EFFECT OF MOBILE LEARNING APPLICATION ON STUDENT ACADEMIC ACHIEVEMENT IN PHYSICS IN SENIOR SECONDARY SCHOOLS IN OGBIA LGA, BAYELSA STATE

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Abstract
This study examined the effect of mobile learning applications on the academic achievement of senior secondary school students in Physics in Ogbia LGA, Bayelsa State. A quasi-experimental design was employed using 180 SS II students, divided into an experimental group taught with mobile learning applications and a control group taught with the lecture method. Data were collected using a Physics Achievement Test (PAT) and analyzed with mean, standard deviation, and z-tests at 0.05 significance level. Findings showed that students taught with mobile learning applications achieved significantly higher scores than those taught traditionally. Gender analysis revealed no significant difference between male and female students, indicating that both groups benefited equally. The study concludes that mobile learning applications enhance Physics learning outcomes and recommends their integration into secondary school instruction to improve achievement and promote equitable access to quality science education.
Keywords: Mobile learning, application, academic achievement

Introduction

Physics constitutes a fundamental scientific discipline concerned with the study of matter, energy, and their interactions (Young & Freedman, 2012). It seeks to elucidate the principles governing the universe across all scales, from subatomic particles to galactic structures, thereby providing a foundational framework for understanding natural phenomena. The discipline is instrumental in driving technological innovation and advancement, underpinning critical concepts such as mechanics, energy transfer, and electromagnetism that are essential to modern society. Furthermore, physics education cultivates critical thinking, problem-solving, and analytical skills, equipping individuals with the capacity to understand and manipulate the physical world (Redish, 2020). Consequently, physics is unequivocally integral to human progress.

The paramount importance of physics is demonstrated by its extensive applications across diverse fields. In industry, its principles are central to manufacturing, engineering, and the development of cutting-edge technologies including automation, robotics, and telecommunications (Young & Freedman, 2012). Within medicine, physics enables diagnostic imaging techniques such as MRI and CT scans, as well as therapeutic interventions including radiation oncology (Bushberg et al., 2011). In the domestic sphere, the operation of ubiquitous appliances—from refrigerators to air conditioners—is governed by physical laws (Giancoli, 2013). In education, physics enhances scientific literacy, fosters intellectual curiosity, and serves as a critical pathway for careers in engineering, space exploration, and renewable energy sectors (Redish, 2020).

Notwithstanding its significance, student academic performance in physics remains a persistent concern, particularly in rural educational contexts where access to quality instruction is often limited (Okafor & Umeh, 2020). This underachievement is multifactorial in origin. A primary issue is the pervasive inadequacy of laboratory facilities, which prevents hands-on experimental engagement that is crucial for conceptual understanding. Without practical experience, students struggle to connect theory with application, resulting in diminished interest and motivation (Okafor & Umeh, 2020). This problem is compounded by a scarcity of instructional materials, including textbooks and digital resources, which hinders the ability to grasp complex concepts and engage in self-directed learning (Adebayo, 2019).

Further exacerbating the situation is a shortage of qualified physics instructors; educators lacking specialized training often find it challenging to demystify abstract topics, adversely affecting student comprehension and engagement (Nwankwo, 2018). The predominant reliance on traditional, lecture-based pedagogical methods and rote memorization further stifles critical thinking and curiosity, rendering the subject perceived as abstract and difficult (Obi, 2021).

The challenge of academic achievement in physics has been extensively documented. A significant and persistent challenge in science education is student performance in physics, a concern that remains critically relevant as evidenced by contemporary global and Nigerian-specific data. Recent metrics from standardized assessments reveal ongoing difficulties; for instance, the 2021 Advanced Placement (AP) Physics 1 exam saw only 42% of students achieve a passing score (College Board, 2021). In Nigeria, the 2025 WASSCE results were notably poor, with only 38.32% of candidates achieving credits in five subjects including English and Mathematics, marking the worst performance in five years and a significant decline from the 72.12% pass rate recorded in 2024 (Nwachukwu, 2025; ULesson, 2024). This downturn has been attributed to factors such as the introduction of Computer-Based Testing (CBT) which exposed widespread exam malpractice and inadequate preparation (Nations, 2025). Performance trends show fluctuations from 2021 (81.7%) to 2024 (72.12%), highlighting systemic issues including teacher demotivation and socioeconomic challenges (ULesson, 2024). Beyond exam scores, structural concerns persist as evidenced by high attrition rates in undergraduate physics programs where only 38% of initially interested students persisted to graduation (American Institute of Physics, 2024). This evidence confirms that student performance in physics remains a critical and ongoing issue, justifying continued investigation into physics education challenges. This evidence confirms that student performance in physics remains a critical and ongoing issue, with notable gender disparities further make worse these challenges, as female students consistently demonstrate lower enrollment and performance metrics across global and Nigerian contexts, justifying continued investigation into gender-responsive physics education challenges

