INTERNATIONAL JOURNAL OF LATEST TECHNOLOGY IN ENGINEERING, MANAGEMENT & APPLIED SCIENCE (IJLTEMAS)

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue X, October 2025

Effect of Learning Platforms on Students' Retention of Algebra Concepts in Port Harcourt in Metropolis, Rivers State

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DOI: https://doi.org/10.51583/IJLTEMAS.2025.1410000106

Received: 20 October 2025; Accepted: 28 October 2025; Published: 14 November 2025

Abstract: This research aimed to investigate the effect of Gamified Quizizz and Google Classroom Platforms on students' retention in algebra. Three research questions and three hypotheses guided the study. A quasi-experimental design was employed, involving 251 Junior Secondary School III Mathematics students (JSS III) from intact classes in three selected private junior secondary schools in the Port Harcourt Metropolis. Data were collected using the Algebra Performance Test (APT), which was further turned Algebra Retention Test (ART), which was validated by three experts and had a reliability coefficient 0.92. Data analysis was performed using SPSS software, with a significance level set at 0.05. Data were analysed using mean, standard deviation, and analysis of covariance (ANCOVA) at the 0.05 significance level. Findings revealed that the retention level of the students taught Algebra concepts using GQP was higher than students taught Algebra concepts using GCP, followed by students taught Algebra concepts using FFM. Also, findings showed that the joint effect of GQP, GCP and FFM and gender in students' retention of the knowledge of Algebra concepts. The study concluded that gamified learning platforms, particularly Quizizz (GQP), significantly improve Algebra retention compared to Google Classroom (GCP) and traditional face-to-face (FFM) methods. It was, however, recommended that curriculum planners should integrate gamified learning approaches into the educational framework for secondary schools in Rivers State to improve the retention of mathematical concepts among students.

Keywords: Learning Platforms, Retention, Algebra Concepts, Students, Port Harcourt

I. Introduction

Knowledge retention, a prerequisite for high achievement, is simply the ability to recall concepts (Mkpa, 2006). It involves retrieving stored information from long-term memory through working memory. Iji, Agbo-Egwu, and Adikwu (2014) observed that long-term memory retention is a central goal of education, noting that the very existence of schools relies on the assumption that learners retain part of what is taught. Retention refers to recalling previously learned knowledge, processes, or skills. Memory plays a vital role in this process. Narli (2011) defines retention as the ability to store and later recall information acquired through learning. Meaningful learning, the ultimate aim of teaching, depends on retention—without it, teaching loses its purpose.

Iji, Agbo-Egwu, and Adikwu (2014) also examined how knowledge structures influence the recollection of experiences. These structures develop from repeated exposure to common features, forming generalized representations. Narli (2011) emphasizes that successful recall depends on efficient encoding, which involves linking new information to existing knowledge. Nneji (2015) describes retention as the act of absorbing and holding learned facts, enabling learners to reproduce acquired knowledge after some time. Students may pass exams after intensive study but fail to retain the material long-term, a common issue in Senior Secondary Schools. Mkpa (2006) argues that retention is influenced by how concepts are taught, highlighting the importance of instructional methods in guiding learning.

Narli (2011) found that lecture-based instruction resulted in the lowest retention levels. However, alternative instructional approaches have shown greater effectiveness. He suggests that retention improves through comprehensive learning and varied teaching methods. Compared to conventional instruction, alternative methods lead to better long-term retention. While immediate learning outcomes may be similar across methods, students taught with diverse strategies tend to outperform those taught solely through lectures when assessed later.

The mind acquires knowledge through sensation and perception. These materials must be retained as mental images for knowledge to develop. Any experience that reaches consciousness leaves impressions, which are stored as images and later revived when triggered by stimuli, enabling memory (Kundu & Tuton, 2006). Retention plays a crucial role in effectively applying learned information. Ausubel and Robinson (2005), cited in Kundu and Tuton (2006), described retention as maintaining access to a replica of acquired meaning. Mkpa (2006) defined it as the sustained ability to perform learned behaviors, emphasizing that teaching methods significantly influence retention. Chanham (2006) noted that retention correlates with positive transfer of learning, a core objective of education. He identified several influencing factors, including the time between learning and recall, intervening experiences, instructional strategies, and environmental conditions. Consequently, student achievement in delayed assessments depends on how well concepts are retained. Those with stronger retention abilities tend to perform better.

