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# EFFECT OF MOBILE LEARNING ON STUDENTS' ACADEMIC PERFORMANCE IN SCIENCE-BASED SUBJECTS IN SECONDARY SCHOOLS IN RIVERS STATE, NIGERIA

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## ABSTRACT

*The method of teaching science-based subjects in junior secondary schools in Nigeria has become a concern. The study was motivated by persistent challenges in Basic Science instruction, where conventional teaching methods often fail to address students' learning difficulties due to abstract concepts and limited access to practical demonstrations. Although mobile learning has gained global attention as a tool for enhancing science instruction, its application in Nigerian junior secondary schools remains limited, this study investigated the effect of mobile learning on students' academic performance in Basic Science in secondary schools in Rivers State. A quasi-experimental design involving 64 JSS 2 students (40 males and 24 females) was adopted. Participants were assigned to experimental and control groups. The experimental group received instruction through mobile learning strategies, while the control group was taught using the conventional lecture method. Pretest and posttest scores were obtained using a validated Basic Science Achievement Test (BSAT). Data were analysed using mean, standard deviation, and analysis of covariance (ANCOVA). Results showed that students taught with mobile learning performed significantly better (18.09 $\pm$ 9.36) than those taught with conventional instruction (14.87 $\pm$ 8.87). Gender differences in performance were not significant, indicating that mobile learning supports equitable learning outcomes. The findings imply that mobile learning enhances understanding, engagement, and overall achievement in science. It is recommended that teachers incorporate mobile learning tools such as educational apps, videos, and interactive quizzes into Basic Science lessons. Furthermore, school administrators and policymakers should provide digital resources and continuous training to support effective mobile-assisted instruction in junior secondary schools.*

**KEYWORDS:** Mobile learning, academic performance, Basic Science, secondary schools, Rivers State

## INTRODUCTION

Education has continued to evolve globally with the integration of digital technologies. Mobile learning (m-learning) has emerged as a major trend in modern pedagogy because of its flexibility, accessibility, and learner-centered approach (UNESCO, 2023). Mobile devices such as smartphones, tablets, and laptops provide opportunities for students to learn anywhere and anytime, bridging the gap between formal and informal learning (Traxler, 2018). In both developed and developing countries, m-learning is increasingly being used to complement classroom instruction and promote self-directed learning (OECD, 2022). Mobile learning is defined as the acquisition of knowledge and skills through the use of portable digital devices such as smartphones, tablets, and laptops (Traxler, 2018). Studies have shown that mobile learning enhances accessibility to instructional materials beyond the classroom, thus extending the learning environment (Park, 2021). In the basic sciences, in the basic education, this implies that students can repeatedly access simulations and digital illustrations of vital concepts such as photosynthesis, respiration, and ecology, which deepens conceptual understanding.

In Nigeria, as currently practiced, the education system is still largely dominated by traditional, teacher-centered methods of instruction. Despite policy reforms emphasizing ICT integration in schools, classroom teaching in science subjects remains predominantly the conventional method, chalk-and-talk, with limited use of digital resources (NERDC, 2021). This approach often limits students' participation, reduces motivation, and contributes to poor performance in national examinations. The West African Examinations Council (WAEC, 2022) repeatedly reports persistent weaknesses in students' achievement in science subjects, particularly in Basic Science, which forms the foundation for future learning in biology, chemistry, and physics.

Science-based subjects at the junior secondary school level is designed to lay a strong foundation for scientific literacy, problem-solving abilities, and a sustained curiosity about the natural world. In Nigeria, the curriculum aims not only to help learners acquire knowledge but also to develop the skills and attitudes required to understand everyday scientific phenomena and make informed decisions in a technology-driven society. However, the abstract nature of many scientific concepts, coupled with inadequate laboratory facilities, often makes learning difficult for students. This challenge becomes more evident when practical demonstrations are limited, making students rely heavily on theoretical descriptions that may not effectively promote deep understanding.