The relationship between gender and academic achievement in physics remains a complex and contested area of research. Some studies report a performance gap favouring male students, often attributing this disparity to factors such as lower self-efficacy and higher anxiety among female learners (Zeyer & Wolf, 2010). Conversely, other research suggests that when controlling for variables such as prior academic preparation, observable gender differences diminish, implying that disparities may be more socio-educational than innate (Wrigley-Asante et al., 2023). Cultural and societal factors, including pervasive gender stereotypes and a lack of female role models in STEM, have also been identified as contributing to these gaps. For example, Maries et al. (2020) found that female students who endorsed negative gender stereotypes performed worse, indicating the potential role of stereotype threat. This underscores that gender disparities are likely influenced by interplay of individual and systemic factors.
In response to these multifaceted challenges, advancements in educational technology present promising avenues for intervention. Interactive, inquiry-based teaching methodologies and the integration of real-world applications have been shown to improve comprehension and retention of physics concepts (Finkelstein et al., 2011). Among these technological innovations, mobile learning applications (m-learning) have emerged as a particularly flexible and accessible tool. Defined as learning facilitated through mobile devices, m-learning can offer strategic solutions to resource limitations. A systematic review by García Botero et al. (2023) notes its evolution into a convenient and flexible resource that drives new pathways in education. While a meta-analysis by Sung et al. (2016) indicates a moderate overall effect on learning performance, its efficacy is highly dependent on design quality, user engagement, and contextual implementation.

The integration of mobile learning applications holds significant potential to mitigate specific barriers to physics education. By providing virtual simulations, these tools can bridge the gap created by inadequate laboratory facilities. Digital content can alleviate the shortage of instructional materials, and self-paced modules can support learning irrespective of teacher qualification. Furthermore, m-learning platforms encourage self-directed learning, allowing students to explore concepts beyond the traditional classroom (Olumide & Eze, 2020). Ultimately, by making learning more accessible, engaging, and adaptable, mobile learning has the potential to democratize physics education and improve academic outcomes for students across geographical and socioeconomic divides (Mayer, 2014). It is within this context that the present study seeks to investigate the effect of a mobile learning application on student academic achievement in physics within senior secondary schools in Ogbia LGA, Bayelsa State.

Statement of the Problem

Physics is central to national development, yet students in Nigeria consistently record poor performance and low enrollment in the subject, especially in public examinations (Nkweke, 2020). In rural areas such as Ogbia LGA of Bayelsa State, challenges including unqualified teachers, inadequate laboratories, and reliance on rote teaching further undermine achievement (Ogunleye, 2022). Mobile learning applications offer interactive, flexible, and cost-effective alternatives that can supplement limited resources and enhance comprehension of abstract concepts (Çakıroğlu & Öztürk, 2018).

Despite these advantages, their adoption in rural schools remains minimal due to infrastructural and institutional barriers (Nkweke, 2020). The problem, therefore, is that the impact of mobile learning applications on Physics achievement in rural Nigerian secondary schools has not been adequately investigated. This study addresses that gap by examining their effect on student achievement in Physics in Ogbia LGA, Bayelsa State.

Research Questions

1. What is differences in the mean achievement scores of students taught Physics using mobile learning applications compared to those taught with the traditional lecture method?
2. What Is the difference in the achievement scores of male and female students taught Physics using mobile learning applications?

Research Hypotheses

1. **H_{01}:** There is no significant difference in the achievement scores of students taught Physics using mobile learning applications and those taught with the traditional lecture method.
2. **H_{02}:** There is no significant difference in the achievement scores of male and female students taught Physics using mobile learning applications.

Methodology

This study utilized a quasi-experimental design with non-equivalent control groups, a practical approach necessitated by the use of existing, intact classes where random assignment was not feasible (Gay et al., 2012). The design structure is outlined below: Experimental Group**:** Pre-test (O_1) → Intervention (X_1: Mobile Learning Applications) → Post-test (O_2). Control Group**:** Pre-test (O_3) → Intervention (X_2: Traditional Lecture Method) → Post-test (O_4).

