Influence of Mobile Learning Applications On Students' Problem-Solving Competence in Mathematics in Rivers State, Nigeria

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Abstract

This study examined the influence of mobile learning applications on students' problem-solving competence in mathematics in public secondary schools in Rivers State, Nigeria. A quasi-experimental design complemented with a descriptive survey approach was adopted. The sample consisted of 240 Junior Secondary School II students drawn from eight public secondary schools. Three researcher-developed instruments were used for data collection: The Mobile Learning Application Usage Questionnaire (MLAUQ), the Mathematics Problem-Solving Competence Test (MPSCT), and the Students' Engagement Scale (SES). Data were analyzed using mean, standard deviation, and independent samples t-test at 0.05 level of significance. Results revealed that students taught with mobile learning applications achieved significantly higher problem-solving competence scores than those taught using the conventional method. The study also found a high level of engagement among students exposed to mobile learning applications. The findings underscore the pedagogical value of integrating mobile learning applications into mathematics instruction. It was recommended that teachers, curriculum planners, and policymakers promote structured use of mobile learning applications in Nigerian secondary schools.

Keywords: Mobile learning, Mathematics education, Problem-solving competence, Student engagement, Secondary schools

Introduction

Mathematics is a core subject in the Nigerian educational system and a fundamental tool for scientific, technological, and economic development. Despite its importance, persistent poor performance of secondary school students in mathematics remains a major concern among educators, parents, and policymakers. One of the major challenges confronting mathematics instruction is students' difficulty in developing effective problem-solving competence. Traditional teacher-centered instructional approaches often fail to actively engage learners and support deep conceptual understanding. Recent advances in information and communication technology have introduced mobile learning applications as innovative tools capable of transforming mathematics instruction. Mobile learning applications provide learners with flexible, interactive, and personalized learning experiences that extend beyond the classroom environment. Through features such as instant feedback, multimedia representations, and adaptive learning pathways, mobile learning applications have the potential to enhance students' engagement and problem-solving competence.

In Rivers State, the increasing availability of smartphones among secondary school students presents opportunities for leveraging mobile learning applications to address persistent challenges in mathematics education. However, empirical evidence on the effectiveness of mobile learning applications in enhancing students' problem-solving competence in mathematics within this context remains limited. This study therefore investigated the influence of mobile learning applications on students' problem-solving competence in mathematics in Rivers State. The concept of mobile learning refers to the use of portable digital devices such as smartphones and tablets to support teaching and learning anytime and anywhere. In mathematics education, mobile learning applications enable students to visualize abstract concepts, practice problem-solving skills, and receive immediate feedback. Problem-solving competence in mathematics involves the ability to understand problems, select appropriate strategies, apply mathematical procedures, and evaluate solutions. The study was anchored on constructivist learning theory, cognitive load theory, and self-determination theory. Constructivism emphasizes active learner engagement in knowledge construction, which is supported by interactive mobile learning environments. Cognitive load theory highlights the importance of instructional designs that reduce extraneous cognitive load, a function achieved through step-by-step guidance and visual representations in mobile applications. Self-determination theory explains how autonomy and competence foster intrinsic motivation, which is enhanced through personalized and self-paced mobile learning experiences. Empirical studies consistently report positive effects of mobile learning applications on students' mathematics achievement, engagement, and problem-solving skills. Previous studies have shown that students exposed to mobile-assisted instruction outperform their counterparts taught using conventional methods. However, contextual gaps exist regarding public secondary schools in Rivers State.

Methodology

A quasi-experimental research design complemented with a descriptive survey design was adopted for the study. The population comprised all Junior Secondary School II (JSS 2) Students in public secondary schools in Rivers State which is three hundred and thirty-two (332) with the population of twenty thousand one hundred and ninety-three 20,193 students [nine thousand nine hundred and twenty (9,920) male and ten thousand hundred and seventy-three (10,273) female)]. Source: Universal Basic Education Commission, 2022 Digest of Basic Education Statistics/Public Schools Enrolment by State. A sample of 240 students was selected using multistage sampling techniques. The students were assigned to experimental and control groups using intact classes. Three instruments were used for data collection: The Mobile Learning Application Usage Questionnaire, the Mathematics Problem-Solving Competence Test, and the Students' Engagement Scale. The instruments that used SA = 4, S = 3, D = 2 and SD = 1 were validated by three (3) experts in mathematics education and educational measurement. Reliability coefficients of 0.82, 0.79, and 0.85 were obtained for the MLAUQ, MPSCT, and SES respectively. The experimental group was taught selected mathematics topics using mobile learning applications for six weeks, while the control group received instruction using conventional teaching methods. Data were analyzed using mean, standard deviation, and independent samples t-test.

Results

Research Question 1: What is the influence of mobile learning applications on students' problem-solving competence in mathematics in Rivers State? The data in Table 1 was used in answering this question.

Table1: **Mean and standard deviation of the influence of mobile learning applications on students' problem-solving competence(Post-test) in mathematics in Rivers State**

Group	SA	A	D	SD	N	Mean	SD
Experimental (Mobile Learning)	52	44	16	8	120	21.45	3.62
Control (Conventional Method)	28	36	34	22	120	16.38	4.01

Table 1 presents the raw score distribution of students' problem-solving competence. The experimental group recorded higher frequencies in Strongly Agree and Agree categories compared to the control group. The higher mean score of the experimental group (21.45) indicates that mobile learning applications had a positive influence on students' problem-solving competence in mathematics.

Research Question 2: What is the level of students' engagement in mathematics when taught using mobile learning applications? The data in Table 2and Table 3 were used in answering this question.