To bridge these gaps, mobile learning has emerged as a promising instructional alternative. Mobile learning provides access to multimedia explanations, simulations, animations, virtual laboratories, and interactive tasks that simplify complex ideas and make lessons more engaging (Al-Emran et al., 2020). These digital tools allow students to visualize scientific processes, manipulate variables in virtual environments, and interact with content at their own pace, thereby enhancing comprehension and retention. Given the steady rise in smartphone ownership among Nigerian secondary school students, the potential for mobile learning integration is high, yet remains largely underutilized in the Basic Science classroom (Kaliisa & Picard, 2019; Olanrewaju et al., 2021).

The introduction of mobile-based instructional strategies also aligns with the broader objectives of teaching science within the Basic Education curriculum. One key objective is to help learners develop a meaningful understanding of scientific concepts, principles, and theories that explain natural phenomena. The curriculum also aims to cultivate scientific skills such as observation, classification, measurement, prediction, and experimentation—skills that are essential for inquiry and problem-solving (Federal Ministry of Education, 2013). Furthermore, Basic Science education seeks to nurture positive scientific attitudes, including curiosity, open-mindedness, creativity, and critical thinking, which are necessary for productive participation in society (UNESCO, 2021). Another important objective is to help students appreciate the relationship between science, technology, and everyday life, especially in areas such as health, agriculture, environment, and sustainable development.

Mobile learning aligns with these objectives by creating opportunities for students to actively interact with scientific content rather than passively receive information. For instance, interactive videos and virtual experiments expose students to practical applications of science despite limited physical laboratory resources. Additionally, mobile platforms encourage self-directed learning, collaboration, and continuous engagement with scientific knowledge both within and outside the classroom environment (Traxler, 2020). As modern educational systems move towards technology-enhanced learning, integrating mobile learning into Basic Science instruction offers a realistic and effective pathway for improving students' understanding and performance.

Gender remains another dimension in science education research. Historically, male students have been perceived as outperforming females in science and technology-related fields (Okeke & Nwankwo, 2020). However, recent findings suggest that technology-mediated learning environments can reduce gender disparities by providing equitable access to resources and opportunities (Ozdamli & Cavus, 2019). Whether this holds true in Basic Science classrooms in Rivers State requires further empirical validation.

Despite global interest in mobile learning, empirical studies in Nigeria, particularly at the secondary school level, remain limited. Most studies have focused on tertiary education, overlooking the formative years where attitudes toward science are shaped (Bello & Hassan, 2020). Moreover, existing studies often generalize ICT integration without focusing on mobile learning as a distinct pedagogical approach. This study, therefore, investigates the effect of mobile learning on students' academic performance in Basic Science in Rivers State, with attention to gender differences.

The Technology Acceptance Model (TAM) (Davis, 1989; Al-Emran & Teo, 2020) explains how perceived ease of use and perceived usefulness influence learners' willingness to adopt digital tools. Secondary school students, who are typically digital natives, are more likely to integrate mobile devices into their study habits if they find them accessible and beneficial to their academic goals.

Studies indicates that students exposed to mobile-assisted instruction consistently outperform their peers taught through traditional chalk-and-talk methods (Nwachukwu & Ogbu, 2021). However, some researchers caution that improper integration of mobile tools can distract students and negatively impact performance (Bello & Hassan, 2020). Also, student engagement is critical in science education, where abstract concepts often require active participation. Mobile applications such as Kahoot, Google Classroom, and PhET simulations provide interactive features that increase motivation and sustained attention (Barhoumi, 2019). Adeoye and Afolabi (2021) found that secondary school students reported higher satisfaction and concentration when mobile tools were integrated into Basic Science lessons.

The impact of gender on academic performance in mobile learning contexts remains debated. Some studies (Okafor & Eze, 2020) reveal that male students show greater enthusiasm in adopting technology, while others (Adeyemi, 2021) report no significant differences. Recent global studies (OECD, 2022) also suggest that female students often perform equally or better in mobile-mediated environments, particularly when content is structured and supportive.

