal with the increasing demand for wood for energy purposes while taking into account the objectives of different policies and the conflicting interests of stakeholders. In 2015-2017 she was co-leader of the project INFORMED (INTegrated research on FOReSt Resilience and Management in the Mediterranean) under the international action FORESTERRA, in 2013-2017 she worked for the project Action COST (Orchestrating forest-related policy analysis in Europe - ORCHESTRA), in 2017-2020 she was Associate Partner at SIMRA - Social innovation in marginalized rural areas project under HORIZON 2020 and in 2021-2023 Partner at ASFORCLIC (Adaptation strategies in forestry under global climate change impacts under action H2020).

4 PUBLICATIONS

Together with her colleagues at the Biotechnical Faculty and abroad, as well as her students, she has authored and (co)authored scientific journal articles, professional articles, monographs and chapters in monographs, popular articles, scientific conference articles, and research reports, all of which are listed on her personal page in the Slovenian Current Research Information System

https://bib.cobiss.net/bibliographies/si/webBiblio/bib201_20230915_215101_07446.html.

Original papers, some of which have been cited multiple times, have been published in Expert Systems with Applications, Journal of Environmental management, Journal of Operations Research, Forest Policy and Economics, Forest Ecology and Management, Biomass and Energy, and others.

She has given 15 invited talks and more than 90 presentations at international scientific conferences published in peer-reviewed proceedings. She has also authored 14 papers in monographs.

Recently, she has contributed an extraordinary number of papers, especially reviews, to impact factor scientific journals (Forest Science, Optimization, EJOR, CJOR, Forest management and ecology, Forest and landscape research, ...). She is editor/co-editor of 17 international proceedings in OR, two monographs in OR, impact factor journal CJOR and was guest editor of CJOR (2011, 2013, 2015, 2017, 2019, 2021, 2023), BSRJ (2012, 2014, 2016, 2018, 2020, 2022) and Forest Policy and Economics (2016).

The following is a more detailed discussion of some of the publications that have to some extent attracted the theoretical researchers and practitioners in the field:

- Her mathematical model based on dynamic programming, which emphasizes the idea of practical utility, was published as a monograph (Zadnik Stirn 1986). This work is valuable in two ways: i) it is a pioneering work in the field of practicality of operational research in natural resource management and has also been used to support the choice of strategies/scenarios set in forest management plans in Slovenia and abroad; ii) the work is written in Slovenian and as such has helped to improve terminology in the field.
- In the journal Forest Ecology and Management (Zadnik Stirn 1990), she published the model for optimal management of environmental systems, in which some new theorems based on discrete dynamic programming and adaptive programming were developed to account for unpredictable long-term properties of the system. The model was considered a novelty and discussed with researchers, practitioners, and students in forestry and related fields. It has been widely cited and used as a theoretical basis for further research on the subject.
- In the journal Ecological Modelling (Zadnik Stirn 2006), she was the only author to publish a theoretically innovative and practically applicable environmental decision model combining stochasticity (fuzzy logic), dynamics and multicriteria.
- In the Journal of food engineering (Osvald and Zadnik Stirn 2008), she and her postdoctoral fellow from Italy published an algorithm for organizing the transportation of perishable goods.
- In the co-authored article (Lipušček et al. 2010), published in The international journal of life cycle assessment, the main environmentally relevant parameters were identified and a model was created to

classify the discussed products in terms of their environmental impact. Utility functions were calculated using the AHP based on previous statistically processed expert results. The modeling allows for critical comparison of products from an environmental hazard perspective and identification of clear advantages and disadvantages of a particular product. The research has generated considerable interest at the national and international level in understanding the factors of production throughout the life cycle of a product. The focus on environmentally friendly production, in addition to existing economic criteria, and the efficient use of raw material resources (wood from well-managed forests) and energy has become one of the most important strategic objectives not only of the wood industry, but of the entire national and global strategy.

- In the European Journal of Operational Research (Grošelj and Zadnik 2012), she and her PhD student published a proof of the consistency of combination matrices in group AHP.

In the Journal of environmental management (Pezdevšek Malovrh et al. 2016), an international team effort was published that presents a three-phase decision-making framework for analyzing the operational environment of strategies to increase forest bioenergy targets. The framework is based on SWOT analysis and SMART methodology. The research has implications for regional and global forest management (policy, governance, management). The mixed methods analysis presented has been used and replicated in other countries to refine national bioenergy policies under the EU 2030 Flexible Climate and Energy Policy.

5 OTHER ACTIVITIES AND SERVICES

She is the founder of the Chair of OR /Methodology at the Biotechnical Faculty of the University of Ljubljana and has introduced several subjects from Operations Research, Mathematical Modeling, Quantitative Methods, Statistics, and Information Science to be taught to students of Environmental Sciences at all levels and beyond.

