Research Article

Gamification Promotes Math Learning in a Fun and Effective Way

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Abstract

The use of technology and gamification has changed the way mathematical concepts are presented and taught, offering new approaches to foster student engagement and active learning. This study examines the effects of using technology-based gamification on mathematics acquisition in elementary and secondary schools. The research analyzes the impact of game elements such as points, levels, rewards, and friendly competition to improve student motivation, persistence, and academic performance.

The methodology combines quantitative and qualitative approaches, including pre-and post-intervention tests, motivation questionnaires, and direct observations. The study involved 100 elementary and secondary school students who used gamification-based educational platforms for three months. The results showed a significant improvement in students' motivation and acquisition of mathematics concepts, especially in areas such as problem-solving and logical thinking. The technology also increased social interaction and teamwork skills.

The study's findings suggest that gamification not only makes learning more fun but also helps reduce math anxiety and boost academic resilience. The research recommends that schools integrate technology and gamification as part of their curricula to maximize learning outcomes. Furthermore, the findings provide a basis for further developing personalized platforms that address the specific needs of students. This study contributes to the existing literature on the *role of technology in education and highlights its potential to transform the way mathematics is taught in the digital age*.

Keywords: *Fun, effective technology, gamification, learning, mathematics.*

Introduction

In recent decades, the integration of technology in education has brought about major changes in the way students acquire knowledge. Among the most promising methods of using technology in education is "gamification" an approach that uses game elements to motivate students and increase their engagement during the learning process (Rachmadi, Situmorang, & Maisyaro, 2025). This approach not only makes learning more fun, but also helps improve students' analytical skills and critical thinking, especially in the field of mathematics (Ortiz-Rojas, Chiluiza, & Valcke, 2025).

Mathematics learning is often perceived as challenging by many students, which can lead to decreased motivation and academic performance. Researchers have shown that the use of game elements, such as leaderboards, virtual rewards, and interactive challenges, creates an environment that fosters student motivation and engagement (Payot & Tandog, 2025). Furthermore, gamification-based technology has shown great potential in reducing math anxiety and increasing self-confidence in solving complex problems (Suleiman, 2024).

Recent studies highlight the importance of adapting gamification methods to meet the individual needs of learners. For example, apps like Prodigy Math Game and Quizizz have been widely used to improve academic outcomes and make learning more interactive (Fauzi, 2025). These platforms not only make complex concepts more accessible but also create an environment built on healthy competition and collaborative assistance (Rabu & Alias, 2025).

Gamification-based technology in mathematics teaching focuses on its effectiveness in improving engagement, performance, and acquisition of mathematical concepts. In addition, the study will provide recommendations for teachers and developers of educational platforms to maximize the potential of this approach.

Problem Identification

Mathematics has traditionally been one of the most challenging subjects for students at all levels of education. For many students, mathematical concepts are perceived as abstract and difficult to understand, which often results in decreased motivation and interest in learning (Rachmadi, Situmorang & Maisyaro, 2025). According to Ortiz-Rojas, Chiluiza, and Valcke (2025), one of the main reasons for this problem is the lack of interactive and personalized approaches in traditional mathematics classrooms.

Another important challenge is the presence of math anxiety, which negatively impacts students' ability to acquire and apply mathematical concepts (Payot & Tandog, 2025). This

situation is exacerbated when teaching methods are based primarily on teacher-led lectures and do not include strategies that encourage student engagement and interaction.

At the same time, technology has advanced significantly, bringing new opportunities to create a more interactive and personalized learning environment. However, despite its potential, many schools have yet to adopt strategies such as "gamification", which has been shown to be effective in motivating students and improving their academic performance (Rabu & Alias, 2025). As highlighted by Suleiman (2024), integrating game elements into mathematics not only improves student engagement but also helps develop skills to solve complex problems.

This study aims to address these challenges by exploring the effects of using technology-based "gamification" to promote mathematics learning in a fun and effective way. The goal is to understand how this approach can improve the acquisition of mathematical concepts, reduce mathematical anxiety, and promote student engagement in the learning process.

