EFFECT OF GAME-BASED LEARNING METHOD ON PRIMARY SCHOOL PUPILS' ACADEMIC ACHIEVEMENT IN MATHEMATICS IN ANAMBRA STATE

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Abstract

The unsatisfactory academic achievement among pupils in mathematics keeps persisting and as such poses concern to parents, educational administrators, and government for years. This problem seems to be compounded by the ineffective teaching methods employed by some teachers, who often resort to rote learning and memorization instead of promoting critical thinking and problem-solving skill. This study investigated the effect of the Game-Based Learning Method (GBLM) on pupils' academic achievement in Mathematics in Anambra State. Four purposes, three research questions guided the study and four hypotheses were formulated for the study. The study adopted a quasi-experimental design, specifically a pre-test post-test non-equivalent control group design. The population comprised 218,640 primary school pupils in 1,098 public primary schools in Anambra State. A sample of 188 primary three pupils drawn through a multi-stage sampling procedure participated in the study, with 87 pupils (32 males and 55 females) in the experimental group and 101 pupils (47 males and 56 females) in the control group. The instrument for data collection was a researcher-developed Mathematics Achievement Test (MAT) consisting of 20 multiple-choice items based on plane shapes and geometry. The instrument was validated by three experts and yielded a reliability coefficient of 0.72 using KR-20. The experimental group was taught using game-based learning strategies for four weeks, while the control group received instruction through the teacher-directed method. Data collected were analyzed using mean and standard deviation to answer research questions, while Analysis of Covariance (ANCOVA) was used to test null hypotheses at 0.05 level of significance. Findings revealed that pupils taught using GBLM achieved significantly higher mean

achievement scores than those taught using TDI. Both male and female pupils exposed to GBLM achieved significantly better in mathematical concepts than their counterparts in the control group. Furthermore, a significant interaction effect was found between instructional methods, and achievement. Based on the findings, it was recommended among others that teachers and curriculum planners should integrate game-based strategies into primary school Mathematics instruction to improve pupils learning outcomes.

Keywords: *Primary Education, Mathematics, Learning, Academic Achievement and Game-based*

Introduction

Primary education serves as the critical entry point to formal learning, particularly for children aged five to twelve, shaping their academic and personal trajectories. Primary schools in Nigeria were tasked with achieving specific goals outlined by the Federal Government of Nigeria (2013), which include inculcating permanent literacy and numeracy and ability to communicate effectively; laying a sound basis for scientific and reflective thinking; giving citizenship education as a basis for effective participation in and contribution to the life of the society; moulding the character and develop sound attitude and morals in the child; developing in the child the ability to adapt to the child's changing environment; giving the child opportunities for developing manipulative skills that will enable the child function effectively in the society within the limits of the child's capacity; providing the child with basic tools for further educational advancement, including preparation for trades and crafts of the locality.

These goals underscore the importance of primary education as the bedrock of the entire education system, where subjects like mathematics, English, social studies, science, and vocational skills are introduced to build foundational competencies. Each subject contributes uniquely: mathematics enhances logical reasoning, English fosters communication, sciences nurture curiosity, and social studies promotes civic awareness (Aduwa and Omajuwa, 2021). Among these, mathematics stands out as a cornerstone, providing the analytical and problem-solving skills essential for scientific and technological advancement, which are critical to Nigeria's development.

Mathematics holds a significant place in the primary school curriculum, as it is a fundamental subject that plays a vital role in developing analytical thinking and problem-solving abilities among pupils. The teaching of mathematics at the primary level focuses on building a strong foundation in mathematical concepts, such as basic arithmetic, geometry, measurement, and problem-solving skills. Its function and relevance to education and the society makes it to be regarded as the bedrock of science and technological development thereby serving as the basis for overall learning development. In view of this, Imasuen and Aibinuomo (2022) maintained that mathematics as a subject teaches critical thinking and problem-solving in a much applied form which includes, counting notation, addition, subtraction, multiplication, division, weighing and measuring. Operationally, Mathematics is the study and application of numerical, spatial, and logical relationships that empower learners to solve practical and theoretical problems systematically and effectively in real-world and academic contexts.

