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The Effectiveness of the Moodle Platform as a Tool for Online Student Assessment

Slađana Ignjatović [1, a, *], Dragica Milinković [1, b], Radoslav Božić [3, c]
[1]University of East Sarajevo, The Faculty of Education, Bijeljina, Republic of Srpska, Bosnia and Herzegovina
[2]Faculty of Teacher Training, Educons University, Sremska Kamenica, Novi Sad, Serbia
[a]sladjana.mitrovic@pfb.ues.rs.ba, [b]dragica.milinkovic@pfb.ues.rs.ba, [c]radoslav.bozic@gmail.com

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Abstract

Distance learning, which became necessary due to the COVID-19 pandemic, led to an increased need for online knowledge assessment. This resulted in the adoption of various multimedia LMS platforms, such as Moodle. The aim of this study was to examine the effectiveness of the Moodle platform as a tool for online student testing within the course *Methodology of Teaching Mathematics 1*. The sample consisted of 30 third-year students of the Faculty of Education in Bijeljina, enrolled in the Primary Education program, who attended the course *Methodology of Teaching Mathematics 1* during the summer semester of the 2020/2021 academic year. Content analysis showed that 61% of the participants achieved a passing grade, which confirms that the use of the Moodle platform for distance learning yields positive results in online student assessment. This study contributes to the understanding of the role of multimedia LMS platforms in higher education and highlights the importance of pedagogically designed online activities for the development of future mathematics teachers' competencies.

Keywords: Moodle platform, mathematics teaching, online testing, knowledge tests.

MSC2020: 97-11, 97U50

1. Introduction

The process of monitoring, assessing, and evaluating knowledge in mathematics education is complex and sensitive. It represents one of the key components of the educational process. Assessment is formally regulated by specific guidelines, and current and future teachers are required to study issues related to evaluation and continuously improve their own criteria for assessing students' knowledge. Knowledge assessment serves multiple functions for both teachers and students. On the one hand, the teachers use assessment to determine the extent to which students have mastered the required content and acquired the necessary knowledge in a given area, while also receiving feedback on their own instructional practices. This process enables the identification and correction of potential shortcomings observed during the period covered by the evaluation.

Knowledge tests represent a fundamental method for evaluating the students' academic achievement and are a key tool in monitoring and improving the teaching process. Unlike aptitude tests, which measure students' potential abilities, knowledge tests focus on the material that has actually been learned, thereby providing a more objective and precise evaluation of student performance. For teaching to be effective, it is essential to regularly assess students' knowledge and skills. The transmission of knowledge to students, together with the monitoring of how that

* Corresponding author
E-mail address: sladjana.mitrovic@pfb.ues.rs.ba

knowledge is acquired, forms a synchronized whole within the instructional process. By assessing the degree of knowledge acquisition, the teacher establishes an essential connection with the students, thereby creating the basic conditions for managing the teaching process.

The use of computers and digital technologies in education increases students' active participation, motivation, and readiness for independent learning. Such approaches encourage collaboration, creativity, inquiry-based learning, and critical thinking, making them especially valuable in the context of higher education.

The development of information and communication technologies in recent decades has significantly transformed educational processes at all levels. A notable increase has occurred in the use of various digital learning environments, improving the possibilities for organizing and monitoring instructional activities in online settings. The COVID-19 pandemic accelerated this transition, as many educational institutions were required to rapidly implement distance learning systems and ensure effective methods for assessing student knowledge. In this context, multimedia LMS (Learning Management System) platforms, such as Moodle, have become essential tools for conducting instruction and evaluating learning outcomes.

The Moodle (Modular Object-Oriented Dynamic Learning Environment) platform offers a wide range of functionalities that enable teachers to create various types of tests, monitor student progress, and perform automated grading. Its flexibility and open-source nature have contributed to its status as one of the most widely used platforms in higher education. It is available in many languages, including Serbian, and is developed by a large international community of programmers and educators. As a result, Moodle has become one of the most accessible and popular tools for supporting education in digital environments. However, despite its widespread use in distance learning, it is necessary to empirically examine its effectiveness in specific contexts, particularly in pedagogically demanding subjects such as the Methodology of Teaching Mathematics.

