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Game-Based Learning on Students' Motivation, Interest, And Academic Performance In Mathematics In Public Secondary Schools In Osun State

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Abstract

The persistent low motivation and interest among students toward mathematics has contributed to poor academic outcomes, particularly in Nigerian secondary schools. This study examined the effect of game-based learning on students' motivation and interest in mathematics in public secondary schools in Osun State, focusing on how integrating game elements into instruction can enhance engagement and performance. The objectives were to: (i) examine the impact of game-based learning on students' motivation; (ii) assess its influence on students' interest; and (iii) compare academic performance before and after the intervention. A quasi-experimental design using pre-test and post-test with control and experimental groups was employed. Sixty JSS2 students from six public schools in Iwo Local Government Area of Osun State participated. The experimental group was taught with Mecama board games and digital activities, while the control group received traditional instruction. Data were gathered using a validated Mathematics Motivation and Interest Scale (MMIS) and a Mathematics Achievement Test (MAT), analyzed with paired t-tests and Pearson correlation. Findings showed a strong positive relationship between game-based learning and both motivation ($r = .816$, $p < .05$) and interest ($r = .750$, $p < .05$). Academic performance also improved significantly in the experimental group ($t = -5.751$, $p < .001$). The study concludes that game-based learning significantly boosts students' motivation, interest, and performance in mathematics. It recommends incorporating game-based strategies into teaching, providing regular teacher training on innovative methods, and ensuring adequate resources to support interactive learning environments.

Keywords: game-based learning, motivation, interest, mathematics, academic performance, Nigerian education, secondary schools.

Introduction

Around the world, mathematics is acknowledged as a fundamental topic that is essential to the growth of logical reasoning, analytical thinking, and problem-solving skills. However, because of the abstract nature of mathematics and conventional teaching methods, pupils frequently show low motivation and interest in the subject in many different countries. According to research conducted in nations including the US, Finland, and Japan, game-based learning (GBL) and other creative teaching techniques greatly enhance students' attitudes towards mathematics (Durmuş & Karakuş, 2018; Smith, 2009; Ferguson, 2012). Both digital and analogue educational games are commonly employed in industrialised nations to encourage learners' self-motivated inquiry, engagement, and interactive learning. Better learning outcomes, greater enjoyment of mathematics, and enhanced classroom participation have resulted from this.

Numerous obstacles affect mathematics education in many African nations, such as inadequate facilities, sizable class sizes, unqualified teachers, and strict curricula. These elements have a part in pupils' lack of interest and subpar maths performance. Despite the continuous increase in ICT and digital tool integration in classrooms throughout the continent, game-based learning is still not widely adopted. Nonetheless, recent research from Ghana, Kenya, and South Africa has demonstrated that using locally tailored educational games can greatly improve students' motivation and conceptual grasp of mathematics (Asamoah & Baah, 2020; Talib & Rizvi, 2018). Some African educators are being encouraged to investigate game-based approaches as a means of addressing low maths performance and disengagement due to the increased awareness of learner-centred pedagogies. In Nigeria, the poor performance of students in mathematics at both the basic and senior secondary levels has been a persistent concern. The reliance on conventional, teacher-centered methods such as rote memorization, chalk-and-talk delivery, and repeated drills has often left students disengaged and unmotivated (Aliakbari & Faraji, 2011). Studies conducted in various Nigerian states have identified low student motivation and interest as major barriers to effective mathematics learning. However, emerging research in Nigerian classrooms has begun to highlight the positive effects of game-based learning on students' participation and achievement. For instance, research by Ghasemzadeh et al. (2015) showed that interactive learning through educational games significantly improved students' performance and motivation in mathematics. Despite these findings, game-based strategies are still underutilized in Nigerian schools, primarily due to limited teacher training, lack of resources, and resistance to pedagogical change.

Game-based learning integrates educational content with game elements such as competition, rewards, challenges, and storytelling to create a dynamic and interactive learning experience. It promotes active participation, immediate feedback, and collaboration among learners, which can potentially transform students' attitudes toward mathematics. Several studies have indicated that when students are actively engaged through games, they tend to develop a greater interest in the subject matter, which in turn boosts their motivation to learn and perform better (Barab et al., 2014; Pring et al., 2018; Papastergiou, 2009).

Game-Based Learning (GBL) has emerged as a powerful instructional strategy that integrates game elements into educational contexts to enhance learning outcomes. Unlike games played solely for entertainment, GBL is intentionally designed with specific learning objectives, using elements such as rules, goals, rewards, competition, and feedback to promote active learning (Durmuş & Karakuş, 2018; Gunning, 2014). It shifts the classroom dynamic from teacher-centered instruction to a more student-centered experience, engaging learners in a way that traditional methods often fail to do.