She joined IUFRO (International Union for Forest Research Organizations, linking forests, science, and people) at the 1986 IUFRO World Congress (WC) in Ljubljana. She was Deputy Coordinator of IUFRO Division 4 ((Forest Assessment, Modeling and Management)) for 10 years and is currently Coordinator of Working Group (WG) 4.05 (Business Management and Accounting, Social Innovation and Entrepreneurship, Forest-based Value Chains). She has co-organized several IUFRO conferences, co-edited conference proceedings and conference reports, organized and chaired meetings, presented papers, and peer-reviewed papers for conference proceedings. She initiated new working parties (WP) within WG 4.05.00. Starting with two WP, RG currently consists of five, and a sixth is under consideration.

In 1992/93 she was one of the founders of the Section of Operations Research - SOR (founders were Prof. Rupnik, Prof. Grad, Prof. L. Bogataj, Prof. M. Bogataj, Dr. D. Čepar, Prof. J. Dekleva, Prof. S. Indihar, Prof. I. Meško, Prof. S. Drobne and Prof. L. Zadnik Stirn). SOR was founded under the umbrella of the Slovenian society INFORMATIKA – SSI. The first president of SOR was Prof. Rupnik. L. Zadnik Stirn took over SOR in 1997, so she has been the president of SOR since 1997. She was also Vice President of SSI (2002-2023). SSI-SOR organized 17 well-founded international symposia at OR since 1993. The most internationally attended were the biennial OR symposia SOR'97, SOR'99, SOR'01, SOR'03, SOR'05, SOR'07, SOR'09, SOR'11, SOR'13, SOR'15, SOR'17, SOR'19, SOR'21, and SOR'23, for which she was chair of the program committee and principal organizer. She presented papers, organized, and chaired sessions, and co-edited 17 proceedings published by SSI-SOR. In 2005, she began advocating for the inclusion of SSI-SOR in IFORS and EURO; SSI-SOR became a member of IFORS and EURO under her leadership in 2008, and she has been the SSI-SOR representative to IFORS and EURO since 2008. She has chaired the judging panel for the EDMS (EURO Distinguished Service Medal). She has been an organizer and session chair at EURO conferences (Prague 2007, Bonn 2009, Lisbon 2010, Vilnius (2012), Rome 2013, Glasgow 2015, Poznan 2016, Valencia 2018, Dublin 2019, Espoo 2022) and at IFORS conferences (Sandton 2008, Melbourne 2011, etc.). She is country correspondent for IFORS News.

Annually, she serves on organizing and program committees for meetings related to OR, computer science, natural sciences, and related fields, works with young scientists to facilitate their participation in EURO conferences, and collaborates with various EURO neighboring societies such as INFORMS.

SSI appointed her as the representative and vice chair/board member of IFIP TC7- "System Modeling and Optimization", She was Vice- Dean of Forestry at the University of Ljubljana (2010-2012), international member of the Forum of Forestry Deans and Directors (2008-2014), ERASMUS coordinator (2006-2014), and member of research assessment committees at the international level (e.g.. Forest Value (2016), Tandem Forest Value (2019)). She is Chair of the Student Scholarship Committee at the Pahernik Foundation, Slovenia. She is also chair or member of several habilitation committees, mainly at the national level.

Since 2017, she has been a member of the PhD committee for the System Engineering and Informatics program at the Faculty of Economics and Management, Czech University of Life Sciences, Prague, Czech Republic.

6 CONCLUSIONS

Her work in the field of information science (IS) is evident in the following areas:

Education: she initiated and successfully developed several new subjects in the field of modelling, i.e., quantitative methods, decision making methodology, operations research, computer science at all levels of study at the University of Ljubljana and beyond

Research: in her research she developed some decision support models based on discrete dynamic, stochastic, fuzzy, and multi-criteria methods for practical use (decision support) in managing various systems related to economic, environmental, social, and technological goals

Publications: Students and practitioners in various fields use her textbook "Operations research methods for business decision making" as a basis for acquiring basic knowledge in operations research; her research results published in journals and monographs or presented at scientific conferences are used by experts for decision making in environmental fields

Management/Promotion: she is a co-founder of SOR and has been its president for 26 years. She has put Slovenia on the global OR map and has been instrumental in presenting/sharing the new OR knowledge at international conferences.

It should be noted that she had the great opportunity to meet many researchers and practitioners in the field of operations research, computer science, natural resources, and social sciences around the world and to visit many countries. But this was not just a leisure activity. She was always willing to go to different places and face hardships - be it physical challenges, remote locations, hearings and meetings, or difficult courses in mathematics, computer science, ecology, economics, and social sciences - with the goal of strengthening her skills, and then sharing through research and teaching her knowledge with younger colleagues, students, and practitioners in the fields of computer science, environment, and entrepreneurship.