Given the importance of knowledge assessment in mathematics education and the current need for high-quality online evaluation tools, the aim of this research is to investigate the effectiveness of the Moodle platform as a tool for online student testing within the course *Methodology of Teaching Mathematics 1*. By analyzing the performance of third-year students at the Faculty of Education in Bijeljina during the 2020/2021 academic year, the study sought to determine the extent to which this platform contributes to the achievement of the intended learning outcomes. The findings provide a deeper understanding of the role of LMS platforms in higher education and highlight the importance of pedagogically informed integration of digital tools into the evaluation process of future mathematics teachers (the primary education - ISCED level 1).

2. Theoretical background

Distance learning represents an organized educational process in which teachers and students are separated in space and time, with instruction being conducted through the intensive use of digital media and communication technologies (Anderson, 2011). The development of information technologies, as well as global societal challenges such as the COVID-19 pandemic, has significantly accelerated the transition of educational systems toward various forms of digitally mediated learning. In this context, e-learning has become one of the key forms of contemporary educational practice.

The term e-learning encompasses a wide range of educational activities based on digital technologies and is often associated in the literature with the terms *online learning* and *distance learning*. Although these terms differ in certain aspects, Moore, Dickson-Deane, and Galyen (2011) emphasize that they all involve the use of the internet as the primary resource for conducting instructional activities. The advantages of e-learning include flexibility, individualization of the instructional process, temporal and spatial accessibility of materials, and the possibility of automated evaluation. However, the success of e-learning largely depends on the quality of

interactions between students, teachers, and the content (Anderson, 2011; Garrison & Anderson, 2003). The study conducted by Mlotshwa, Tunjera, and Chigona (2020) demonstrated that students who engaged with the Moodle platform achieved higher levels of performance, as the use of various Moodle-integrated tools (e.g., quizzes, forums, and digital resources) enabled them to construct knowledge more independently.

At the same time, e-learning presents certain challenges, including feelings of isolation, the need for highly developed digital competencies, and potential technical difficulties. For this reason, online instruction must be grounded in high-quality pedagogical design, clearly defined mechanisms of support for students and teachers, and carefully planned activities that encourage active participation and interaction (Siemens, 2005).

Moodle is one of the most widespread and influential learning management systems (LMS) in the field of education. As an open-source platform, Moodle was developed on constructivist learning principles, enabling students to actively construct knowledge through interaction, collaboration, and reflection (Dougiamas & Taylor, 2003). Its flexibility, modularity, and adaptability make Moodle suitable for different educational contexts, particularly in higher education.

Moodle offers a wide range of activities, including quizzes, assignments, forums, lessons, databases, workshop-based assessment models, and advanced tracking of student activity. The advantages of Moodle in evaluation are strongly emphasized in the literature (Gravani & Karagiannidis, 2020), and include:

- a variety of task and question types;
- randomization and individualization of question sets;
- automated feedback;
- high test reliability and reduced subjectivity in grading.

These features make Moodle especially suitable for testing mathematical and methodological knowledge, where precision, objectivity, and timely feedback are of critical importance.

The use of Moodle in mathematics education and in the methodology of teaching mathematics has proven to be highly beneficial (Dien Fitrieyah, 2021). Various studies confirm that digital tools and dynamic software environments contribute to a better understanding of mathematical concepts and improved student performance. Zlatanovska et al. (2016) found that students achieve better results on online tests administered through Moodle than on traditional paper-based tests. Research in the field of mathematics education indicates that interactive and innovative teaching methods increase intrinsic motivation and contribute to the development of a deeper understanding of mathematical content. Zubac, Milinković, and Marković (2021) emphasize that dynamic software environments, computers, and digital applications enhance student engagement and support more effective problem solving.

Research findings (Garcia & Pacheco, 2013) suggest that integrating computer-based tools with conventional methods improves student motivation and fosters discussion and collaboration based on their investigative experiences. The use of the Moodle platform for online student testing provides timely feedback, increases student engagement, and enhances their motivation (Huerta-Gómez & Requena-García Cruz, 2024). Moreover, Moodle facilitates more objective and transparent assessment, reducing the subjective element in the evaluation of student performance (Suad et al. 2023). Kamaruddin (2020) emphasizes that although e-learning cannot fully replace conventional instruction, it can substantially enhance the learning process by enriching instructional content and incorporating digital tools (e.g. Moodle) that provide students with greater autonomy in knowledge acquisition and increased flexibility in accessing learning materials.