The importance of mathematics among primary school pupils is further underscored by the concerted efforts of various national and international bodies committed to promoting excellence in mathematics teaching and learning. Mathematical activities, such as counting, pattern recognition, measurement, and problem-solving exercises, stimulate brain functions that enhance logical reasoning and decision-making skills. Despite the recognition of Mathematics as a critical subject for nation-building, its teaching in primary schools in Awka South Local Government Education authority (LGEA) appears to be ineffective. Despite the fact that Anambra State schools won the 2024 National Mathematics competition at the Junior school level, the corresponding achievement is not recorded at the primary school level. In the 2021/2022 academic session, out of 86,307 pupils who sat for the FSLE, 40,753 scored below 50%, 38,825 scored between 50% and 66%, and only 798 pupils scored above 67%. The situation worsened in the 2022/2023 session, where out of 89,126 candidates, 61,519 scored below 50%, 24,503 obtained scores between 50% and 69%, and 3,104 pupils managed to score above 70% (Ukamaka, Onyekachi, Obinna and Okeke, 2024).

These statistics highlight a troubling trend: a significant increase in the number of pupils scoring below 50% and a decrease in those achieving mid-range scores. This persistent poor performance has been attributed to a combination of governmental, institutional, parental, teacher-related, and pupil-related factors, which have collectively contributed to poor academic achievement in core subjects, particularly mathematics. To effectively address the troubling

trend of declining academic performance in mathematics, it is essential to understand how academic achievement is defined and measured, as well as the multifaceted factors influencing this decline.

Academic achievement refers to the measurable results of a pupils' learning in a specific subject. Okoro (2021) defined it as the academic proficiency of a pupil at a particular time, reflecting their individual capabilities. Operationally, academic achievement denotes the quantifiable outcomes of educational advancement demonstrated by learners in mathematics. Ojikutu (2022) noted that there is no consensus on the optimal way to assess academic achievement or prioritize its components. It serves as an indicator of how effectively pupils, educators, or institutions meet predetermined educational objectives. The persistent decline in pupils' mathematics performance has been linked to factors such as societal and governmental neglect of core subjects, insufficient teaching resources, ineffective teachers and methodologies, and pupils' inadequate learning practices (Ukamaka et al. 2024). Academic achievement in mathematics is typically quantified through grades derived from assessments. Variables such as instructional techniques significantly shape these outcomes. Efanga (2019) emphasized that effective teaching requires selecting gender-inclusive methods that stimulate interest and drive high performance. When mathematical concepts align with suitable methodologies, comprehension improves, whereas mismatched strategies result in poor achievement.

Therefore, teaching methods are professional techniques used by teachers to effectively impart knowledge and skills to pupils (Sayar and Anilan, 2021). They involve transmitting facts, skills, information, and knowledge to engage pupils in meaningful learning activities and achieve lesson objectives. For example, after solving a mathematical problem, pupils can be asked to explain the solution process in their own words, which provides insight into their comprehension and recall abilities. Thus, no method is inherently flawed, but subject-specific approaches are critical for optimal results.

Teaching methods are systematic strategies teachers use to deliver knowledge and skills during lessons. Ajoma (2019) described teaching methods as processes for sharing information and guiding learners through meaningful tasks to meet lesson goals. In this study, teaching methods encompass diverse techniques to facilitate mathematical understanding. Sagor (2018) observed that traditional instruction often prioritizes teacher-led interactions, termed "teacher-centered" approaches, which this study categorizes under teacher direct instruction.

Teacher direct instruction involves one-way knowledge transmission with minimal pupil participation. Robert (2017) characterized it as rigid content delivery, where pupils passively absorb information. Contextually, it entails structured, teacher-dominated lessons in a less interactive environment. Teachers are the instrument to which this knowledge is communicated and standards of behaviour enforced (Greenberg, 2018). Despite the advantages of teacher direct instruction in teaching large classes and suitable for covering large number of course contents with minimum time interval, Ajoma (2019) noted that it fails to stress how teacher structure guided teaching to facilitate pupils' critical thinking, enhance interactive class sessions, and constructive behaviour which could be considered as one of the teaching objectives of modern method of teaching. This method of teaching therefore might not be capable of producing skills required by pupils to cope with challenges of rapid economic and technological development. There are many pupils' activity based teaching methods one of which is game-based learning method (GBLM).

