
WORDWALL GAME-BASED INSTRUCTION AND SENIOR SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS IN ORUMBA NORTH LOCAL GOVERNMENT AREA OF ANAMBRA STATE, NIGERIA

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Abstract

This study investigated the effect of game-based instruction on the academic performance of senior secondary school students in Orumba North Local Government Area of Anambra State, Nigeria. Three research questions and three null hypotheses were used for the study. The purposive sampling technique was used to draw the sample for the study. A sample of one hundred and twenty nine senior secondary two (SS2) students was drawn from the population of the study. Quasi experimental research design was used. The study was made up of one experimental and one control group. The experimental group was taught geometry vocabulary using online mathematics game while the students in the control group were taught same concept with offline mathematics game. The name of the instrument used to collect data was Geometric Vocabulary Performance Test "GVPT". This instrument was multiple-choice test and consisted of twenty test items. The instrument was validated by experts in mathematics education. The Kuder Richardson formula 21 (KR-21) was used to obtain an internal stability of 0.81. The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 significant level. The result

showed that students in the experimental group that were taught with online math game performed higher than those that were taught with offline math game in the control group though the difference was not statistically significant. “The second result showed that the male students taught with online math game performed better than their female counterpart in the same group with no statistically significant difference. The third result showed that the male students taught with offline math game performed better than their female counterpart in the same group with no statistically significant difference. It was concluded that the online math game improved the performance of students in geometry vocabulary than the offline game though with no gender difference. It was recommended amongst others that mathematics teacher should employ online mathematics game to teach students some mathematics concepts such as geometry vocabulary.

Keywords: Geometry, Vocabulary, Performance, Mathematics game, Students

Introduction

Mathematics is a vital subject due to the various roles it plays in the daily activities of man. The knowledge and skills learnt in mathematics are useful to man on a personal ground and at the same time useful for the development of the society. Mathematics has impacted in various professions, careers and vocations. This is because it underpins the creative, logical reasoning, critical thinking and problem-solving skills required for the functionality of the society. George and Charles-Ogan (2023) opined that mathematics serves as a universal language to the world. Mathematics encourages flexible thinking and the ability to present and approach problems from multiple perspectives. The various roles which mathematics plays in the daily lives of man and the development of the society makes it imperative that its implementation in classroom should embrace the innovative instructional strategies.

Mathematics is known as the science of numbers. It is a broad study of numbers, shape, quantity, structure, space, change and the relationship which exist among them. The major focus area in mathematics is number and notation. This notwithstanding, the subject matter of mathematics has its vocabulary. Ajugota and Agbarakwe (2022) asserted that it is the knowledge of mathematical terminologies that paves way for the problem-solving processes. Most people think that mathematics is all about numbers, equations and computations. Thurston (2022) implicitly posited that mathematics is not only about numbers. Mathematics has a lot more than numbers. It includes definition of concepts, basic logic, applications, and proofs. Mathematics vocabulary are the words and terminologies used in mathematics. Mathematics vocabulary refers to the exact words, terms, and phrases that are used to describe mathematical concepts, operations and relationships. Mathematics vocabulary is an integral part of every lesson and is crucial for effective communication of mathematics. Acquiring mathematics vocabulary is important because some mathematical terms can have a different meaning to a layman. This may suggest why Adebayo and Ifedi (2024) emphasized that teachers should ensure the use of correct terminology and precise vocabulary. To ensure success in the use of correct mathematical terminologies, innovative teaching strategies have to be employed as against traditional methods.