Research Objectives

The main goal of this research is to examine the effects of using technology based on "gamification" to promote mathematics learning in a fun and effective way. In particular, this study aims to:

Analyze the impact of "gamification" on the acquisition of mathematical concepts among elementary and secondary school students. Through elements such as rewards, levels, and leaderboards, the study will assess whether this approach helps students better understand and apply mathematical concepts.

Gamification-based technology in reducing math anxiety and increasing students' self-confidence. Math anxiety is a major obstacle to academic performance, and this study aims to find out if gamification helps overcome this challenge.

Investigate the impact of "gamification" on student motivation and engagement during the learning process. Motivation is an essential component of academic success, and the study will explore whether technology and educational games can foster student interest in mathematics.

Identify best practices for integrating "gamification" into the learning process. Through the analysis of existing platforms and tools, the goal is to recommend effective strategies for teachers and educational institutions.

The research also aims to contribute to the existing literature on the role of technology and innovative methods in mathematics education. By embracing the potential of "gamification", this study aims to help improve the quality of teaching and learning in an increasingly digitalized era.

Research Questions

1. Gamification-based technology affects the acquisition of mathematical concepts by elementary and secondary school students?
2. Does "gamification" help reduce math anxiety and improve students' self-confidence in tackling math problems?
3. Which elements of "gamification" (rewards, levels, leaderboards, interactive challenges) are most effective in increasing student motivation and engagement?

4. What are the differences between traditional teaching approaches and those based on "gamification" in relation to academic outcomes and student engagement?
5. What are the perceptions of teachers and students on the use of "gamification" in the learning process?

Research Hypotheses

Hypothesis 1: The use of gamification-based technology positively impacts the acquisition of mathematical concepts by elementary and secondary school students.

Hypothesis 2: Technology based on "gamification" significantly reduces math anxiety and increases students' self-confidence in tackling math problems.

Hypothesis 3: Specific elements of " gamification ", such as rewards, levels, and leaderboards, have a distinct and positive impact on increasing student motivation and engagement.

Hypothesis 4: Gamification-based approaches are more effective than traditional teaching methods in improving academic outcomes and student engagement.

Hypothesis 5: Personalized educational platforms based on "gamification" improve learning outcomes regardless of students' level of technological experience.

LİTERATURE REVİEW

Innovative strategies such as "gamification" have significantly impacted the learning process, opening up new opportunities to motivate and engage students in subjects such as mathematics. Numerous studies in recent years have analyzed the effectiveness of "gamification" and its applications in mathematics education, providing important perspectives on the advantages and challenges of this approach.

Gamification and Improving Mathematical Learning

Recent studies have shown that the use of "gamification" can significantly improve the acquisition of mathematical concepts. For example, according to a systematic review by Fauzi (2025), platforms such as Quizizz have proven to be powerful tools for increasing student achievement by combining fun and learning. Such platforms offer interactive challenges and leaderboards that increase student engagement. Meanwhile, a gamified classroom model, based on the collaborative analysis method, has shown significant improvements in students' understanding and application of complex mathematical concepts (Song, Zhang, & Wang, 2025). The study by Orhani and Shatri (2025) emphasizes that through interactive mechanisms and approaches based on rewards and challenges, computer games help students develop important skills such as critical thinking, collaboration, and problem-solving (Orhani & Shatri, 2025).

Reducing Math Anxiety and Increasing Self-Confidence

Another important aspect of gamification is its ability to reduce math anxiety. According to a study by Triswidrananta and Pramudhita (2025), gamification-based applications help students feel more confident in solving math problems, improving their academic retention. Also, recent studies show that integrating game elements into classrooms reduces psychological pressure and math anxiety, helping students focus better on learning (Timm et al., 2025).

The Impact of Gamification Elements on Motivation

Gamification elements such as rewards, leaderboards, and levels have a significant impact on student motivation. Batsaikhan and Correia (2024) report that these elements create a sense of achievement that encourages students to be more involved in the learning process, helping to improve academic retention. Also, the use of leaderboards and levels through gamification motivates students by creating a remarkable sense of achievement and continuous progress" (Lee & Kim, 2024).