Researchers like Prensky (2013) emphasize that GBL not only makes learning more enjoyable but also supports the development of 21st-century skills such as problem-solving, critical thinking, and collaboration. In mathematics education, GBL has been used to teach arithmetic, geometry, and algebra through interactive board games, digital simulations, and problem-solving quests. For example, students can practice basic operations through Mecama games, Bingo-style games or apply geometric concepts in puzzle-based environments, which increase motivation and help solidify conceptual understanding. Mecama (2016) also emphasizes that game-based learning using Mecama board games is designed for the development of intellectual abilities, referring to them as “games of the intelligentsia.” Papastergiou (2009) found that digital games used in high school computer science classes significantly enhanced both student performance and motivation. Similarly, Ferguson (2012) demonstrated that students who designed their own educational games exhibited deeper learning strategies and higher engagement compared to those who only played them. GBL also supports diverse learning styles, allowing students to learn at their own pace, revisit tasks, and receive instant feedback (Barab et al., 2014). This adaptability makes it a particularly effective tool for subjects like mathematics, which many students find abstract or intimidating. Research by Smith (2009) and Talib and Rizvi (2018) shows that when implemented properly, game-based learning can improve student motivation, interest, engagement, and academic performance, particularly in subjects like mathematics that many students find abstract or intimidating.

Motivation and interest are critical psychological factors that significantly influence students' learning behaviors, academic achievement, and long-term attitudes toward school subjects particularly mathematics. Motivation refers to the internal drive or external stimulus that prompts students to engage in learning activities, while interest denotes the personal relevance or emotional connection a student feels toward a subject (Ghasemzadeh et al., 2015). In the context of mathematics, both constructs are interlinked and essential for sustaining effort, persistence, and engagement in what many learners consider a challenging subject. Research by Durmuş and Karakuş (2018) has consistently shown that students' low motivation and declining interest are key contributors to poor performance in mathematics. According to Talib and Rizvi (2018), students are more likely to participate and excel in mathematics when they value the subject and believe in their ability to succeed. However, traditional teaching approaches characterized by passive instruction, rote memorization, and a lack of real-world applications often fail to foster this sense of value or confidence, leading to disinterest and math anxiety (Asamoah & Baah, 2020).

Conversely, learning environments that are interactive, supportive, and responsive to students' needs tend to promote greater motivation and interest. For example, instructional strategies that involve hands-on activities, real-life problem solving, peer collaboration, and immediate feedback have been shown to enhance students' enjoyment and perception of mathematics (Ferguson, 2012). Moreover, the use of technology and innovative pedagogies such as game-based learning has demonstrated positive outcomes in motivating learners and making mathematics more accessible and enjoyable (Barab et al., 2014; Papastergiou, 2009).

In the Nigerian context, studies by Aliakbari and Faraji (2011) and Gunning (2014) affirm that students often show improved attitudes toward mathematics when exposed to engaging and participatory methods. However, despite this evidence, many classrooms still rely heavily on conventional methods, which do little to stimulate student interest or intrinsic motivation.

Therefore, increasing students' motivation and interest in mathematics remains a crucial goal for educators and policymakers, particularly in developing regions. This can be achieved by integrating student-centered approaches that connect mathematical concepts to learners' experiences, encourage exploration, and support emotional engagement with the subject.

Constructivist theory posits that learners construct knowledge actively rather than passively receiving information. According to Piaget, students learn best through hands-on experiences that allow them to

explore, manipulate, and reflect. Vygotsky adds a social dimension, emphasizing the importance of interaction and scaffolding through more knowledgeable others (Vygotsky, 1978).

Game-based learning aligns closely with this theory by providing an interactive environment where students actively engage with mathematical concepts, collaborate with peers, and receive feedback all of which help in constructing meaningful understanding. The constructivist perspective implies that game-based learning can serve as a powerful instructional tool in mathematics by encouraging learners to explore and discover mathematical ideas independently and collaboratively. Rather than memorizing formulas or procedures, students immersed in game scenarios are more likely to develop conceptual understanding through active problem-solving. This approach also supports differentiated learning, where students progress at their own pace and build knowledge through experience. Therefore, implementing GBL in mathematics instruction has the potential to increase students' interest and motivation by making learning more engaging, meaningful, and socially interactive. The theory justifies the shift from passive reception to active construction of knowledge, which is particularly important in addressing the motivational challenges commonly associated with mathematics education.

Despite the growing interest in game-based learning, there remains a need for more empirical studies that specifically examine how it affects students' motivation and interest in mathematics. Particularly in developing countries, where traditional approaches still dominate the classroom, the adoption of game-based strategies could be instrumental in improving mathematics education outcomes.