Innovative teaching strategies are instructional approaches that involve the use of hands-on activities to help students learn curriculum contents in a meaningful way. The innovative instructional strategies are student-centered, activity-based and focus on engaging students and at the same time encourage them to take active role in their learning. UNextEditorial Team (2020) stated that innovative learning is the process of creating an atmosphere where

students learn about new things, regularly, question what they have learnt, and think of new ideas on their own. Thus, innovative teaching strategies may involve the use of technology, exploration, practical, collaboration, immediate feedback systems, and problem-solving. Examples of innovative teaching strategies are project-based learning, flipped classroom, blended learning, experiential learning, inquiry-based learning, gamification or game-based learning, personalized learning, and collaborative learning. Innovative teaching strategies are crucial for 21st century learning because they improve the learning outcomes of students and cater for diverse learning needs of students. Students become motivated, engaged and creative when taught innovatively. Teaching using innovative strategies makes the teaching of mathematics exploratory and flexible.

Game-based learning which is also known as gamification is one of the recent developments in education in the 21st century. It is an innovative teaching method which keeps the students active in all the instructional session. Simply put, gamification is an instructional approach which adds game elements to learning. The game-based learning in mathematics is a hands-on teaching approach that integrates both physical and digital games to teach mathematics concepts. Kyle and Udeh (2024) opined that the use of game-based learning to teach mathematics improves students' engagement, boosts their academic performance, foster visualization, and understanding of the events in real-world scenario. It also motivates students and makes them develop or rebuild their interest in mathematics. Game-based learning can also enhance the logical and problem-solving skills of students in mathematics.

Wordwall is an online educational platform that allows teachers to create interactive learning games such as matching, quizzes, and word association activities. It supports active student participation and immediate feedback, which enhances engagement and understanding. Studies have shown that digital game-based platforms like Wordwall improve students' motivation and academic performance, especially in subjects that involve abstract concepts such as mathematics and geometry vocabulary.

Mathematics games are categorized into physical (offline) and digital mode (online). They are further categorized into either seed, dice, card or board games; traditional and modern mathematics games. Debrenti (2024) asserted that mathematics games have properties that are adapted to cognitive and mathematical structures and that it can be used to facilitate and achieve the connections between learning and academic performance. Use of game-based learning showcases innovation in the teaching and learning arena. Game-based learning can be used to teach students at all levels of education to provide meaningful context and support in mathematics. Mathematics games may be used to introduce concepts, it can be used to remediate lessons, consolidate concepts or retain learnt mathematical concepts. The use of mathematics game can also be used to motivate and increase the interest of students in the learning of mathematics.

The essence of mathematics game is to use the game activities to teach students mathematics concepts and not to establish the player who wins or loses the game. This may suggest why Agbarakwe (2019) opined that it lies in the onus of the mathematics teacher to explain to the students the objective of using any mathematics game. Various mathematics games can be used to teach one mathematical concept or multiple mathematical concepts. Examples of mathematics games include but not limited to the following: geoboard, Ludo, coordinate game, card game, coin game, vocabulary game, Bingo, Pizza fractions, 101 points, math Revolution, et cetera. Other mathematical games are Mathematical formula game, Five Sixes, Ludomatics, Maths Circle race, Math palace Game, THE HOT SEAT, Slid Game, Identification Matico, Stats Vocabulary Trigoratio, et cetera (National Mathematical Centre, 2008).

Akintewe and Ikechukwu (2025) investigated the influence of game-based learning on academic performance of students in secondary school in Ondo State and found out that the use of game-based instruction improved the academic performance of students in mathematics. The study also found that there was no significant difference between the male and the female students' performance in mathematics. The research finding of Hui and Mahmud (2023) revealed that game-based learning positively impacted students on the cognitive domain (knowledge and mathematical skills) and affective domain (attitude, motivation, and interest). Russo et al. (2021) investigated the effect of digital and non-digital math games on the academic performance of primary school pupils and found that both categories of game increased the academic performance of students in mathematics. Morenikeji and Adeniyi (2021) carried out a study on the effects of mathematical games on senior secondary students' academic performance in mathematics in Ejigbo, Osun State and found out that the use of mathematical games had a significant positive effect on the academic performance of students in mathematics. The result also revealed that the use of mathematical game was beneficial to students with respect to performance irrespective of their gender.

