Using Gamified Learning Strategies to Enhance Problem-Solving Performance in Mathematics

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ABSTRACT

In an age where student motivation in mathematics continues to decline, gamified learning emerges as a dynamic strategy to turn struggling learners into engaged problem-solvers. This study determined the effectiveness of gamified learning strategies in improving the mathematical problem-solving performance and engagement of first-year students who enrolled in mathematics-related subjects in the College of Education in one of the private institutions in Ozamiz City, Philippines, during the School Year 2024–2025. A one-group pretest-posttest design was used, involving 28 students who participated in eight instructional sessions using gamified elements such as points, leaderboards, and interactive tasks. Data were gathered using a researcher-made Gamified Problem-Solving Performance Test and a Student Engagement and Motivation Questionnaire. Findings revealed that students initially demonstrated very poor performance and low levels of engagement and motivation. After the intervention, significant improvements were observed in both problem-solving skills and learner engagement. Statistical analysis showed a significant difference between pretest and posttest results in terms of mathematical performance as well as engagement and motivation. These results affirm that gamified learning is an effective instructional strategy for enhancing students' academic outcomes and motivational levels in mathematics. Integrating such strategies into classroom instruction is therefore recommended to foster more active, enjoyable, and effective learning experiences.

Keywords: gamified learning, mathematics education, problem-solving, student engagement, motivation, instructional strategy, first-year education students

INTRODUCTION

Mathematics is not just a subject but a fundamental tool that shapes various aspects of daily life and numerous fields of study. It plays a crucial role in the development of critical thinking, logical reasoning, and problem-solving skills. However, many students struggle with engagement and motivation in mathematics, leading to poor academic performance and weak problem-solving abilities (Maryana et al., 2024). One such approach is gamified learning, which integrates game-like elements such as points, rewards, competition, and interactive challenges into educational activities (Jun & Lucas, 2025). Gamification in mathematics education has shown significant potential in enhancing students' engagement, motivation, and problem-solving abilities. Studies have found that gamified learning platforms provide an immersive learning experience that encourages students to participate more actively and develop mathematical proficiency (Corpuz-Sanchez & Pasia, 2024).

Gamification has been widely studied for its positive impact on student engagement, learning outcomes, and problem-solving abilities (Maryana et al., 2024). A quasi-experimental study involving 200 middle school students revealed that those who engaged with a gamified learning platform demonstrated significantly higher engagement levels, improved academic performance, and a more positive attitude toward mathematics compared to those who followed a traditional curriculum. These findings highlight the effectiveness of gamification in creating a more interactive and motivating learning environment for mathematics education (Maryana et al., 2024).

Gamified learning platforms such as Kahoot and Quizizz have been shown to increase student motivation and participation in mathematics classes (Rachmadi et al., 2025). The integration of leaderboards, point systems, and interactive challenges has contributed to higher student motivation, which, in turn, leads to better problem-solving performance (Rachmadi et al., 2025). A comparative study on Kahoot-assisted gamification versus PowerPoint-based instruction found that students using Kahoot demonstrated greater retention of mathematical concepts and improved learning outcomes. These studies suggest that game-based learning environments not only increase student engagement but also strengthen their ability to apply mathematical concepts in problem-solving tasks (Jurani & Nuh, 2025).

Furthermore, research has demonstrated that gamified learning can foster collaboration, improve self-efficacy, and enhance digital literacy among students (Situmorang et al., 2025). The use of digital gamification tools, such as Quizizz-assisted case and team-based projects, has been found to improve students' ability to identify problems, process information, and formulate problem-solving plans. A study conducted on fifth-semester economic education students revealed that 100% of participants successfully identified problems, 83.33% mastered information transformation, and 50% developed problem-solving plans, highlighting the role of gamification in promoting higher-order thinking skills (HOTS) (Situmorang et al., 2025). Similarly, gamification strategies that align with the principles of constructivist learning theories have shown a positive impact on students' ability to analyze and apply mathematical concepts, reinforcing the idea that interactive and engaging learning environments contribute to academic success (Anggoro et al., 2025)

Gamification has also been found to enhance students' problem-solving skills by fostering critical thinking and creativity (Boom-Cárcamo et al., 2024). Students in gamified learning environments developed stronger analytical skills and demonstrated greater confidence in solving mathematical problems (Boom-Cárcamo et al., 2024). Research on the Gamification of Mathematics Teaching Materials (GEMAS) revealed that students who used gamified instructional resources exhibited significant improvements in higher-order thinking skills (HOTS), particularly in analyzing and solving complex mathematical problems (Suryani et al., 2024).

Students' self-efficacy also influences the effectiveness of gamification in mathematics education. A study on the interaction between gamification and self-efficacy found that students with high self-efficacy achieved significantly better learning outcomes compared to those with low self-efficacy (Jurani & Nuh, 2025). Similarly, research on AI-powered gamified learning systems showed that students who participated in gamified AI-driven learning experienced lower math anxiety and exhibited a higher willingness to engage in problem-solving activities (GA et al., 2025).

There appears to be an empirical gap in the prior research. There is a lack of rigorous research in the prior literature on the direct impact of real-life and contextualized mathematics instruction on students' appreciation and application of mathematical concepts in everyday situations. Some of these unexplored aspects of contextual learning, particularly its role in developing higher-order thinking skills (HOTS) and practical problem-solving strategies, are important and worthy of investigation in the context of secondary mathematics education. An empirical investigation of these issues is vital because while existing studies emphasize engagement and relevance, fewer have explored how real-world integration enhances students' ability to analyze, connect, and apply mathematical concepts effectively.

Furthermore, previous research has focused primarily on qualitative studies concerning students' perceptions and attitudes toward contextualized learning, rather than quantitative analyses of its effects on actual appreciation and application outcomes. No study to date has directly attempted to empirically evaluate whether real-life–based learning strategies lead to measurable improvements in students' ability to use mathematics meaningfully beyond the classroom. Very little empirical research has been done on the long-term effects of contextualized mathematics learning on students' appreciation, engagement, and cognitive development in understanding math as part of daily life (Miles, 2017).

This research examines the influence of Gamified Learning Strategies (GLS) on the problem-solving performance of first-year college students in mathematics at Misamis University. The results can assist teachers, school administrators, and educational policymakers in understanding how gamification enhances engagement, motivation, and mathematical problem-solving skills. The research identifies an empirical gap

and seeks to contribute to the improvement of mathematics instruction within higher education, particularly at Misamis University and nearby institutions.