Interactive Approaches and Personalization

In another study by Meylani (2025), the importance of personalizing gamification platforms to meet the individual needs of students is emphasized. Personalized platforms that take into account the different abilities and needs of students have been shown to be more effective in improving their performance. Whereas, interactive platforms that adapt to the learning pace of each student are more effective in improving knowledge acquisition and supporting their learning style (Garcia et al., 2023).

Gamification and the Sustainable Development Goals

According to a review by Laksana and Saputro (2024), the use of "gamification" in mathematics education supports the achievement of the Sustainable Development Goals (SDGs), by promoting lifelong learning skills and improving the quality of education. On the other hand, "Innovations in "gamification" promote lifelong learning skills, thereby fulfilling some of the objectives of SDG 4 on quality education" (Harris, 2025).

RESEARCH METHODOLOGY

Gamification-based technology for learning mathematics in a fun and effective way. The research uses a combined approach (quantitative and qualitative) to provide a comprehensive analysis of the impact of gamification on student performance and motivation.

Research Design

This study is a mixed-methods experimental research, combining quantitative and qualitative analyses to evaluate the effectiveness of gamification in mathematics learning. The experiment included an experimental group (students who used gamification-based technology) and a control group (students who followed traditional instruction).

Research Participants

The study involved 100 primary and secondary school students from various public and private schools. The selection of participants was done through a random controlled trial, with 50 students included in the experimental group (learning through "gamification"), and 50 students included in the control group (traditional teaching). The selected school was the primary and lower secondary school "Heronjtë e Lumës" Vërmicë in the municipality of Prizren, Republic of Kosovo.

Data Collection Instruments

To collect data on the effects of "gamification", including:

Pre- and post-intervention tests – All groups underwent math tests to measure changes in their performance.

Questionnaires on motivation and engagement – Students completed questionnaires to assess their level of motivation before and after using gamification platforms.

Interviews with students – To obtain detailed opinions on the effectiveness and challenges of "gamification" in mathematics learning.

Research Procedures

The research was conducted over a 3-month period, going through the following phases:

Phase One - Preparation

Determining criteria for selecting participants.

Development and testing of questionnaires and other data collection tools.

Training teachers on the use of technology based on "gamification".

Phase Two - Implementation of the Intervention

The experimental group was exposed to gamification platforms like Prodigy. Math Game, Quizizz, and Kahoot!.

The control group continued to learn through traditional methods.

Data collection was conducted from students' experiences.

Phase Three - Assessment and Analysis

Analyzing test results to compare performance improvement between the two groups.

Processing data from questionnaires and interviews to draw conclusions about student motivation and engagement.

Data Analysis Methods

Statistical analysis: Statistical methods such as t-tests were used to compare test results before and after the intervention.

Qualitative analysis: Thematic analysis was used to process data from interviews and observations.

Correlations: The relationship between motivation and improved academic results after using "gamification" was analyzed.

Research Limitations

The study was conducted over a short period of time, which may not be sufficient to measure the long-term effects of gamification. Student motivation may also be influenced by other factors such as the school environment and parental support. The study was also conducted in only one school, limiting the generalizability of the results.

RESULTS

This chapter presents the main results of the research based on the analysis of data collected from pre- and post-intervention tests, as well as from questionnaires on student motivation and engagement. The results are presented through statistics to compare the impact of "gamification" on mathematics learning.

Results from Pre- and Post-Intervention Tests

Data from math tests conducted before and after the use of "gamification"was processed to compare the academic performance of the experimental group (using gamification-based technology) and the control group (traditional learning).

Table 1

Group	Average	Standard Deviation	Min	Max
Experimental before	6.02	0.75	4.63	7.68
Experimental after	8.51	0.7	6.4	9.75
Control before	6.07	0.81	4.56	8.07
Control after	7.07	0.71	5.79	9.18

The results of the research show a significant improvement in the academic performance of the students in the experimental group, who used the technology based on "gamification". The average of their grades increased from 6.02 to 8.51, reflecting an improvement of 2.49 points, compared to a smaller increase of 1 point in the control group, where learning was carried out with traditional methods. The standard deviation decreased in both groups, but was more pronounced in the experimental group, indicating a more equal distribution of improvements among students. Moreover, the minimum and maximum values suggest that students with lower performance benefited more from this method. The comparison between the two groups confirms that the use of "gamification" not only improves academic results but also increases motivation and engagement in the learning process, making this method an effective strategy for teaching mathematics.