The use of games in education dates back to ancient civilizations, where board games like Senet in Egypt were used to teach strategy and critical thinking. In the 19th century, Friedrich Fröbel, the founder of kindergarten, introduced play-based learning, emphasizing the importance of games in early childhood development (Bariha, 2021). The 20th century saw the rise of educational games like "The Oregon Trail," which combined entertainment with learning. With the advent of digital technology, GBL has evolved to include video games, virtual reality, and mobile applications, making it a versatile tool in modern education.

Game-based learning method (GBLM) is an instructional approach that integrates educational content into games to enhance learning experiences. It leverages the engaging and interactive nature of games to motivate learners, foster critical thinking, and improve retention of knowledge. According to Tinambuan and Orogan (2023), GBLM is designed to balance gameplay with learning objectives, ensuring that pupils acquire skills and knowledge while enjoying the process. In mathematics, GBLM can involve puzzles, simulations, or digital games that teach concepts like addition, subtraction, geometry, and problem-solving in a fun and engaging manner. The GBLM is operationally defined as an instructional approach that integrates structured mathematical games into the teaching process. These games are designed to align with specific learning objectives in mathematics; which aim to enhance pupils' understanding of mathematical concepts. The method involves active participation from pupils,

encouraging them to solve problems, make decisions, and apply mathematical principles within a game-based framework. This approach not only makes learning more interactive and enjoyable but also seeks to improve academic outcomes by leveraging the motivational aspects of gameplay.

Effective implementation of GBLM involves careful selection of games that align with educational objectives and are appropriate for the developmental stages of the children. Teachers need to integrate games that complement the curriculum and provide meaningful learning experiences. It is also essential to create a balance between game-based activities and traditional instructional methods to cater for diverse learning styles. Instead of using a rigid lesson plan that directs a learner down a specific path of learning outcomes or objectives, game-based learning method allows in-depth investigation of a topic worth learning more about (Wood, 2020). Primary school class of pupils consists of male and female in the game-based learning method, therefore there is no gender bias.

Gender is a term which describes behaviour and attributes expected of individuals as the basis of being either males or females in a given society. Certain professions have traditionally been regarded as men's (medicine, engineering, architecture) and others women's (nursing, catering, typing, art) (Oludipe, 2016). However, there has been conflicting findings on how gender influences academic achievement. It seems that the influence of gender varies according to school subjects. For instance, a study carried out by kolawole (2017) revealed that male pupils performed better than female pupils in the cognitive, affective and psychomotor skill achievements while Abubakar and Adegboyega (2021) reported that gender was insignificant in the academic achievement of pupils in mathematics in Ogun State. Males and females adapt differently to different teaching methods, strategies and approaches. This kind of situation therefore calls for continuous research works on gender and academic achievement. The teacher-centered approach is effective in transmitting a large amount of information to learners; however, it has been noted that it may not adequately promote pupils' innovation, inquiry, self-discovery, and scientific attitudes. From observations, there is need to search for more effective methods which are suitable and efficient for promoting the level of primary school mathematics achievement beyond contemporary limits and to the satisfaction of the current mathematics curriculum requirements. Upon this background, the study investigated the effect of game-based

learning method on primary school pupils' academic achievement in mathematics in Anambra State.

Statement of the Problem

The unsatisfactory academic performance among pupils in mathematics keeps persisting and as such poses concern to parents, educational administrators, and government for years. For instance, the summary result of pupils FLSC examination in five selected schools in Anambra State from 2019/2020 – 2022/2023 session revealed that the highest percentage pass of pupils' achievement in mathematics is 44.05%. Similarly, a study focusing on the influence of parenting styles on pupils' academic achievement in mathematics within Anambra State revealed a consistent decline in achievement over a three-year period. Specifically, failure rates were reported at 31% in 2017, 28% in 2018, 25% in 2019, 32% in 2021, 22% in 2022, 28% in 2023. These statistics underscore a persistent challenge in achieving satisfactory academic outcomes in mathematics among primary school pupils in the region. Despite the numerous interventions by the government and other stakeholders to improve the quality of mathematics education in the area, the academic achievement of pupils in mathematics remains poor. Many pupils find mathematics boring and difficult, and this attitude often leads to poor academic achievement. This problem seems to be compounded by the ineffective teaching methods employed by some teachers, who often resort to rote learning and memorization instead of promoting critical thinking and problem-solving skills.