THEORETICAL FRAMEWORK

This study is anchored on Constructivist Learning Theory by Jean Piaget (1972) and Self-Determination Theory (SDT) by Deci and Ryan (1985).

The Constructivist Learning Theory (Piaget, 1950; Vygotsky, 1978) suggests that learning is an active process in which students construct knowledge through experiences and interactions. Piaget (1950) emphasized that learners develop their understanding by engaging with problems, manipulating concepts, and making sense of ideas through exploration. Meanwhile, Vygotsky (1978) introduced the Zone of Proximal Development (ZPD) and scaffolding, which highlight the role of social interaction and guided learning in cognitive development. According to this theory, students learn best when they actively engage in problem-solving tasks and receive appropriate support from teachers or peers.

In the context of gamified learning, Constructivist Learning Theory is highly relevant as it emphasizes active participation, exploration, and collaborative learning. Studies show that integrating game-based learning strategies enhances student engagement and motivation, leading to improved problem-solving abilities in mathematics (Maryana et al., 2024). Interactive elements such as points, rewards, leaderboards, and game-based challenges encourage students to experiment with different problem-solving approaches, refine their reasoning skills, and deepen their understanding of mathematical concepts (Rachmadi et al., 2025). Additionally, gamified learning fosters collaborative learning environments, aligning with Vygotsky's emphasis on peer interaction and scaffolding to enhance problem-solving performance.

The significance of Constructivist Learning Theory in this study lies in its alignment with the core principles of gamified instruction. By recognizing that learners construct knowledge through active engagement, the study supports the use of interactive and exploratory learning experiences to strengthen students' mathematical thinking. This theory serves as a foundational guide in designing learning environments where students are not just passive recipients of information, but active participants who build understanding through dynamic tasks and meaningful feedback. As such, it underpins the rationale for integrating gamified strategies to foster deeper cognitive involvement and better problem-solving outcomes in mathematics education.

The Self-Determination Theory (SDT) (Deci & Ryan, 1985) explains the psychological factors that influence students' motivation in learning. According to SDT, individuals are more likely to engage in tasks when their three basic psychological needs—competence, autonomy, and relatedness—are met. Competence refers to the feeling of mastery over a subject, autonomy relates to having control over one's learning process, and relatedness involves a sense of connection with others. When these needs are satisfied, students develop intrinsic motivation, leading to higher engagement, persistence, and improved academic performance.

Gamified learning supports the principles of Self-Determination Theory by incorporating structured challenges and reward-based progress systems that foster a sense of competence among students. Research has demonstrated that students who engage with gamified platforms develop stronger motivation, persistence, and problem-solving abilities compared to those exposed to traditional instructional methods (Boom-Cárcamo et al., 2024). Features such as self-paced learning, instant feedback, and adaptive problem-solving tasks give students autonomy over their learning process, increasing their willingness to engage with mathematical challenges (Jurani & Nuh, 2025). Moreover, the social components of gamification, including competition, teamwork, and peer collaboration, align with SDT's concept of relatedness, creating an interactive and enjoyable learning environment that enhances problem-solving performance.

By anchoring this study on Constructivist Learning Theory and Self-Determination Theory, the research aims to examine how gamified learning strategies enhance students' engagement, motivation, and problem-solving skills in mathematics. Through active exploration, structured problem-solving activities, and motivational game elements, gamification has the potential to transform traditional mathematics instruction into an

engaging, student-centered learning experience, ultimately leading to improved mathematical reasoning and problem-solving proficiency.

CONCEPTUAL FRAMEWORK

The effect of Gamified Learning Strategies (GLS) as an independent variable on students' engagement, motivation, and problem-solving performance in mathematics is an innovative instructional approach that utilizes game-based mechanics, interactive challenges, and reward systems to enhance students' cognitive development and mathematical problem-solving skills. Studies, including one by Maryana et al. (2024), indicate that gamification fosters active participation, improves retention, and enhances mathematical reasoning. Additionally, research by Jurani and Nuh (2025) suggests that Kahoot-assisted gamification significantly improves students' learning outcomes, particularly for those with high self-efficacy.

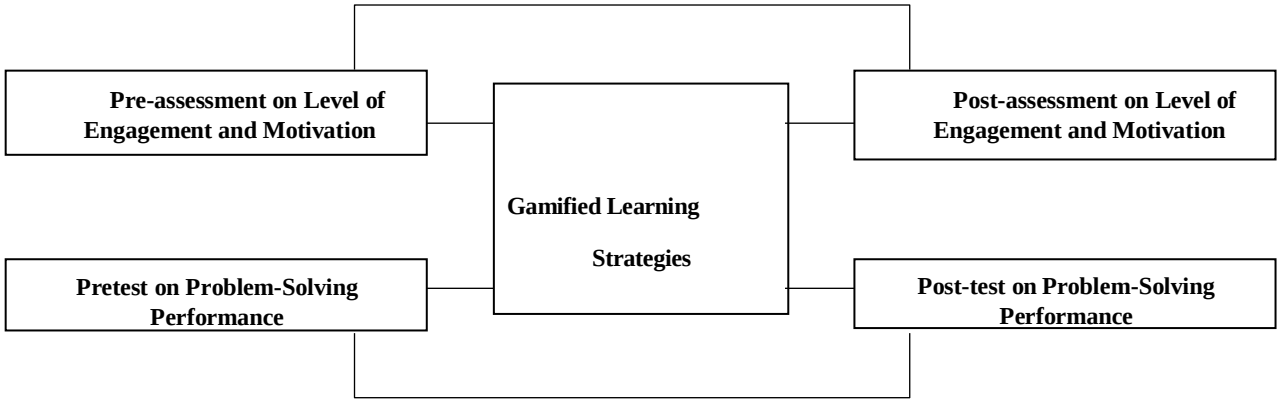
This study operationally defines one of the dependent variables, problem-solving performance, as students' ability to analyze mathematical problems, develop strategies, and apply problem-solving techniques effectively. According to Boom-Cárcamo et al. (2024), students in gamified learning environments develop stronger analytical reasoning, critical thinking, and persistence in solving mathematical tasks. The second dependent variable, engagement and motivation, is measured through students' active participation in gamified tasks, willingness to solve problems, and overall interest in mathematics learning. Research by Suryani et al. (2024) highlights that gamification creates an engaging and interactive learning experience, allowing students to take ownership of their learning and develop perseverance in problem-solving.

