IMPROVING TRUST IN INFORMATION SOURCES: SERBIAN WIKIPEDIA USE CASE

Dragana Dudić[1], Nebojša Ratković[2], Ivana Firaunović[3], Olja Krčadinac[4]

[1]*Faculty of Informatics and Computer Science, University Union Nikola Tesla, Belgrade, Serbia, ddudic@unionnikolatesla.edu.rs, 0000-0001-8513-6529*
[2]*Wikimedia Serbia, Belgrade, Serbia, nebojsa.ratkovic@vikimedija.org, 0000-0001-5983-9642*
[3]*Šabac Grammar School, Šabac, Serbia, ivanafiraunovic@sabackagimnazija.edu.rs, 0009-0007-2885-7267*
[4]*Faculty of Informatics and Computer Science, University Union Nikola Tesla, Belgrade, Serbia, okrcadinac@unionnikolatesla.edu.rs, 0000-0002-6299-371X*

Abstract: For almost two decades, Wikimedia Serbia has active collaboration with educational institutions in Serbia, promoting Wikipedia to young people, training and encouraging them to create and edit Wikipedia with special focus on Wikipedia trust concepts as the important factor of every information source. This paper presents our findings on the current level of students' understanding of trust mechanisms in information sources and examines the impact of conducted targeted educational intervention on this domain. This study was conducted as part of the collaboration between Wikimedia Serbia, the Faculty of Computer Science and Informatics at Union Nikola Tesla University, and Šabac Grammar School. We used structured questionnaires to determine the initial state of trust mechanisms awareness in students. After analyzing the obtained results, we organized instructional session which included comprehensive lectures on Wikipedia, its structure, rules and its editing process. Afterwords, students selected Wikipedia-related assignments aligned with their course interests. The follow-up questionnaire revealed great improvement in correct referencing and licensing usage, in both educational institutions emphasizing the importance of proper referencing and licensing as trust mechanism and its influence in digital literacy in general.

Keywords: digital literacy, higher education, secondary education, technology integration in education, Wikipedia

INTRODUCTION

Opportunities and Challenges in the Digital Age

In the digital age, the availability of vast amounts of information presents both opportunities and challenges. While the internet provides immediate access to diverse perspectives, the credibility and accuracy of information are frequently questioned, leading to a pressing need for mechanisms that help users discern reliable sources from misinformation[10]. The trustworthiness of online resources has become crucial as individuals rely on digital platforms not only for casual browsing but also for educational, professional, and decision-making purposes [7].

The Role of Wikipedia in Digital Information

Among these platforms, Wikipedia stands out as one of the most popular and widely consulted encyclopedic sources, accessible in multiple languages and open for user contributions worldwide [15]. As one of the most visited language versions in the Balkans, Serbian Wikipedia serves as a significant source of information in Serbia and neighboring countries, with specific relevance to the region's language, history, and culture [5]. However, the credibility and acceptance of Wikipedia, including its Serbian version, continue to be a subject of debate, primarily due to its open editing model, which invites contributions from a wide spectrum of users with varying levels of expertise [9].

Building Trust in Wikipedia

The challenge of building trust in Wikipedia lies in balancing open access with the rigorous standards of quality information. Since its inception, Wikipedia has implemented several mechanisms aimed at

improving the quality and reliability of its content, such as citation requirements, verification of sources, and community oversight through discussion pages and edit histories [6]. Yet, public trust in Wikipedia remains varied, often influenced by factors such as familiarity with its editing processes, awareness of quality controls, and perceived biases [16]. In Serbia, the situation is particularly nuanced, as users often navigate Wikipedia in tandem with other regional and global sources, evaluating it within the broader context of regional media trust issues, political narratives, and historical sensitivities

Evaluating Wikipedia Articles

Wikipedia articles can be evaluated using the CRAAP test, which highlights the importance of currency, relevance, authority, accuracy, and purpose in the evaluation of information sources [2]. The structure of Wikipedia inherently supports the evaluation of four out of these five criteria. For instance, Wikipedia articles provide details on the currency of information (last updated date), authority (author or editor identity), and purpose (educational content). However, accuracy, which reflects trust in the provided information, depends on proper referencing and licensing mechanisms. These mechanisms, when adhered to, ensure that information is evidence-based, sourced, and compliant with intellectual property [14].

