Enhancing Students' Learning Outcomes Using Gamification

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Gamification has emerged as a promising strategy to improve student engagement, motivation, and academic performance. This study investigates the impact of gamification on second-grade mathematics learning by comparing traditional teaching methods with a gamified approach using the Matific.com platform. Employing a quasi-experimental design, the study involved 40 students divided into control and experimental groups, with data collected through pre- and post-tests and motivation surveys. Statistical analysis revealed that students exposed to gamified learning demonstrated significantly higher academic performance and motivation levels compared to those taught through conventional methods. The results indicate that gamification not only enhances cognitive outcomes but also fosters emotional engagement, suggesting its potential as a scalable and effective tool in early-grade education. This research contributes practical insights for educators and policymakers seeking to integrate innovative methods into traditional classrooms, especially within underperforming education systems like Pakistan's.

Keywords: Gamification, Student Engagement, Educational Technology, Mathematics Education, Learning Motivation

Introduction:

Education, the foundation of human intellect and societal progress, has constantly evolved, introducing new methods aimed at improving student learning outcomes. In Pakistan, the education sector faces serious challenges, particularly in mathematics and science. These subjects are essential for developing critical thinking skills, yet most students gain only a basic understanding of them. A comprehensive study by Aga Khan University found that over 90% of primary and lower-secondary students had only basic or weak competence in mathematics and science, scoring average marks of just 27 and 34 out of 100, respectively [1], [2]. Such alarming results highlight the urgent need for effective educational interventions.

In this context, gamification has emerged as a promising educational strategy. It involves integrating game elements—like points, badges, and leaderboards—into non-game environments to boost learning through intrinsic motivation. This thesis examines the effectiveness of gamification in enhancing mathematics learning for second-grade students, especially in light of declining student engagement and motivation—a situation worsened by the sudden shift to online learning during the COVID-19 pandemic. Based on a review of existing literature, this study underscores the pressing need for innovative teaching methods, as traditional approaches often fall short in the Pakistani context [3], [4].

This research aims to revitalize the teaching process by introducing game design elements into educational practices. It aligns with the global trend of educational gamification, which is expected to grow in the coming years [5]. Successful initiatives like MathLand and Kahoot! have already demonstrated that gamification can lead to improved learning outcomes [6], [7]. Through this exploratory study, the goal is to further establish gamification as a viable teaching method and assess its relevance in Pakistan's unique educational landscape. The shift toward gamification in education is more than a passing trend—it reflects a critical need to rethink teaching methods in regions where traditional systems are failing. Reports from various studies expose a real crisis in teaching, particularly in mathematics and science, compounded by the educational disruptions caused by the COVID-19 pandemic. The move to online learning further affected student engagement and motivation [8].

Fundamentally, gamification offers a transformative shift from conventional teaching by incorporating engaging game elements known to boost motivation and involvement in the learning process [9]. These components—such as points, badges, and leaderboards—tap into students' intrinsic motivation. The implications of this study are significant. It addresses major gaps in Pakistan's education system and may serve as a replicable model for similar contexts. This work not only aligns with global trends but also contributes to the growing literature supporting gamification as an effective educational tool.

As a practical and region-specific study, this research is a unique addition to the global discourse on gamification in education—especially since such applied studies are rare in Pakistan. It emphasizes the universal benefits of gamification across various educational and cultural settings, and provides valuable empirical evidence of its impact on student learning. More than just a theoretical contribution, this study offers concrete insights that could help enhance the quality of education in Pakistan and beyond.

Objectives and Novelty of the Study:

The primary objective of this study is to investigate the effectiveness of gamification in improving mathematical learning outcomes among second-grade students in Pakistan. The novelty of this research lies in its focus on early-grade mathematics using a structured gamified platform (Matific.com) within a Pakistani context—where empirical studies on gamification are still scarce. Unlike prior studies, this research integrates quantitative

measures of both academic performance and motivational engagement to provide a holistic evaluation that increases the learning outcome of students.

Literature Review:

Traditional schooling and its challenges highlight the systemic issues within conventional educational practices, with a particular emphasis on the Pakistani education system. Persistent problems such as student disengagement, a one-size-fits-all teaching approach, and limited personalized learning opportunities have led to poor outcomes especially in key subjects like mathematics [10]. A comprehensive report by Arab News, covering over 15,000 students, reveals an alarming reality: the vast majority of primary and pre-secondary students in Pakistan possess only basic or weak knowledge of mathematics and science. These findings, reflected in significantly low average scores, emphasize the urgent need for reforms in teaching methods, curriculum design, and pedagogical innovation [11].