Enhancing students' problem-solving and mathematical performance involves immersing them in interactive learning environments where they experience real-world problem-solving tasks through game-based challenges and feedback systems. Through gamified learning, students are encouraged to engage in trial-and-error problem-solving, receive immediate feedback, and develop self-regulated learning strategies. Research by GA et al. (2025) suggests that gamification reduces math anxiety and builds students' confidence in approaching complex mathematical tasks, which ultimately enhances their problem-solving skills. Unlike traditional instructional approaches, gamified learning fosters intrinsic motivation by incorporating engaging elements such as point systems, leaderboards, and rewards (Attah et al., 2024).

This study examines student motivation and self-efficacy as crucial links between gamified learning strategies and the improvement of problem-solving performance in mathematics. Students who feel motivated and confident in their problem-solving abilities are more likely to engage actively in mathematical challenges and persist through difficulties. Research by Sheybani and Yaftian (2025) highlights that gamification enhances students' self-regulation, metacognitive abilities, and motivation, leading to better learning outcomes in mathematics. Furthermore, this study will evaluate students' mathematical performance, engagement, and motivation before and after exposure to gamified learning strategies to determine the effectiveness of this instructional approach in enhancing students' problem-solving skills and overall mathematics achievement.

The next page shows the schematic diagram of the study.

Figure 1. Schematic Diagram of the Study



Statement of the Problem

This study aimed to determine the effect of gamified learning strategies on students' engagement and motivation in mathematics during the SY 2024-2025 in one of the higher education institutions in Ozamiz City. Specifically, it sought to answer the following questions:

1. What is the learners' problem-solving performance in mathematics before the implementation of gamified learning strategies?
2. What is the learners' level of engagement and motivation in mathematics before the implementation of gamified learning strategies?
3. What is the learners' problem-solving performance in mathematics after the implementation of gamified learning strategies?
4. What is the learners' level of engagement and motivation in mathematics after the implementation of gamified learning strategies?
5. Is there a significant difference between the learners' problem-solving performance before and after the implementation of gamified learning strategies?
6. Is there a significant difference between the learners' engagement and motivation before and after the implementation of gamified learning strategies?

Null Hypotheses

$H_0$1: There is no significant difference between the learners' problem-solving performance before and after the implementation of gamified learning strategies.

H_O2: There is no significant difference between the learners' engagement and motivation before and after the implementation of gamified learning strategies.

RESEARCH METHODOLOGY

Research Design

This employed a one- quantitative research approach group pretest-posttest design to examine the effectiveness of Gamified Learning Strategies (GLS) in enhancing the problem-solving performance of first-year college education students in mathematics at Misamis University. A pretest-posttest design is a widely used research methodology that evaluates the effectiveness of an intervention by measuring participants' knowledge or performance before and after the instructional treatment (Maryana et al., 2024). In the context of gamified learning, this design allows researchers to assess how game-based strategies influence student engagement, motivation, and problem-solving skills (Rachmadi et al., 2025). This design was selected due to its effectiveness for classroom settings and its ability to measure learning gains over a short intervention period.

Research Setting

This study was conducted in one of the higher education institutions in Ozamiz City, Misamis Occidental, Philippines. This institution is a private non-sectarian institution that offers various undergraduate programs, including education-related courses. The research focused on first-year college students enrolled in the College of Education, particularly those taking mathematics-related courses.

A single section of first-year students was selected as respondents for this study. This group is ideal for examining the effects of Gamified Learning Strategies (GLS) on engagement, motivation, and problem-solving performance in mathematics, as first-year students are still transitioning from high school to college-level mathematical problem-solving. By assessing their experiences with gamified learning, this study aims to determine how game-based instructional methods influence mathematical comprehension, critical thinking, and problem-solving skills.

Respondents of the Study

This study includes first-year college students enrolled in the College of Education at a higher education institution in Ozamiz City, Misamis Occidental, Philippines, for the 2024-2025 academic year. They have chosen to use purposive sampling, ensuring that the selected respondents are those taking mathematics-related courses and are directly engaged in problem-solving activities. Only students who consented to participate were included in the study, ensuring adherence to ethical research standards. This selection aims to address the gap in research on the effectiveness of Gamified Learning Strategies (GLS) in improving mathematical engagement, motivation, and problem-solving skills among first-year college students.

Research Instrument

The study used the following questionnaire as a data gathering instrument:

The Gamified Problem-Solving Performance Test (Appendix A). This instrument is a researcher-designed assessment tool developed to evaluate first-year college students' mathematical problem-solving performance before and after the implementation of Gamified Learning Strategies (GLS). This test was created based on previous studies highlighting the role of gamification in improving students' engagement, cognitive processing, and analytical problem-solving skills (Situmorang et al., 2025). The test consists of 50 items, structured around problem-solving tasks integrated with game-based elements, following structured learning activities over four sessions spanning four weeks. Each 90-minute session, conducted once a week, includes a 15-minute pretest, a 60-minute gamified instructional activity, and a 15-minute posttest. The test measures problem-solving competencies based on critical thinking in mathematical reasoning, logical application of problem-solving techniques, and strategy development for tackling complex mathematical tasks (Anggoro et al., 2025).

To assess students' problem-solving performance, the study will use a 5-point Likert scale, where 5 represents the highest level of proficiency and 1 represents the lowest:

Scores	Remarks
47-50	Outstanding
44-46	Very Satisfactory
42-43	Satisfactory
40-41	Fair
38-39	Poor
1-37	Very Poor

The validity and reliability of the GPSPT were established through expert consultations, pilot testing, and statistical validation. Mathematics educators and assessment specialists reviewed the test content to confirm its alignment with college-level mathematical competencies and problem-solving standards. A pilot study was conducted with a sample group of students to assess clarity, coherence, and difficulty level, and Cronbach's alpha was used to measure the internal consistency of the instrument. Previous research has emphasized that gamified assessments can significantly enhance students' problem-solving abilities and engagement, as they provide an interactive and motivating environment for learning mathematics (Situmorang et al., 2025; Anggoro et al., 2025)

Student Engagement and Problem-Solving Motivation Questionnaire (Appendix B). This researcher-made questionnaire is designed to assess students' engagement and motivation levels in a gamified learning

environment. This questionnaire uses a 5-point Likert scale, with responses ranging from Strongly Disagree (1) to Strongly Agree (5), adapted from Song et al. (2025). The instrument comprises 20 items, categorized into four key constructs: Cognitive Engagement (5 items), Affective Engagement (5 items), Behavioral Engagement (5 items), and Motivation (5 items). These constructs evaluate how students interact with gamified learning strategies, their level of enthusiasm, and their persistence in problem-solving tasks. This questionnaire is highly relevant to the study, as it measures explicitly the impact of Gamified Learning Strategies (GLS) on student engagement and motivation in mathematics. The instrument was administered as both a pre-assessment before the intervention and a post-assessment after completing the sessions, allowing for a comparative analysis of changes in student engagement and motivation. Previous research has shown that gamification positively influences student participation, enjoyment, and willingness to engage in problem-solving activities, making it an essential aspect of this study (Song et al., 2025).

