

## **EFFICACY OF PRACTICAL PHYSICS SKILLS ON SENIOR SECONDARY TWO STUDENTS' ACHIEVEMENT AND RETENTION IN PHYSICS IN BARKIN LADI, PLATEAU STATE, NIGERIA**

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### **Abstract**

This study examined the efficacy of practical physics skills on senior secondary two students' achievement and retention in Physics inBarkinLadi, Plateau State, Nigeria. The quasi-experimental research design was adopted for the study. The population of the study consisted of 920 senior secondary two (SS II) students who offered Physics; from whereassample of 130 SS II students from two intact classes, one eachfrom two co-educational schools was obtained. The simple random sampling technique was used to select the two schools. The instruments used for data collection were the Practical Physics Skills Achievement Test (PPSAT) and the Practical Physics Skills Retention Test (PPSRT). The instruments were validated by three experts. Kuder-Richardson formula 21 (KR-21) was employed to obtain the reliability coefficient of PPSAT as 0.82.Two research questions were answered and two hypotheses were tested at 0.05 level of significance. The mean and standard deviation were used to answer the research questions while analysis of covariance (ANCOVA) was used to test the hypotheses. Findings from the study revealed, amongst others, that practical Physics skills improve students' achievement and retention in Physics.One recommendation the study made, amongst others, was that Physics teachers should integrate practical physics into their teaching because practical skills significantly improved achievement.

**Keywords:** Practical Physics, Skills, Students' Achievement, Students' Retention

### **Introduction**

Education is universally a vital instrument for personal empowerment, social transformation, and national development. It equips science students with the intellectual capacity, skills, values and attitudes required to function effectively in the society and contribute meaningfully to the socio-economic and technological growth of the society. In Nigeria, secondary education occupies a strategic position within the educational system, serving as a transitional stage where students at that level acquire fundamental knowledge and skills required for future use in the wider society. The quality of instruction at this level, therefore, has far-reaching implications for the study of science at the higher institutions of learning.

Science plays a vital role in achieving the goals of technological development of every nation. It promotes scientific literacy, inquiry skills, and problem-solving abilities essential for understanding and addressing contemporary challenges. The Federal Republic of Nigeria, FRN, (2014) emphasized the acquisition and application of scientific and technological knowledge as a means of fostering national progress, economic self-reliance, and global competitiveness. Biology, Chemistry and Physics are core science subjects at the senior secondary school level of education.

Among the science subjects, Physics occupies a unique and foundational position. It explains the fundamental principles governing matter, energy, and the interactions between them. It serves as the bedrock for disciplines such as engineering, medicine, geology, telecommunications, energy studies and information technology. When students study Physics, they acquire analytical thinking, logical reasoning and problem-solving skills, which lead to scientific innovations and growth in technology. Despite the importance of Physics to national development, Josiah (2025), Josiah and Markus (2025) posited that students' achievement in Physics at the senior secondary school level in Nigeria has been fluctuating and generally unimpressive, particularly in external examinations. This could be a consequence of students' poor retention of concepts taught in Physics classroom.

A major factor contributing to this problem is the instructional approach commonly employed in the teaching of Physics. In many Nigerian secondary schools, Physics instruction is dominated by teacher-centered methods such as the lecture method (Josiah, Mallo & Inyang, 2019) which are theoretical, de-emphasizing emphasis on hands-on practical activities. While these methods may allow teachers to cover large portions of the syllabus within a short period, they often do not promote active engagement of students in the learning process. As a consequence, students offering Physics tend to memorize formulae, laws, principles, definitions and other topics taught without developing deep conceptual understanding; leading to poor achievement and lack of retention of Physics concepts.

Practical Physics skills represent a critical instructional strategy for improving students' learning outcomes in Physics. They skills are data collection, measurement, observation, graph plotting, data analysis, and interpretation acquired through Practical activities which are hands-on engagements with laboratory equipment and experimental procedures. Josiah (2013) and Omeodu (2018) found out that when students are exposed to practical Physics knowledge, they achieve high in Physics. Through practical work, students are able to connect abstract theories to real-life phenomena, thereby enhancing conceptual understanding and long-term memory retention. The study was anchored on the constructivist learning theory propounded by Piaget in 1970. The theory posits that learners construct their own knowledge by interacting with their environment, particularly through hands-on experiences that challenge their current thinking and problem-solving tasks, to develop skills. The theory offers a framework for understanding how students learn Physics through practical engagement, actively constructing knowledge through interaction with their environment, a process driven by curiosity, experimentation, and reflection. This implies that learners actively construct knowledge through experience, interaction, and reflection, rather than passively receiving information.