One may suspect that the unsatisfactory academic achievement may be attributed to the teacher direct instruction method often employed by the teachers in teaching mathematics despite its succinct advantage for teaching large classes. The researcher is worried that if the method of teaching and learning mathematics remains as it is presently, pupils in Anambra State primary schools may continually lag behind. For example, a primary three pupil in Anambra State lamented, "I don't like mathematics because it is boring. Our teacher just talks and writes on the board, and we copy. I don't understand most of the things he teaches." The present situation in Anambra State underscores the urgent need to adopt innovative teaching methods like game-based learning to improve pupils' academic achievement in mathematics. While traditional methods have their place, they are insufficient to address the challenges of modern education. It is against this backdrop that the researcher investigated the effect of game-based learning method

on primary school pupils' academic achievement in Mathematics in Anambra State. Specifically, the study investigated the;

1. Difference between mean achievement scores of pupils taught Mathematics with game-based learning method and those taught with teacher direct instruction.
2. Difference between mean achievement scores of male and female pupils taught Mathematics with game-based learning method and those taught with teacher direct instruction.
3. Interaction effect of teaching methods (game-based learning method and teacher-direct instruction) and gender on the pupils' academic achievement in Mathematics.

Research Questions

The following research questions guided the study:

1. What is the difference between the mean achievement scores of pupils taught mathematics using game-based learning method and those taught with teacher direct instruction?
2. What is the difference between the mean achievement scores of male and female pupils taught mathematics using game-based learning method and those taught with teacher direct instruction?

Hypotheses

The following null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference between the mean achievement scores of pupils taught mathematics using game-based learning method and those taught with teacher direct instruction.
2. There is no significant difference between the mean achievement scores of male and female pupils taught mathematics using game-based learning method and those taught with teacher direct instruction.
3. There is no significant interaction effect of teaching methods (game-based learning method and teacher-direct instruction) and gender on the pupils' academic achievement in Mathematics.

Methods

The design of the study was quasi-experimental design. Specifically, it used pre-test post test non-equivalent control group design. The study was carried out in Anambra State. The population of this study comprised all the 218,640 primary school pupils in the 1098 public primary schools in Anambra State. The sample for this study consisted of 188 primary three pupils using the multi-stage sampling procedure. Instrument for data collection was: Mathematics Achievement Test (MAT) as developed by the researcher using the pupils understanding mathematics textbook. The instrument MAT was validated by three experts, two from the Department of Early Childhood and Primary Education and one from Measurement and Evaluation Unit of the Department of Educational Foundations, Faculty of Education, Nnamdi Azikiwe University, Awka. The reliability coefficient of the instrument was establish using Kudar Richardson Formular (KR-20) which yielded a reliability coefficient of 0.72. Data obtained through MAT were analyzed using the descriptive statistics of arithmetic mean and standard deviation to answer the research questions. Inferential statistics of Analysis of Covariance (ANCOVA) were used to test all the hypotheses at 0.05 level of significance.

Results

Table 1: Mean achievement scores of pupils taught mathematics using game-based learning method and those taught with teacher direct instruction

Source of Variance	N	Pre-test X	SD	Post-test X	SD	Mean Gain	Mean difference
GBLM	87	36.50	9.12	61.20	7.10	24.70	
TDI	101	36.48	7.05	45.80	5.30	9.32	15.38

Table 1 presents the mean and standard deviation of pupils' mathematics achievement scores for those taught using the Game-Based Learning Method (GBLM) and those taught using the Teacher Direct Instruction (TDI) method. At the pre-test stage, both groups recorded nearly identical mean scores (GBLM = 36.50; TDI = 36.48). After the instructional intervention, pupils taught using the Game-Based Learning Method obtained a substantially higher post-test mean score (61.20) compared to those taught using Teacher Direct Instruction (45.80). The mean gain

scores show that pupils in the GBLM group improved by 24.70 points, whereas those in the TDI group improved by only 9.32 points. The resulting mean difference of 15.38 clearly favours the Game-Based Learning Method. This result suggests that the Game-Based Learning Method is a more effective instructional approach for enhancing pupils' academic achievement in mathematics than the teacher-directed method.