To determine the students' level of engagement and motivation toward the implementation of Gamified Learning Strategies, the study used the following continuum, based on the adapted scale from Song et al. (2025):

Responses	Continuum	Interpretation
5 – Strongly Agree	4.20-5.00	Extremely High
4 – Agree	3.40-4.19	High
3 – Neutral	2.60-2.39	Moderate
2 – Disagree	1.80 – 2.59	Low
1 – Strongly Disagree	1.00 – 1.79	Extremely Low

Lesson Plan (Appendix C). In this study, Gamified Learning Strategies (GLS) were integrated into the college-level mathematics curriculum, covering topics such as simple interest, compound interest, logic, and ISBN. Each of the four sessions began with a pretest to assess students' initial understanding, followed by a teacher-facilitated gamified activity, where students engaged in interactive problem-solving tasks related to the day's topic. For example, students might calculate compound interest using a game-based simulation or analyze simple and compound regression models through gamified data analysis challenges. After completing the gamified activities, a posttest was administered to evaluate students' learning gains and measure the impact of Gamified Learning Strategies on their mathematical performance and problem-solving skills. By comparing pretest and posttest scores, this study assessed the effectiveness of game-based learning interventions in improving students' engagement, motivation, and ability to apply mathematical concepts in real-world problem-solving scenarios.

Data Gathering Procedure

Before conducting the study, the researcher obtained the necessary approvals by submitting a formal request to the Dean of the College of Education at Misamis University. Upon approval, authorization was secured from the School Administrator of Misamis University to conduct the study with first-year college students enrolled in mathematics-related courses. An orientation was held to explain the study’s purpose, procedures, and voluntary nature of participation, and students signed informed consent forms.

The study followed a one-group pretest-posttest design over four weeks, consisting of four instructional sessions utilizing Gamified Learning Strategies (GLS). Before implementation, a Student Engagement and Motivation Questionnaire and a Problem-Solving Performance Pretest were administered to assess participants' initial engagement, motivation, and mathematical problem-solving skills. During the intervention, students participated in eight 90-minute gamified sessions conducted twice per week, structured into three phases: a

pretest (15 minutes) to assess prior understanding, a 60-minute gamified learning activity incorporating interactive quizzes, leaderboard challenges, and real-world problem-solving tasks, and a posttest (15 minutes) to measure immediate learning outcomes. After the intervention, the Problem-Solving Performance Posttest and Student Engagement and Motivation Questionnaire were re-administered to evaluate improvements. Data analysis involved comparing pretest and posttest mean scores and conducting a paired t-test to determine significant changes in engagement, motivation, and problem-solving performance. The findings provided insights into the effectiveness of Gamified Learning Strategies (GLS) in enhancing students' problem-solving skills in mathematics.

Ethical Considerations

Before conducting the study, ethical considerations were carefully established to prioritize the well-being, rights, and privacy of all participants. Approval was sought from the Misamis University Research Ethics Board (MUREB) to ensure compliance with institutional and ethical research standards. This study adhered to ethical guidelines outlined in previous research on gamified learning, particularly studies emphasizing the importance of ethical considerations in technology-enhanced education. According to Chiu et al. (2025), integrating gamification in educational settings necessitates strict adherence to ethical standards, ensuring that students' engagement is promoted without causing undue stress or pressure. Similarly, Fernández-Velásquez et al. (2025) highlighted the need for privacy protection and data security in gamified learning platforms to prevent ethical risks associated with digital learning environments.

Ethical protocols included obtaining informed consent from all participating students, who were thoroughly briefed on the study's objectives, procedures, potential risks, and benefits before voluntarily agreeing to participate. Since all respondents were above 18 years old, parental consent was not required. Participants were assured of their right to withdraw from the study at any time without consequences. To maintain confidentiality and anonymity, data collection and analysis were conducted without any identifiable personal information. In compliance with Republic Act No. 10173 (Data Privacy Act of 2012), strict data management protocols were implemented to safeguard participants' privacy and dignity. Additionally, all research procedures followed the ethical principles of beneficence, respect for autonomy, and justice, ensuring that participants' welfare remained the highest priority throughout the study.

Data Analysis

This study utilized the following statistical methods for data analysis using JAMOVI software:

Frequency and percentage were employed to examine learners' problem-solving performance in mathematics before and after the implementation of Gamified Learning Strategies (GLS).

Mean and standard deviation were utilized to measure the learners' level of engagement and motivation in mathematics before and after the implementation of GLS. The mean represented overall progress, while the standard deviation indicated the consistency of responses among participants.

A paired t-test was conducted to explore significant differences in learners' problem-solving performance in mathematics before and after the implementation of Gamified Learning Strategies (GLS). Likewise, it was applied to assess variations in learners' level of engagement and motivation in mathematics before and after the implementation of GLS. This statistical procedure aimed to evaluate the effectiveness of GLS in fostering students' engagement, motivation, and mathematical problem-solving capabilities.

RESULTS AND DISCUSSIONS

Learners' Problem-Solving Performance in Mathematics Before the Implementation of Gamified Learning Strategies

The data in Table 1 shows the students' problem-solving performance in Mathematics. Overall, their performance was very poor before using Gamified Learning Strategies (M=23.36). All 28 students (100%)

scored poorly in Math, highlighting a widespread lack of basic problem-solving skills. These results suggest that students had a limited understanding of key mathematical topics. This indicates that traditional teaching methods did not effectively help learners develop their problem-solving abilities.

Several factors likely contributed to this poor performance. These include a lack of student engagement, low motivation, minimal use of interactive learning tools, a lack of confidence in tackling math problems, and few chances for meaningful practice. Traditional lectures may not have suited various learning styles, leading to low retention and understanding. To tackle these issues, the Gamified Learning Strategy (GLS) was introduced. GLS combines game elements like points, badges, challenges, and rewards into the learning process. This approach aims to boost student engagement, motivation, and participation. It allows learners to apply mathematical concepts in an interactive and fun way, improving their problem-solving skills and overall performance in Mathematics.

