

USABILITY EVALUATION OF THE "MATHEARENA" EDUCATIONAL APPLICATION: A CASE STUDY IN SERBIA**ЕВАЛУАЦИЈА УПОТРЕБЉИВОСТИ ОБРАЗОВНЕ АПЛИКАЦИЈЕ "MATHEARENA": СТУДИЈА СЛУЧАЈА У СРБИЈИ**

Jovana Medic, Slavko Rakic, *Faculty of Technical Sciences, University of Novi Sad, Serbia*

Research Field – ENGINEERING MANAGEMENT

Abstract – *This study evaluates the usability of the MatheArena educational app, designed to improve math skills, using the Usability Platform Test method. Conducted as part of the EdTech Talents project, it tested eighth-grade students in Apatin, Serbia. Key challenges were found in navigation, communication, design, and technical quality. While user satisfaction and learning progress were rated high, improvements are needed in language localization and content alignment with local curricula. The study highlights the importance of usability testing and recommends enhancing technical performance, localizing content, and adding progress tracking features to boost engagement.*

Keywords: *Educational Technology, Usability Platform Test, MatheArena, Gamification, User Experience.*

Кратак садржај – Ова студија оцењује употребљивост образовне апликације „MatheArena“, дизајниране за побољшање математичких вештина, коришћењем методе „Usability Platform Test“. Студија је спроведена у оквиру пројекта „EdTech Talents“, док је тестирање извршено са ученицима осмог разреда основне школе у Апатину, у Републици Србији. Идентификовани су главни изазови у навигацији, комуникацији, дизајну и техничком квалитету. Иако су задовољство корисника и напредак у учењу високо оцењени, потребна су побољшања у локализацији језика и усклађености садржаја са локалним наставним плановима. Студија истиче значај тестирања употребљивости и препоручује унапређење техничких перформанси, локализацију садржаја и додавање функција праћења напретка ради повећања ангажованости ученика.

Кључне речи: *Образовне технологије, Usability Platform Test, MatheArena, гамификација, корисничко искуство.*

1. INTRODUCTION

With the rapid growth of educational technologies, the demand for high-quality, user-friendly applications has never been more critical. Digital tools play a pivotal role in modern education, offering new ways to engage learners, deliver content, and support educators [1].

NOTE:

This paper is derived from a master's thesis supervised by Dr. Slavko Rakic, Assistant Professor

However, the success of these tools largely depends on their usability and the user experience they provide [2]. Usability testing has been recognized as a key factor in the development and improvement of educational technologies, as it ensures that applications meet the functional and cognitive needs of both students and educators [3]. Despite the increasing number of educational applications, many suffer from usability issues that negatively impact learning outcomes. Poorly designed user interfaces, unclear navigation paths, and a lack of intuitive functionality can lead to frustration among users, reducing the effectiveness of the application and the overall learning experience [4]. Recent studies have shown that even small improvements in usability can significantly enhance user engagement and learning performance [5]. The "Usability Platform Test" (UPT) method provides a structured approach to evaluating digital tools in terms of user satisfaction, ease of use, and overall effectiveness. The UPT method has been successfully applied in various domains, but its application in the field of educational technologies remains underexplored [6]. This study seeks to bridge that gap by applying the UPT method to assess the usability of the educational application "MatheArena," which is designed to enhance mathematical skills among students. The main goal of this research is to identify usability challenges within "MatheArena" and provide actionable insights for improving its design and functionality. By evaluating the application using the UPT method, this study aims to determine how effectively the application meets the needs of its target users and how it can be optimized for better educational outcomes.

Thus, the research addresses the following question: *How effective is the Usability Platform Test in evaluating the user experience of the "MatheArena" educational application, and what usability issues can be identified to improve the app's overall performance?*

2. EDTECH TALENTS AND MATHEARENA

The EdTech Talents project aims to strengthen collaboration between the education and technology sectors in Serbia, Hungary, and Estonia. The project connects researchers from these countries with experts from Austria, Germany, and Spain, facilitating knowledge transfer and professional development. By providing personalized training and guidance, EdTech Talents helps educators adopt innovative digital tools and practices. The project is focused on improving the educational technology (EdTech) ecosystems in developing regions

by fostering cross-border partnerships and practical collaboration between academic institutions and EdTech companies [7]. On the other hand, MatheArena, one of the featured partners in the EdTech Talents project, is an Austrian educational technology company founded in 2021. The application is designed to help students aged 10 to 19 enhance their mathematical skills through a gamified learning experience. The app adapts to each student's skill level, using game mechanics and a personalized learning path to make mathematics more approachable and engaging. With its roots in both Austrian and international education systems, MatheArena has successfully integrated cutting-edge algorithms to assess and adjust the difficulty of math problems, creating a flexible and scalable solution for learners across various educational levels [8].