The teaching and learning of Physics in Nigerian secondary schools, particularly in areas such as Barkin Ladi, face numerous challenges. These include inadequate laboratory

facilities, lack of modern equipment, large class sizes, insufficient instructional materials, poor funding, and limited teacher expertise in conducting effective practical lessons. Consequently, many students could be denied opportunities to acquire essential practical Physics skills such as measurement skill, observation skill, data analysis and interpretation skills, problem solving skill, data collection and recording skill, drawing/plotting skill, which negatively affect their achievement and retention of learned concepts. BarkinLadi is one of the 17 local government areas of Plateau State, Nigeria. It is close to Jos, the capital city of Plateau state; and, in this study, it is delineated as BarkinLadi.

Achievement in Physics refers to the extent to which students demonstrate understanding and mastery of Physics concepts, principles, and skills, usually measured through tests and examinations. Musasia (2016) found out that practical skills enhance students' achievement. Apart from students' achievement in Physics, it is necessary for the students to retain concepts they have learnt. Retention refers to students' ability to remember and apply, over time, learned knowledge. In Musasia (2016), Josiah and Pwols (2020) studies, students were found to retain Physics concepts. Students' achievement and retention could be influenced by teaching methods, availability of learning resources, and students' exposure to practical activities.

### **Statement of the Problem**

Physics at the senior secondary school level in Nigeria has been persistently characterized by fluctuating and generally unimpressive student achievement, especially in practical components of the subject. While noting that practical examinations constitute approximately 35–40% of the total Senior School Certificate Examination (SSCE) Physics assessment, weaknesses in practical skills significantly undermine students' overall performance in the subject. Reports, on the West African Senior School Certificate Examination (WASSCE) results for BarkinLadi between 2015 and 2024, by the Educational Resource Centre, ERC (2025) in Jos, Plateau state, Nigeria indicate the credit pass rate of students in Physics as 64.7%, 58.9%, 48.5%, 56.1%, 58.6%, 94.3%, 94.3%, 94.3%, 16.7%, 65.8% and 65.8%. The WAEC Chief Examiners Report (2020) revealed that many students demonstrate poor practical Physics skills and experience difficulty in understanding core topics including Snell's laws, simple harmonic motion and moment of a force.

In the study area, WASSCE results from 2015 to 2024 reveal fluctuating credit pass rates in Physics, suggesting instability in students' achievement and concern for the failure rates. Despite government interventions such as the provision of laboratory equipment, instructional materials, and encouragement of improvisation in teaching, students' performance has not shown consistent improvement. This raises serious concerns about the effectiveness of the instructional methods predominantly used by Physics teachers in the area.

The absence of adequate or delay in exposing students to practical Physics skills in most public schools, limits students' active participation and engagement in the learning process and could contribute to the unsatisfactory achievement of students in Physics. If this problem persists, many students may be denied admission into higher institutions of learning to pursue science, technology, engineering, and mathematics (STEM) courses, thereby reducing the pool of skilled manpower required for national development. This study, therefore, sought to answer this broad question: What is the efficacy of practical Physics

skills on senior secondary two students' achievement and retention in Physics in BarkinLadi, Plateau State, Nigeria?

### **Aim and Objectives of the Study**

The aim of this study was to determine the efficacy of the use of practical physics skills on senior secondary two students' achievement and retention in Physics in BarkinLadi, Plateau State, Nigeria. Specifically, the study sought to:

1. Determine the efficacy of practical physics skills on senior secondary two (SS II) students' achievement in Physics.
2. find out the efficacy of practical physics skills on SS II students' retention in Physics.

### **Research Questions**

The study was guided by the following research questions:

1. What is the efficacy of practical physics skills on SS II students' achievement in Physics?
2. What is the efficacy of practical physics skills on SS II students' retention in Physics?

### **Hypotheses**

The following null hypotheses were formulated and tested at 0.05 level of significance:

1. There is no significant efficacy of practical physics skills on SS II students' achievement in Physics.
2. There is no significant efficacy of practical physics skills on SS II students' retention in Physics.

### **Methodology**

The study adopted the quasi-experimental pretest, posttest non-equivalent control group design. This design was considered appropriate because intact classes were used, as random assignment of students to groups was not feasible. The population of the study comprised all senior secondary two (SS II) students offering Physics in all the public secondary schools in BarkinLadi, Plateau State, Nigeria. The sample consisted of 130 students from two intact classes, one class from each of the two sampled schools were randomly selected. One of the intact classes was randomly assigned as the experimental group while the other was assigned into the control group. There were 77 students (41 male and 36 female) in the experimental group and 53 (23 male and 30 female) in the control group.

The experimental group was taught selected Physics topics using practical Physics skills, while the control group was taught the same topics using the conventional lecture method. The instrument used for data collection was the practical physics skills achievement test (PPSAT) and practical physics skill retention test (PPSRT), designed to measure students' level of interest in Physics. The instrument was validated by experts in Physics education and measurement and evaluation, and its reliability was established using Cronbach's Alpha method. The treatment lasted for six weeks. Data collected were analyzed using mean and standard deviation to answer the research questions, while independent

samples t-test was used to test the hypotheses at the 0.05 level of significance using ANCOVA.