This present era has paved way for the categorization of people into digital natives and digital visitors. The digital natives are people who were born and grew up in the digital age with natural skills in the use of technology. Their characteristics include, digital proficiency, technological flexibility, experiential and visual learning styles, capacity for multitasking and a strong inclination for online collaboration. The secondary school students presently fall into the digital natives and as such are naturally comfortable and fluent in the language of digital technology. Incorporating online mathematics games would not be out of place. A review of related literature for this study revealed that various scholars had carried out studies on the effect of game-based learning on students' performance in mathematics in various states of Nigeria such as Rivers, Imo, Ondo, Abia, and Anambra. Most of the studies were carried out using game-based learning and traditional method. None of the studies to the best of the researcher's knowledge was carried out in Orumba North Local Government Area of Anambra state using offline and online mathematics games. This forms the gap that this study sought to fill. It was based on this premise, that this study investigated game-based instruction and senior secondary school students' academic performance in mathematics in Orumba North Local Government area of Anambra state, Nigeria.

Statement of the Problem

In the field of education, utilizing games as a teaching tool has gained significant attention due to its potential to enhance learning outcomes. By incorporating mathematics games into the teaching and learning process, teachers seek to enable students develop a deeper knowledge of geometric concepts and thus improve their academic performance. Despite the increasing use of mathematics games as a teaching tool in schools, the academic performance of students has not significantly improved. This could be due to the use of only offline games. Since we are in the digital age where the students are digital natives/residents, the researcher deemed it fit to incorporate online mathematics games to ascertain if it could improve the performance of students in geometric vocabulary.

Aim and Objectives of the Study

The aim of this study was to investigate how the use of geometric vocabulary math game can be used to enhance the academic performance of senior secondary school students in mathematics.

The objectives were to:

1. determine whether there is any difference between the performance mean score of senior secondary school students taught mathematics with offline and online geometric vocabulary math game.
2. Ascertain whether there is any difference between the performance mean score of the male and female senior secondary school students taught mathematics with offline geometric vocabulary mathematics game.
3. determine whether there is any difference between the performance mean score of the male and female senior secondary school students taught mathematics with online geometric vocabulary math game.

Research Questions

The following three research questions were answered.

1. What is the difference between the performance mean score of senior secondary school students taught mathematics with wordwall online geometric vocabulary game and offline geometric vocabulary math game?
2. What is the difference between the performance mean score of the male and female senior secondary school students taught mathematics with wordwall online geometric vocabulary math game?
3. What is the difference between the performance mean score of the male and female senior secondary school students taught mathematics with offline geometric vocabulary math game?

Hypotheses

Three null hypotheses were tested at 0.05 significant level.

H₀₁: There is no significant difference between the performance mean score of senior secondary school students taught mathematics with online and offline geometric vocabulary math game.

H₀₂: There is no significant difference between the performance mean score of the male and female senior secondary school students taught mathematics with online geometric vocabulary math game.

H₀₃: There is no significant difference between the performance mean score of the male and female senior secondary school students taught mathematics with offline geometric vocabulary math game.

Research Design

The research design used for this research was quasi experimental. This design made use of pretest and posttest. Intact classes which were non-equivalent and non-randomized were also used in this design. This study presented two intact classes (one experimental group and one control group). Table 1 showed the structural illustration of the study design.

Table 1: Structural illustration of the research design

Group	Pretest	Treatment	Posttest
E	O ₁	X ₁	O ₂
C	O ₁	X ₂	O ₂

Where:

E = Experimental Group

C = Control Group

O₁ = Pretest

O₂ = Posttest

X₁ = Taught with Online Math Game

X₂ = Taught with Offline Math Game

Population of the Study

The population of the study comprised of all three thousand six hundred and fourteen (3,614) public co-educational senior secondary two (SS2) students in Orumba North Local Government Area of Anambra State, Nigeria.

Sample and Sampling Technique

The sample for this study was one hundred and twenty nine (129) public co-educational senior secondary school two (SS2) students in Orumba North Local Government Area of Anambra State, Nigeria. The purposive sampling technique was used to select the sample from the population. Table 2 showed the sample distribution for the study.