Table 2: Distribution of Students' Responses on Engagement Scale (Raw Scores)

Response	Weight	Frequency	Weighted Score
Strongly Agree (SA)	`4	48	192
Agree (A)	3	64	192
Disagree (D)	2	26	52
Strongly Disagree (SD)	1	12	12
Total		150	448

Table 3: Mean and Standard Deviation of Engagement Scores

N	Mean	SD
150	2.99	0.7

Table 1 and 2 show that the majority of students either strongly agreed or agreed with engagement statements. The computed mean score of 2.99, which is above the criterion mean of 2.50, indicates a high level of engagement among students taught using mobile learning applications.

Research Question 3: Is there a difference in problem-solving competence between students exposed to mobile learning applications and those taught using the conventional method? The data in Table 4 was used in answering this question.

Table 4: Pre-test and Post-test Mean Scores of Experimental Group

Test	Mean	SD
Pre-test	14.12	3.85
Post-test	21.45	3.62

Table 4 reveals a substantial increase in the post-test mean score of students exposed to mobile learning applications, indicating improvement in problem-solving competence after the intervention.

Hypotheses

H_{01}: There is no significant difference in the mean problem-solving competence scores of students taught mathematics using mobile learning applications and those taught using the conventional method.

Table 5: Summary of analysis of t – test on the difference in the mean scores of problem-solving competence scores of students taught mathematics using mobile learning applications and those taught using the conventional method in Rivers State

Group	N	Mean	SD	df	t-cal	t-crit	Decision
Experimental	120	21.45	3.62	238	9.84	1.96	Rejected
Control	120	16.38	4.01				

Table 5 shows the t – test analysis for the test of hypothesis one. The mean response of experimental was 21.45 with SD of 3.62, while the mean response of control was 16.38 with SD of 4.01. The degree of freedom is 238 which is 120 + 120 – 2, the calculated t – score is 9.84. The data further revealed through t – test and analysis that there is significant difference between the mean responses of the groups. The result of the analysis is an indication that the t-cal (9.84) > t-crit (1.96), hence the null hypothesis one (H_{01}) was rejected at 0.05 alpha level. This implies that there is a significant difference in the problem-solving competence of students taught using mobile learning applications and those taught using the conventional method in Rivers State.

H_{02}: There is no significant relationship between students' use of mobile learning applications and their problem-solving competence in mathematics.

Table 6: Pearson Correlation between Students' Use of Mobile Learning Applications and Problem-Solving Competence

Variables	N	r-cal	r-crit	df	Decision
Mobile Learning Application Use and Problem-Solving Competence	240	0.63	0.138	238	Rejected

Table 6 shows that the calculated correlation coefficient (r-cal = 0.63) is greater than the critical r-value (r-crit = 0.138) at 0.05 level of significance and 238 degrees of freedom. Therefore, the null hypothesis is rejected. This implies that there is a significant positive relationship between students' use of mobile learning applications and their problem-solving competence in mathematics. Increased use of mobile learning applications is associated with higher problem-solving competence among students.

"Pearson's r-test was used to determine the relationship between mobile learning application usage and problem-solving competence, while the independent t-test was used to compare engagement levels between two independent groups."

H_{03}: There is no significant difference in engagement levels between students taught using mobile learning applications and those taught using conventional methods.

Table 7: Summary of analysis of t – test on the difference in the mean scores of engagement levels scores of students taught mathematics using mobile learning applications and those taught using the conventional method in Rivers State

Group	N	Mean	SD	df	t-cal	t-crit	Decision
Mobile Learning Application Group	120	3.02	0.71	238	6.47	1.96	Rejected
Conventional Method Group	120	2.41	0.68				

The data on **t**able 7 shows the t – test analysis for the test of hypothesis three. The mean response of experimental was 3.02 with SD of 0.71, while the mean response of control was 2.41 with SD of 0.68. The degree of freedom is 238 which is 120 + 120 – 2, the calculated t – score is 6.47. The data further revealed through t – test and analysis that there is significant difference between the mean responses of the groups. The result of the analysis is an indication that the t-cal (6.47) > t-crit (1.96), hence the null hypothesis one (H_{03}) was rejected at 0.05 alpha level. This implies that there is a significant difference in engagement levels between students taught using mobile learning applications and those taught using conventional teaching methods, with students in the mobile learning group demonstrating higher engagement in Rivers State.

Summary

Results indicated that students exposed to mobile learning applications recorded higher mean scores in mathematics problem-solving competence than those taught using conventional methods. Raw score distributions showed higher frequencies of agreement and strongly agree responses among the experimental group. Independent samples t-test revealed a statistically significant difference between the mean scores of the two groups in favor of the experimental group. The engagement results further showed that students taught using mobile learning applications demonstrated high levels of behavioral, emotional, and cognitive engagement in mathematics learning. These findings indicate that mobile learning applications positively influence both engagement and problem-solving competence.

Discussion of the Findings

The findings of this study align with constructivist learning theory, which emphasizes active engagement in learning. The superior performance of students exposed to mobile learning applications can be attributed to the interactive and learner-centered nature of mobile instruction. The high engagement levels observed support self-determination theory, suggesting that mobile learning applications enhance students' autonomy and motivation.

The findings corroborate previous empirical studies that reported significant improvements in mathematics achievement and engagement through mobile-assisted instruction. The study extends existing literature by providing context-specific evidence from public secondary schools in Rivers State.

Conclusion

The study concludes that mobile learning applications significantly enhance students' problem-solving competence and engagement in mathematics. Integrating mobile learning applications into mathematics instruction can improve learning outcomes in public secondary schools.

Recommendations

It is recommended that mathematics teachers incorporate mobile learning applications into instructional practices, curriculum planners embed mobile learning strategies into mathematics curricula, and educational authorities provide necessary digital infrastructure to support mobile learning.

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