3. USABILITY PLATFORM TEST

The UPT is a method used to evaluate the intuitiveness, user flows, and content of an application or website. This testing approach involves engaging users who closely resemble the target audience, allowing them to interact with the digital product. The primary goal is to gather real-time feedback on the usability of the application, identifying areas that require improvement before full-scale deployment. Usability testing has become an essential tool for ensuring that applications meet user expectations and provide a smooth, intuitive experience [9]. By focusing on actual user interactions, this method eliminates design assumptions and generates actionable insights for improving user satisfaction.

The UPT method also serves as a way to optimize product development by ensuring that the final product is user-friendly and meets market demands. This process includes identifying key design flaws, simplifying user interactions, and enhancing overall functionality, all of which contribute to the product's success and profitability [10]. Research shows that effective usability testing can reduce support costs, improve user efficiency, and increase customer retention by delivering a more satisfactory experience [11]. Therefore, integrating usability testing into the design process is critical for achieving a competitive advantage in the EdTech sector.

4. CASE STUDY: ELEMENTARY SCHOOL "ŽARKO ZRENJANIN" IN APATIN

To reach Technology Readiness Level 6, usability testing was conducted in a real-world environment. The testing took place at the Elementary School "Žarko Zrenjanin" in Apatin. A group of 12 eighth-grade students participated in the test, where they had the opportunity to interact with the application. The testing was conducted during a single school period, lasting 45 minutes. During the first 30 minutes, after receiving introductory instructions, the students tested the functionalities of the MatheArena application under the supervision of a moderator. Following the functionality testing, through a specialized usability testing platform, the students were able to provide valuable feedback, which included a comprehensive assessment of the application's usability, performance, and ease of use. The results of the usability test, as well as a more detailed discussion, will be presented in the next chapter of this paper.

5. RESULTS

The usability test was conducted with 10 students online, while two students performed the test offline. The students tested the application using mobile devices. The usability test results are presented below. **Navigation:** This section of the questionnaire focuses on how easy it is to create a profile and navigate the application. The average scores for each question in this section are as follows: I can easily download the application – 5.20, I can easily create an account – 5.50, I can easily log into the application – 4.17, I can easily find content that suits me – 4.17, I like the navigation structure in the application – 4.60. *The average score for the entire navigation section is 4.73.* **Communication:** This section concerns the user's interaction with the application. The questions and average scores are as follows: I can easily access resources from the platform – 4.37, the application is easy to use – 4.12, reading comments is easy – 4.57, sharing resources from the application is easy – 4.57, I can easily change the language – 3.83, finding contact information is easy – 4.14, finding the help or online support option is easy – 4.67. *The average score for the entire communication section is 4.33.* **Design:** This section evaluates the design and functionalities of the application. The questions and average scores are as follows: I like the aesthetic design of the application – 4.86, I like the images in the application – 4.43, I like the font used in the application – 4.67, I like the sound in the application – 4.57, I like the colors in the application – 4.57, I like the page design – 4.14. *The average score for the entire design section is 4.54.* **Content Analysis:** This section evaluates the quality of tasks in the application. The questions and average scores are as follows: The information is accurate – 5.60, the tasks are relevant to my educational level – 3.83, the tasks are relevant to my school curriculum – 4.16, the feedback on tasks is sufficient – 4.43, the feedback on tasks is of good quality – 5.00, the number of tasks/questions is sufficient – 5.50. *The average score for the entire content analysis section is 4.75.* **Technical Quality:** This section assesses the technical functionalities of the application. The questions and average scores are as follows: The application is easy to use – 4.83, the application has a fast response time – 4.14, the application has all the functionalities I need – 4.14, the application has good technical support – 4.43, there are no technical limitations in the application – 4.57. *The average score for the entire technical quality section is 4.42.* **User Satisfaction:** This section relates to the user's experience and satisfaction with the application. The questions and average scores are as follows: I am satisfied with the application – 4.86, I am satisfied with the application's functionalities – 4.37, the application helps me understand the material – 4.62, the application allows me to easily learn new things – 4.88, I feel secure using the application – 5.25. *The average score for the entire user satisfaction section is 4.80.* **Motivational Aspects:** This section assesses how motivated the users feel to use the application and whether they would use it again. The questions and average scores are as follows: I am motivated to learn through the application – 4.67, I am inspired to learn again through the application – 4.25, I am satisfied with how I can track my progress in the