Throughout her career, she has always emphasized the importance of interdisciplinarity, internationality, teamwork, collaboration, and communication, which are the most important approaches especially in the field of operations research, computer science and environment.

That she has been able to accomplish the teaching, research, and organizational tasks presented is due to many people - from family to teachers/mentors, students, and colleagues who have helped and advised her, and with whom she has had the privilege of collaborating in research, teaching, publishing, IUFRO, SSI-SOR, and management tasks.

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Dosežki kandidata S. Štefančič

Achievements of the Candidate S. Štefančič

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POVZETEK

V prispevku so opisani dosežki avtorja pri uvedbi informacijsko-komunikacijske tehnologije v prakso in v smislu kandidature za "Dvorano slavnih slovenskega računalništva in informatike".

KLJUČNE BESEDE

Življenjski dosežki, gospodarstvo, e-poslovanje, digitalizacija, vodenje projektov

ABSTRACT

In the article, the author's achievements in the implementation of information and communication technology into practice are described in the context of candidacy for the "Hall of fame of Slovenian Computer Science and Informatics".

KEYWORDS

Life achievements, industry, e-business, digitization, project management

1 UVOD

Stoletja je bil papir edino sredstvo za dokumentiranje poslovnih transakcij, z izjemno hitrim razvojem informacijsko-komunikacijskih tehnologij pa se je to korenito spremenilo. Kandidat Stane Štefančič je v svet računalnikov in informatike vstopil kot študent tehnične matematike na FNT v Ljubljani in se najprej soočil z luknjalnimi karticami v IBM računalniku na Fakulteti za matematiko in fiziko in v 50 letih s svojim delovanjem prispeval pomembne rezultate na področju informatike v našem prostoru do sedanjega obdobja digitalizacije poslovanja v digitalni družbi.

V prispevku je predstavil svoje delovanje in svoje največje dosežke v štirih obdobjih:

1. Avtomatizacija poslovanja.
2. Outsourcing in Reinženiring Informacijskih sistemov.
3. Prenovitev informacijskih sistemov in uvajanje e-Poslovanja.
4. Veliki projekti za državljane in storitve na oblaku.

*Article Title Footnote needs to be captured as Title Note

[†]Author Footnote to be captured as Author Note

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2 AVTOMATIZACIJA POSLOVANJA

V 70. letih prejšnjega stoletja je bil glavni namen računalnikov v obdelavi prejetih podatkov in podajanju rezultatov na tiskalnikih. Prve poslovne programe v Fortranu je kot študent sprogramiral leta 1972 po zahtevah Urbanističnega Inštituta Slovenije na takrat najsodobnejšem računalniku Cyber 70 na RRC na Jadranski. Pridobil je zelo zahteven projekt definiranja zahtev, programiranja in izvajanja obdelav Projekcije prebivalcev Slovenije iz leta 1971 v 1981 za 60 občin z upoštevanjem naravnega prirasta, gospodarske rasti in ekonomskih migracij. Obdelave so imele veliko parametrov in je takrat izkoristil izjemne možnosti vnosa podatkov na terminalu.

Po študiju se je zaposlil v Računskem centru Železarne Jesenice, kjer je sodeloval na razvoju in vzdrževanju poslovnih aplikacij na računalniku IBM 360 z luknjanimi karticami: Glavna knjiga, Osnovna sredstva, Pred in Po-kalkulacije izdelkov, Stroški poslovanja, Analiza nabave investicijske opreme, Statistične metalografske preiskave.

Dosežki 1. obdobja:

- Sodelovanje pri vzpostavitvi leta 1980 najsodobnejšega IBM računalniškega centra z MVS operacijskim sistemom, migraciji aplikacij, podatkov in obdelav ter standardov imen in postopkov razvoja programske opreme: razvoj-test-produkcija ter delovanja računalniške podpore.
- Sistemski inženir za uvedbo on-line terminalskih aplikacij s platformo za design in razvoj aplikacij: uporabniške zahteve z definicijo ekranov, podatkovni model s slovarjem podatkov, generator programov in izvajalno okolje

3 REINŽENIRING INFORMACIJSKIH SISTEMOV IN POSLOVNIH PROCESOV

Reinženiring informacijskih sistemov predstavlja prilagajanje IT organizacij nenehnim spremembam v poslovanju in tehnologiji, pri čemer sta ključna dejavnika razlika in kompleksnost informacijskih sistemov (IS). Pri reinženiringu IS uporabljamo štiri različne pristope k spremembam: prilagoditve, migracija, prenos in tranzicija. Informacijska podpora deluje s ciljem optimizacije stroškov in nadgradnje tehnično-tehnološkega znanja. Večina podjetij se intenzivno osredotoča na dodajanje vrednosti v poslovanju ob hkratnem zmanjševanju stroškov ter pričakuje "več in boljše storitve za enak vložek". Podjetja, ki so