Statement of the Problem

Mathematics is essential yet often poorly understood and disliked by students, especially in Nigeria, due to traditional teaching methods such as lecture-based instruction, rote memorization, repetitive drills, and teacher-centered delivery that fail to engage or motivate learners. These approaches contribute to low interest, poor performance, and negative attitudes toward the subject. Game-based learning (GBL) has emerged globally as an effective strategy to enhance motivation and interest through interactive and enjoyable learning experiences. However, its application in Nigerian classrooms remains limited, with little empirical evidence on its effectiveness. This study seeks to examine the impact of GBL on students' motivation, interest and academic performance in mathematics, aiming to improve instructional practices and learning outcomes.

The main objective is to examine the effect of game-based-learning on students' motivation and interest in mathematics. Other objectives are to;

i. examine the impact of game-based learning on students' motivation levels in learning mathematics.
ii. assess how game-based learning influences students' interest in mathematics lessons.
iii. compare students' academic performance in mathematics before and after the implementation of game-based learning strategies.

Research Questions

i. How does game-based learning affect students' motivation toward learning mathematics?
ii. To what extent does game-based learning influence students' interest in mathematics lessons?
iii. Is there a significant difference in students' academic performance in mathematics before and after the introduction of game-based learning?

Research Hypotheses

This study guided by the following hypotheses:

H_{o1}: There is no significant relationship between game-based-learning and students' motivation towards learning mathematics

H_{o2}: There is no significant relationship between game-based-learning and students' interest in learning mathematics.

H_{o3}: There is no significant difference in students' academic performance in mathematics before and after the implementation of game-based learning.

Methodology

This study adopted a quasi-experimental design involving a pre-test and post-test with control and experimental groups to determine the effect of game-based learning on students' motivation and interest in mathematics. The design was chosen to allow for a comparison between students taught using traditional methods and those exposed to game-based strategies. The population consisted of Junior Secondary School Two (JSS2) students in public secondary schools within Iwo Local Government area of Osun State, Nigeria. A sample of 60 students was selected using purposive sampling from six public schools with similar academic records. The students were divided into two

groups: an experimental group (30 students), which received game-based instruction, and a control group (30 students), which was taught using traditional methods.

Two research instruments were used: Mathematics Motivation and Interest Scale (MMIS) and a Mathematics Achievement Test (MAT). The MMIS was a validated questionnaire designed to measure students' motivation and interest before and after the intervention, while the MAT was used to assess academic performance in selected topics. Instrument reliability was confirmed with a Cronbach's Alpha value of 0.82. The intervention lasted for six weeks. The experimental group was taught mathematics using games, including board game (Mecama) and digital formats, while the control group received conventional instruction. Pre- and post-tests were administered to both groups.

Data were analyzed using inferential statistics. A paired t-test was used to assess pre- and post-test differences within groups, while Pearson correlation was employed to examine the relationship between students' motivation and interest. All hypotheses were tested at a 0.05 level of significance using SPSS software.

Results

H_{o1}: There is no significant relationship between game-based-learning and students' motivation towards learning mathematics

Table 1: Model Summary of Pearson Correlation between game-based-learning and students' motivation

		Game-Based-Learning	Students' Motivation
Game-Based-Learning	Pearson Correlation	1	.816
	Sig. (2-tailed)		.022**
	N	60	60
Students' Motivation	Pearson Correlation	.816	1
	Sig. (2-tailed)	.022**	
	N	60	60

**Correlation is significant at the 0.05 level (2-tailed).

Source: *Spss Output, 2025*

Table 1 result revealed a Pearson correlation coefficient of 0.816, indicating a strong positive relationship between game-based learning and students' motivation. This suggests that as the use of game-based learning strategies increases, students' motivation to learn mathematics also tends to rise. Furthermore, the p-value obtained was 0.022, which is less than the significance level of 0.05. This indicates that the relationship is statistically significant. As a result, the null hypothesis (H_{01}), which posited that there is no significant relationship between game-based learning and students' motivation, is rejected. Findings show that game-based learning has a significant positive effect on students' motivation to learn mathematics in public secondary schools in Southwest Nigeria. This highlights the potential of game-based strategies in enhancing students' interest and engagement in mathematical learning.

H_{02}: There is no significant relationship between game-based-learning and students' interest in learning mathematics.