application – 4.62, the rewards in the application motivate me to learn again – 4.11, the application keeps me focused while learning – 4.62. *The average score for the entire motivational aspects section is 4.46.* **Learning Progress:** This is the final section of the usability test, focusing on how the application helps users acquire new knowledge in mathematics. The questions and average scores are as follows: The application uses methods that help me remember how to solve tasks/questions – 5.00, I can use different learning methods (visual, auditory, kinesthetic) – 4.37, the resources in the application are useful for the learning process – 4.75, the application supports my continuous learning process – 4.62, the application improves my learning process – 4.75. *The average score for the entire learning progress section is 4.70.* Based on the results of all the previously mentioned segments, a radar chart was created to show the relationship between the different segments. Figure 1 presents this diagram, which will be discussed further in the following section. The overall results for each segment are: Navigation – 4.73, Communication – 4.33, Design – 4.54, Content Analysis – 4.75, Technical Quality – 4.42, User Satisfaction – 4.80, Motivational Aspects – 4.46, Learning Progress – 4.70. Figure 1 shows the results of the UPT on the MatheArena app.

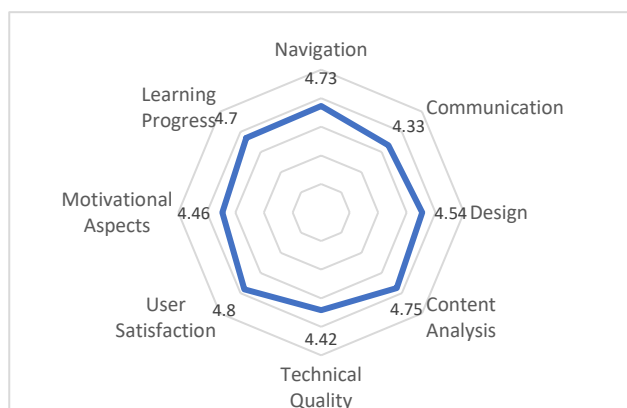


Figure 1. Results of the UPT on the MatheArena app

Based on the presented results, it is evident that there is significant space for improvement in each segment. The areas with the most potential for improvement are the Communication and Technical Quality segments, which should be prioritized. To address these issues, it is necessary to resolve page loading issues, introduce the language of the country where the app will be used (in this case, Serbian), and adapt the application and tasks to the educational curriculum of the country where the app is intended to be marketed. Additionally, it would be beneficial to introduce a "guide" for new users that walks them through the app's features during their first use, explaining how the app functions. Moreover, adding a feature for tracking user progress via charts and graphs would be a highly engaging and motivating option.

6. DISCUSSION AND CONCLUSION

This paper aims to evaluate the usability of the educational technology application, MatheArena, using the UPT method, with a focus on assessing user experience and identifying areas for improvement. The research was conducted within the framework of the

EdTech Talents project, which aims to enhance cross-border collaboration between the educational and technology sectors in Europe, with particular emphasis on Serbia, Hungary, and Estonia. The MatheArena application, a gamified platform designed to improve mathematical skills, was evaluated for its usability across several dimensions, including navigation, communication, design, content, technical quality, user satisfaction, motivational aspects, and learning progress. The study involved real-world testing in an educational setting, specifically at the Elementary School "Žarko Zrenjanin" in Apatin, Serbia, with 12 eighth-grade students as participants. The results were analyzed both quantitatively and qualitatively, offering a comprehensive view of the application's strengths and weaknesses. The overall findings show that the MatheArena app has considerable potential but also requires targeted improvements in certain key areas. The usability test results revealed that the application scored well in terms of User Satisfaction and Learning Progress, indicating that the app provides a positive learning experience and supports students in improving their mathematical skills. The aesthetic design of the app was also well-received, suggesting that students were engaged by the visual aspects of the application. Moreover, students found the tasks within the app to be sufficiently challenging and relevant to their learning, although there were concerns about the alignment of the content with local educational curricula. However, the results also highlighted significant space for improvement in the Communication and Technical Quality segments. The lower scores in these areas point to challenges such as page loading delays, difficulties in accessing specific resources, and the lack of localized language support. For example, students expressed difficulty in navigating through the app's interface and changing the language settings, which were not fully aligned with their needs. Moreover, the app's inability to fully support the Serbian language—critical for the specific test environment—emphasized the importance of localization in educational technology. The primary research question of this study was: *How effective is the Usability Platform Test in evaluating the user experience of the "MatheArena" educational application, and what usability issues can be identified to improve the app's overall performance?*