Retention is essential for academic success. Students must retain classroom information to benefit from instruction, and educators are responsible for supporting this process. Narli (2011) asserted that retention is directly influenced by the depth of original learning, which in turn depends on the instructional approach. Despite the rise of digital learning tools, secondary school students in Port Harcourt still struggle to retain fundamental algebraic concepts. Traditional methods often fail to maintain engagement or

ISSN 2278-2540 | DOI: 10.51583/IJLTEMAS | Volume XIV, Issue X, October 2025

foster long-term understanding, leading to poor retention and academic underperformance. With the emergence of gamified and interactive platforms, it is vital to explore their impact on students' ability to retain complex mathematical principles. This study aims to evaluate the effectiveness of various learning platforms in enhancing retention of algebraic concepts.

Aim and Objectives of the Study

The main purpose of this study was to investigate the effect of Gamified Quizizz and Google Classroom Platforms on students' retention in mathematics, specifically algebra. The study aimed to:

1. Ascertain the effect of learning platforms (Gamified Quizizz Platform (GQP), Google Classroom Platform (GCP) and Face-to-Face Method (FFM)) on students' retention of Algebra concepts.

2. Determine the influence of gender on students' retention of Algebra concepts.

3. Determine the joint effect of learning platform (GQP, GCP, FFM) and gender on students' retention in Algebra concepts

Research Questions

1. What difference exists among students taught using Gamified Quizizz Platform (GQP), Google Classroom Platform (GCP) and Face-to-Face Method (FFM) in their retention of the knowledge of Algebra concepts?

2. What is the difference between male and female students in their retention of the knowledge of Algebra concepts?

3. What is the joint effect of learning platforms (GQP, GCP and FFM) and gender on students' retention of knowledge of algebra concepts?

Hypotheses

At a significance level of 0.05, the following hypotheses were tested:

1. There is no significant difference among students taught using GQP, students taught using GCP and students taught using FFM in students' retention of Algebra concepts.

2. There is no significant difference between male and female students' retention of Algebra concepts.

3. There is no significant joint effect of learning platform and gender on students' retention of Algebra concepts.

II. Method and Materials

A quasi-experimental design was employed for this study, conducted in Private Junior Secondary Schools in Port Harcourt Metropolis, Rivers State. The population for this study comprised two million, one hundred ninety-eight thousand, four hundred forty-three (2,198,443) Junior Secondary School III Mathematics students (JSS III) in 743 fully accredited private junior secondary schools in Port Harcourt Metropolis. The study sample included 251 Junior Secondary School III Mathematics students (JSS III) drawn from intact classes in three selected private junior secondary schools in Port Harcourt Metropolis. The multi-stage sampling procedure was used to obtain the sample for this study. The three selected schools were allocated to two experimental groups and one control group, which was done by flipping a coin. Data were collected using the Algebra Performance Test (APT), which was further turned Algebra Retention Test (ART). The instrument was validated by three experts, and the reliability of the instrument was assessed with a Kuder Richardson Formula 21 (KR-21) reliability score of 0.92. The two experimental groups were taught using Gamified Quizizz and Google Classroom Platforms, while the control group received traditional face-to-face instruction. Mathematics teachers received a readiness assurance training on using Gamified Quizizz and Google Classroom Platforms to teach Simplification of Algebraic Expressions, Simple Equations and Variations. Pretesting with the Algebra Performance Test (APT) was conducted before the experiment, and post-test results were recorded after four weeks. Then, a post posttest was conducted two weeks after the post-test to determine the retention score. Data were analysed using mean, standard deviation, and analysis of covariance (ANCOVA) at the 0.05 significance level.

III. Results

Research Question One: What difference exists among students taught using Gamified Quizizz Platform (GQP), Google Classroom Platform (GCP) and Face-to-Face Method (FFM) in their retention of the knowledge of Algebra concepts?