Gamified Learning Strategies provide a strong alternative by including rewards, competition, and interactive tasks. Research from Maryana et al. (2024) and Boom-Cárcamo et al. (2024) supports these methods. These features increase student motivation, participation, and higher-order thinking skills. They are particularly effective in closing performance gaps through engaging learning experiences (Fabito et al., 2021). Gamification also significantly helps students persevere when facing challenging problems (Rachmadi et al., 2025). Overall, GLS can change academic performance and improve learners' confidence and attitudes toward mathematics (Su & Cheng, 2015).

In summary, the very poor pretest results highlight the shortcomings of traditional instruction and support the need for Gamified Learning Strategies. These strategies can enhance both basic and advanced problem-solving skills. The results justify a shift in teaching methods toward approaches that better foster engagement, understanding, and sustained motivation in learning mathematics.

Table 1 Learners' Problem-Solving Performance in Mathematics Before the Implementation of Gamified Learning Strategies

Performance	Frequency	Percentage
Very Poor	28	100
Overall Performance		23.36-Very Poor

Scale: 47-50 (Outstanding); 44-46 (Very Satisfactory);42-43(Satisfactory); 40-41(Fair);38-39 (Poor); 37 and below (Very Poor)

Learners' Level of Engagement and Motivation Before the Implementation of Gamified Learning Strategies

The data in Table 2 shows the learners' level of engagement in Mathematics before they started using Gamified Learning Strategies. Overall, students were classified as less engaged (M = 2.37; SD = 0.47). This means they were not fully involved in the learning process and showed little enthusiasm and focus during math tasks. The data also points to a general lack of energy, interest, and drive in academic tasks related to Mathematics.

The learners' cognitive engagement was also classified as less engaged (M = 2.55; SD = 0.37). This indicates that students were not deeply involved in thinking, reasoning, or problem-solving activities. They put in limited mental effort to understand mathematical concepts. Students might have struggled to concentrate, lacked critical thinking during lessons, and found it hard to connect different mathematical ideas. The low standard deviation of 0.37 shows that most students had similar cognitive engagement levels, suggesting a widespread pattern of disengagement. There was little variation in responses, emphasizing that this issue

affected many rather than just a few students. Such low levels of cognitive engagement suggest that traditional teaching methods did not spark students' curiosity. Consequently, learners may have found it hard to acquire and retain mathematical knowledge.

In terms of affective engagement, the mean score of 2.21 (SD = 0.52) also falls under the less engaged category. This shows that students had low emotional attachment and interest in Mathematics. Affective engagement is crucial for shaping students' attitudes and willingness to participate in class activities. When students feel emotionally disconnected from learning, they tend to see the subject as unimportant or uninteresting. This emotional disengagement can lead to frustration, low self-esteem, and decreased academic persistence.

For behavioral engagement, the mean score was 2.48 (SD = 0.57), again reflecting a less engaged level. This means that students rarely showed consistent participation, attentiveness, or effort during class. Behavioral engagement includes actions like completing tasks, asking questions, and following instructions, which were likely lacking among the learners. This low level of involvement indicates a lack of discipline and initiative in learning Mathematics, suggesting that the learning environment did not inspire students to take ownership of their academic progress.

Regarding motivation in problem-solving, students had a mean score of 2.24 (SD = 0.43), which also falls under the less engaged category. This implies that students were not motivated to push through or put in effort when faced with math challenges. A low level of motivation may lead to avoiding problem-solving tasks and giving up easily when difficulties arise. It also suggests that learners lacked confidence in their mathematical abilities. Without sufficient motivation, students are unlikely to develop the perseverance or critical thinking skills needed for success in Mathematics.

To tackle the low levels of engagement and motivation shown in Table 2, Gamified Learning Strategies (GLS) can be used to improve the learning experience in Mathematics. The results show that learners were less engaged across all areas—cognitive, affective, behavioral, and motivational—highlighting a widespread disconnection from the subject. Implementing gamification offers a chance to change these trends by encouraging more meaningful involvement. By incorporating game elements such as points, challenges, rewards, and immediate feedback into lessons, students can be motivated to participate more actively (behavioral engagement), think critically (cognitive engagement), and develop a stronger emotional connection to the subject (affective engagement). Moreover, using gamified tasks can enhance students' motivation in problem-solving by promoting persistence and confidence when tackling math challenges. In essence, gamification transforms the learning environment into one that is more interactive, student-centered, and motivating, creating conditions that promote sustained engagement and improved academic outcomes in Mathematics.

Gamified learning boosts cognitive engagement by encouraging deeper understanding and interaction with content (Maryana et al., 2024). It also increases affective engagement by making learning more enjoyable and emotionally rewarding (Boom-Cárcamo et al., 2024). Its positive impact on behavioral engagement is reflected in participation and consistent involvement in classroom tasks. Rachmadi et al. (2025) found that gamification enhances motivation in problem-solving by helping students build perseverance. Su and Cheng (2015) concluded that gamified environments can significantly change students' engagement and academic performance.

Overall, Gamified Learning Strategies can create a more dynamic and student-centered learning environment. They offer a structure where students can enjoy learning while improving their problem-solving and critical thinking skills. With greater engagement across all areas, students are more likely to build confidence and develop positive attitudes toward Mathematics. The shift from traditional to gamified instruction fosters inclusivity and meets diverse learning needs. As a result, students not only perform better academically but also become more motivated, participative, and resilient learners.

Table 2 Learners' Level of Engagement and Motivation Before the Implementation of Gamified Learning Strategies

Constructs	M	SD	Remarks
1. Cognitive Engagement	2.55	0.37	Less Engaged
2. Affective Engagement	2.21	0.52	Less Engaged
3. Behavioral Engagement	2.48	0.57	Less Engaged
4. Motivation in Problem-Solving	2.24	0.43	Less Engaged
Overall Engagement	2.37	0.47	Less Engaged

Note. scale: 4.20-5.00 (Highly Engaged); 3.40-4.19 (Engaged); 2.60-3.39 (Moderately Engaged); 1.80-2.59 (Less Engaged); 1.00-1.79 (Least Engaged)

Learners' Performance in Mathematics After the Implementation of Gamified Learning Strategies

The data in Table 3 shows how learners performed in problem-solving for Mathematics after using Gamified Learning Strategies. Overall, the learners' performance notably improved, with a mean score of 46.54, placing them in the Outstanding category. Most students (n = 17; 60.72%) received an Outstanding rating. Others scored Very Satisfactory (n = 7; 25.00%), Satisfactory (n = 1; 3.57%), Fair (n = 2; 7.14%), and only one learner (n = 1; 3.57%) stayed at the Very Poor level. These findings suggest a significant improvement in learners' mathematical skills, showing greater ability in solving problems. The overall results indicate that Gamified Learning Strategies (GLS) greatly helped improve students' understanding and performance in Mathematics.