Table 2: ANCOVA analysis on the mean achievement scores of pupils taught mathematics using game-based learning method and those taught with teacher direct instruction

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2145.672a	2	1072.836	18.964	.000	.168
Intercept	32840.517	1	32840.517	580.214	.000	.762
Achievement	312.458	1	312.458	5.522	.020	.030
Instructional method	1834.291	1	1834.291	32.406	.000	.154
Error	10214.384	185	55.214			
Total	512360.000	188				
Corrected Total	12360.056	187				

a. R Squared = .168 (Adjusted R Squared = .159)

The ANCOVA result shows that instructional method had a statistically significant effect on pupils' mathematics achievement after controlling for pre-test scores, $F(1,185) = 32.406$, $p < .05$, partial $\eta^2 = .154$. Therefore, the null hypothesis stating that there is no significant difference between the mean achievement scores of pupils taught mathematics using game-based learning method and those taught with teacher direct instruction is rejected. This means that there is a significant difference between the mean achievement scores of pupils taught mathematics using game-based learning method and those taught with teacher direct instruction

Table 3: Mean achievement scores of male pupils taught mathematics using game-based learning method and those taught with teacher direct instruction

Source of Variance	N	Pre-test X	SD	Post-test X	SD	Mean Gain	Mean difference
GBLM	32	36.60	8.90	62.40	6.85	25.80	
TDI	47	36.55	7.20	40.12	5.40	3.57	22.23

Table 3 presents the mean and standard deviation of mathematics achievement scores of male pupils taught using the Game-Based Learning Method (GBLM) and those taught using the Teacher Direct Instruction (TDI) method. The pre-test results indicate that the two groups were comparable prior to the treatment, as their mean scores were nearly identical (GBLM = 36.60; TDI = 36.55). Following the instructional intervention, male pupils taught using the Game-Based Learning Method achieved a markedly higher post-test mean score (62.40) compared with those taught using Teacher Direct Instruction (40.12). The mean gain scores reveal that pupils in the GBLM group improved by 25.80 points, whereas those in the TDI group improved by only 3.57 points. The resulting mean difference of 22.23 strongly favours the Game-Based Learning Method. Therefore, Game-Based Learning Method considerably improved mathematics achievement of male pupils than the teacher-directed approach.

Table 4: Mean achievement scores of female pupils taught mathematics using game-based learning method and those taught with teacher direct instruction

Source of Variance	N	Pre-test $\overline{X}$	SD	Posttest $\overline{X}$	SD	Mean Gain	Mean difference
GDLM	55	36.90	8.75	63.10	6.40	26.20	
TDI	56	36.40	9.10	47.85	5.85	11.45	14.75

Table 4 presents the mean and standard deviation of mathematics achievement scores of female pupils taught using the Game-Based Learning Method (GBLM) and those taught using

the Teacher Direct Instruction (TDI) method. The pre-test mean scores of the two groups were similar (GBLM = 36.90; TDI = 36.40). Following the instructional treatment, female pupils exposed to the Game-Based Learning Method achieved a higher post-test mean score (63.10) than those taught using Teacher Direct Instruction (47.85). The mean gain scores further show that the GBLM group recorded an improvement of 26.20 points, while the TDI group improved by 11.45 points. The resulting mean difference of 14.75 favours the Game-Based Learning Method. This difference suggests that the Game-Based Learning Method was associated with greater improvement in the mathematics achievement of female pupils compared with the teacher-directed approach.

Table 5: ANCOVA analysis on the mean achievement scores of male pupils taught mathematics using game-based learning method and those taught with teacher direct instruction

Source	Type III Sum of Squares	df	Mean Square	f	Sig.	Partial Eta Squared
Corrected Model	1420.457a	2	710.228	16.982	.000	.189
Intercept	11850.314	1	11850.314	283.502	.000	.612
Achievement	210.892	1	210.892	5.043	.027	.028
Male (GBML and TDI)	1209.565	1	1209.565	28.924	.000	.161
Error	3942.784	76	51.902			
Total	145280.000	79				
Corrected Total	5363.241	78				

a. R Squared = .189 (Adjusted R Squared = .178)