Based on the above, it can be concluded that Moodle, with its capabilities for digital evaluation, interactive learning, and individualised feedback, represents a valuable tool in the education of future mathematics teachers. Its use supports the deve lopment of digital literacy, professional

competencies, critical thinking, and self-regulated learning-key elements of contemporary approaches to the methodology of teaching mathematics.

Modern education increasingly relies on digital technologies and distance-learning platforms, which fundamentally transform the way teachers are educated and professionally developed. In the context of the methodology of teaching mathematics, Moodle enables the creation of realistic practice situations, the development of tasks that encourage reflection and analysis, and the enhancement of pedagogical-digital competencies.

The platform provides:

- the ability to simulate instructional situations;
- opportunities to develop various didactic scenarios;
- the creation of innovative teaching materials;
- monitoring of student progress and evaluation of the reliability of their solutions;
- an environment for continuous professional development of future teachers.

In this way, Moodle is positioned not only as a technical tool for evaluation but also as an integral component of the contemporary educational process, contributing to the formation of competent, digitally literate, and pedagogically skilled future mathematics teachers (Dien Fitrieyah, 2021). The findings of the study conducted by Maryati et al. (2023) indicate that Moodle effectively supports the development and implementation of interactive digital instructional materials in higher education and can serve as a reference point for further instructional innovation.

3. Methodology

Due to the rapid development of modern technology in education, especially during the COVID-19 pandemic, teaching has increasingly relied on digital and multimedia platforms. One of the most widely used platforms in higher education is the Moodle platform, which enables the creation, distribution, and evaluation of instructional materials (Dougiamas & Taylor, 2003; Gravani & Karagiannidis, 2020). The purpose of this research was to examine the effectiveness of the Moodle platform in online testing of students' knowledge in the methodology of teaching mathematics.

The study was transversal in nature and conducted with the aim of analyzing the success of student testing using the Moodle platform. The sample consisted of 30 third-year students enrolled in the Primary Education program at the Faculty of Education in Bijeljina, who attended the course *Methodology of Teaching Mathematics 1* during the summer semester of the 2020/2021 academic year. All students took the test simultaneously, with an allotted time of 45 minutes for solving the tasks.

The test consisted of six problem-solving questions designed to cover various competencies in the field of mathematics. The tasks required different types of answer input (numerical entry, multiple choice, and short text). Each task carried a predefined number of points, and the final grade was determined by summing the points of all correctly solved tasks according to a predefined scale, with a designated passing threshold.

Students could achieve a total of 100 points, and the grading scale was formed in accordance with the Law on Higher Education of the Republic of Srpska:

- $0 - 50\%$ grade UNSATISFACTORY (5)
- $51\% - 60\%$ grade SATISFACTORY (6)
- $61\% - 70\%$ grade GOOD (7)
- $71\% - 80\%$ grade VERY GOOD (8)
- $81\% - 90\%$ grade EXCELLENT (9)
- $91\% - 100\%$ grade OUTSTANDING (10)

The test results were processed using descriptive statistics and presented in percentages, accompanied by an analysis of students' success based on final grades. This approach allows for an

accurate assessment of the reliability and effectiveness of the Moodle platform in online student testing.

The first task (presented in Fig. 1) required students to meet the necessary conditions and then enter the corresponding solutions in a drop-down menu (each box contained the correct options plus one incorrect one). The text of the task is stated as follows:

There are a total of 400 pencils in five boxes. The first and second boxes contain 208 pencils, the second and third boxes contain 172 pencils, the third and fourth boxes contain 138 pencils, and the fourth and fifth boxes contain 120 pencils. How many pencils are there in each box?(Choose correct answer from the drop-down box)