Importance of Referencing and Copyright Licensing

While proper referencing and copyright licensing are often regarded as common knowledge, mistakes are still frequently made [17]. These skills are essential and should be explicitly incorporated into academic or professional activities that require proper attribution and responsible use of intellectual property. Incorporating Wikipedia article writing into educational curricula provides an effective avenue to teach these skills.

Prior Research on Trust and Wikipedia

The use of Wikipedia in education has been studied extensively [1][8] [19][20][21], but research focusing on referencing and copyright licensing is limited. Only one prior study has examined the importance of trust concepts in this context but lacked a deep insight [5]. Additionally, studies on trust in Wikipedia often explore its use as a source in scientific papers [3][14][22][23] or its credibility from a user perspective rather than focusing on fostering trust through improved editorial practices [11][12][18].

Focus of This Study

Our research examines trust mechanisms in Wikipedia from two key perspectives: readers, who assess the credibility of content, and content creators, who build trust through proper referencing and copyright practices. This dual approach aims to enhance both the perception and production of trustworthy information on Wikipedia. In this paper, we provide insights into the current state of students' knowledge about referencing and copyright licensing mechanisms. We also examine the influence and power of targeted educational interventions in improving referencing and licensing abilities, focusing on Serbian Wikipedia articles. By addressing the specific challenges faced in this regional context, this research contributes to improving local digital literacy and offers broader insights into enhancing trust in open-access platforms worldwide. This study is based on a pilot test conducted with a small sample, with plans for future expansion in various directions.

METHODS AND MATERIALS
Research Design

This study utilizes a quasi-experimental design to assess the effectiveness of an educational intervention aimed at improving students' understanding of referencing and copyright licensing mechanisms in the context of Serbian Wikipedia. The research was conducted as part of a collaboration between Wikimedia Serbia, the Faculty of Computer Science and Informatics at Union Nikola Tesla University, and Šabac Grammar School. A pilot study approach was chosen to gather initial insights into the impact of targeted educational sessions on digital literacy, with the intention to expand the scope in future studies.

Participants

The study involved two groups of students:
* Group 1: 20 third-year students from the Faculty of Computer Science and Informatics at Union Nikola Tesla University.

- Group 2: 20 fourth-year students from the information technology program at Šabac Grammar School.

Both groups were selected based on their strong backgrounds in computer science and research skills, ensuring a baseline level of familiarity with academic writing and research practices. All participants voluntarily agreed to take part in the study.

Educational Intervention

The intervention consisted of a series of educational lectures and activities designed to improve participants' understanding of proper referencing and copyright licensing, with a specific focus on the use of these mechanisms in Wikipedia articles.

The intervention was divided into four phases:

1. Initial Phase: Baseline data was collected through a structured questionnaire to assess the students' pre-existing knowledge of referencing, copyright, and the use of Wikipedia.
2. Informative Phase: Lectures and practical workshops were conducted by Wikimedia Serbia representatives. These sessions covered the importance of referencing and copyright in digital platforms, focusing on how Wikipedia incorporates these mechanisms.
3. Proactive Phase: Students were tasked with creating or editing Wikipedia articles, applying the knowledge they had gained during the informative phase. They selected topics related to their academic interests and worked under supervision to ensure proper application of referencing and licensing practices.
4. Evaluation Phase: A post-intervention questionnaire was administered to evaluate changes in students' understanding of referencing and copyright licensing. The responses were compared with baseline data to assess the effectiveness of the intervention.