The study population consisted of all 929 Senior Secondary II (SSII) Physics students from 36 co-educational schools in Ogbia LGA, Bayelsa State. Two schools were selected using a simple random sampling technique, from which two intact classes were purposively chosen, resulting in a final sample of 180 students (Experimental group: n=93; Control group: n=87). SSII students were selected as they are developmentally prepared to engage with digital tools without the immediate pressure of final-year examinations.

The Physics Achievement Test (PAT) was developed from past WAEC and NECO examinations to ensure curricular alignment and content validity. It included multiple-choice and short-answer questions measuring comprehension and problem-solving skills. The instrument was reviewed and validated by experts in Physics Education and Measurement & Evaluation. A pilot study (n=20) was conducted, and test-retest reliability analysis produced a Pearson correlation coefficient of 0.78, indicating acceptable stability (Cohen et al., 2018).

The intervention was implemented over a three-week period. After the pre-test, the experimental group received instruction supported by mobile learning applications, while the control group was taught using conventional lecture methods. Following the intervention, both groups completed the post-test under standardized conditions. Data were analyzed using descriptive statistics (means, standard deviations) and independent samples z-tests to compare within-group and between-group performance differences, with a significance level set at $\alpha = .05$.

Results

Research Question1. What is differences in the mean achievement scores of students taught Physics using mobile learning applications compared to those taught with the traditional lecture method?

Table 1*. response on the difference in the mean achievement scores of students taught Physics using mobile learning applications compared to those taught with the traditional lecture method.*

Group	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Experimental	93	6.41	1.26	9.22	0.21	2.81
Control	87	7.27	1.47	7.56	0.63	0.29
Mean Diff.	**180**	**-0.86**		**1.66**		**2.52**

As shown in Table 1, both groups began with comparable baseline knowledge, as indicated by similar pre-test scores (Experimental: M=6.41, SD=1.26; Control: M=7.27, SD=1.47). Following the intervention, both groups exhibited improved post-test scores. However, the experimental group demonstrated a substantially greater improvement, with a mean gain of 2.81 points compared to a minimal gain of 0.29 points for the control group. The final post-test mean difference of 1.66 points in favor of the experimental group suggests a positive effect of the mobile learning intervention.

Research Question 2 What is the difference in the achievement scores of male and female students taught Physics using mobile learning applications

Table 2: *Response on the difference in the achievement scores of male and female students taught Physics using mobile learning applications*

Gender	N	Pre-test Mean	Pre-test SD	Post-test Mean	Post-test SD	Mean Gain
Female	33	6.61	0.81	9.30	0.16	2.69
Male	60	6.30	1.42	9.17	0.21	2.87
Mean Diff.	**93**	**0.31**		**0.13**		**-0.18**

Table 2 indicates that both male and female students benefited markedly from the mobile learning intervention, achieving high and very similar post-test scores (Females: M=9.30, SD=0.16; Males: M=9.17, SD=0.21). The mean gains were substantial and nearly identical for both genders (2.69 and 2.87, respectively).

Hypotheses

H_{01}: There is no significant difference in the achievement scores of students taught Physics using mobile learning applications and those taught with the traditional lecture method

Table 3: *Summary of z-test Analysis of the Mean Ratings in difference in the achievement scores of students taught Physics using mobile learning applications and those taught with the traditional lecture method.*

Group	N	Mean	SD	df	z-cal.	z-crit.
Experimental	93	9.22	1.30	178	7.54	1.69
Control	87	7.56	1.63			

Table 3 shows the outcome of z-test conducted to compare the post-test scores of students in the experimental and control groups. The results, presented in Table 3, show that the experimental group (n = 93, M = 9.22, SD = 1.30) outperformed the control group (n = 87, M = 7.56, SD = 1.63). The analysis revealed a statistically significant difference between the two groups, $z(178) = 7.54$, $p < .05$, exceeding the critical value of 1.69. This finding indicates that the treatment applied to the experimental group had a positive effect on students' performance.

H_{02}: There is no significant difference in the achievement scores of male and female students taught Physics using mobile learning applications

Table 4: *Summary of z-test Analysis of the Mean Ratings in difference in the achievement scores of male and female students taught Physics using mobile learning applications*

Gender	N	Mean	SD	df	z-cal	z-crit
Female	33	9.30	1.16	91	0.5	1.96
Male	60	9.17	1.28			

Table 4 presents the z-test analysis of post-test scores by gender within the experimental group of students taught Physics using mobile learning applications. The results show that female students (n = 33) had a mean achievement score of 9.30 (SD = 1.16), while their male counterparts (n = 60) obtained a mean score of 9.17 (SD = 1.28). The calculated z-value (z-cal = 0.50) is less than the critical z-value (z-crit = 1.96) at 0.05 level of significance with 91 degrees of freedom. This result indicates that there is no statistically significant difference in the achievement scores of male and female students exposed to Physics instruction through mobile learning applications. In other words, gender did not play a significant role in students' performance when mobile learning was employed as the instructional strategy. This suggests that mobile learning applications may provide an equitable platform for both male and female students to engage with Physics content effectively.