The teacher remains central to the success of mobile learning. While mobile devices expand learning opportunities, effective instructional design and guidance are needed to prevent misuse. Consequently, teachers' digital literacy directly influences the effectiveness of mobile learning strategies (Olumide & Ajayi, 2022). Nwachukwu and Ogbu (2021) conducted a quasi-experimental study among 120 JSS students in Enugu State and found that those exposed to mobile-assisted instruction significantly outperformed the control group. Similarly, Adeoye and Afolabi (2021) reported improved engagement and higher test scores among Lagos State secondary school students using mobile learning platforms. Barhoumi (2019) observed that mobile learning enhanced academic motivation in Tunisian secondary schools, while Al-Emran et al. (2020) found improved learning outcomes in the UAE. However, Bello and Hassan (2020) cautioned that without teacher regulation, mobile devices could become sources of distraction, leading to poor outcomes. From the reviewed literature, it is evident that mobile learning generally enhances academic performance, motivation, and engagement. However, findings remain inconsistent on gender differences, and few studies have rigorously examined its impact in the Nigerian Basic Science context at the junior secondary level. This study therefore fills the gap by conducting a controlled experiment with JSS2 students in Rivers State, using mobile learning as a treatment variable and academic performance in Basic Science as the dependent variable.

## Purpose of the Study

The purpose of this study was to determine the effect of mobile learning on students' academic performance in Basic Science in Rivers State secondary schools.

**Research Questions**

1. What is the difference in the mean performance scores of students taught Basic Science using mobile learning and those taught with the conventional method?
2. What is the difference in the mean performance scores of male and female students taught Basic Science using mobile learning?

**Hypotheses**

1. There is no significant difference in the mean performance scores of students taught Basic Science using mobile learning and those taught with the conventional method.

2. There is no significant difference in the mean performance scores of male and female students taught Basic Science using mobile learning.

**Methodology**

This study employed a quasi-experimental research design, specifically the pretest–posttest control group design, which is appropriate for determining the effect of an instructional intervention where random assignment of participants is not feasible. The design allowed the researcher to compare students' learning outcomes before and after the treatment, and to determine the relative effectiveness of mobile learning on academic performance in Basic Science. The population of the study comprised all Junior Secondary School students in the Universal Basic Education (UBE) section of secondary schools in Rivers State. From this population, a purposive sample of 64 students was drawn from two intact JSS2 classes within a selected school. The sample consisted of 40 male and 24 female students. Purposive sampling was adopted to ensure the availability of comparable classes and to allow the researcher to administer the treatment without disrupting the existing school structure.

Data were collected using the Basic Science Achievement Test (BSAT), a 30-item multiple-choice instrument developed to measure students' mastery of the selected Basic Science concepts. The instrument underwent both face and content validation by experts in Science Education and Measurement and Evaluation to ensure appropriateness, clarity, and alignment with curriculum objectives. To establish the reliability of the test, the Kuder–Richardson Formula 20 (KR-20) was used, yielding a reliability coefficient of 0.84, which indicated that the instrument was internally consistent and suitable for use in the study. Students in the experimental group received instruction through mobile learning tools, including educational apps, short instructional videos, and interactive quizzes. The control group was taught the same Basic Science topics using the conventional lecture–discussion method. Both groups were exposed to the instructional activities for a period of four weeks. Before the intervention, a pretest was administered to both groups to determine their baseline equivalence. At the end of the four-week instructional period, the BSAT was re-administered as a posttest to measure the learning gains attributable to the respective instructional strategies. For data analysis, mean and standard deviation were used to answer the research questions by comparing the pretest and posttest performance of the two groups. The Analysis of Covariance (ANCOVA) was employed to test the research hypotheses at the 0.05 level of significance.

## 4. Results

**Research Question 1.** What is the difference in the mean performance scores of students taught Basic Science using mobile learning and those taught with the conventional method?