Data Collection

Data was collected through structured questionnaires administered at two points during the study:

- Pre-Intervention (Initial Phase): A set of 10 questions aimed at gauging students' baseline understanding of referencing, copyright, and digital literacy in the context of Wikipedia.
- Post-Intervention (Evaluation Phase): A fol-

low-up questionnaire containing similar questions to assess changes in students' knowledge after completing the educational intervention.

The questionnaires included both closed-ended questions (with multiple choice, nominal or Likert-scale responses) and two open-ended questions to gather qualitative insights into the students' perceptions of the intervention.

The inclusion of general knowledge and attitudinal questions, in addition to trust-specific items, was designed to capture a comprehensive picture of students' starting points. This broader approach ensures that improvements in trust-related practices can be interpreted alongside changes in overall digital literacy and familiarity with Wikipedia's structure and use.

Questionnaire Design

The questionnaires were designed to assess knowledge in the following key areas:

- Referencing: Questions related to when and how to reference sources in academic and digital contexts, with a focus on Wikipedia (Table 1 and 2).
- Copyright Licensing: Questions regarding the understanding and use of copyright licenses, within Wikipedia articles (Table 3 and 4).
- Students' General Wikipedia Knowledge: Questions aimed at assessing the participants' foundational understanding of Wikipedia. (Table 5 and 6)

Table 1. Questions IPQ5-IPQ7 from the initial phase questionnaire

IPQ6: What does referencing consist of?
A1: Citation of information sources
A2: Listing everything we have read that is related to the given topic
A3: Rewriting
A4: A set of rules that makes writing difficult
A5: citation of literature at the end of the essay
IPQ7: When to cite and when not? (multiple answers possible)
A1: Never
A2: When I literally copy a text from a book or textbook
A3: When I literally copy any text
A4: When I literally state something that is common knowledge
A5: When I retell something that is common knowledge
A6: When I retell a text from a book or textbook
A7: When I retell any text
A8: When I literally state something someone told me

A9: When I retell what someone told me
A10: When I retell someone else's ideas
A11: When I literally state someone else's ideas
A12: When I state my ideas
A13: When I copy someone else's entire table
A14: When I copy part of someone else's table

Table 2. *Questions EPQ5-EPQ7 from the evaluation phase questionnaire*

EPQ7: Do you understand the importance of referencing sources of information better now than before writing an article on Wikipedia?
A1: Yes, much clearer
A2: Yes, mostly clearer
A3: Yes, clearer
A4: No, still somewhat unclear
A5: No, still unclear
EPQ8: (the same as in IPQ6)
EPQ9: To what extent do you understand how to reference sources of information?
A1: Completely understand
A2: Mostly understand
A3: Understand
A4: Mostly don't understand
A5: Don't understand

Table 3 *Questions IPQ8-IPQ10 from the initial phase questionnaire*

IPQ8: What is a copyright?
A1: The right that someone claims to their work
A2: Part of intellectual property
A3: A method to prohibit everyone from using a particular source of information
A4: Source of income
A5: The author's right to determine how his work will be used
IPQ9: Which copyright licenses do you know?
A1: Creative Commons
A2: Copyleft
A3: GNU
A4: Public domain
A5: SPARC
A6: Finding Images
A7: Open Educational Resources
A8: Open Access
IPQ10: Have you ever used copyright licenses
A1: Yes
A2: No

Table 4. *Questions EPQ10 from the evaluation phase questionnaire*

EPQ10: Do you understand the importance of using copyright licenses better now than before writing an article on Wikipedia?
A1: Yes, much clearer
A2: Yes, mostly clearer
A3: Yes, clearer
A4: No, still somewhat unclear
A5: No, still unclear