Table 2

t-test results

Group	t-statistic	p-value	Difference Average	CI 95% - Lower	CI 95% - Upper
Experimantal	-17.23	0.0	2.49	2.22	2,76
Control	-6.52	0.0	0.99	0.69	1.29

The t-test results show a significant difference in students' academic performance after the intervention with the gamification-based technology. The t-statistic value for the experimental group was -17.23, while for the control group, it was -6.52, indicating a greater difference in the results of the group that used gamification. Furthermore, the p-value = 0.00 in both groups suggests that the differences in performance are statistically significant, eliminating the possibility that these improvements are due to chance.

The mean difference between the pre-and post-intervention tests confirms this conclusion. Students in the experimental group improved their average scores by +2.49 points, compared to only +0.99 points in the control group. This shows that the "gamification" method has a much greater impact on the acquisition of mathematical concepts than traditional teaching.

The 95% confidence interval (CI 95%) analysis also supports this conclusion. For the experimental group, the mean improvement is between 2.22 and 2.77 points, while for the control group, it is between 0.69 and 1.29 points. Since these intervals do not include the value 0, it means that the difference in both groups is statistically significant and is not the result of chance. Furthermore, the narrower interval in the experimental group indicates that the benefits are evenly distributed among the students.

Thus, the results clearly show that the use of gamification-based technology has a significant and positive impact on improving students' mathematical performance. The significant improvement of the experimental group, compared to the control group, indicates that gamification not only increases student engagement but also helps in better acquisition of mathematical knowledge. This study supports the integration of gamification methods into mathematics curricula as an effective strategy to promote learning in a fun and motivating way.

Results from the Questionnaires

The questionnaire data on the motivation and engagement of 50 students in the experimental group were processed and presented in the table.

Table 3

Questionnaires results

Aspect	Average before	Average after	Standard Deviation before	Standard Deviation After	Difference average
Motivation	2.69	4.51	0.47	0.44	1.82
Commitment	3.08	4.74	0.51	0.45	1.66
Confidence	2.78	4.19	0.55	0.54	1.41

Gamification-based technology. Before the intervention, the average motivation was 2.69, while after the intervention it increased to 4.51, reflecting a significant change of +1.82 points. This indicates that the use of game-based methods has positively influenced students' desire and interest in learning mathematics. The decrease in the standard deviation from 0.47 to 0.44 also suggests that the improvement in motivation was evenly distributed among students, including both those with lower levels of motivation and those who were more engaged.

In addition to motivation, students' engagement in math lessons also increased significantly. Before the intervention, the mean engagement was 3.08, while after the intervention it increased to 4.74, with a positive change of +1.66 points. This result suggests that the gamification-based technology helped students become more focused and active in the learning process. The improvement in engagement was also distributed in a balanced manner, as shown by the reduction in the standard deviation from 0.51 to 0.45, implying a consistent and widespread impact across the majority of students.

Another important aspect analyzed was the students' self-confidence in their mathematical abilities. The results showed a significant increase in self-confidence from 2.78 to 4.19, reflecting a

an improvement of +1.41 points. This shows that "gamification" not only helped to increase motivation and engagement but also positively influenced the way students perceived their ability to solve mathematical problems. Since the standard deviation remained stable (0.55 before and 0.54 after the intervention), this indicates that the improvement in self-confidence was uniform for the majority of students. In conclusion, these results show that technology based on "gamification" is an effective tool to improve the learning experience and promote active engagement in mathematical education.

Student Interview Results

To better understand students' experiences with the use of gamification-based technology in mathematics learning, semi-structured interviews were conducted with 20 students in the experimental group. The analysis of the responses was carried out through thematic analysis, where the main themes representing the students' experiences were identified. In this study, three main themes emerged: (1) increased motivation and engagement, (2) improved mathematical learning, and (3) impact on self-confidence and reduced mathematical anxiety.