Several factors might have led to this positive change in performance. Adding gamified elements like rewards, interactive tasks, and real-time feedback helped keep students interested and motivated. Students engaged more actively in learning, which led to better understanding and retention of mathematical concepts. The learning environment also became more welcoming and livelier, encouraging participation from all kinds of learners. Through GLS, students gained a deeper appreciation and confidence in their math skills.

To tackle the previous issues of low engagement and poor performance, Gamified Learning Strategies was introduced as a new approach. GLS uses game elements such as points, badges, and challenges to boost student motivation and involvement in class. These features not only make learning fun but also encourage students to persist with complex math problems. Learners have chances to interact with the material in meaningful ways, making Mathematics easier and more interesting.

Gamified Learning Strategies present a promising solution by promoting motivation, enjoyment, and emotional involvement in math classrooms (Ibáñez et al., 2014). They have also been shown to enhance student performance by increasing participation and concept retention through game-based learning (Fabito et al., 2021). Palička et al. (2021) stated that gamification encourages collaborative behavior and increases engagement in the classroom. Rachmadi et al. (2025) found that gamified activities help students develop perseverance, especially with difficult tasks. Su and Cheng (2015) confirmed that gamification effectively develops both problem-solving abilities and positive feelings toward mathematics. Overall, GLS can change academic performance and improve learners' confidence and attitudes towards math (Su & Cheng, 2015).

In summary, the post-test results in Table 3 highlight the success of Gamified Learning Strategies in fixing the learning gaps noted in earlier assessments. The change from very poor to outstanding performance confirms the effectiveness of GLS in improving problem-solving skills. This educational innovation is a powerful tool for raising both achievement and engagement in Mathematics. As a result, students not only learn more effectively but also build the confidence and motivation needed for long-term academic success. The findings support a continued shift toward gamified and student-centered learning methods in math education.

Table 3 Learners' Performance in Mathematics After the Implementation of Gamified Learning Strategies

Performance	Frequency	Percentage
Outstanding	17	60.72
Very Satisfactory	7	25.00
Satisfactory	1	3.57
Fair	2	7.14
Very Poor	1	3.57
Overall Performance	46.54-Outstanding	

Scale: 47-50 (Outstanding); 44-46 (Very Satisfactory);42-43(Satisfactory); 40-41(Fair): 38-39 (Poor); 37 and below (Very Poor)

Learners' Level of Engagement and Motivation in Mathematics Before the Implementation of Gamified Learning Strategies

The data in Table 4 shows the learners' engagement level in Mathematics after implementing Gamified Learning Strategies. Overall, both engagement and motivation were extremely high (M = 4.35; SD = 0.31). This indicates that students were very involved in the learning process and displayed strong enthusiasm, participation, and focus during mathematics tasks. The data suggests that learners were more motivated and willing to engage with academic content in meaningful ways. The use of gamified elements likely played a key role in improving this engagement.

The level of cognitive engagement among learners was also rated extremely high (M = 4.40; SD = 0.30). This means that students were deeply involved in thinking, reasoning, and solving mathematical problems. This improvement reflects their enhanced ability to analyze and apply mathematical concepts critically. Gamified activities that included challenges, rewards, and interactive content helped sharpen students' higher-order thinking skills. The engaging structure of gamified lessons made learners more attentive and mentally invested in tasks. According to Anggoro et al. (2025), game-based learning significantly improves students' higher-order thinking skills in mathematics.

In terms of affective engagement, the mean score of 4.28 (SD = 0.33) also falls within the extremely high category. This indicates that students formed a stronger emotional connection to Mathematics and found it more enjoyable and relevant. When learners enjoy the learning process, their attitude toward the subject becomes more positive, reducing the fear and anxiety often associated with Mathematics. Gamified tasks provided a sense of enjoyment and accomplishment that fueled learners' emotional investment. Alt (2023) found that gamification promotes positive emotions and boosts students' motivation in mathematics.

For behavioral engagement, learners showed a mean score of 4.31 (SD = 0.28), reflecting an extremely high level of participation. This means that students consistently completed tasks, collaborated in class activities, and showed initiative. The gamified approach made students more active and responsible in their learning. Structured rewards and levels encouraged students to stay on task and participate meaningfully. Apas and Ventayen (2019) reported that gamified teaching greatly increases classroom participation and active learning behavior.

Regarding motivation in problem-solving, the learners achieved a mean score of 4.40 (SD = 0.35), which falls under the extremely high category. This shows that students were highly motivated to tackle challenging problems and persisted in finding solutions. Elements of gamification such as scoring, feedback, and rewards gave learners a sense of accomplishment and challenge, encouraging perseverance. Learners also showed more

resilience and confidence in their problem-solving abilities. Attah et al. (2024) found that gamification-based teaching improves students' motivation and performance in problem-solving tasks.

Gamified Learning Strategies (GLS) addressed all aspects of engagement: cognitive, affective, behavioral, and motivational. By incorporating interactive digital games, points, levels, and real-time feedback, learners felt more driven to participate actively. GLS made the learning experience more student-centered, enjoyable, and focused on mastery. As a result, students began to take ownership of their learning journey and grew to have more positive attitudes toward Mathematics.

Gamified learning boosts cognitive processing by encouraging exploration and critical thinking in mathematical tasks (Anggoro et al., 2025). It also improves affective engagement by making the learning experience more enjoyable and meaningful (Alt, 2023). Behavioral engagement is encouraged through interactive game mechanics that promote consistent participation and collaboration (Apas & Ventayen, 2019). Motivation in problem-solving is strengthened as students face enjoyable challenges that build perseverance and confidence (Attah et al., 2024). Furthermore, Boom-Cárcamo et al. (2024) emphasize that gamification enhances creativity and motivation when combined with problem-based learning strategies.

Overall, Gamified Learning Strategies have created a more engaging, inclusive, and dynamic learning environment. The structured use of gamification has improved students' focus, motivation, and attitudes toward Mathematics. With increased engagement in all areas, learners are more likely to develop essential skills such as critical thinking, creativity, and persistence. The shift from traditional teaching methods to gamified instruction has effectively addressed learner needs. As a result, students not only performed better academically but also became more enthusiastic and confident in tackling mathematical challenges.