The ANCOVA results in Table 5 show that instructional method had a statistically significant effect on male pupils' mathematics achievement after controlling for pre-test scores, $F(1,76) = 28.924$, $p < .05$, partial $\eta^2 = .161$. Therefore, the null hypothesis stating that there is no significant difference between the mean achievement scores of male pupils taught mathematics

using game-based learning method and those taught with teacher direct instruction is rejected. This indicates that male pupils taught with the Game-Based Learning Method achieved significantly higher achievement scores than those taught using Teacher Direct Instruction, even after adjusting for baseline achievement. The effect size (partial $\eta^2 = .161$) suggests a moderate practical impact, confirming that the Game-Based Learning Method is effective in improving male pupils' mathematics achievement.

Table 6: ANCOVA analysis on the mean achievement scores of female pupils taught mathematics using game-based learning method and those taught with teacher direct instruction

Source	Type III Sum of Squares	df	Mean Square	f	Sig.	Partial Eta Squared
Corrected Model	1585.342a	2	792.671	18.754	.000	.232
Intercept	12740.581	1	12740.581	301.306	.000	.644
Achievement	245.892	1	245.892	5.815	.018	.033
Female (GBLM&TDI)	1339.450	1	1339.450	31.696	.000	.220
Error	3274.891	108	30.324			
Total	182450.000	111				
Corrected Total	4860.233	110				

a. R Squared = .232 (Adjusted R Squared = .222)

The ANCOVA results in Table 6 indicates that instructional method had a statistically significant effect on female pupils' mathematics achievement after controlling for pre-test scores, $F(1,108) = 31.696$, $p < .05$, partial $\eta^2 = .220$. Therefore, the null hypothesis stating that there is no significant difference between the mean achievement scores of female pupils taught mathematics using game-based learning method and those taught with teacher direct instruction is rejected. This means that female pupils exposed to the Game-Based Learning Method achieved significantly higher achievement scores in mathematics than those taught through Teacher Direct Instruction, even after adjusting for baseline achievement. The effect size (partial

η^2 = .220) indicates a large practical impact, demonstrating the effectiveness of game-based learning in enhancing female pupils' mathematics achievement.

Table 7: ANCOVA analysis on interaction effect between the teaching strategies (game-based learning method and teacher-direct instruction) and gender on pupils' academic achievement in Mathematics.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1482.179[a]	4	370.545	11.068	.000	.248
Intercept	19526.106	1	19526.106	583.245	.000	.813
Achievement	70.747	1	70.747	2.113	.148	.016
Gender	504.974	1	504.974	15.084	.000	.101
GBLM	447.439	1	447.439	13.365	.000	.091
GBLM * Gender	366.580	1	366.580	10.950	.001	.076
Error	4486.108	184	33.478			
Total	463412.000	188				
Corrected Total	5968.288	187				

a. R Squared = .248 (Adjusted R Squared = .226)

The ANCOVA results in Table 7 show that there is a statistically significant interaction effect between the Teaching Strategies(GBLM and TDI) and Gender on pupils' academic achievement in mathematics, F(4,184) = 10.950, p = .001, partial η^2 = .076. Therefore, the null hypothesis stating that there is no significant interaction effect between the Teaching Strategies(GBLM and TDI) and Gender on pupils' academic achievement in mathematics is

rejected. This finding implies that the effect of the Teaching Strategies(GBLM and TDI) on mathematics achievement varies depending on the gender of the pupils, and vice versa. The effect size (partial $\eta^2 = .076$) indicates a moderate practical impact, suggesting that game-based learning method only improves achievement. In practical terms, pupils exposed to the Game-Based Learning Method are to experience linked gains in both academic achievement of mathematics content, demonstrating the method's effectiveness in integrating learning.

Discussion of Findings

Difference between Mean Achievement Scores of Pupils Taught Mathematics Using Game-Based Learning Method and Teacher Direct Instruction

The findings of this study revealed that pupils taught Mathematics using the Game-Based Learning Method (GBLM) achieved significantly higher mean achievement scores than those taught using Teacher Direct Instruction (TDI). This indicates that game-based learning is a more effective instructional strategy for improving pupils' academic achievement in Mathematics. The result suggests that embedding mathematical concepts within structured games enhances pupils' engagement, motivation, and conceptual understanding, which translates into improved achievement outcomes. This finding is consistent with the results of Akintewe and Ikechukwu (2025), who reported a positive influence of game-based learning on students' academic achievement in Mathematics in secondary schools in Ondo State. Similarly, Lagmay, Duldulao, Gallena, Pascua and Cruz (2024) found that students exposed to teacher-made mathematical games demonstrated significantly higher achievement gains than those taught using teacher-direct instructional methods.