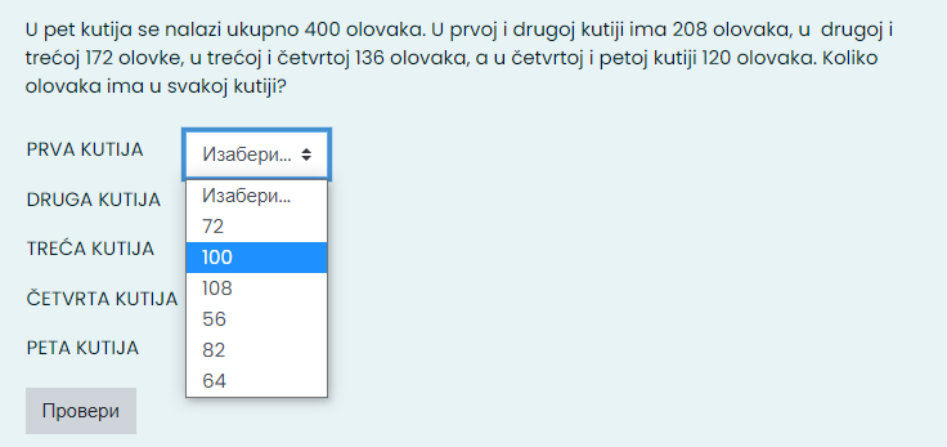

Fig. 1. Task 1 layout with available answers (in Serbian)

The second task (presented in Fig. 2) required students to solve the problem and enter a numerical value in the designated answer field without additional explanations. The text of the task is stated as follows:

The son is 8 years old today, and the father is 34 years old. After how many years will the father be three times as old as the son? Enter only the numerical value in the answer field.

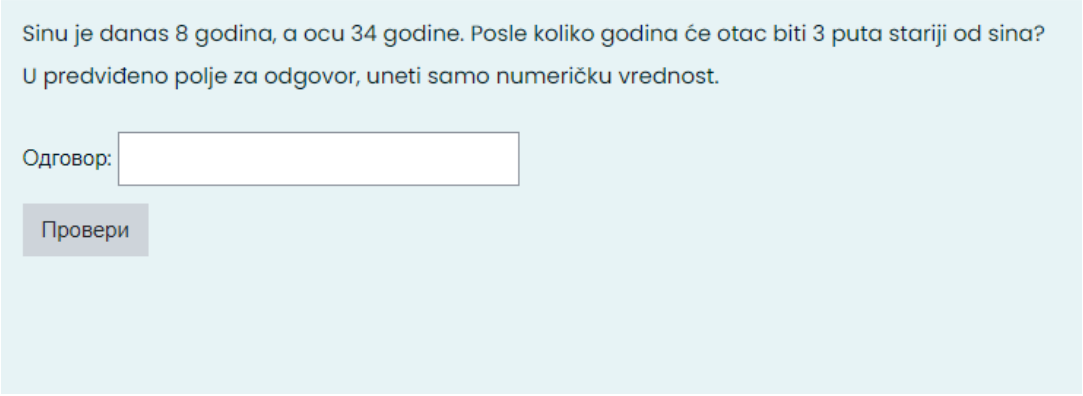

Fig. 2. Task 2 layout (in Serbian)

The third task (presented in Fig. 3) was structured as a sentence that students needed to confirm or refute through calculation, with the required answer offered as true or false. The text of the task is stated as follows:

The book has 345 pages. To number them, 927 digits are needed. Is this claim true or false? Choose the correct answer: true or false.

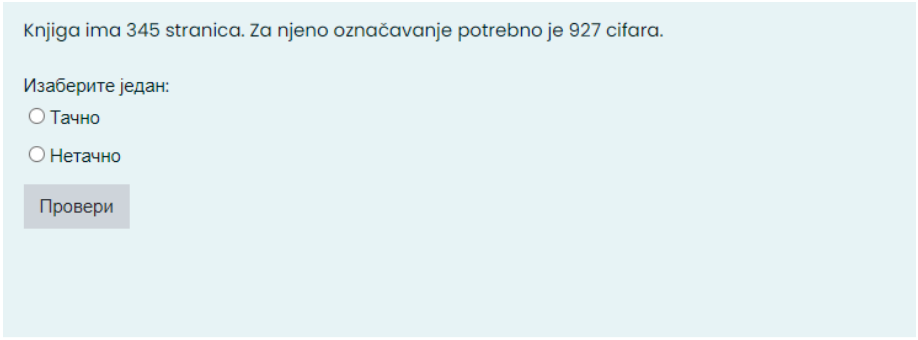

Fig. 3. Task 3 layout (in Serbian)

In the fourth task (presented in Fig. 4), after calculating the required value, students chose one correct answer from the options. The text of the task is stated as follows:
To cover a floor, 200 rectangular tiles measuring 22 cm × 11 cm are needed. How many square tiles measuring 20 cm × 20 cm would be required to cover the same floor? (Choose the correct answer)