že uspešno zmanjšala stroške na zeleno raven, se lahko osredotočijo na dejavnosti, ki jim omogočajo rast in širitev poslovanja, s tem pa tudi povečanje njihove dodane vrednosti. Pri analizi in reševanju teh izzivov imajo pomembno vlogo predvsem računovodske in finančne službe, z njihovim strokovnim znanjem, uspešnostjo in iznajdljivostjo. Dejstvo je, da na nekaterih področjih poslovanja še vedno obstajajo možnosti za dodano vrednost in nominalne prihranke, le najti je treba pot do njih.

Poseben poudarek je treba nameniti pregledu postopkov pogodbenih obveznosti in naročanja, prevzemu storitev in izdelkov, ter pregledu in odobravanju prejetih računov, fakturiranju, načrtovanju denarnih tokov in sredstev potrebnih za nemoten potek delovanja organizacije.

Dosežki 2. obdobja:

- Organizator konferenc Re'91,92,93,94,95 Reinženiring informacijskih sistemov [1] na Bledu skupaj z dr.Krisperem iz FRI ter dr.Gyorkosem in dr.Welzerjevo iz FERI.
- Uvedba CASE orodja POSE z največ instalacijami na vsem področju nekdanje skupne države.
- Outsourcing - zunanje storitve računalniške podpore podjetjem za bistveno razšitev[2] delovanja Podatkovnega centra SRC Kemija.

4 VELIKI PROJEKTI ZA DRŽAVLJANE IN STORITVE V OBLAKU

Organizacije dajejo izredno velik poudarek na izboljševanje postopkov. V ta namen so se začele uporabljati tudi nove tehnike, predvsem na področju vodenja in informacijske podpore procesov-projektov. Ko govorimo o nekem postopku ali projektu kot posebni obliki postopka (npr. uvajanje novega izdelka-storitve), potem le-tega lahko razdelimo v več vzporednih procesov: osnovni postopki, postopki razvoja, podporni (pomožni) postopki, organizacijski postopki (delovne skupine, funkcijski oddelki itn.), informacijski postopki (zbiranje, distribucija, avtorizacija dokumentov, pregledovanje itn.), kadrovski postopki (izobraževanja kadrov za dvig znanja).

Vsem tem postopkom lahko izmerimo hitrost. Za skrajšanje celotnega postopka-projekta je potrebno, da imajo vsi postopki vsaj podobno hitrost. Vodenje projektov[5] je izredno pomembno pri obvladovanju podpornih procesov, saj ima lahko izjemen vpliv na hitrost. Ugotavljali so pomanjkljivosti v organizaciji in obstoječih procesih (»as-is«) in predlagali rešitve (»to-be«), s pomočjo sodobnih konceptov modeliranja podatkov in upravljanja prenovitve procesov.

Dosežki 4. obdobja:

- Skupaj s sodelavci MNZ (ga. Irena Tršinar) so v letu 2000 vzpostavili prenovljen Centralni Register Prebivalcev na Oracle bazi podatkov in internetnim vpogledom prebivalcev v lastne osebne podatke.
- V maju 2005 so vzpostavili delovanje prenovljenih temeljnih državnih registrov prebivalstva [6] (matični, prebivališča, tujci, listine, volitve) na najsodobnejši

Web/Oracle tehnologiji in skrajšali vrste na upravnih enotah.

- Uvedli so produkt SDM-sodobno delovno mesto [4] na delovni postaji z bistvenimi funkcijami za referenta na upravni enoti pri pridobivanju podatkov o osebi iz registrov ter zajemanju biometričnih podatkov (prstni odtis, fotografija) in podpisovanje na elektronski tablici.
- V letu 2007 so bili del izjemnega dosežka slovenske e-Uprave, ki je dosegla 2. mesto med članicami EU.
- V letu 2013 so bili del konzorcija projekta e-Sociala, ki je bil nagraden s 1. Združenih narodov za javne storitve za Evropo in Severno Ameriko.
- Na oblaku so uvedli modula e-Računi elektronsko vodenje prejetih računov[7] in i-Računi elektronsko izdajanje računov.
- Skupaj s partnerji iz Italije, Romunije, Belgije in Slovenije so izvedli uspešen pilotni EU projekt ECRN - European Civil Registry Network.
- Kot predsednik sekcije eGovernment, pri ZIT na Gospodarski Zbornici Slovenije, je promoviral slovenske informacijske rešitve in storitve na Balkanu ter sodeloval na projektih APAI CRVS v Afriki.

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