Table 2: Model Summary of Pearson Correlation between game-based-learning and students' interest

		Game-Based-Learning	Students' Interest
Game-Based-Learning	Pearson Correlation	1	.750
	Sig. (2-tailed)		.020**
	N	60	60
Students' Interest	Pearson Correlation	.750	1
	Sig. (2-tailed)	.020**	
	N	60	60

**Correlation is significant at the 0.05 level (2-tailed).

Source: *Spss Output, 2025*

In table 2 result revealed a Pearson correlation coefficient of 0.750, which indicates a strong positive relationship between game-based learning and students' interest in mathematics. This means that as game-based learning approaches are more frequently used, students tend to develop greater interest in the subject. The p-value is 0.020, which is less than the conventional significance level of 0.05. This shows that the relationship is statistically significant, and not due to random chance. Therefore, the null hypothesis (H_{02}), which proposed that there is no significant relationship between game-based

learning and students' interest in learning mathematics, is rejected while alternative hypothesis is accepted.

H_{03}: There is no significant difference in students' academic performance in mathematics before and after the implementation of game-based learning.

Table 3: Model Summary of t-test results

Gender	N	Mean	SD	Df	t-test	Sig. (2-tailed)	Remarks
Pre-test	30	1.800	0.402	58.00	-5.751	0.000	Accepted
Post-test	30	2.970	1.039				

Source: SPSS Output, 2025

Results are shown in Table 3. The findings reveal that the mean score before the introduction of game-based learning (pre-test) was 1.800 with a standard deviation of 0.402, while the mean score after the implementation (post-test) increased to 2.970 with a standard deviation of 1.039. This indicates an observable improvement in students' academic performance following the adoption of game-based learning strategies. The t-test value is -5.751, and the p-value (Sig. 2-tailed) is 0.000, which is less than the 0.05 significance level. This means that the difference in performance is statistically significant and did not occur by chance. As a result, the null hypothesis (H_{03}), which stated that there is no significant difference in academic performance before and after the implementation of game-based learning, is rejected. Results clearly indicate that game-based learning has a significant positive impact on students' academic performance in mathematics. This suggests that incorporating game-based methods into mathematics instruction can enhance students' understanding and achievement in the subject.

Discussion of Finding

Firstly, the study found a strong and significant relationship ($r = 0.816$, $p = 0.022$) between game-based learning and students' motivation towards mathematics. This suggests that the integration of educational games in the classroom can energize and stimulate students' desire to engage with mathematical content. This finding supports the work of Durmuş and Karakuş (2018), who reported that game-based learning significantly improved primary school students' attitudes toward mathematics.

Secondly, the result of the second hypothesis showed a positive and significant correlation (r = 0.750, p = 0.020) between game-based learning and students' interest in learning mathematics. This implies that games not only motivate but also sustain students' curiosity and engagement with mathematical tasks. This finding is consistent with Smith (2009), who highlighted the influence of game-based learning on pupils' attitudes and interest in mathematics.

Thirdly, the paired-sample t-test result demonstrated a statistically significant difference in students' academic performance before and after the implementation of game-based learning (t = -5.751, p = 0.000). The post-intervention mean score (2.970) was substantially higher than the pre-intervention score (1.800), indicating that game-based learning had a clear impact on improving students' academic performance. This outcome aligns with the findings of Erlina and Nurhayati (2020), who explored cooperative learning approaches and found that interactive, student-centered techniques led to significant improvements in pupils' mathematics achievement and interest.

Conclusions

The findings provide clear evidence that game-based learning significantly enhances all three dimensions of students' learning outcomes. The Pearson correlation analyses showed strong and statistically significant relationships between game-based learning and both students' motivation and interest in mathematics. This suggests that when mathematics instruction is delivered in a more interactive and engaging manner, students are more likely to be motivated and maintain interest in the subject. Furthermore, the paired-sample t-test revealed a significant improvement in students' academic performance after the implementation of game-based learning strategies.

Based on these findings, it is concluded that game-based learning is an effective instructional approach that positively influences students' engagement and achievement in mathematics. Incorporating game-based strategies into the teaching of mathematics can help address common challenges such as lack of interest, low motivation, and poor performance, thereby fostering a more enjoyable and productive learning environment.

Recommendations

1. Enhancing Student Motivation through Game-Based Learning: It is recommended that mathematics teachers integrate educational games regularly into their instructional practices.

Doing so will help stimulate students' enthusiasm and reduce learning fatigue, thereby encouraging sustained engagement with mathematical concepts.

2. Fostering Student Interest through Interactive Instruction: Since game-based learning significantly boosts students' interest in mathematics, schools should promote the use of interactive, game-oriented activities that align with curriculum objectives. Teachers should be encouraged to adopt digital and physical game tools that sustain learners' curiosity, attention, and enjoyment during mathematics lessons.

3. Improving Academic Performance through Active Learning Strategies: As the study showed a significant improvement in academic performance after implementing game-based learning, educational authorities should invest in training and resources that enable teachers to design and apply effective game-based learning strategies. This approach should be supported at policy level to ensure consistency and scalability across schools for measurable academic gains.

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