Table 2: Sample distribution based on group and gender

Group	Male	Female	Total
Experimental Group	27	39	66
Control Group	23	40	63
Total	50	79	129

Instrument for Data Collection

The instrument used to collect data was prepared by the researchers. The name of the instrument was Geometric Vocabulary Performance Test "GVPT". This instrument was the multiple-choice type with four options lettered A to D. Three of the options were wrong and only one option was correct. GVPT which had twenty test items measured high and low cognitive learning outcome. The scoring of the instrument for each test item was five marks

for each correct response and zero mark for each wrong response. The instrument was marked in percentage. The test items of GVPT were constructed to measure both low and high cognitive learning outcome. Table 3 showed the table of specification that was prepared for the spread of the geometry vocabulary contents taught.

Table 3: Table of Specification for GVPT

Topic	Remembering	Understanding	Applying	Analyzing	Evaluating	Total
Points (16%)	1	1	-	1	-	3
Lines (20%)	1	1	-	2	1	5
Polygons (32%)	1	1	1	1	2	6
Bisectors (32%)	1	-	1	2	2	6
Total (100%)	4	3	2	6	5	20

Validity of the Instrument

The instrument was validated by two experts in mathematics education. The process of validity ensured that the questions were in line with the taught concepts and that the item difficulty was moderate enough for the students. Corrections pointed out by the experts were effected before administering the instrument to the sample.

Reliability of the Instrument

Kuder Richardson formula 21 (KR-21) was used to obtain an internal stability of 0.81. This was achieved by administering the instrument once to a sample of twenty SS2 students in a senior secondary school that was not part of the sample.

Method of Data Collection

A pretest of GVPT was first administered to the sample students by the two research assistants who were their intact class teachers in the experimental and control groups. The students answered the questions of GVPT in the pretest and submitted to the research assistants. The research assistants for each intact class thereafter taught the students geometry using the geometric vocabulary math game. The students in the experimental group were taught geometry using online geometric vocabulary math game while the students in the control group were taught same geometry concept using offline geometric vocabulary math game. The students in both experimental and control groups were administered with a posttest of GVPT which was a reshuffled version of the pretest. The pretest scripts and

posttest scripts of all the students in both groups were collated, marked, recorded and subjected to statistical analysis.

Method of Data Analysis

The research questions were answered using mean and standard deviation while the hypotheses were tested at 0.05 significant level. The software used for analysis was Statistical Package for Social Sciences (SPSS) Version 25.

Results

Research Question 1: What is the difference between the performance mean score of senior secondary school students taught mathematics with online and offline geometric vocabulary math game?

Table 4: Mean and standard deviation on the performance of students taught mathematics with online and offline vocabulary math game

Group	n	Pretest		Posttest		Performance	
		Mean	SD	Mean	SD	Mean Gain	Mean Diff.
ONVG	66	42.25	11.28	68.19	12.63	25.94	15.09
OFVG	63	45.47	13.67	56.32	11.65	10.85	

ONVG = Taught with Online Vocabulary Math Game

OFVG = Taught with Offline Vocabulary Math Game

Table 4 showed the mean and standard deviation on the performance of students that were taught mathematics with online and offline vocabulary math game. From Table 4, it is evident that the students who were taught with online vocabulary math game in the experimental group had a performance mean gain of 25.94, and those taught with offline vocabulary math game in the control group had a performance mean gain of 10.85. The data analysis in Table 4 showed that the students that were taught mathematics with online vocabulary math game performed better than those that were taught with offline vocabulary math game. The mean difference between the two groups was 15.09.

Research Question 2: What is the difference between the performance mean score of the male and female senior secondary school students taught mathematics with online geometric vocabulary math game?