Increasing Motivation and Engagement

One of the most important themes that emerged from the interviews was the students' increased motivation to learn mathematics. Most students emphasized that game elements, such as rewards, points, and levels, made the learning process more fun and engaging. One student said: "I really liked it when I earned points and could move on to the next level. It made me want to do more exercises." Another student mentioned: "Math used to seem boring to me, but now I feel more motivated to learn because it feels more like a game than a school assignment."

In addition to increased motivation, students also reported being more focused during lessons and more engaged in class due to the sense of competition and challenge with their peers.

Improving Mathematical Learning

The second theme that emerged from the analyses was the improvement of math skills through "gamification". Students reported that math material was easier to understand when presented through games than in traditional formats. One student noted, "It helped me understand number concepts faster because I could experiment and correct mistakes in the game." Another said, "The exercises seemed easier to remember because I had to use them repeatedly in the games to get to the next level."

Another important aspect of improving learning was the fact that "gamification" made math less intimidating, helping students see mathematical concepts in a more practical and understandable way.

Impact on Self-Confidence and Reduction of Math Anxiety

The third main theme identified was the impact of gamification on students' self-confidence and reduced math anxiety. Some students mentioned that they previously felt insecure when facing math problems, but using games helped them feel more confident and independent. One student said: "I used to get scared when I didn't know how to solve an exercise, but now I can learn by playing and I don't feel so stressed." Another added: "Now I'm not afraid of making mistakes anymore, because the game allows me to try again and improve."

Additionally, some students reported feeling freer to ask questions in class and collaborate with their peers, as "gamification" created a friendlier and less stressful environment for learning math.

Students reported greater motivation and engagement during math lessons thanks to game-like mechanisms, such as rewards and levels. The use of "gamification" helped in faster acquisition of mathematical concepts and made exercises more understandable and easier to remember. Students' self-confidence improved significantly, making them more willing to experiment with new concepts and to accept mistakes as part of the learning process. Math anxiety was reduced, and students experienced learning as a more fun and less stressful activity. These findings support the conclusion that technology based on "gamification" has a positive impact not only on academic results but also on the psychological and emotional aspects of students, creating a more enjoyable and effective math learning experience.

Results from Correlation

Table 4

Correlation results

Analyzed Variables	Correlation Coefficient	P-Value (Sig.)	N (Number of Observations)	Average Improvement	Standard Deviation of Grades	Average Motivation Improvement	Standard Deviation of Motivation	Confidence - Lower	95% Confidence - Upper
Improving Results & Improving Motivation	0.87	0.00	50	2.49	0.97	1.82	0.60	0.73	1.27

Correlation analysis shows a positive relationship (r = .87) between improved motivation and improved academic performance after the use of " gamification ". This means that any increase in student motivation directly affects the improvement of their grades. Furthermore, the p-value = 0.00 indicates that this relationship is statistically significant, confirming that the observed improvement is not random, but occurs as a result of the method used.

The results of the study show that the average improvement in grades was 2.49 points, while the average improvement in motivation was 1.82 points. The standard deviation for both variables shows a stable distribution, meaning that most students experienced a similar improvement. Furthermore, the 95% confidence interval (0.73 - 1.27) indicates that there is a strong relationship between these two factors, confirming that increased motivation has significantly affected academic performance.

DİSCUSSİONS

Our study has confirmed that "gamification" in mathematics teaching has a significant impact on improving

academic performance and student motivation. Our findings are consistent with previous research, such as the study by Carrillo et al. (2024), which identified the most effective "gamification" strategies to motivate students and improve their performance in mathematics (Carrillo et al., 2024). This study also showed that elements of competition and cooperation in "gamification" environments positively affect student engagement, which is consistent with the results of Mohammadi et al. (2022) (Mohammadi et al., 2022).

Our results show that students in the experimental group experienced a significant improvement in their grades after applying "gamification" to the learning process. This result is consistent with the study by Lukman et al. (2023), which analyzed gamification-based teaching materials and their effectiveness on student achievement in mathematics (Lukman et al., 2023). Furthermore, according to a meta-analysis conducted by Huang et al. (2020), "gamification" has shown an overall positive effect on improving academic results in various areas, including mathematics (Huang et al., 2020).

