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Effect Of Mobile Learning Instructional Strategy On Mathematics Students' Achievement And Retention In Senior Secondary Schools In Delta Central Senatorial District

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ABSTRACT
The study explored the effect of mobile learning instructional strategy on mathematics students' achievement and retention in Delta Central Senatorial District. The study was guided by four research questions and four corresponding hypotheses. A quasi-experimental design of pretest, posttest and delayed posttest was employed. The total population comprised 12,116 SS I mathematics students from 190 public schools across Delta Central Senatorial District in Delta State. A sample of 389 SS 1 mathematics students from public mixed secondary schools was used for the study, being students from six intact classrooms. Data were collected using a validated Mathematics Achievements Test (MAT) with a reliability coefficient of 0.78 established using the Kuder-Richardson formula 21 (K-R 21). Statistical analyses involve mean, standard deviation, independent sample t-test, and ANCOVA. The findings showed that there were significant differences in the main achievement and retention scores among the two instructional methods, with mobile learning instructional strategy (MLIS) yielding the highest benefits. Secondly, there was a significant differences between male and female students achievement taught using mobile learning instructional strategy, and lastly, there was no significant differences in retention between male and female students taught using mobile learning instructional strategy. The study concluded that mobile learning instructional strategy enhanced mathematics students' achievement more than the traditional lecture method. It was therefore recommended that mathematics teachers should adopt the use of mobile learning (Nigeria learning passport) in the teaching of mathematics passport.
Keywords: mobile learning, strategy, mathematics student, achievement retention

INTRODUCTION

Education is fundamental to individual and national development, with mathematics serving as a core subject in Nigeria's secondary school curriculum and a prerequisite for admission into science, technology, and most social science programmes. Mathematics develops learners' logical reasoning, analytical ability, creativity, and problem-solving skills, making it indispensable for intellectual and technological advancement (Skaalvik, Federici, & Klassen, 2015; Zhang & Wang, 2020). The objectives of the mathematics curriculum, as outlined by the Nigerian Educational Research and Development Council (NERDC, 2012), align with the goals of the Federal Republic of Nigeria (FRN, 2013), which

recognizes mathematics as a compulsory subject for national development (FRN, 2004). Despite its importance, students' achievement in mathematics has remained poor, with the WAEC Chief Examiners' reports (2021–2024) revealing persistently low pass rates. Researchers have consistently attributed this trend to ineffective pedagogical approaches, particularly the dominance of the conventional lecture method (Agah & Okeke, 2017; Boyle, 2019; Ginga & Kauru, 2019).

The lecture method, though widely used because of its simplicity, promotes passive learning, rote memorization, and limited interaction between teachers and students (Kelly, 2014). Consequently, educational researchers have advocated learner-centred instructional approaches such as the Mobile Learning Strategy (MLS), which utilizes smartphones, tablets, and other portable digital devices to provide flexible, interactive, and personalized learning experiences. Mobile learning enables students to access instructional materials anytime and anywhere, thereby improving engagement, motivation, collaboration, and understanding of mathematical concepts (Burke, Kearney, Schuck, & Aubusson, 2021; Moreno-Guerrero et al., 2020). The integration of digital technologies into mathematics education has also helped bridge resource gaps, improve academic performance, and enhance students' opportunities for success in examinations such as WAEC, NECO, and UTME (Mailizar, Maulina, & Bruce, 2020; García et al., 2016; Korhonen, Tapola, Linnanmäki, & Aunio, 2016; Bringula et al., 2017).

Mobile learning has gained increasing acceptance in educational practice because it supports constructivist learning, where students actively participate in knowledge construction rather than passively receiving information. Through mobile applications, digital libraries, interactive videos, quizzes, and online discussion platforms, learners can revisit mathematical concepts, receive immediate feedback, and engage in collaborative learning activities at their own pace. This learner-centred approach not only promotes deeper understanding of mathematical concepts but also encourages independent learning and critical thinking skills required in the 21st century. As more schools embrace digital technologies, mobile learning has emerged as a viable instructional strategy capable of complementing classroom teaching and addressing the limitations associated with conventional instructional methods (Burke, Kearney, Schuck, & Aubusson, 2021; Mailizar, Maulina, & Bruce, 2020; Moreno-Guerrero et al., 2020).

Academic achievement refers to the extent to which instructional objectives are attained (Nwanze, 2016), while retention is the ability of learners to recall previously acquired knowledge over time. Research suggests that active learning strategies significantly improve retention, whereas poor teaching techniques contribute to low academic outcomes (Nikos, 2017; Salau, 2009). Mobile learning enhances retention by allowing students to repeatedly access and review learning materials at their convenience. Although studies have reported mixed findings regarding the influence of sex on mathematics achievement and retention, recent large-scale evidence indicates no significant difference between male and female students (Asante, 2010; Stevens, Wang, Olivarez, & Hamman, 2017; Oliweh, 2017; Ajai & Imoko, 2015; Thomson, Hillman, & Wernet, 2021). Given the contrasting characteristics of the conventional lecture method and Mobile Learning Strategy, it becomes necessary to determine whether exposure to mobile learning will significantly improve students' achievement and retention in mathematics.