Further studies by the Institute for Educational Development at Aga Khan University stress the critical need for targeted strategies and interventions to support the mathematics and science curricula at the primary and lower-secondary levels in Pakistan [1], [2].

Globally, the educational gamification market is projected to grow at a compound annual growth rate of 31.29% in the coming years, signaling its rising adoption in diverse educational settings [8]. Foundational research on gamification highlights its potential to boost motivation, engagement, and learning outcomes. Scholars have detailed how gamification influences student behavior, though they also emphasize the need for further empirical studies to assess its long-term effectiveness in various learning environments [9], [10], [12]. Gamification and e-learning have transformed the educational process, especially during the COVID-19 pandemic, which accelerated the shift to online platforms. This transition has underscored the importance of gamification in sustaining student engagement [13].

One study exploring game-based learning in universities concluded that gamification elements such as points, badges, and leaderboards significantly improved learner motivation and performance. However, it also noted a lack of personalization in current systems and stressed the need for adaptive, individualized learning experiences [14]. Empirical evidence consistently shows that gamification enhances academic performance and motivation. A systematic review published by Smart Learning Environments on gamification in online higher education identified game mechanics like badges and leaderboards as key to increasing student engagement [15]. Gamification's impact on motivation is further supported by Self-Determination Theory (SDT), which highlights intrinsic motivation as a core driver of learning. Shane Ede's study found that while gamification boosts motivation, its effect on intrinsic motivation varies depending on the quality of implementation and student interest [16].

In Malaysian schools, platforms like Frog VLE and FrogPlay have shown increased student interest and active participation in learning activities through gamified content [17]. Gamification is also linked to cognitive skill development, including problem-solving, memory, and mathematical reasoning. Studies on platforms such as Kahoot and Mentimeter show that both competitive and cooperative game mechanics can support cognitive growth [18]. Notably, cooperative strategies are more effective in achieving long-term learning goals [19]. Key features that contribute to gamified learning's success include personalized content and interactive assessments.

In the post-pandemic context, gamification has played a leading role in adapting education to new realities. Mårell-Olsson's research uniquely illustrates how gamification has helped foster student engagement and develop 21st-century skills in online learning environments [20]. In this context, COVID- era gamification is seen as a careful balancing

act aimed at boosting motivation and minimizing learning disruptions [11]. While gamification holds strong promise for improving learning outcomes, notable research gaps remain. These include a need for longitudinal studies to evaluate its long-term effects, exploration of cultural and regional differences in its effectiveness, and strategies for effectively integrating gamification into diverse educational environments.

Methodology:

The research follows a quasi-experimental design, aimed at comparing the impact of gamification on student learning outcomes. It involves two groups: a Control Group (CG), which receives traditional teaching, and an Experimental Group (EG), which uses gamified learning tools through Matific.com. This design helps measure cause-and-effect relationships while accommodating real-world constraints in an educational setting. The two weeks study was carried out at Smart School Ghulam Muhammad Campus, Hala, and included 40 students of second-grade. Participants were randomly assigned to CG and EG to ensure balanced academic performance between the groups. Students were selected based on their willingness to participate, parental consent, and active school enrollment. Figure 1 shows the flow diagram of methodology.

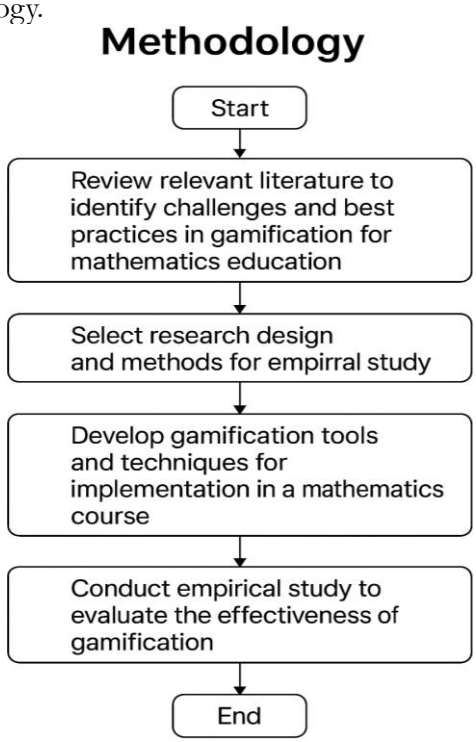

Figure 1. Flow diagram of Methodology.