Table 5. *Questions IP1-IPQ4 from the initial phase questionnaire*

IPQ1: To what extent do you find interesting the possibility to edit Wikipedia?
A1: Extremely interesting
A2: Very interesting
A3: Interesting
A4: Little interesting
A5: No interesting
IPQ2: Have you ever tried to edit Wikipedia?
A1: Yes
A2: No
IPQ3: Have you ever successfully edited Wikipedia?
A1: Yes
A2: No
A3: I have never tried to edit Wikipedia
IPQ4: What does Wikipedia represent to you?
A1: Online source of information
A2: Literature for essay writing
A3: Knowledge sharing point
A4: Online searching tool
A5: Internet encyclopedia
IPQ5: For what purpose do you use Wikipedia?
A1: Writing essays
A2: Expanding knowledge
A3: Online searching
A4: Fun
A5: Finding something new

Table 6. *Questions EPQ1-EPQ6 from the initial phase questionnaire*

EPQ1: How would you rate the training on editing Wikipedia?
A1: Excellent
A2: Very good
A3: Good
A4: Satisfactory
A5: Unsatisfactory
EPQ2: How understandable was the training on editing Wikipedia to you?
A1: Extremely clear

A2: Very clear
A3: Clear
A4: Somewhat unclear
A5: Unclear
EPQ3: To what extent was the training on editing Wikipedia useful to you?
A1: Extremely useful
A2: Very useful
A3: Useful
A4: Mostly useless
A5: Useless
EPQ4: To what extent were the instructors available to you during the creation of the article on Wikipedia?
A1: Extremely available
A2: Very available
A3: available
A4: Mostly available
A5: Unavailable
EPQ5: What new things did you learn during the training on editing Wikipedia? (open ended, max 50 words)
EPQ6: How would you describe the process of creating an article on Wikipedia? (open ended, max 50 words)

Data Analysis

The data from both the pre- and post-intervention questionnaires were analyzed using descriptive statistics to summarize participants' responses. To assess the effectiveness of the intervention, statistical tests were conducted using programming language R, including:

- Fisher's Exact Test: To evaluate significant differences between groups and pre- and post-intervention where possible. (fisher.test() function from the stats package)
- Cramér's V: To measure the strength of associations between variables, particularly between education level and changes in understanding. (assocstats() function from the vcd package)

For questions with more than five answers, hierarchical clustering was employed to group similar responses and reveal patterns in participants' answers:

- Distance Matrix: Generated using Gower's distance with the daisy() function from the cluster package.
- Clustering Algorithm: Hierarchical clustering was performed with the hclust() function from the stats package, applying the Ward2 method for optimal grouping.

- Tree Cutting: The resulting dendrogram was cut at a height of 3 using the cutree() function to form distinct clusters.

The results from the questionnaires were compared to determine whether there were statistically significant improvements in participants' knowledge of referencing and copyright licensing after the educational intervention and in between categories.

Ethical Considerations

The study adhered to ethical guidelines to ensure participants' rights and privacy were respected. Informed consent was obtained from all participants, and they were assured that their responses would be confidential and used only for the purposes of this research. Participants were also informed that their involvement in the study was voluntary, and they could withdraw at any time without consequence.

RESULTS

Referencing

Figure 1 illustrates students understanding and perspectives on the importance of accurate referencing.

The answers to question IPQ7 were clustered into four categories (A1; A2, A3, A13, A14; A4, A8, A11, A12; A5, A6, A7, A9, A10).

In Figure 2 are given obtained results in evaluation phase regarding improvement in students abilities in proper referencing.

For question EPQ8, the answers were clustered into four categories (A1, A4, A5, A12; A2, A6; A3, A7, A8, A9, A10, A11, A13, A14). The collected responses show improvement in 64-95% questioned students regarding the Wikipedia's referencing usage and understanding of referencing in general.