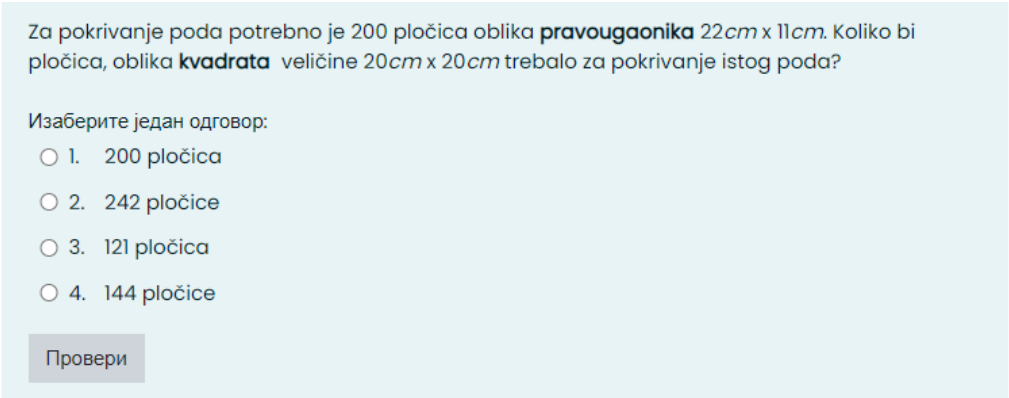

Fig. 4. Task 4 layout (in Serbian)

The fifth task (presented in Fig. 5) required determining the requested numbers, subtracting them, and entering the result in the blank field. The text of the task is stated as follows:
Determine the difference between the largest and smallest numbers that can be formed using the digits 0, 2, 3, 6, 7, and 9, with each digit appearing exactly once in each number.

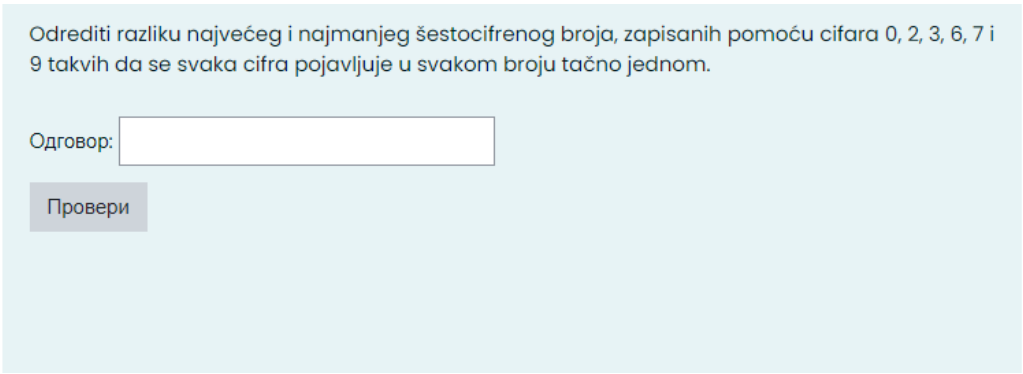

Fig. 5. Task 5 layout (in Serbian)

In the final sixth task (presented in Fig. 6), after performing the calculation, students selected the correct answer(s), with the note that more than one correct response was possible. The text of the task is stated as follows:
If a cube with a volume of 1 cubic meter is cut into cubes with a volume of 1 cubic centimeter, and these small cubes are then stacked one on top of another, how tall would the resulting column be? Choose one or more answers.

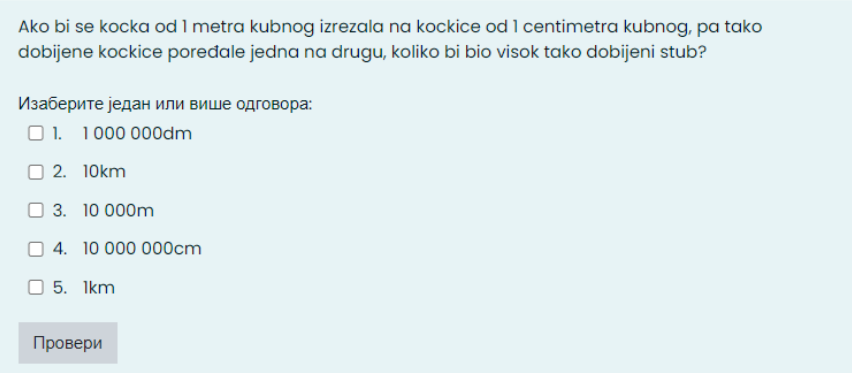

Fig. 6. Task 6 layout (in Serbian)

After completing and submitting the test, students received automated feedback on their performance, including the resulting grade. An example is shown in Fig. 7.