Table 1: Mean and standard deviation of the difference that exists among students taught using Gamified Quizizz Platform (GQP), Google Classroom Platform (GCP) and Face-to-Face Method (FFM) in their retention of the knowledge of Algebra concepts

Instructional Strategy	n	Posttest		Retention		Mean Gain
		$\bar{x}$	SD	$\bar{x}$	SD	
GQP	83	65.92	10.70	72.75	6.71	6.83
GCP	86	57.94	9.92	62.98	11.24	5.04

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FFM	82	46.48	10.42	47.59	10.99	1.11

Table 1 shows the difference that exists among students taught using GQP, GCP and FFM in their retention of the knowledge of Algebra concepts. The result revealed that the retention level of the students taught Algebra concepts using GQP was higher (Posttest: Mean = 65.92, SD = 10.71, Retention: Mean = 72.75, SD = 6.71, Mean Gain = 6.83) than students taught Algebra concepts using GCP (Posttest: Mean = 57.94, SD = 9.92, Retention: mean = 62.98, SD = 11.24, Mean Gain = 5.04), and followed by students taught Algebra concepts using FFM (Posttest: Mean = 46.48, SD = 10.42, Retention: Mean = 47.59, SD = 10.99, Mean Gain = 1.11). The difference in the mean gain showed that students taught Algebra concepts using GQP had a slightly higher retention than their counterparts taught using GCP, and followed by the students taught using the FFM.

Research Question Two: What is the difference between male and female students in their retention of the knowledge of Algebra concepts?

Table 2: Mean score and standard deviation of the difference between male and female students in their retention of the knowledge of Algebra concepts

Gender	**n**	**Posttest**		**Retention**		**Mean Gain**
		$\bar{x}$	**SD**	$\bar{x}$	**SD**	
Male	138	58.04	13.06	61.46	13.88	3.42
Female	113	55.36	12.85	60.84	14.73	5.48

Table 2 shows the difference between male and female students in their retention of the knowledge of Algebra concepts. The result revealed that the retention level of the female students taught Algebra concepts was higher (Posttest: Mean = 55.36, SD = 12.85, Retention: Mean = 60.84, SD = 14.73, Mean Gain = 5.48) than their male counterparts (Posttest: Mean = 55.36, SD = 12.85, Retention: Mean = 60.84, SD = 14.73, Mean Gain = 5.48). The difference in the mean retention level of male and female students in Algebra concepts differs substantially in favour of the female students.

Research Question Three: What is the joint effect of learning platforms (GQP, GCP and FFM) and gender on students' retention of knowledge of algebra concepts?

Table 3: Mean score and standard deviation of the joint effect of Gamified Quizizz Platform (GQP), Google Classroom Platform (GCP) and Face-to-Face Method (FFM) and gender in students' retention of the knowledge of Algebra concepts

Instructional Strategy	**Gender**		**Posttest**		**Retention**		**Mean Gain**
		n	$\bar{x}$	**SD**	$\bar{x}$	**SD**	
GQP	Male	50	65.86	10.66	72.06	6.84	6.20
	Female	33	66.00	10.94	73.79	6.46	7.79
GCP	Male	46	58.78	11.16	62.00	11.60	3.22
	Female	40	56.97	8.29	64.10	10.85	7.13
FFM	Male	42	47.90	10.80	48.24	11.13	0.34
	Female	40	44.98	9.92	46.90	10.93	1.92

Table 3 showed the joint effect of Gamified Quizizz Platform (GQP), Google Classroom Platform (GCP) and Face-to-Face Method (FFM) and gender in students' retention of the knowledge of Algebra concepts. The result revealed that the retention level of the female students taught Algebra concepts using GQP was higher (Posttest: Mean = 66.00, SD = 10.94, Retention: mean = 73.79, SD = 6.46, Mean Gain = 7.79) than their male counterparts (Posttest: 65.86, SD = 10.66, Retention: mean = 72.06, SD = 6.84, Mean Gain = 6.20).