Statement of the Problem

Mathematics is a core subject in senior secondary schools and a prerequisite for admission into science- and technology-related courses. Despite its importance, students' achievement and retention in mathematics at the senior secondary school level have remained persistently poor, particularly in external examinations such as the West African Senior School Certificate Examination (WASSCE). Reports of the WAEC Chief Examiners from 2020 to 2024 consistently revealed that many candidates demonstrated weak computational skills, poor understanding of mathematical concepts, inability to apply formulas correctly, and low retention of previously learned topics. The reports further highlighted students' difficulties in algebra, trigonometry, statistics, and problem-solving, as well as widespread presentation errors and incomplete solutions, all of which contributed to mass failure in mathematics. This low achievement is worrisome as it will in turn affect other professions such as Engineering, Robotics, Artificial Intelligence, Astronomy, Medicine, and others. This persistent poor achievement has been

attributed partly to the continued use of conventional teaching approaches, especially the lecture method, which often promotes passive learning and limits students' engagement. Such teacher-centered practices may not adequately support students' active participation, independent learning, and long-term retention of mathematical concepts. In addition, the abstract nature of mathematics requires interactive and flexible learning environments that allow students to revisit instructional content, practice repeatedly, and receive immediate feedback, opportunities that are often limited in traditional classroom settings. With the growing availability of smartphones and mobile technologies among secondary school students, mobile learning has emerged as an innovative instructional approach capable of enhancing students' engagement, improving understanding, and promoting retention. Mobile learning enables students to access instructional materials anytime and anywhere, participate in interactive activities, receive instant feedback, and learn at their own pace. Despite these potentials, it is unclear whether the use of mobile learning can significantly improve mathematics students' achievement and retention, particularly in senior secondary schools in the Delta Central Senatorial District. As a result of this, the statement of the problem, therefore, is: Will the use of mobile learning improve students' achievement and retention in mathematics more than the lecture method?

Research Questions

The following research questions guided the study:

1. What is the difference in the mean achievement scores of students taught mathematics using mobile instructional learning strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District?
2. What is the difference in the mean achievement scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District?
3. What is the difference in the retention scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District?
4. What is the difference in the retention scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District?

Hypotheses

The following null hypotheses were raised and tested at the 0.05 alpha level:

1. There is no significant difference in the mean achievement scores of students taught mathematics using mobile instructional learning strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District.
2. There is no significant difference in the mean achievement scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District.
3. There is no significant difference in the retention scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District.
4. There is no significant difference in the retention scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District.

METHODOLOGY

This study adopted a quasi-experimental pretest-posttest delayed posttest control group design to determine the effect of Mobile Learning Instructional Strategy (MLIS) on students' achievement and retention in Mathematics. The study was conducted among a population of 12,166 Senior Secondary One (SS1) Mathematics students in 190 public mixed secondary schools in Delta Central Senatorial District, from which a sample of 386 students in six randomly selected schools was drawn using the simple random sampling technique. Data were collected using the researcher-developed Mathematics

Achievement Test (MAT), comprising 50 multiple-choice items adapted from past WAEC examinations. The instrument was face and content validated, while its reliability was established using the Kuder-Richardson 21 (KR-21) statistic, yielding a reliability coefficient of 0.78. The six schools were assigned to either the experimental (MLIS) or control (lecture method) group, and mathematics teachers were trained to implement the respective instructional approaches over six weeks using uniform lesson periods. The MAT was administered as a pretest before treatment, a posttest immediately after treatment, and a delayed posttest four weeks later to assess students' achievement and retention.

Data Analysis

Mean and standard deviation were used to answer the research questions, while Analysis of Covariance (ANCOVA) was used to test the hypotheses

RESULTS

Research Question 1: What is the difference in the mean achievement scores of students taught mathematics using mobile instructional learning strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District?

Table 1: Descriptive Statistics of Mean and Standard Deviation Comparison of the Post-Test Mean Achievement Scores of Students Taught Mathematics Using Mobile Learning Instructional Strategy and Lecture Method

GROUPS	N	$\bar{X}$	$\bar{X}$Diff	SD
MLIS	177	41.11	9.31	5.28
LM	209	31.80		4.34

Table 1 shows that at post-test, the group exposed to MLIS had a mean achievement score of 41.11 with a standard deviation of 5.28, while the group exposed to the lecture method had a mean achievement score of 31.80 with a standard deviation of 4.34. The difference is 9.31. This indicates a difference between the groups.