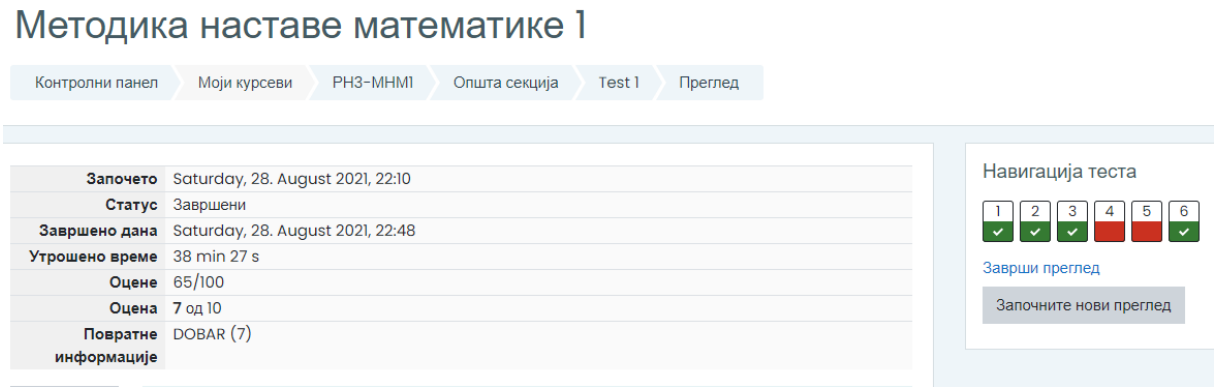

Fig. 7. Feedback after test completion (in Serbian)

4. Results and discussion

In accordance with the research methodology, Table 1 presents the performance results of students who completed the test via the Moodle platform.

Table 1. The results of students' online testing

Grade	Number of students	Share (%)
Unsatisfactory (5)	11	39%
Satisfactory (6)	8	26%
Good (7)	4	13%
Very Good (8)	3	10%
Excellent (9)	2	6%
Outstanding (10)	2	6%

Reviewing the results in Table 1 shows that 39% of respondents were below the passing threshold, meaning 11 students did not pass the exam. A total of 26% of students achieved the grade *satisfactory* (6), representing the minimum passing score. Thirteen percent of students earned a *good* (7), and 10% achieved a *very good* (8). The smallest percentage of students received grades *excellent* (9) and *outstanding* (10), each accounting for 6%.

A graphical representation of the online test performance is shown in the graph presented in Fig. 8.