The result also revealed that the retention level of the female students taught Algebra concepts using GCP was higher (Posttest: Mean = 56.97, SD = 8.29, Retention: mean = 64.10, SD = 10.85, Mean Gain = 7.13), than their male counterparts (Posttest: 58.78, SD = 11.16, Retention: Mean = 62.00, SD = 11.60, Mean Gain = 3.22)

The result also revealed that the retention level of the male students taught Algebra concepts using FFM (Posttest: 44.98, SD = 9.92, Retention: Mean = 46.90, SD = 10.93, Mean Gain = 1.92), was higher than their male counterparts (Posttest: 47.90, SD = 10.80, Retention: Mean = 48.24, SD = 11.13, Mean Gain = 0.34). The difference in the joint effect of Gamified Quizizz Platform (GQP), Google Classroom Platform (GCP) and Face-to-Face Method (FFM) and gender in students' retention of the knowledge of Algebra concepts showed that female students taught Algebra concepts using GQP had better retention than their male counterparts.

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Also, female students taught using GCP had better retention than their male counterparts. Lastly, female students taught using FFM had better retention than their male counterparts.

Hypothesis One: There is no significant difference among students taught using GQP, those taught using GCP and those taught using FFM in their retention of the knowledge of Algebra concepts.

Table 4: Summary of ANCOVA on the difference that exists among students taught using GQP, those taught using GCP and those taught using FFM in their retention of the knowledge of Algebra concepts.

Dependent Variable: Retention						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	30609.80[a]	3	10203.27	125.23	0.00	0.60
Intercept	12049.48	1	12049.48	147.89	0.00	0.38
Posttest	4072.41	1	4072.41	49.98	0.00	0.17
Group	**8132.73**	**2**	**4066.37**	**49.91**	**0.00**	**0.29**
Error	20125.14	247	81.48			
Total	990204.00	251				
Corrected Total	50734.93	250				
a. R Squared = .603 (Adjusted R Squared = .599)						

Table 4 shows that there is a significant difference among students taught using GQP, those taught using GCP and those taught using FFM in their retention of the knowledge of Algebra concepts ($F_2 = 49.91$, df = 247, $P < 0.05$). Hence, null hypothesis three was rejected at the 0.05 alpha level. The partial eta squared value of 0.29 indicates a small effect size, demonstrating that the difference in the means slightly differed across the groups. This is an indication that a significant difference exists among students taught using GQP, those taught using GCP and those taught using FFM in their retention of the knowledge of Algebra concepts.

Hypothesis Two: There is no significant difference between male and female students in their retention of the knowledge of Algebra concepts.

Table 5: Summary of ANCOVA on the difference between male and female students in their retention of the knowledge of Algebra concepts

Dependent Variable: Retention						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	22588.61[a]	2	11294.30	99.52	0.00	0.45
Intercept	4714.39	1	4714.39	41.54	0.00	0.14
Posttest	22565.04	1	22565.04	198.82	0.00	0.45
Gender	**111.54**	**1**	**111.54**	**0.98**	**0.32**	**0.00**
Error	28146.33	248	113.49			
Total	990204.00	251				
Corrected Total	50734.93	250				
a. R Squared = .445 (Adjusted R Squared = .441)						

Table 5 shows that there is no significant difference between male and female students in their retention of the knowledge of Algebra concepts ($F_1 = 0.98$, df = 248, $P > 0.05$). Hence, null hypothesis six was retained at the 0.05 alpha level. This is an indication that there was no significant difference between male and female students in their retention of the knowledge of Algebra concepts. The partial eta squared value of 0.00 indicates a small effect size, demonstrating that the difference in the means does not differ across the groups.

Hypothesis Three: There is no significant joint effect of learning platforms and gender on students' retention of the knowledge of Algebra concepts.