Table 4 Learners' Level of Engagement and Motivation in Mathematics Before the Implementation of Gamified Learning Strategies

Constructs	**M**	**SD**	**Remarks**
1. Cognitive Engagement	4.40	0.30	Extremely High
2. Affective Engagement	4.28	0.33	Extremely High
3. Behavioral Engagement	4.31	0.28	Extremely High
4. Motivation in Problem-Solving	4.40	0.35	Extremely High
Overall Engagement	4.35	0.31	Extremely High

Note. scale: 4.20-5.00 (Extremely High); 3.40-4.19 (High); 2.60-3.39 (Moderate); 1.80-2.59 (Low); 1.00-1.79 (Extremely Low)

Significant Difference between the Learners' Performance Before and After the Implementation of Gamified

Learning Strategies

The data in Table 5 compares learners' engagement levels before and after using Gamified Learning Strategies (GLS). The results show significant improvements in all engagement areas, with p-values at 0.000. This is well below the threshold of $p < .001$, which indicates very significant differences. The null hypothesis (Ho), which claimed there was no significant difference between pre- and post-engagement levels, was rejected in all cases. These findings confirm the strong positive impact of GLS on learners' cognitive, emotional, behavioral engagement, and motivation in problem-solving. The jump from low to high engagement shows that gamification tackled the important learning challenges earlier seen in the classroom.

Specifically, the t-value for cognitive engagement was -20.58*** (p = 0.000). This indicates a very significant increase in students' intellectual involvement after gamified instruction. Learners showed stronger focus, analytical thinking, and deeper understanding of mathematical content. Through interactive activities like quizzes, digital challenges, and progression levels, students engaged more in problem-solving and grasping complex topics. Anggoro et al. (2025) pointed out that game-based learning improves higher-order thinking skills in Mathematics, allowing learners to interact more critically and meaningfully with the content.

For emotional engagement, the t-value was -18.84*** (p = 0.000), which signifies a very significant improvement in students' emotional connection to Mathematics. After using GLS, students reported more enjoyment and enthusiasm during math lessons. They developed more positive attitudes and felt less anxious about the subject. Alt (2023) highlighted that gamification increases student satisfaction and emotional investment, contributing to ongoing learning and improved classroom morale.

Regarding behavioral engagement, the result was also very significant, with a t-value of -16.79*** (p = 0.000). This shows that students became more active in class, regularly completing tasks and joining discussions. Game features like leaderboards, instant feedback, and team competitions encouraged discipline, task completion, and peer interaction. Apas and Ventayen (2019) noted that gamified learning environments boost participation and help students build habits of academic responsibility.

The biggest difference was seen in motivation in problem-solving, with a t-value of -21.62* (p = 0.000), the highest among all variables. This suggests that learners became much more persistent and confident in solving mathematical problems. They were more likely to face challenges with enthusiasm, driven by both intrinsic and extrinsic rewards in gamified tasks. Attah et al. (2024) reported similar findings, showing that gamification enhances learners' motivation and perseverance in math.

Finally, the overall confidence, measured with a t-value of -17.45*** (p = 0.000), showed very significant improvement. This supports the positive effects of gamification across all engagement areas. Boom-Cárcamo et al. (2024) stated that combining gamification with problem-based learning strategies encourages creativity, motivation, and self-confidence, which are crucial for success in Mathematics.

In conclusion, the results from Table 5 provide strong evidence that Gamified Learning Strategies significantly improved learners' cognitive, emotional, behavioral, and motivational engagement in Mathematics. These notable improvements affirm the effectiveness of GLS in addressing disengagement, boosting academic confidence, and transforming the learning experience. By using interactive and game-based methods, educators can create a more engaging and supportive environment that helps learners excel both academically and emotionally. The data supports a continued and deliberate use of gamification in math instruction to promote deeper learning and better outcomes.

Table 5 Significant Difference between the Learners' Performance Before and After the Implementation of Gamified Learning Strategies.

Variables	t value	p value	Decision
Pre-Cognitive Engagement	-20.58***	0.000	Reject Ho
Post-Cognitive Engagement			
Pre-Affective Engagement	-18.84***	0.000	Reject Ho
Post-Affective Engagement			
Pre-Behavioral Engagement	-16.79***	0.000	Reject Ho

Post-Behavioral engagement			
Pre-Motivation in Problem-Solving	-21.62***	0.000	Reject Ho
Post- Motivation in Problem-Solving			
Overall Confidence	-17.45***	0.000	Reject Ho

Ho: There is no significant difference between the learners' level of engagement before and after the implementation of gamified learning strategies.

Note: Scale: *** p < .001 (Very Highly Significant); **p<0.01 (Highly Significant); *p<0.05 (Significant); p>0.05 (Not significant)

Significant Difference in Students' Performance Before and After the Use of Gamified Learning Strategies

The data in Table 6 shows the overall performance of learners in Mathematics before and after using the Gamified Learning Strategy (GLS). The mean score before GLS was M = 23.26 (SD = 4.57). This score is in the very poor category, indicating weak mathematical performance among students. After implementing GLS, the mean rose significantly to M = 46.45 (SD = 2.68). This suggests a major improvement in the learners' problem-solving skills. The computed t-value of 18.43* and p-value of 0.000 show that the difference is highly significant (p < .001). This leads to rejecting the null hypothesis, which stated that there was no significant improvement in performance. This result confirms that using gamified learning had a strong positive effect on students' academic performance in Mathematics.

The low pretest scores suggest that traditional teaching methods may not have effectively engaged learners or built their foundational skills in problem-solving. Without enough motivation, interactivity, or varied learning tasks, students likely had difficulty retaining concepts and applying them in real-world situations. The poor performance reflected students' lack of confidence, limited cognitive engagement, and low perseverance when facing math challenges. According to Jurani and Nuh (2025), traditional methods often fail to address self-efficacy, which is crucial for doing well in mathematics.

In contrast, the posttest results show that GLS improved learners' performance by creating a more engaging and student-centered environment. Game elements like rewards, progress tracking, and group tasks encouraged active participation and gave learners immediate feedback. These features helped keep attention, foster motivation, and made learning math more enjoyable and relevant. Chaiyarat (2024) noted that gamified cooperative learning significantly enhances creative problem-solving and intrinsic motivation in academic settings.

Additionally, the decrease in standard deviation from 4.57 to 2.68 indicates a more consistent level of performance among learners after the GLS was applied. This consistency suggests increased fairness in learning outcomes, with more students reaching higher levels of understanding and skill. As shown by Cajilla and Bug-os (2022), gamified systems in learning platforms improve satisfaction and performance by allowing students to progress at their own pace while staying engaged.