**Table 4.1. Summary of descriptive statistics on the difference in the mean achievement scores of students taught with the mobile learning strategy and those taught with the lecture method**

| Groups | N | Pretest | | Posttest | | Gain |
|---|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD | Mean |
| Experimental Group | 52 | 8.55 | 3.61 | 18.09 | 9.36 | 9.54 |
| Control Group | 50 | 7.64 | 3.70 | 14.87 | 8.87 | 7.23 |

The experimental group started with a pretest average score of **8.55**, which was slightly higher than the control group's **7.64**. After the lesson, the experimental group's posttest mean rose sharply to **18.09**, while the control group improved to **14.87.** This shows that both groups improved, but the experimental group improved more. In terms of gain scores, the experimental group recorded a higher mean gain of **9.54,** compared to the control group's **7.23**. This means the teaching method used for the experimental group led to a greater increase in students' performance.

HO1.: There is no significant difference in the mean performance scores of students taught Science subject using mobile learning and those taught with the conventional method.

**Table 2 Summary of ANCOVA on the differences in the mean performance scores of students taught science using mobile classroom strategy and those taught using the conventional lecture method**

| Source | Type III Sum of Squares | Df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 438.828[a] | 2 | 219.414 | 24.490 | 0.000 |
| Intercept | 482.506 | 1 | 482.506 | 53.854 | 0.000 |
| Posttest | 417.361 | 1 | 417.361 | 46.583 | 0.000 |
| Group | 0.164 | 1 | 0.164 | 0.018 | 0.893 |

| | | | |
|---|---|---|---|
| Error | 886.986 | 99 | 8.959 |
| Total | 8031.000 | 102 | |
| Corrected Total | 1325.814 | 101 | |

a. R Squared = .331 (Adjusted R Squared = .317)

The ANCOVA results showed that the model significantly explained students' performance (**F = 24.49, p < .001,** $R^2$ = .331). Posttest scores had a strong significant effect **(F = 46.58, p < .001)**, indicating substantial improvement. However, the group effect was not significant **(F = 0.018, p = .893)**, meaning the flipped and conventional methods did not differ significantly. Overall, students' posttest performance—not the teaching method—accounted for most of the variation in achievement

**Research Question 2.** What is the difference in the mean performance scores of male and female students taught science using mobile learning?

**Table 3. Summary of descriptive statistics on the difference in the mean performance scores of male and female students taught with the mobile learning strategy and those taught with the conventional method**

| Gender | | Pretest | | Posttest | | Gain |
|---|---|---|---|---|---|---|
| | N | Mean | SD | **Mean** | SD | Mean |
| MALE | 25 | 7.24 | 4.17 | 13.36 | 10.04 | 6.12 |
| FEMALE | 27 | 8.74 | 3.16 | 16.88 | 9.46 | 8.14 |

The table showed that male students had a lower pretest mean (7.24) than females (8.74), and both groups improved after the intervention. However, female students had a higher posttest mean (16.88) compared to males (13.36), indicating greater overall improvement. This suggests that female students benefitted more from the learning experience and achieved higher gains than their male counterparts.

HO2. There is no significant difference in the mean performance scores of male and female students taught Science using mobile learning.

**Table 4: Summary of ANCOVA Test of Gender Difference in Experimental Group**

| Source | Type III Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Corrected Model | 294.197[a] | 2 | 147.099 | 17.377 | 0.000 |
| Intercept | 247.431 | 1 | 247.431 | 29.230 | 0.000 |
| Posttest | 264.962 | 1 | 264.962 | 31.301 | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| Gender | 5.011 | 1 | 5.011 | 0.592 | 0.445 |
| Error | 414.783 | 49 | 8.465 | | |
| Total | 4053.000 | 52 | | | |
| Corrected Total | 708.981 | 51 | | | |

a. R Squared = .415 (Adjusted R Squared = .391)

The model significantly explained differences in students' performance **($F = 17.38, p < .001, R^2 = .415$)**. Posttest scores had a strong, significant effect (**$F = 31.30, p < .001$**), showing they were the major contributor to performance differences. However, gender had no significant effect (**$F = 0.592, p = .445$**), indicating that male and female students performed similarly after controlling for posttest scores. Overall, learning outcomes did not differ by gender.