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Table 6: Summary of ANCOVA on the joint effect of learning platforms (GQP, GCP and FFM) and gender on students' retention of the knowledge of Algebra concepts

Dependent Variable: Retention						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	30835.20[a]	6	5139.20	63.01	0.00	0.61
Intercept	11878.74	1	11878.74	145.65	0.00	0.37
Posttest	4107.42	1	4107.42	50.36	0.00	0.17
Group	8099.44	2	4049.72	49.66	0.00	0.29
Gender	126.45	1	126.45	1.55	0.21	0.01
Group * Gender	**95.19**	**2**	**47.60**	**0.58**	**0.56**	**0.01**
Error	19899.74	244	81.56			
Total	990204.00	251				
Corrected Total	50734.93	250				
a. R Squared = .608 (Adjusted R Squared = .598)						

Table 6 shows that there is no significant joint effect of learning platforms (GQP, GCP and FFM) and gender on students' retention of the knowledge of Algebra concepts ($F_2 = 0.58$, df = 244, $P > 0.05$). Hence, null hypothesis nine was retained at the 0.05 alpha level. This is an indication that there was no significant joint effect of learning platforms and gender on students' retention of the knowledge of Algebra concepts. The partial eta squared value of 0.01 indicates a small effect size, demonstrating that the difference in the means does not differ across the groups.

IV. Discussion of Findings

The findings from research question one revealed that students taught Algebra concepts using the Gamified Quizizz Platform (GQP) demonstrated higher retention levels than those taught with the Google Classroom Platform (GCP), followed by those taught using the Face-to-Face Method (FFM). The mean gain indicated that GQP led to slightly better retention than GCP, with FFM yielding the lowest retention. Hypothesis one confirmed a significant difference in retention among students across the three instructional methods.

This outcome aligns with studies by Rivas-García and Magadán-Díaz (2022) and Pitoyo et al. (2020), which found that gamified platforms like Quizizz enhance engagement and motivation, thereby improving retention. Similarly, Kaufilua and Miranda (2021) supported the effectiveness of problem-solving-based learning in Google Classroom, although its impact was slightly lower than that of GQP. Alabdulaziz and Tayfour (2023) noted that while face-to-face instruction positively influences retention, it remains less effective than interactive and gamified approaches—consistent with the current study's finding that FFM resulted in the lowest retention rates.

Research question two showed that female students had higher retention levels than their male counterparts (Posttest: Mean = 55.36, SD = 12.85; Retention: Mean = 60.84, SD = 14.73; Mean Gain = 5.48). Despite this difference, hypothesis two revealed no statistically significant gender-based variation in retention. This supports findings by Ajai and Imoko (2015), who reported no significant gender differences in achievement and retention when students were taught using problem-based learning (PBL). Olaoye (2019) also found that PBL was more effective than conventional methods, with no significant gender effect on academic performance.

Research question three examined the joint effect of instructional method (GQP, GCP, FFM) and gender on retention. Results showed that female students consistently outperformed male students across all three methods. However, hypothesis three indicated no significant joint effect of instructional method and gender on retention. This finding aligns with Pham (2023), who reported that gamified learning significantly improved grammar achievement compared to traditional methods. It contrasts with Kelly (2009), who found no significant difference in retention between online and face-to-face classes. Additionally, Garratt-Reed, Roberts, and Heritage (2016) observed that gender differences can influence retention and satisfaction in educational settings.

V. Conclusion

This study concluded that gamified learning platforms, particularly Quizizz (GQP), significantly improve Algebra retention compared to Google Classroom (GCP) and traditional face-to-face (FFM) methods. While female students showed slightly higher retention scores, gender was not a statistically significant factor in outcomes. The effectiveness of a platform does not depend on

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student gender. Therefore, adopting gamified digital tools is a recommended strategy for enhancing long-term conceptual understanding in Algebra for all students.

VI. Recommendations

Considering the findings, discussion and conclusions of this study, the following recommendations are made:

1. Curriculum planners should integrate gamified learning approaches into the educational framework for secondary schools in Rivers State to improve the retention of mathematical concepts among students.

2. Parents and guardians should encourage the use of interactive and gamified platforms at home to support students' learning of Algebra concepts, emphasising that these tools are equally effective for both male and female learners.

3. Education supervisory bodies should monitor and evaluate the implementation of gamified teaching methods in schools, ensuring they are effectively utilised and aligned with educational goals while promoting a supportive environment for innovation in teaching practices.

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