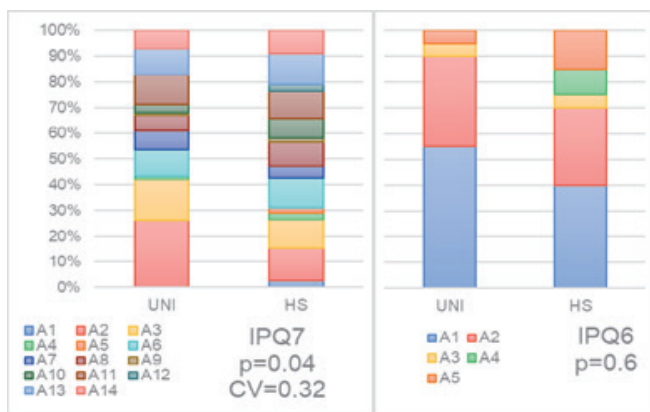We compared the results of questions IPQ7 and EPQ9 for high school and university students.

Figure 1. Visualization of initial phase questions related to referencing

For high school students, we found a p-value of 0.0004 and a Cramér's V value of 0.46, while for university students, the p-value was 0.0005, and the Cramér's V value was 0.58.
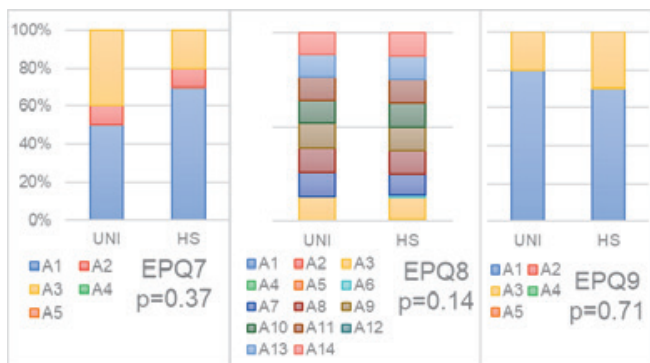
Copyright licensing

Figure 2. Visualization of evaluation phase questions related to referencing

Figure 3 provides an overview of students' perspectives on copyright and licensing practices together with recognition of existing copyright licenses.
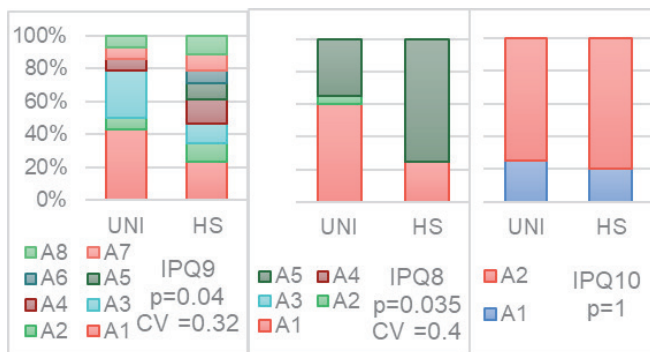
Figure 3. Visualization of initial phase questions related to copyright licenses

For question IPQ9, the answers were clustered into four categories (A1; A2, A4; A3, A7, A8; A5, A6). None of the students selected answers A3 or A4 for question IPQ8.

Evaluation phase results regarding students overall understanding of copyright licensing are presented in Figure 4.

Also, the results obtained regarding copyright licensing usage indicate significant improvement in this domain where 90-95% of surveyed students completely understood the licensing usage.
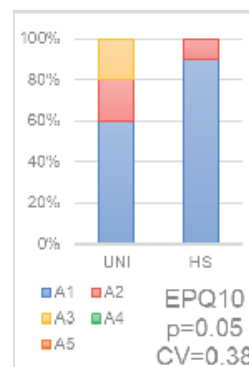
DISCUSSION

Figure 4. Visualization of evaluation phase questions related to copyright licenses

Initial Knowledge Gaps in Referencing and Copyright Licensing

Despite the small sample size in this pilot study, the results were surprising, given that all participants were computer science students. The initial questionnaire revealed a significant lack of awareness about referencing and copyright licensing, as well as the necessity of citations in academic work.