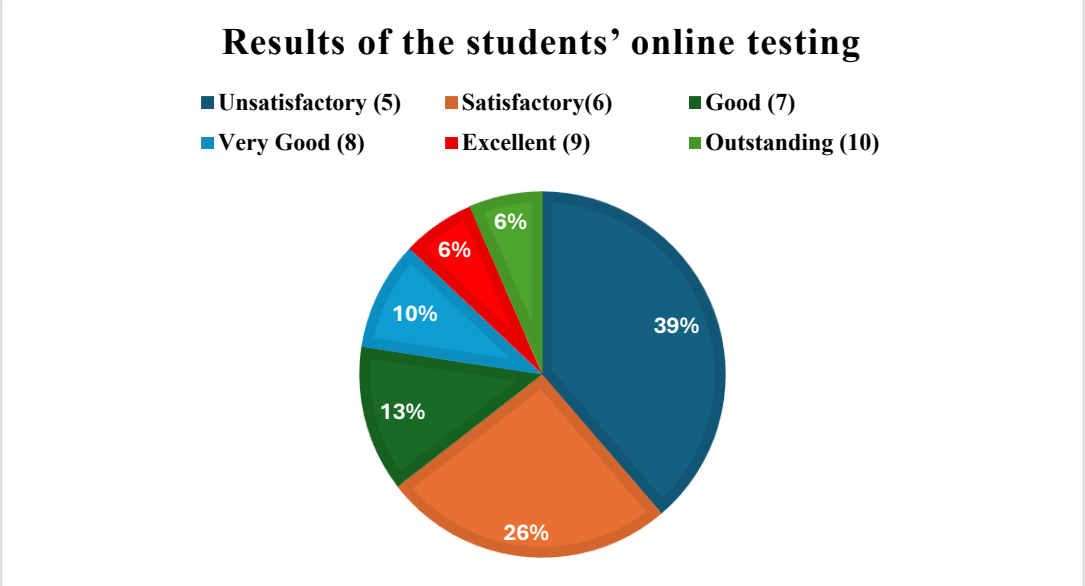

Fig. 8. Results of the students' online testing (in percentages)

Content analysis revealed that 61% of students achieved a passing grade and successfully completed the test. This indicates that students found working on a computer engaging and showed substantial interest in solving online tests with a combined task structure.

The analysis confirms that 61% of students passed the test, supporting the effectiveness of online testing through the Moodle platform. At the same time, the results indicate that students actively participated and showed interest in solving computer-based tasks, suggesting that digital tools may significantly contribute to their engagement in the learning process.

5. Conclusion

The findings of this study confirm that the use of the Moodle platform in online testing offers significant advantages for both students and teachers. The analysis shows that 61% of students achieved a passing grade, indicating a high level of efficiency in digital testing for the evaluation of mathematical and methodological competencies.

Beyond the quantitative results, students evaluated this method of assessment as interactive and motivating, which highlights the importance of digital tools in promoting self-regulation and engagement in the learning process. In this way, Moodle not only enables reliable evaluation of knowledge but also contributes to the development of lasting pedagogical skills, including planning, analysis, and adaptation of instructional activities.

In conclusion, the integration of multimedia LMS platforms into the teaching methodology of mathematics creates a synchronized unit of knowledge transfer and assessment, strengthening the connection between teachers and students and ensuring objectivity in grading. These findings suggest that digital evaluation not only increases testing efficiency but also supports student motivation, which has long-term implications for the improvement of higher education teaching practices. The use of such tools, therefore represents a step toward the modernization of instructional practices and the enhancement of educational quality.

The goal of implementing innovations in teaching is to improve student achievement, develop mathematical and digital literacy, and promote the application of acquired knowledge in real-life contexts. Another goal is to reduce resistance to mathematical subjects and dispel the misconception that mathematics is "difficult" or intimidating. The teacher, as the organizer and coordinator of the instructional process, can and must contribute to increasing students' motivation for work. Through their actions, feedback systems, and various forms of external motivation, teachers can significantly influence the development of students' intrinsic motivation.

The use of computers in mathematics teaching enhances not only the quality of the instructional process but also the overall quality of education. The process of acquiring mathematical knowledge through computer use involves intense intellectual activity (abstract thinking) in addition to perceptions formed through observation – an important consideration for the effective application of computers in teaching mathematics. Computer use will support the development of mathematical thinking and the successful acquisition of mathematical concepts only if it ensures and stimulates appropriate cognitive engagement among students. Through the use of educational technologies, students acquire certain perceptual information, which must be transformed into conceptual understanding – a process achievable exclusively through cognitive activity.

Although the results indicate a high level of efficiency of the Moodle platform in online testing of mathematical competencies, several limitations must be acknowledged. The sample of 30 students limits the generalizability of the findings to a broader population, while conducting the study within a single semester restricts the possibility of applying the results to other courses or time periods. Additionally, the specificity of the LMS used and technical factors such as internet connectivity or students' prior experience with digital tools may significantly influence the outcomes. Despite these limitations, the findings have important implications for pedagogical practice and theory.

Moodle and similar platforms provide teachers with an effective means of evaluating knowledge, identifying areas where students encounter difficulties, and adapting instruction to their needs. The use of combined tasks in online testing further enhances student engagement and strengthens their self-regulation in learning. Theoretically, the results emphasize the importance of digital tools for objective knowledge assessment and minimizing teacher subjectivity. This study also provides a foundation for future research that could examine the long-term effects of digital testing on students' knowledge, motivation, and pedagogical competencies.

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