Hypothesis 1: There is no significant difference in the mean achievement scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District.

Table 2: Analysis of Covariance (ANCOVA) Summary showing the significant difference in the mean achievement scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method

Dependent Variable: Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	12640.152[a]	2	6320.076	520.147	.000
Intercept	5054.333	1	5054.333	415.976	.000
Pretest	3845.537	1	3845.537	316.491	.000
Groups	11107.946	1	11107.946	914.193	.000
Error	4653.661	383	12.151		
Total	522892.000	386			
Corrected Total	17293.813	385			

a. R Squared = .731 (Adjusted R Squared = .730)

Table 2 shows that there is a significant difference in the mean achievement scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District. This is based on the fact that the calculated significant value of 0.000 is less than the critical significant value of 0.05 ($P < 0.05$). Therefore, Hypothesis 1 is rejected.

Research Question 2: *What is the difference in the mean achievement scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District?*

Table 3: Descriptive statistics of mean and standard deviation comparison of the post-test mean achievement scores of male and female students taught mathematics using mobile learning instructional strategy

Sex	N	$\bar{X}$	$\bar{X}$ Diff.	SD
Male	92	41.98	1.25	5.75
Female	85	40.73		5.23

Table 3 shows a posttest mean achievement score of 41.98 with a standard deviation of 5.75 for male students taught mathematics using mobile learning instructional strategy, while their female counterpart had a posttest mean achievement score of 40.73 with a standard deviation of 5.23. The mean difference between both sexes is 1.25, in favour of the male students.

Hypothesis 2: There is no significant difference in the mean achievement scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District.

Table 4: Analysis of Covariance (ANCOVA) Summary showing the significant difference in the mean achievement scores of male and female students taught mathematics using mobile learning instructional strategy

Dependent Variable: Posttest

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	856.191[a]	2	428.095	19.984	.000
Intercept	2261.167	1	2261.167	105.553	.000
Pretest	787.286	1	787.286	36.751	.000
Sex	123.713	1	123.713	5.775	.017
Error	3727.447	174	21.422		
Total	307640.000	177			
Corrected Total	4583.638	176			

a. R Squared = .187 (Adjusted R Squared = .177)

Table 4 shows that there is a significant difference in the mean achievement scores of male and female students taught mathematics using mobile learning instructional strategy. This is based on the fact that the calculated significant value of 0.017 is less than the critical significant value of 0.05 ($P < 0.05$). Therefore, Hypothesis 3 is rejected.

Research Question 3: *What is the difference in the retention scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District?*

Table 5: Descriptive statistics of mean and standard deviation comparison of the delayed posttest (retention) scores of mathematics students taught using mobile learning instructional strategy and lecture method

Groups	N	$\bar{X}$	$\bar{X}$ Diff.	SD
MLIS	177	37.79	9.56	5.29
LM	209	28.29		4.39

Table 5 shows that students taught mathematics using MLIS had a mean delayed posttest score (retention) of 37.79, with a standard deviation of 5.29, while those taught using LM had a mean delayed posttest score of 28.29, which indicates the retention score with a standard deviation of 4.39. The mean difference is 9.56. This suggests that there is a difference between the delayed posttest scores (retention) of the groups.

Hypothesis 3: There is no significant difference in the retention scores of students taught mathematics using mobile instructional learning strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District.

Table 6: Independent sample t-test comparison of the delayed posttest (retention) scores of mathematics students taught using mobile learning instructional strategy and lecture method

Groups	N	$\bar{X}$	$\bar{X}$ Diff.	SD	Df	t-cal	Sig. (2-tailed)	Decision
MLIS	177	37.79	9.56	5.29	384	19.400	0.000	**H_{05} is Rejected**
LM	209	28.29		4.39				

Table 6 shows that there is a significant difference in the many retention scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method. This is because the calculated significant value of 0.000 is less than the critical significant value of 0.05. With this, $Ho_{4,}$ which states that there is no significant difference in the retention scores of students taught mathematics using mobile learning instructional strategy and those taught using the lecture method in senior secondary schools in Delta Central Senatorial District, is rejected.

Research Question 4: What is the difference in the retention scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District?

Table 7: Descriptive statistics of mean and standard deviation comparison of the delayed post-test mean achievement (retention) scores of male and female students taught mathematics using mobile learning instructional strategy

Groups	N	$\bar{X}$	$\bar{X}$ Diff.	SD
Male	92	38.00	0.45	5.85
Female	85	37.55		4.63

Table 7 shows that male students taught mathematics using MLIS had a mean delayed posttest score (retention) of 38.00, with a standard deviation of 5.85, while their female counterparts had a mean delayed posttest score of 37.55, which signifies the retention score with a standard deviation of 4.63. The mean difference is 0.45. This indicates that there is a difference between the delayed posttest scores of the groups.