Before the educational intervention, about half of the students were familiar with referencing, but fewer than 10% understood when citations were necessary. Notably, the majority of students from both groups (university and grammar school) indicated they would reference only when directly copying from a source, with the highest percentage observed in university students (26.06%) and grammar school students (12.73%), both when copying from books. While university students showed limited awareness of the need to reference retold information (only 10.14%), a slightly higher percentage of grammar school students (11.82%) acknowledged this need.

Furthermore, the findings revealed that a significant percentage of both student groups (75-80%) had never used copyright licenses, and the meaning of copyright referencing was largely unknown. This was true for 75% of grammar school students and 40% of university students, indicating a general lack of understanding of copyright mechanisms across both groups.

Impact of Educational Interventions

Significant differences in responses between grammar school and university students were found for certain questions (e.g., IPQ7, IPQ8, IPQ9, EPQ10), all with strong associations (Cramér's V = 0.46 for grammar school students and 0.57 for university students). This suggests that education level or academic background plays a substantial role in how students understand and interpret the concepts being assessed.

The statistically significant results ($p = 0.0004$) from Fisher's Exact Test for both groups indicate that the responses before and after the lecture differ significantly. This supports the hypothesis that the educational intervention impacted students' knowledge of referencing and copyright licensing. The stronger effect size (Cramér's V = 0.57 for university students and 0.46 for grammar school students) suggests that university students exhibited a greater change in understanding compared to grammar school students. This could be attributed to their prior knowledge, higher cognitive ability, or more advanced learning skills, which might have helped them engage with the lecture content more effectively.

Strengthening Digital Literacy Through Targeted Education

The educational intervention successfully improved students' knowledge of referencing and copyright licensing, as evidenced by the significant changes observed in the responses. Over 85% of students reported an improvement in their ability to reference correctly, and nearly all students gained a clearer understanding of copyright licensing. The stronger effect observed among university students is likely due to their higher pre-existing knowledge and academic maturity, which may have allowed them to grasp the material more effectively. Grammar school students, though showing improvement, had a moderate change in understanding, indicating that additional instructional support may be necessary to enhance their comprehension.

These findings underscore the importance of targeted educational interventions to improve students' digital literacy, particularly in areas like referencing and copyright licensing. Given that a significant portion of both groups started with little knowledge in these areas, the educational phases (informative and proactive) were essential in bridging these gaps.

Localized Context: Serbian Wikipedia as a Case Study

The findings of this study extend beyond the Serbian Wikipedia to provide insights into global trust-building efforts in digital resources. The Serbian edition's unique cultural and historical context highlights the importance of tailoring trust-building strategies to specific user communities. Factors such as political sensitivities, regional media trust issues, and language-specific challenges influence users' perceptions of digital platforms like Wikipedia.

The Serbian Wikipedia plays a dual role as both an educational tool and a cultural repository, emphasizing the need for localized strategies to build trust. This study highlights the challenges faced in this context and demonstrates that fostering digital literacy through tailored educational programs can address such issues effectively.

Global Implications for Trust in Open-Access Platforms

While rooted in the Serbian context, the findings have broader implications for other language-specific Wikipedia editions and open-access platforms. Educational interventions that improve referencing and licensing skills have the potential to enhance trust across diverse user groups. By addressing local challenges, this study offers a replicable framework for global efforts, bridging the gap between regional nuances and universal strategies for fostering trust in digital information systems.

By connecting local challenges with global solutions, this research emphasizes that understanding the unique dynamics of user communities can significantly enhance the credibility and utility of open-access knowledge systems. The Serbian Wikipedia, in this context, serves as a vital case study for illustrat-

ing how localized efforts contribute to a global movement toward reliable, accessible, and trustworthy digital resources.

The findings align with [14] who emphasize that the quality of citations is a critical factor in enhancing Wikipedia's trustworthiness.

CONCLUSION

Referencing and copyright licensing are typically considered common knowledge, but the practical findings from this research suggest otherwise.