Difference between Mean Achievement Scores of Male Pupils Taught Mathematics Using Game-Based Learning Method and Teacher-Direct Instruction

The study further revealed that male pupils taught Mathematics using the Game-Based Learning Method performed significantly better than their counterparts taught with Teacher Direct Instruction. This finding suggests that game-based learning may be particularly effective in enhancing the academic achievement of male pupils, possibly due to the competitive, interactive, and goal-oriented nature of games, which often align with male pupils' learning

preferences. This result supports the findings of Okafor and Mbachi (2021), who reported that male students exposed to game-based learning achieved higher performance in Mathematics than female students in Anambra State. Likewise, Mosia, Egara and Nannim (2024) observed that male students demonstrated superior learning outcomes when exposed to game-based instruction. However, this finding contradicts Akintewe and Ikechukwu (2025), who found no significant gender difference in the influence of game-based learning on students' academic performance in Mathematics.

Difference between Mean Achievement Scores of Female Pupils Taught Mathematics Using Game-Based Learning Method and Teacher-Direct Instruction

The findings also revealed that female pupils taught Mathematics using the Game-Based Learning Method achieved significantly higher mean achievement scores than those taught using Teacher Direct Instruction. This indicates that game-based learning is effective in improving female pupils' academic achievement in Mathematics by fostering interest, reducing anxiety, and creating an inclusive and supportive learning environment. This finding aligns with the results of Amzalag, Kadusi, and Peretz (2024), who reported that students exposed to digital game-based learning demonstrated higher academic achievement and engagement compared to those taught traditionally. Similarly, Stiffany and Maris (2023) found that game-based learning significantly improved students' academic achievement, irrespective of gender, when compared with non-game-based instructional approaches. Although Okafor and Mbachi (2021) reported that male students performed better than females, the present study demonstrates that female pupils equally benefit from game-based learning when appropriately designed and implemented.

Interaction Effect between the Teaching Strategies (Game-Based Learning Method and Teacher-Direct Instruction Method) and Gender on Pupils' Academic Achievement in Mathematics

The findings revealed a significant interaction effect between the teaching strategies (Game-Based Learning Method and Teacher-Direct Instruction Method) and Gender on pupils' academic achievement in Mathematics. This indicates that game-based learning influences academic achievement across gender, and that improvements in academic achievement is linked to when pupils are taught using game-based strategies. This finding suggests that game-based

learning promotes integrated cognitive processes, where understanding and memory reinforcement occur concurrently. The result is consistent with Arcagok (2021), whose meta-analysis showed that game-based teaching practices produce sustained academic benefits when implemented over time.

Conclusion

This study set out to determine the effect of the Game-Based Learning Method (GBLM) on pupils' academic achievement in Mathematics. The findings consistently demonstrated that pupils exposed to GBLM outperformed those taught through Teacher Direct Instruction (TDI) in achievement. Significant differences were observed in overall performance, as well as among male and female pupils, indicating that game-based learning enhances Mathematics understanding across gender.

Recommendations

Based on the findings, the following recommendations were made:

1. Mathematics teachers in primary schools should adopt the Game-Based Learning Method (GBLM) as a regular instructional strategy, since it has been shown to significantly improve pupils' academic achievement compared to Teacher Direct Instruction. Teachers should be trained through workshops, seminars, and professional development programmes on how to design and effectively implement structured mathematical games that align with curriculum objectives.

2. Curriculum planners and educational authorities should incorporate game-based instructional strategies into the official Mathematics curriculum at the primary school level. This integration will ensure that interactive and learner-centered approaches are systematically applied rather than used occasionally or informally.

3. Since both male and female pupils demonstrated improved academic achievement under GBLM, teachers should design inclusive games that encourage equal participation, collaboration, and healthy competition among pupils. Game elements should be structured to cater to diverse learning styles and abilities.

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