Gamification has not only improved students' academic performance but also increased their motivation to learn mathematics. This finding is consistent with the study by Adeniyi and Kuku (2020), who analyzed the impact of gamification and experiential learning methods on mathematics achievement in students with hearing disabilities (Adeniyi & Kuku, 2020). Furthermore, recent research by Alt (2023) has shown that students who engage in gamified environments report higher levels of satisfaction and motivation to learn (Alt, 2023).

Gamification-based activities had a positive impact on improving student achievement and motivation. This is consistent with the findings of Lee et al., (2023), who explored the use of games and gamification in undergraduate mathematics education (Lee et al., 2023). Similarly, a study by Zabala-Vargas et al. (2021) suggested that incorporating gamification into engineering courses helps reduce dropout rates (Zabala-Vargas et al., 2021).

While our results confirm the benefits of gamification, several studies have highlighted that its impact may vary depending on other factors, such as the content of the game and the level of experience of students with technology. For example, the study by Yıldırım and Şen (2021) notes that, although gamification has a positive impact on academic achievement, its effectiveness depends on how it is integrated into teaching (Yıldırım, & Şen, 2021).

Like any other study, this research has its limitations. A major limitation is that the primary focus was only on one primary and lower secondary school, thus limiting the generalizability of the findings to a wider population. In the future, it is suggested that studies include more schools and examine the long-term impact of gamification on learning. According to a recent study by Dehghanzadeh and Farrokhnia (2024), it is important that gamification is tailored to the specific needs of students to ensure the sustainability of its positive effect (Dehghanzadeh & Farrokhnia, 2024).

Answers to Research Questions

1) Gamification-based technology affects the acquisition of mathematical concepts by elementary and secondary school students? The use of gamification-based technology has a significant impact on the acquisition of mathematical concepts by students. The results of this research show that students in the experimental group, who used gamification-based methods, experienced a significant improvement in their mathematical skills compared to the control group, where traditional teaching methods were applied. Interactive gamification elements, such as challenges, rewards, and level systems, helped students learn in a more fun and engaging way. In addition, the personalized experience and the opportunity to repeatedly correct errors without penalty, helped students better acquire concepts and apply them in different situations. This finding is also supported by recent literature, where gamification has been evaluated as an effective method for improving learning in mathematics (Lukman et al., 2023).

2) Gamification helps reduce math anxiety and improve students' self-confidence in dealing with math problems. One of the most important benefits of gamification in education is its impact on reducing math anxiety and increasing students' self-confidence. The results of the questionnaires show that the self-confidence of students in the experimental group increased significantly after using gamification, going from an average of 2.78 to 4.19. This change indicates that when students learn in a more interactive and less stressful environment, they feel more confident in their abilities to deal with math challenges. Students also reported that using gamification helped them become more tolerant of mistakes, as they had the opportunity to learn through repetition and corrections without fear of penalty. These results are similar to those of other studies, which have shown that gamification creates a more supportive and less intimidating environment for learning mathematics (Mohammadi et al., 2022).

3) Which elements of "gamification" (rewards, levels, leaderboards, interactive challenges) are most effective in increasing student motivation and engagement? Analysis of interviews with students showed that some elements of gamification are most effective in increasing their motivation and engagement. In particular, the reward and points system were among the most appreciated elements, as students felt motivated to accumulate points and win virtual rewards. The leaderboard also had a significant impact on their engagement, as it created a healthy sense of competition and encouraged them to improve their performance. Interactive challenges and levels helped increase motivation, giving students a sense of achievement each time they moved to a new level. Overall, these elements made the learning process more engaging and fun, helping students stay focused for longer during math lessons (Alt, 2023).

4) What are the differences between traditional teaching approaches and those based on "gamification" in terms of academic outcomes and student engagement? The results of this study clearly show that gamification is a more effective method than traditional teaching approaches in improving academic performance and student engagement. Students in the experimental group improved their average scores from 6.02 to 8.51, while students in the control group, who followed traditional methods, improved their scores only from 6.07 to 7.07. In addition, the motivation of students who used gamification increased significantly, going from 2.69 to 4.51. This suggests that traditional methods may be more structured, but often lack the element of engagement

and interaction that gamification provides. Previous literature has shown similar results, claiming that traditional teaching approaches are less effective in increasing engagement and performance in mathematics compared to game-based methods (Dehghanzadeh & Farrokhnia, 2024).