This study highlights the importance of tailored educational interventions in enhancing digital literacy, particularly in trust mechanisms related to referencing and copyright licensing. The findings provide valuable insights into how educational background influences the effectiveness of these interventions. While previous studies have highlighted the potential mistrust stemming from Wikipedia's open-access model [13], [24],[25], this research demonstrates that improving the referencing and copyright licensing skills of Wikipedia editors can significantly contribute to the creation of more trustworthy Wikipedia articles. Educating users on evaluating sources, recognizing authoritative references, and understanding copyright licensing will ultimately strengthen trust in Wikipedia as a reliable information source.

After completing the first year of this pilot research successfully, we achieved promising outcomes. Initial phase showed that many students were only superficially familiar with trust concepts, and fewer had a practical grasp of their importance in evaluating information quality. Findings from the initial phase guided the study, enabling us to address emerging issues effectively. The evaluation phase results showed a significant improvement in students' ability to critically assess Wikipedia articles, indicating that structured guidance can effectively enhance digital literacy. Key outcomes include better awareness of when and why to cite sources, how licensing impacts content use, and how collaborative efforts on Wikipedia support information reliability. As more students gained familiarity with these concepts, they expressed increased confidence in using Wikipedia responsibly, suggesting that such educational programs could be a model for similar initiatives elsewhere.

According to aforementioned, we can answer the main research question by stating that many of the surveyed students initially have a limited understanding of trust mechanisms, underscoring the value of targeted educational interventions. Such interventions play a crucial role in enhancing students' digital literacy and their ability to critically evaluate online information sources, which is beneficial for developing responsible information consumption habits and fostering greater trust in credible content.

The findings from this study offer an insights for other Wikipedia language editions and similar open-access projects aiming to increase their credibility among diverse user bases. By addressing the unique needs of the Serbian-speaking audience and understanding the factors that influence trust, this case study underscores the role that localized efforts can play in enhancing the global movement for reliable and accessible knowledge. Ultimately, the Serbian Wikipedia serves not only as a tool for information but also as a vehicle for fostering media literacy, critical evaluation skills, and a collaborative approach to knowledge-sharing, all of which are essential to building trust in information sources in today's digital environment.

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ABOUT THE AUTHORS
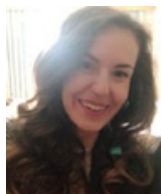
Dragana Dudić obtained BSc and MSc degree in Computer Science at the Faculty of Mathematics, University of Belgrade, and PhD degree in Computer Science at the Faculty of Information Technology, Pan – European University Apeiron Banja Luka. She is an assistant professor at Faculty of Computer Science and Informatics, University Union Nikola Tesla. Dragana is author of more than 40 scientific papers published in peer-reviewed journals and international conferences, with research focus on bioinformatics, software development, digital literacy and technology integration in education.

Nebojša Ratković holds a degree in Political Science with a focus on International Politics. He has been working in the non-governmental sector since 2010 on projects centered on youth education. Since August 2016, he has been involved with Wikimedia Serbia as the Education Program Manager, promoting the use of new technologies in secondary and higher education institutions, with a particular emphasis on Wikipedia. His research focus is on digital literacy and technology integration in education.

Ivana Firaunović graduated from the Faculty of Mathematics at the University of Belgrade, where she also completed her master's degree, both in the field of Computer Science and Informatics. Ivana has shared her knowledge and skills over the years as a mathematics teacher in several educational facilities in Serbia. Currently, she is employed as a mathematics and computer science teacher at Šabac grammar school. Her research focus on digital literacy and technology integration in education.

Olja Krčadinac (Latinović, maiden name) is assistant professor at "Union – Nikola Tesla" University - Faculty of Informatics and Computer Science. She earned her Ph.D. in biometric field from University of Belgrade – Faculty of Organizational Science. Olja has authored numerous impactful publications in peer-reviewed journals. Her research focuses on biometric, sensors, IoT, AI and technology integration in education.

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