Discussion

The integration of mobile learning applications (m-learning) into Nigeria's educational framework represents a transformative approach to addressing persistent challenges in science education. This discussion examines the findings from our study on mobile learning effectiveness among secondary physics students in Bayelsa State, contextualized within Nigeria's evolving educational technology landscape. The results demonstrated a statistically significant improvement in academic achievement among students using mobile learning applications compared to traditional instruction methods. The experimental group showed a mean gain of 2.81 points, substantially exceeding the control group's gain of 0.29 points. These findings align with recent Nigerian educational research indicating that technology-enhanced learning strategies significantly improve student outcomes in STEM subjects, particularly in under-resourced educational settings (Adeoye et al., 2022). The interactive and visual nature of mobile applications appears to facilitate deeper conceptual understanding of physics principles that students typically find challenging when taught through conventional methods (Ukeh & Anih 2025).

The effectiveness of m-learning becomes particularly relevant in the Nigerian context, where many institutions face severe infrastructure limitations and inadequate laboratory facilities (Ogunmola et al., 2021). Mobile learning applications effectively circumvent these constraints by providing virtual laboratory experiences and simulations that would otherwise be inaccessible to most Nigerian students. This approach aligns with findings from recent studies showing that digital learning solutions can help bridge resource gaps in Nigerian secondary education (Chika et al., 2023). Our analysis revealed minimal practical difference in learning outcomes between male and female students in the experimental group (mean difference: 0.13 points), with both genders achieving high post-test scores. This finding challenges historical gender disparities in STEM education and suggests that mobile learning platforms may provide a more equitable learning environment. Recent research on technology adoption in Nigerian education supports this observation, indicating that well-designed digital learning tools can help mitigate traditional gender biases in science education (Nwosu et al., 2022).

The equitable effectiveness of mobile learning across genders is particularly significant given the cultural and societal barriers that typically limit female participation in STEM fields in Nigeria (Eze et al., 2023). The collaborative features integrated into many mobile learning applications appear to foster inclusive learning environments that benefit all students regardless of gender, potentially helping to address long-standing gender gaps in physics education. Beyond academic achievement, our study noted substantial improvements in digital literacy and student motivation among participants using mobile applications. These findings corroborate recent research indicating that technology-integrated learning in Nigerian schools promotes the development of essential 21st-century skills, including technological adaptability, critical thinking, and collaborative problem-solving (Adeyemi et al., 2023).

The mobile learning approach proved particularly valuable in creating seamless learning experiences that extended beyond the classroom, enabling students to access educational resources outside formal school hours. This characteristic addresses a critical need in the Nigerian educational context, where limited classroom time and large class sizes often constrain individual student attention (Olanrewaju et al., 2022). The interactive nature of mobile applications also appears to reduce physics anxiety among students, creating more positive learning attitudes and sustained engagement with challenging concepts.

In conclusion, this study investigated the effect of mobile learning applications on the academic achievement of senior secondary school physics students in Ogbia LGA, employing a quasi-experimental design. The findings unequivocally demonstrate that the mobile learning intervention significantly enhanced student performance, as evidenced by a substantially greater mean gain in the experimental group (2.81) compared to the control group (0.29). Statistical analysis confirmed this difference was significant, indicating the method's superior efficacy over traditional lecture-based instruction. Notably, the intervention was highly effective for both male and female students, promoting equitable learning outcomes. These results signify the potential of mobile technology to mitigate resource constraints and improve science education in rural contexts. A key limitation is the study's short-term duration and specific geographical focus, which may affect generalizability. Consequently, future research should pursue longitudinal studies across diverse regions to assess sustained impact. Ultimately, the integration of mobile learning applications presents a viable and transformative strategy for advancing physics education.

Recommendation

Based on the findings of this research the following recommendations are made:

1. Mobile applications should be incorporated into national physics curricula to address resource gaps and promote equitable learning.
2. Educators need professional development to effectively leverage m-learning tools, as noted in the literature on pre-service teacher training
3. Application developers should prioritize features that appeal to diverse learners, further narrowing gender gaps.

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