Gamified Learning Platform: Matific.com was selected because it aligns well with educational goals and offers adaptive learning experiences that cater to individual student needs.

Traditional Teaching Materials: The Control Group (CG) used worksheets, textbooks, and teacher-led lessons to maintain consistency in the instructional content.

Assessment Tools: Pre-tests and post-tests were administered to evaluate student learning progress before and after the intervention.

Engagement and Motivation Surveys: Likert-scale surveys were used to assess students' interest and motivation both before and after the intervention.

Data Collection Phases: Data was gathered at three key stages—baseline (pre-test), during the intervention (learning phase), and after the intervention (post-test). The pre-test established students' initial skill levels, while the post-test measured progress made following the gamified learning experience.

Data Analysis: Quantitative data analysis was conducted using SPSS. T-tests were used to compare pre-test and post-test scores between the Control Group (CG) and the Experimental Group (EG). An independent samples t-test determined the statistical significance of score differences, and effect size calculations were applied to evaluate the impact of gamification on learning outcomes.

Ethical Considerations: Informed consent was obtained from the students' guardians. Ethical approval was granted by the institutional review board. The study was conducted in accordance with ethical principles, including confidentiality, voluntary participation, and unbiased data analysis.

Results:

Data Analysis: The purpose of the data analysis was to assess the impact of gamification on students' academic performance. A combination of descriptive and inferential statistical methods was used to compare the performance, engagement, and motivation levels of the Control Group (CG) and the Experimental Group (EG). Data collected through pre-tests and post-tests was analyzed using the Statistical Package for the Social Sciences (SPSS). Table 1 Shows both groups pre-test scores, demonstrating that students had similar levels of baseline knowledge before the intervention.

Table 1. Pre-Test Scores of Control Group and Experimental Group.

Group	N	Mean	Std. Deviation
Control Group (CG)	20	3.05	1.15
Experimental Group (EG)	20	3.05	1.15

Table 2 presents the post-test results following the intervention, indicating that students in the Experimental Group (EG) performed significantly better than those in the Control Group (CG). Table 2: Post-Test Scores of Control Gorup and Experimental Group.

Table 2. Post-Test Scores of Control Gorup and Experimental Group.

Group	N	Mean	Std. Deviation
Control Group (CG)	20	3.80	1.10
Experimental Group (EG)	20	4.80	0.25

An independent samples t-test was conducted to compare the performance differences between the Experimental Group (EG) and the Control Group (CG). The results revealed a statistically significant difference in post-test scores for the EG ($p < 0.05$). Additionally, a paired samples t-test showed a significant improvement between the pre-test and post-test scores within the EG, further validating the effectiveness of gamification in enhancing learning outcomes.

Student engagement and motivation were also assessed through pre- and post-intervention surveys. The findings indicated that students in the EG demonstrated higher levels of enjoyment, enthusiasm, and engagement compared to those in the CG. Gamification elements such as rewards, badges, and leaderboards played a key role in sustaining students' interest and involvement in the learning process.

Table 3. Engagement and Motivation Scores (Post-Intervention)

Metric	Group	Mean	Std. Deviation
Engagement	Control group (CG)	2.80	1.10
	Experimental Group (EG)	4.60	0.30
Motivation	Control group (CG)	2.90	1.15
	Experimental Group (EG)	4.70	0.40

EG outperformed CG in both engagement and motivation, with statistically significant differences observed in the post-intervention data. These results provide strong

evidence that gamification can positively influence academic performance, particularly in subjects like mathematics, where engagement and motivation are crucial to student success. The results are presented through multiple graphical illustrations, highlighting the positive impact of gamification on student learning. These figures depict trends in engagement levels, motivation scores, and comparative academic performance between the CG and EG.