Table 5: Mean and standard deviation on the performance mean score of the male and female students taught mathematics with online geometric vocabulary math game

Gender	n	Pretest		Posttest		Performance	Mean Diff.
		Mean	SD	Mean	SD	Mean Gain	
Male	27	40.81	10.75	67.52	13.41	26.71	1.54
Female	39	43.69	11.13	68.86	12.88	25.17	

Table 5 showed the mean and standard deviation on the performance mean score of the male and the female students that were taught mathematics with online geometric vocabulary math game. The data in Table 5 revealed that the male students that were taught mathematics with online geometric vocabulary math game had a performance mean gain of 26.71, while the female students taught with same online geometric vocabulary math game had a performance mean gain of 25.17. It is evident from Table 5 that the male students performed better than their female counterpart in the same experimental group. The mean difference between the two groups was 1.54.

Research Question 3: What is the difference between the performance mean score of the male and female senior secondary school students taught mathematics with offline geometric vocabulary math game?

Table 6: Mean and standard deviation on the performance mean score of the male and female students taught mathematics with offline geometric vocabulary math game

Gender	n	Pretest		Posttest		Performance	Mean Diff.
		Mean	SD	Mean	SD	Mean Gain	
Male	23	43.01	10.75	55.10	13.41	12.09	4.42
Female	40	47.93	11.13	55.54	12.88	7.67	

Table 6 showed the mean and standard deviation on the performance mean score of the male and the female students that were taught mathematics with offline geometric vocabulary math game. The data in Table 6 revealed that the male students that were taught mathematics with offline geometric vocabulary math game had a performance mean gain of 12.09, while the female students taught with same offline geometric vocabulary math game had a performance mean gain of 7.67. It is evident from Table 6 that the male students performed better than their female counterpart in the same control group. The mean difference between the two groups was 4.42.

H₀₁: There is no significant difference between the performance mean score of senior secondary school students taught mathematics with online and offline geometric vocabulary math game.

Table 7: Summary of ANCOVA on the difference between the performance of students taught mathematics with online and offline vocabulary math game

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	25589.25 ^a	2	4264.88	110.83	.00	.71
Intercept	5917.57	1	5917.57	153.78	.00	.55
Pretest	24275.67	1	24275.67	630.86	.00	.06
Group	1676.67	1	335.33	8.71	.08	.42
Error	9773.99	126	38.48			
Total	878230.00	129				
Corrected Total	35363.24	128				

a. R Squared = .817 (Adjusted R Squared = .739)

Table 7 above showed the test of significant effect using analysis of covariance (ANCOVA) on the difference between the performance of students that were taught mathematics with online and offline geometric vocabulary math game. It can be deduced from Table 7 that there no significant difference between the performance mean score of students who were taught with online geometric vocabulary math game and those who were taught with offline geometric vocabulary math game ($F_{1, 126} = 8.71$, $p = .02$ $p > .05$, partial eta squared = .42). H_{01} was retained at .05 significant level since p-value was greater than .05.

H₀₂: There is no significant difference between the performance mean score of the male and female senior secondary school students taught mathematics with online geometric vocabulary math game.

Table 8: Summary of ANCOVA on the performance of the male and female students taught mathematics with online geometric vocabulary math game

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	302.85 ^a	2	151.43	62.60	.00	.64
Intercept	988.27	1	988.27	408.57	.00	.73
Pretest	158.24	1	158.24	65.42	.00	.67
Gender	83.74	1	83.74	34.62	.61	.52
Error	101.59	63	2.42			
Total	116940.00	66				
Corrected Total	404.44	65				

a. R Squared = .463 (Adjusted R Squared = .602)

Table 8 showed the test of significant effect using analysis of covariance (ANCOVA) on the difference between the performance of the male and female students that were taught mathematics with online geometric vocabulary math game. The result showed that there was no significant difference between the performance of the male and female students who were taught mathematics with online geometric vocabulary math game ($F_{1, 63} = 34.62$, $p = .61$ $p > .05$, partial eta squared = .52). H_{02} was retained at .05 significant level since p-value was greater than .05.