Hypothesis 4: There is no significant difference in the retention scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District.

Table 8: Independent sample t-test comparison of the delayed post-test mean achievement (retention) scores of male and female students taught mathematics using mobile learning instructional strategy

Groups	N	$\bar{X}$	$\bar{X}$Diff.	SD	Df	t-cal	Sig. (2-tailed)	Decision
Male	92	38.00	0.45	5.85	175	0.561	0.576	**H_{06} is not rejected**
Female	85	37.55		4.63				

Table 8 shows that there is no significant difference in the retention scores of male and female students taught mathematics using mobile learning instructional strategy. This is because the calculated significant value of 0.576 is greater than the critical significant value of 0.05. With this, Ho_6, which states that there is no significant difference in the retention scores of male and female students taught mathematics using mobile learning instructional strategy in senior secondary schools in Delta Central Senatorial District, is not rejected.

DISCUSSION

The findings from RQ1 and Ho1 revealed a significant difference in the post-test achievement scores of students taught Mathematics using the Mobile Learning Instructional Strategy (MLIS) and those taught using the Lecture Method (LM), as indicated by $F(1, 383) = 914.193$, $p < .05$. The null hypothesis was therefore rejected, indicating that MLIS significantly improved students' academic achievement compared to the lecture method. This improvement may be attributed to the interactive, flexible, and learner-centred nature of mobile learning, which promotes active engagement and continuous access to learning materials. This finding agrees with the studies of Mira and Uluhan (2025), Carl (2024), and Ezeanyi (2025), who reported that mobile learning enhances students' academic performance more effectively than conventional teaching methods. The result also supports the assumptions of Constructivist Learning Theory, which emphasizes active knowledge construction through learner engagement.

The results of RQ2 and Ho2 showed a significant difference in the achievement scores of male and female students exposed to MLIS ($F = 5.775$, $p = .017 < .05$), leading to the rejection of the null hypothesis. This implies that sex significantly influenced students' achievement under the mobile learning strategy, possibly due to differences in technological competence, motivation, and learning preferences. The finding is consistent with Itedjere (2025) but disagrees with the findings of Joseph and Eguma-Nyems (2025) and Nwoke, Ajuzie, Unamba, and Onyegbuchulem (2025), who reported no significant gender differences in achievement using technology-based instructional approaches.

Findings from RQ3 and Ho3 indicated that students taught using MLIS demonstrated better long-term retention than those taught with the lecture method. The superior retention may be attributed to the opportunity for repeated practice, continuous access to instructional materials, interactive learning experiences, and immediate feedback provided through mobile learning. These findings are consistent with Cognitive Learning Theory, which emphasizes active participation and meaningful rehearsal as key factors in improving retention. They also align with empirical evidence supporting the effectiveness of technology-enhanced instructional strategies in promoting both achievement and retention, although studies specifically comparing MLIS and the lecture method in mathematics retention remain limited.

The findings of RQ4 and Ho4 revealed no significant difference in the retention scores of male and female students taught using MLIS. Although male students recorded a slightly higher mean score, the difference was not statistically significant, suggesting that both sexes benefited equally from the strategy. This implies that mobile learning provides an inclusive learning environment by offering self-paced learning, repeated access to instructional materials, and multimedia support that cater to diverse learning needs. The finding is consistent with studies reporting no significant gender differences in retention under learner-centred, technology-based instructional approaches, although empirical studies on sex differences in mathematics retention using MLIS remain scarce.

CONCLUSION

Based on the findings of this study, it was concluded that the Mobile Learning Instructional Strategy (MLIS) is more effective than the conventional lecture method in improving Senior Secondary School students' achievement and retention in Mathematics. Students exposed to MLIS demonstrated significantly higher achievement and better long-term retention of mathematical concepts than those taught through the lecture method. Although sex significantly influenced students' achievement under the mobile learning strategy, it had no significant influence on students' retention, indicating that both male and female students benefited equally in retaining the concepts learned. Therefore, the study concludes that integrating mobile learning into mathematics instruction provides a more engaging, learner-centred, and effective approach to enhancing students' academic outcomes and should be encouraged in secondary schools.

RECOMMENDATIONS

Arising from the findings, the following recommendations were made:

1. Mathematic teachers should adopt mobile learning instructional strategy in their classroom instruction because it significantly improves both students' achievement and retention compared to the traditional lecture method. Moreso, mobile learning allows students to interact with content repeatedly, receive immediate feedback, and learn at their own pace, which are critical factors in mastering mathematics.
2. The government and educational administrators should move beyond general ICT advocacy and make mobile learning a funded priority in secondary education. This means providing reliable infrastructure such as affordable internet access, stable electricity, and subsidized or school-supported mobile devices for students.

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