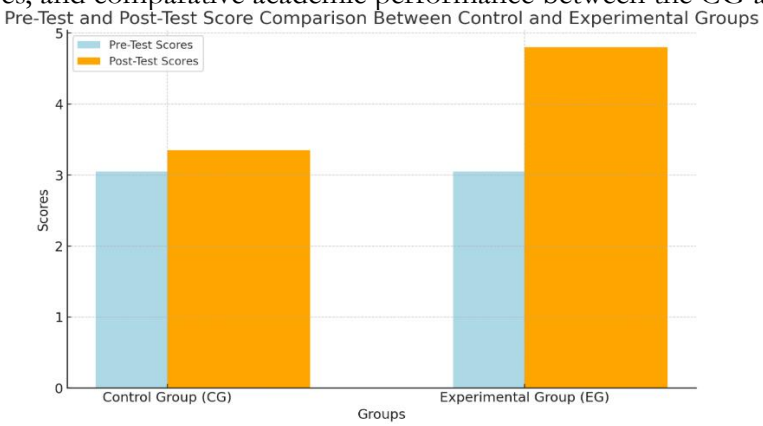

Figure 2. Pre-Test and Post-Test Score Comparison of CG and EG

While both groups showed improvement, the Experimental Group's substantial gains suggest that the use of game-based elements in education can be a powerful tool for enhancing learning outcomes.

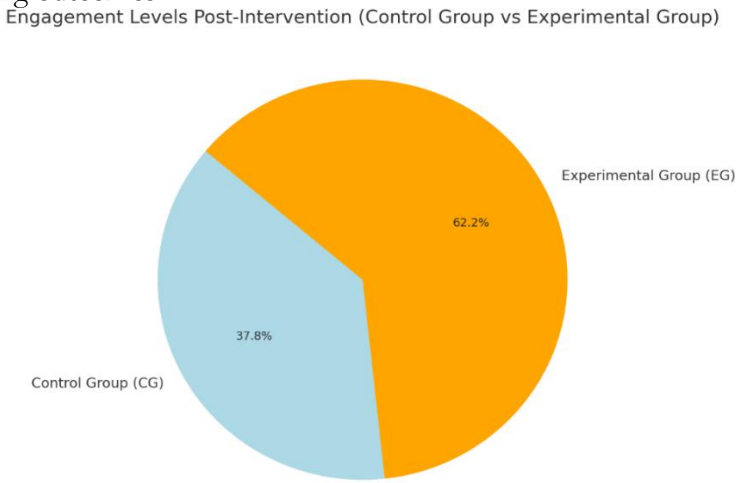

Figure 3. Engagement Levels After

Gamification Implementation

The findings demonstrate that gamification positively influences students' engagement, motivation, and academic performance. The Experimental Group (EG) outperformed the Control Group (CG), highlighting the effectiveness of gamified learning strategies in enhancing the learning experience. These results support existing literature that confirms gamification as a powerful educational tool capable of improving learning outcomes.

Discussion:

The results of this research provide empirical evidence that gamification significantly improves math learning outcomes among students. The Experimental Group (EG), instructed using the gamified learning platform Matific.com, showed substantial improvement in post-test scores compared to the Control Group (CG). The use of game design elements such as rewards, challenges, and instant feedback contributed to higher levels of student engagement and motivation. These findings are consistent with studies such as those by Ede [7] and Mohammadi et al. [6], were gamification significantly enhanced

student motivation and performance. Similarly, studies like those by Mårell-Olsson [19] emphasized the role of gamification in sustaining student engagement during post-pandemic online education. The increase in engagement scores in our study mirrors the outcomes from Kahoot! and Frog VLE studies in Malaysia [16], where competitive elements increased active participation and learning outcomes.

While this study contributes valuable insights into the use of gamification to improve educational quality, several limitations should be noted. The research was conducted at a single educational institution with a relatively small sample size, limiting the generalizability of the findings. Furthermore, the study focused on short-term learning outcomes, and future research should examine the long-term effects of gamification on academic performance and cognitive development.

Future studies should explore the broader applications of gamification in various grades and subjects. Longitudinal research would help assess the sustained impact of gamification on students' learning outcomes. Additionally, qualitative methods—such as student interviews and classroom observations could provide deeper insights into the motivational factors that drive engagement in gamified learning experiences.

Conclusion:

This research demonstrates that gamification is an effective learning tool for promoting student engagement, motivation, and academic achievement in mathematics. The integration of game design elements into learning environments makes the learning process more enjoyable and engaging, which is key to enhancing both intrinsic and extrinsic motivation. The study contributes to the existing literature on gamification in education, providing practical recommendations for teachers, policymakers, and researchers who aim to leverage technology to improve learning outcomes. Additionally, policymakers should consider implementing gamified learning reforms to address low student engagement and poor academic performance in STEM subjects. It is recommended that educators incorporate gamification software into math education to foster greater engagement and motivation.

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