The overall significant difference in scores before and after GLS matches the findings of Alahakoon and Niranjala (2023), who found that gamification in university-level Mathematics enhanced achievement through greater participation and focus. Similarly, Çetin et al. (2023) concluded that gamified tutoring systems greatly improved problem-solving skills by encouraging consistent effort and strategic thinking.

In conclusion, the data in Table 6 offers strong evidence that the Gamified Learning Strategy significantly improved students' performance in Mathematics. The highly significant statistical findings confirm the

effectiveness of gamification in creating an interactive and motivating learning experience. By engaging learners cognitively, emotionally, and behaviorally, GLS helps close the gap between low performance and mastery. The findings highlight the need to integrate innovative, game-based strategies in Mathematics instruction to foster meaningful learning, build confidence, and enhance academic success.

Table 6 Significant Difference in Students' Performance Before and After the Use of Gamified Learning Strategies

Variables	M	SD	T-value	p-value
Before Engaging in Gamified Learning Strategy	23.26	4.57	18.43***	0.000
After Engaging in Gamified Learning Strategy	46.45	2.68		

Scale: *** p < .001 (Highly Significant);**p<0.01 (Highly Significant); *p<0.05 (Significant); p>0.05 (Not significant)

SUMMARY, FINDINGS, CONCLUSION, AND RECOMMENDATION

Summary

This study examined how gamified learning strategies influenced students' engagement, motivation, and problem-solving skills in mathematics during the school year 2024-2025 at a higher education institution in Ozamiz City. It aimed to answer these specific questions: (1) What is the students' problem-solving performance in mathematics before implementing gamified learning strategies? (2) What is the students' level of engagement and motivation in mathematics before implementing gamified learning strategies? (3) What is the students' problem-solving performance in mathematics after implementing gamified learning strategies? (4) What is the students' level of engagement and motivation in mathematics after implementing gamified learning strategies? (5) Is there a significant difference in the students' problem-solving performance before and after implementing gamified learning strategies? (6) Is there a significant difference in the students' engagement and motivation before and after implementing gamified learning strategies?

The study used a one-group pretest-posttest design with 28 students. Their performance and levels of engagement and motivation were measured before and after implementing gamified learning strategies. The research tools included pretest and posttest evaluations on mathematical problem-solving, along with surveys on engagement and motivation. The data collected were analyzed using mean, standard deviation, and t-tests to find significant differences.

Findings

The following are the salient findings of this study:

1. Learners' problem-solving performance before the implementation of gamified learning strategies was very poor with all students scoring below the minimum proficiency threshold.
2. The learners' level of engagement and motivation before the implementation was generally low, with the lowest ratings in affective engagement and motivation in problem-solving.
3. After the implementation of gamified learning strategies, learners' problem-solving performance significantly improved and was classified as Outstanding, with most students reaching high achievement levels.
4. Learners' level of engagement and motivation after the intervention was rated as Extremely High, indicating marked improvement across all engagement constructs.

5. There was a statistically significant difference between the learners' problem-solving performance before and after the implementation of gamified learning strategies.
6. There was a statistically significant difference between the learners' level of engagement and motivation before and after the implementation of gamified learning strategies.

Conclusions

Based on the findings, the following conclusions were drawn:

1. Learners have poor problem-solving skills. This shows that traditional teaching methods do not effectively promote mathematical understanding. There is a clear need for new teaching methods that actively involve students and help them develop critical thinking skills in math. Without these changes, students may keep struggling to apply math concepts in real-life situations.
2. Before the intervention, learners lacked emotional engagement and personal motivation, making it hard to learn math effectively. When students are not emotionally connected or personally motivated, they are less likely to participate meaningfully or remember math concepts.
3. Gamified learning strategies greatly improved learners' math performance. This shows that using game-like elements can lead to better academic results, especially in tough subjects like math. It also indicates that students respond well to interactive and rewarding learning environments.
4. After the gamified intervention, learners showed significant increases in cognitive, behavioral, and emotional engagement, as well as motivation in math. These findings highlight the importance of gamified learning in enhancing various aspects of student engagement, which are essential for long-term academic growth.
5. Gamified learning strategies serve as a useful tool to boost academic success and encourage deeper emotional and cognitive involvement in math. By integrating gamification, learners gain enjoyable and meaningful experiences that promote persistence and a positive attitude toward the subject. This can be especially helpful for those who have seen math as difficult or boring in the past.
6. Using gamified learning strategies in teaching creates an engaging and motivating environment that supports both academic and personal development. This approach encourages students to take an active part in their learning and helps them build essential life skills like teamwork, determination, and self-confidence. Ultimately, this leads to more independent, confident, and motivated learners.

Recommendations

Based on the findings and conclusions, it is recommended that:

1. Math teachers may integrate gamified learning strategies into their instruction to improve learner motivation, engagement, and problem-solving skills. Platforms like Kahoot, Quizizz, and game-based classroom tasks should be considered. These tools not only make lessons more interactive but also provide chances for instant feedback and assessment. Gamified learning makes students feel more engaged and challenged, which can lead to better learning outcomes and more enthusiasm for math.
2. Curriculum developers may design modules and resources that incorporate gamified elements such as point systems, leaderboards, and instant feedback to maintain learner interest. These features can help keep learners engaged and provide quick reinforcement that aids in mastering concepts.
3. School administrators may support professional development and training focused on gamified teaching methods to ensure effective use in regular teaching practices. Workshops, seminars, and mentoring programs can help boost teachers' skills and confidence in using gamification. Moreover, administrative support in terms of time, resources, and recognition can greatly impact the successful adoption of these methods in classrooms.
4. Policymakers may encourage the integration of gamified strategies into math education policy and teacher training programs to align teaching practices with student-centered approaches. Including gamification in policy helps standardize innovative teaching methods and ensures their implementation across schools. Teacher training programs, both for newcomers and current educators, should include gamification as a key part to prepare them for the demands of 21st-century teaching.

5. Researchers may investigate the long-term effects of gamified learning on student achievement and well-being to better guide instructional reforms and sustainable education practices. Future studies should look into how gamification impacts student motivation over time, its effects on different types of learners, and its role in inclusive education. Evidence-based insights can refine and improve gamified strategies for varied educational contexts.
6. Students may actively participate in gamified learning settings and promote collaboration among peers to make the most of the cognitive and motivational benefits these strategies offer. Fully engaging in these activities not only boosts academic performance but also helps develop skills in communication, teamwork, and problem-solving.

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