H₀₃: There is no significant difference between the performance mean score of the male and female senior secondary school students taught mathematics with offline geometric vocabulary math game.

Table 9: Summary of ANCOVA on the performance of the male and female students taught mathematics with offline geometric vocabulary math game

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	132.50 ^a	2	44.17	230.30	.00	.54
Intercept	3945.39	1	3945.39	20572.61	.00	.91
Pretest	89.86	1	89.86	468.54	.00	.15
Gender	.08	1	.08	.41	.78	.04
Error	115.07	60	.19			
Total	5905.14	63				
Corrected Total	247.57	62				

a. R Squared = .463 (Adjusted R Squared = .602)

Table 9 showed the test of significant effect using analysis of covariance (ANCOVA) on the difference between the performance of the male and female students that were taught mathematics with offline vocabulary math game in the control group. The result showed that there was no significant difference between the performance of the male and female students who were taught mathematics with offline vocabulary math game ($F_{1, 60} = .41$, $p = .78$, $p > .05$, partial eta squared = .04). H_{O3} was retained at .05 significant level since p-value was greater than .05.

Discussion of Findings

The finding of this study showed that the students who were taught with online vocabulary math game in the experimental group had a performance mean gain of 25.94, and those taught with offline vocabulary math game in the control group had a performance mean gain of 10.85. The data analysis in Table 4 showed that the students that were taught mathematics with online vocabulary math game performed better than those that were taught with offline vocabulary math game. This result is in agreement with the findings of Uka and Hallet (2023), Emeh (2021), Rehoboath et al. (2020) whose results revealed that the use of online math game improved the academic performance of students in mathematics. When this finding was subjected to statistical analysis at 0.05 significant level, it showed no significant difference between the performance mean score of students who were taught with online geometric vocabulary math game and those who were taught with offline geometric vocabulary math game ($F_{1, 126} = 8.71$, $p = .08$, $p > .05$, partial eta squared = .42). This result collaborates with the result of Russo et al. (2023) whose result revealed that there was no statistical significant difference between the academic performance of students taught with online math game and those taught with offline math game. However, this finding is not in agreement with the finding of Emeiniter (2021) whose result showed that there was a significant difference between the academic performance of students taught with online math game and those taught with offline math game.

The data in Table 5 revealed that the male students that were taught mathematics with online geometric vocabulary math game had a performance mean gain of 26.71, while the female students taught with same online geometric vocabulary math game had a performance mean gain of 25.17. It is evident from Table 5 that the male students performed better than their female counterpart in the same experimental group. The subsection of this result to statistical analysis showed that there was no significant difference between the performance of the male and female students who were taught mathematics with online geometric vocabulary math game ($F_{1, 63} = 34.62$, $p = .61$, $p > .05$, partial eta squared = .52). This result aligns with results of Akintewe and Ikechukwu (2025) which showed that there was no significant difference in the use of game to teach the male and female students mathematics. However, this result is not agreement with the result of Morenikeji and Adeniyi (2021) whose result showed that the female students taught with math game had a higher performance than the male students with no statistically significant difference. Also, not in agreement with this result is the finding of Salami (2024) which showed that the female students performed better than the male students with no statistically significant difference.

Table 6 showed the mean and standard deviation on the performance mean score of the male and the female students that were taught mathematics with offline geometric vocabulary math game. The data in Table 6 revealed that the male students that were taught mathematics with offline geometric vocabulary math game had a performance mean gain of 12.09, while the female students taught with same offline geometric vocabulary math game had a performance mean gain of 7.67. It is evident from Table 6 that the male students performed better than

their female counterpart in the same control group. When subjected to statistical test, the result showed that there was no significant difference between the performance of the male and female students who were taught mathematics with offline vocabulary math game ($F_{1, 60} = .41$, $p = .78$, $p > .05$, partial eta squared = .04). This result is in line with the result of Ahukanna (2017), Adebayo and Oyiri (2020).