The UPT proved to be a highly effective method for evaluating the user experience of the MatheArena application. By focusing on real-time feedback from actual users—students who closely resemble the app's target audience—the UPT method enabled the identification of key usability challenges. The test highlighted the importance of ease of navigation and communication, especially in the context of educational technologies where users must frequently interact with complex features in a seamless manner. In addressing these challenges, the UPT method has provided actionable insights for improving MatheArena's design and functionality. Key recommendations include: **Localization of Content:** Introducing Serbian as a language option and aligning the tasks and content with the local educational curriculum to enhance relevance for students in specific regions. **Technical Enhancements:** Improving the app's response time and resolving page

loading issues to ensure smoother user interaction. **User Support:** Incorporating a first-time user guide to help students navigate through the app's features during their initial interaction, which would address the confusion noted in the navigation segment. **Motivational Tools:** Adding features such as progress tracking via charts or graphs to enhance student motivation and engagement with the learning process.

While this study offers valuable insights into the usability of the MatheArena application, several limitations should be noted. First, the sample size was relatively small, with only 12 students participating in the test. Although their feedback provided meaningful data, a larger, more diverse group of participants across different educational levels and regions would yield a more comprehensive understanding of the app's usability. Second, the study was conducted in a single school within a specific cultural and educational context.

As such, the results may not be entirely generalizable to other regions or school systems. For example, the usability issues related to language and curriculum alignment might not be as significant in other contexts where the app's content is already localized. Finally, the test was conducted over a short time period (45 minutes), which may not have been sufficient for students to fully explore all the features and functionalities of the app. A longer testing period, perhaps involving multiple sessions, could provide more in-depth insights into the app's performance over time.

The findings of this study have several implications for future research and development in the field of educational technologies. First, future studies should focus on expanding the sample size and including students from different grade levels and regions to obtain more diverse feedback. Additionally, longitudinal studies that track student engagement and performance over time would provide a deeper understanding of how educational apps like MatheArena influence learning outcomes. From a development perspective, the study underscores the importance of integrating usability testing throughout the design process of educational technologies. Researchers should prioritize the localization of content and technical enhancements to meet the needs of users in specific regions. Furthermore, implementing motivational tools, such as progress tracking and rewards systems, can significantly improve user engagement and the overall effectiveness of educational applications.

In conclusion, the UPT method has proven to be a valuable tool for evaluating the usability of educational technology applications. In the case of MatheArena, the test successfully identified areas for improvement, particularly in navigation, communication, and technical quality. By addressing these issues and implementing the recommended changes, MatheArena has the potential to significantly enhance its user experience and expand its reach in international educational markets.

7. ACKNOWLEDGMENT

European Union Funding has supported this research via call HORIZON-WIDERA- 2022-TALENTS- 03, through project "EdTech Talents" (project no. 101119689).

8. REFERENCES

- DOI: <https://doi.org/10.24867/31GI02Medic>
 DOI: <https://doi.org/10.24867/31GI02Medic>
 DOI: <https://doi.org/10.24867/31GI02Medic>
 DOI: <https://doi.org/10.24867/31GI02Medic>
 DOI: <https://doi.org/10.24867/31GI02Medic>
 DOI: <https://doi.org/10.24867/31GI02Medic>
 DOI: <https://doi.org/10.24867/31GI02Medic>
 [7] EdTech Talents Project Website. [Online]. Available: <https://edtechtalents.eu>. Accessed: Sep. 21, 2024.
 [8] MatheArena Website. [Online]. Available: <https://mathearena.com>. Accessed: Sep. 21, 2024.
 DOI: <https://doi.org/10.24867/31GI02Medic>
 [10] C. K. Coursaris and D. J. Kim, "A Meta-Analytical Review of Empirical Mobile Usability Studies," *J. Usability Stud.*, vol. 6, no. 3, pp. 117-171, 2011.
 [11] S. Rakic, S. Softic, Y. Andriichenko, I. Turcin, B. Markoski, and J. Leoste, "Usability Platform Test: Evaluating the Effectiveness of Educational Technology Applications," in *Proc. Int. Conf. Interactive Collaborative Learning (ICL)*, 2024.

Short biography:



Jovana Medić (born January 30, 2001, Sombor, Serbia) is a master's student in Engineering Management at the Faculty of Technical Sciences, with a GPA of 9.91. She specialized in Project Management during her undergraduate studies and continued the same focus in her master's, which she is set to complete successfully in 2024.

Contact: jovana.medic123@gmail.com



Slavko Rakic (born February 14, 1994, Zrenjanin, Serbia) is an Assistant Professor of Industrial Engineering and Management at the University of Novi Sad, Faculty of Technical Sciences. His research, teaching, and advisory activities are at the intersection of innovation, service engineering, and EdTech.