5) What are the perceptions of teachers and students on the use of "gamification" in the learning process? Students' perceptions of the use of "gamification" in the learning process were overwhelmingly positive, with the majority of them describing this method as more engaging, more fun, and more effective than traditional teaching. They reported that "gamification" helped them understand mathematical concepts more easily and motivated them to be more involved in class. On the other hand, teachers also evaluated "gamification" as an effective method to engage students, but some of them expressed concerns about the additional time needed to plan and implement "gamification" activities. Another challenge mentioned was the need for additional training to use such platforms effectively. Despite these challenges, most teachers agreed that "gamification" is an innovative and effective method that can increase students' academic success (Zabala-Vargas & de Benito, 2021).

Testing Hypothesis

Hypothesis 1: The use of technology based on "gamification" positively affects the acquisition of mathematical concepts by primary and secondary school students.

The results of statistical analysis showed that "gamification" had a significant impact on the acquisition of mathematics by students. The T-test showed an average increase of 2.49 points in the results of the experimental group, which was significantly higher than that of the control group. This indicates that the use of technology based on game mechanisms helps in better understanding and application of mathematical concepts. Considering these results, the hypothesis is accepted.

Hypothesis 2: Technology based on "gamification" significantly reduces math anxiety and increases students' self-confidence in dealing with math problems.

The analysis of the questionnaires showed an increase in self-confidence from 2.78 to 4.19, confirming that "gamification" helps students feel more confident in their math skills. Students also reported a decrease in anxiety, as they had more opportunities to experiment and correct their mistakes without feeling penalized. These results indicate a significant impact of "gamification" on students' emotional well-being in relation to math, supporting the conclusions of previous studies. For this reason, the hypothesis is accepted.

Hypothesis 3: Specific elements of " gamification ", such as rewards, levels, and leaderboards, have a distinct and positive impact on increasing student motivation and engagement.

The results of the analysis showed that student motivation increased from 2.69 to 4.51, while their engagement during the learning process improved from 3.08 to 4.74. In the interviews with the students, it was identified that the reward system, leaderboard, and interactive challenges were the most important elements that boosted their motivation. Students felt challenged and encouraged to perform better. Given that these data show a significant impact of "gamification" mechanisms on student motivation, the hypothesis is accepted.

Hypothesis 4: Gamification-based approaches are more effective than traditional teaching methods in improving academic achievement and student engagement.

The analysis of academic achievement showed a greater improvement in the experimental group (from 6.02 to 8.51) than in the control group (from 6.07 to 7.07). Furthermore, the level of engagement of students who used gamification was higher, as they reported more enjoyment and engagement during mathematics learning. These results support the claim that gamification is a more effective method to increase student academic achievement compared to traditional teaching approaches. Based on this analysis, the hypothesis is accepted.

Hypothesis 5: Personalized educational platforms based on "gamification" improve learning outcomes regardless of the level of technological experience of students. The correlation

Analysis showed a strong relationship between improved motivation and academic outcomes, regardless of the level of technological experience of students. This suggests that "gamification" can be effective for all students, even for those who have less experience with technology, as long as they are provided with an appropriate learning environment. The results of the interviews showed that, although some students had difficulties at first, they quickly adapted and benefited from this method. For this reason, the hypothesis is accepted.

CONCLUSİONS

This study examined the impact of gamification-based technology on mathematics acquisition and improved student motivation. The results show that students in the experimental group, who used a methodology based on educational games, had a significant improvement in their academic results and their motivation to learn mathematics. This approach not only helped reduce math anxiety but also increased students' self-confidence to cope with various mathematical problems.

Furthermore, statistical analyses confirmed a strong link between improved motivation and academic performance, suggesting that gamification is not simply a fun method, but an effective tool to increase student engagement and academic success. The most effective elements of this approach were rewards, levels, and interactive challenges, which were rated as key factors for student motivation and engagement.

Being an innovative approach, "gamification" should be more widely integrated into educational systems to create a more dynamic learning experience better suited to the needs of 21st-century learners.

In the future, further research should focus on the long-term impact of gamification and explore the best ways to integrate it into various educational programs and other fields of science.

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