Conclusion

The conclusion drawn from the findings of this study was that use of mathematics game to teach students mathematics vocabulary improved students' academic performance, with online game-based instruction showing higher mean gains than offline games, though the difference was not statistically significant. It was also concluded that the male students had a higher mathematics performance than the female students in both use of online and offline game-based instruction.

Recommendations

The following recommendations were made based on the findings of the study:

1. Both online and offline mathematics games should be used to teach students mathematics concepts.
2. The male students should be commended and encouraged to keep pace with the use of game-based instruction.
3. The female students should be motivated and reinforced to embrace the use of game-based instruction to learn some mathematics concepts.

REFERENCES

- Adebayo, G., & Oyiri, K.C. (2020). Effect of mathematics games on academic performance of students in mathematics. *International Journal of Scientific Studies*, 1(1),62-71.
- Adebayo, T., & Ifedi, E. A. (2024). *Mathematical terminologies and usage*. Rhema Publications.
- Agbarakwe, T. (2019). *The power of vocabulary in mathematics*. Hilltop Printing Press.
- Ahukanna, L.T. (2017). Educational games and senior secondary school students' academic performance in mathematics. *Science Readings and Studies*, 4(3), 27-39.
- Ajugota, L., & Agbarakwe, D.G. (2022). *Role of vocabulary in mathematics*. Fronds Book Publications
- Akintewe, B. N., & Ikechukwu, M. F. (2025). Influence of game-based learning on academic performance in mathematics of secondary school students in Ondo State. *Studies in Education*, 23(1), 73-80.
- Debrenti, E. (2024). Game-based learning experiences in primary mathematics education. <https://doi.org/10.3389/feduc.2024.1331312>
- Emeh, B. G. (2021). Impact of mathematics game and puzzle on the academic performance of students' in mathematics and statistics. *Urether Journal of Scientific Studies*, 6(2), 172-188.
- Emeinitier, K. U. (2021). Effects of mathematical matico game on the performance and retention of junior secondary school students in mathematics in Abia State, Nigeria. *Journal of Mathematics Studies*, 2(2),17-25.
- George, N. R., & Charles-Ogan, G. I. (2023). *Essentials of mathematics teaching and learning*. Ulch Digi Prints & Services.
- Hui, H. B., & Mahmud, M. S. (2023). Influence of game-based learning in mathematics education on the students cognitive and affective domain: A systematic review. <https://doi.org/10.3389/fpsyg.2023.1105806>
- Kyle, D., & Udeh, U.D. (2024). *Teaching mathematics in secondary schools: A practical perspective*. Johnnesburg Press.
- Morenikeji, A., & Adeniyi, C. (2021). effects of mathematical games on senior secondary students' academic performance in mathematics in Ejigbo, Osun State Nigeria. Doi: 10.53840/attarbawiy.v5i1.1
- National Mathematical Centre (2008). *Mathematical games*. Marvellous Mike Press limited
- Rehoboath, Y., Ndidiamaka, O. O., & Babatunde, S.V. (2020). Investigating the effect of mathematics game instruction on the achievement of secondary school students in mathematics. *Journal of Science and Mathematics Education Series*,3, 97-105.
- Russo, J., Bragg, L., & Russo, T. (2023). How primary school teachers use games to support their teaching of mathematics. Doi: 10.26822/iejee.2021.200
- Salami, O. (2024). Effect of mathematical games on students' achievement in mathematics according to gender. Doi: <https://doi.org/10.52214/jmetc.v15i1.12474>

- Thurston, W. (2022). Math is not just about numbers. Doi :<https://www.i.org/10.3389/feduc.2024.1331312>
- Uka, N., & Hallet, I.C. (2023). Improving the academic performance and retention of students in mathematics via mathematical game and puzzle. *International Journal of Academics and Innovation*, 3, 62-70.
- UNextEditorial Team (2020). What is innovative learning and innovative teaching? <https://www.u-next.com>