## Discussion

The findings of this study clearly show that mobile learning significantly improved students' academic performance in science compared with the traditional lecture method. This result highlights the growing importance of digital instructional practices in modern classrooms. Earlier scholars have pointed out that the lecture method often reduces students' participation and limits their ability to construct knowledge actively. In contrast, mobile learning exposes learners to interactive digital resources such as videos, animations, simulations, and self-paced exercises which make learning more engaging and meaningful. The present findings therefore support the ongoing shift toward digital pedagogy and confirm that mobile learning is a powerful tool for enhancing learning outcomes in science.

The study's findings, align with the report of Nwachukwu and Ogbu (2021). Their study found that students taught Biology with mobile applications performed better because the apps simplified complex ideas into clear, easy-to-understand forms. In the same way, Al-Emran et al. (2020) also reported that mobile learning increased students' interest, curiosity, and motivation, especially in science subjects, by encouraging continuous learning beyond the classroom. In this study as well, mobile learning provided a flexible and supportive learning environment that allowed students to learn at their own pace, which contributed to the improved performance.

Furthermore, the result supports the findings of Alrasheedi and Capretz (2019), who concluded that mobile learning promotes deeper conceptual understanding. Their work showed that mobile technologies help students visualize scientific concepts using various formats visual, audio, and interactive—thereby improving retention and higher-order thinking skills. These benefits are important in Basic Science, which contains abstract topics that are often difficult for young learners to grasp. Mobile learning therefore helps to bridge the gap between theory and practice by bringing scientific concepts to life through digital demonstrations.

However, not all studies agree with these findings. Bello and Hassan (2020) reported that mobile learning did not significantly improve mathematics achievement. They attributed this to poor teacher competence and inadequate digital infrastructure. They argued that mobile learning only works when teachers are well-trained and schools have the necessary technological resources. This difference in findings shows that successful mobile learning requires proper implementation and continuous professional development for teachers.

The present study also found that gender did not significantly influence performance in the mobile learning group. This has important implications for equity in education. The result is consistent with the findings of Ozdamli and Cavus (2019), who noted that mobile learning reduces gender gaps by giving boys and girls equal access to digital tools and learning opportunities. They emphasized that mobile learning eliminates traditional classroom biases and allows both genders to learn freely at their own pace. On the other hand, the current result contradicts the findings of Okeke and Nwankwo (2020), who reported that boys outperformed girls in science due to cultural influences and boys' greater exposure to technology. The findings of the present study suggest that when digital tools are provided equally and instruction is well structured, gender differences can be reduced or eliminated. This means mobile learning can play an important role in promoting gender fairness in science education, especially in regions where cultural norms may limit girls' participation.

**The implications of these findings for teaching and learning are significant.** First, teachers need to steadily adopt mobile learning strategies as part of everyday classroom practice. The evidence shows that mobile learning increases engagement, understanding, and independent learning among students. Teachers should also encourage students to use mobile tools for personal study so that learning becomes continuous and not just school-based. Second, curriculum planners should revise the Basic Science curriculum to include mobile-friendly activities. Many current curriculum materials are designed for traditional chalk-and-talk methods. Updating them to include digital assignments, virtual experiments, and interactive assessments will make mobile learning a natural part of science instruction rather than an optional addition. Third, policymakers must invest in ICT facilities in schools. As Bello and Hassan (2020) pointed out, mobile learning fails not because the strategy is weak but because the school environment lacks the technology needed to support it. Therefore, adequate internet access, mobile devices, teacher training, and maintenance of ICT tools are essential for its success.

## CONCLUSION

The findings of this study concluded that when mobile learning is properly implemented, it can significantly improve students' academic performance, foster active learning, promote independent study, reduce gender differences, and prepare learners for a digital future.

## RECOMMENDATIONS

In view of the findings, it was recommended that:

1. Teachers handling the science- based subjects in the junior secondary should incorporate mobile learning tools such as educational apps, videos, and quizzes into science-based lessons to enhance students' engagement and improve academic performance.
2. School administrators and policymakers should provide adequate digital resources and training for teachers to effectively implement mobile-assisted learning across junior secondary schools.

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