## Results

**Research Question One:** What is the efficacy of practical Physics skills on SS II students' achievement in Physics?

Table1:

Mean and Standard Deviation of SS II Students' Achievement in Physics

| Group        | N  | Pre-test |      | Post-test |      | Mean Gain | $\bar{x}$ -Gain difference |
|--------------|----|----------|------|-----------|------|-----------|----------------------------|
|              |    | Mean     | SD   | Mean      | SD   |           |                            |
| Experimental | 60 | 37.42    | 5.30 | 71.42     | 7.50 | 34.00     | 23.00                      |
| Control      | 70 | 37.06    | 5.18 | 48.06     | 5.68 | 11.00     |                            |

Source: Fieldwork

Table 1 shows the Mean and Standard Deviation of SS II Students' Achievement in Physics. The experimental group obtained a pre-test mean score of 37.42 with a standard deviation of 5.30 and a post-test mean score of 71.42 with a standard deviation of 7.50, yielding a mean gain of 34.00 after exposure to practical Physics skills. The control group had a pre-test mean score of 37.06 with a standard deviation of 5.18 and post-test mean score of 48.06 with a standard deviation of 5.68, yielding a mean gain of 11.00. The result indicated that students in the experimental group had a higher mean gain score after exposure to practical Physics skills than those in the control group who were not given treatment. The mean gain difference was 23.00 in favour of the experimental group. This means that practical Physics skills did increase the students' achievement in Physics.

**Hypothesis One:** There is no significant efficacy of practical Physics skills on SS II students' achievement in Physics.

Table 2:

ANCOVA Result on the Efficacy of Practical Physics Skills on SS II Students' Achievement in Physics

| Source              | Type III Sum of Squares | Df | Mean Square | F       | Sig. | Partial Eta Squared |
|---------------------|-------------------------|----|-------------|---------|------|---------------------|
| Corrected Model     | 17633.545 <sup>a</sup>  | 2  | 8816.773    | 202.042 | .000 | .761                |
| Intercept           | 9235.923                | 1  | 9235.923    | 211.647 | .000 | .625                |
| Achievement pretest | 4.292                   | 1  | 4.292       | .098    | .754 | .001                |
| Group               | 17627.244               | 1  | 17627.244   | 403.940 | .000 | .761                |

|                 |            |     |        |
|-----------------|------------|-----|--------|
| Error           | 5542.062   | 127 | 43.638 |
| Total           | 473231.000 | 130 |        |
| Corrected Total | 23175.608  | 129 |        |

a. R Squared = .761 (Adjusted R Squared = .757)

**Research Question Two:** What is the efficacy of practical Physics skills on SS II students' retention in Physics?

Table 3:

Mean and Standard Deviation of SS II Students' Retention in Physics

| Group        | N  | Pre-test |      | Post-test |       | Mean Gain | $\bar{x}$ -Gain difference |
|--------------|----|----------|------|-----------|-------|-----------|----------------------------|
|              |    | Mean     | SD   | Mean      | SD    |           |                            |
| Experimental | 60 | 37.10    | 6.15 | 75.72     | 10.14 | 38.72     | 26.82                      |
| Control      | 70 | 37.21    | 5.16 | 49.11     | 5.64  | 11.90     |                            |

Source: Fieldwork

Table 3 shows the Mean and Standard Deviation of SS II Students' Retention in Physics. The experimental group obtained a pre-test mean score of 37.10 with a standard deviation of 6.15 and a post-test mean score of 75.72 with a standard deviation of 10.14, yielding a mean gain of 38.72 after exposure to practical Physics skills. The control group had a pre-test mean score of 37.21 with a standard deviation of 5.16 and post-test mean score of 49.11 with a standard deviation of 5.64, yielding a mean gain of 11.90. The result indicated that students in the experimental group had a higher mean gain score after exposure to practical Physics skills than those in the control group who were not given treatment. The mean gain difference was 26.82 in favour of the experimental group. This means that practical Physics skills did increase the students' retention in Physics.

**Hypothesis Two:** There is no significant efficacy of practical Physics skills on SS II students' retention in Physics.

Table 4:

ANCOVA Result on the Efficacy of Practical Physics Skills on SS II Students' Retention in Physics

| Source            | Type III Sum of Squares | Df | Mean Square | F       | Sig. | Partial Eta Squared |
|-------------------|-------------------------|----|-------------|---------|------|---------------------|
| Corrected Model   | 22935.912 <sup>a</sup>  | 2  | 11467.956   | 177.981 | .000 | .737                |
| Intercept         | 9516.071                | 1  | 9516.071    | 147.688 | .000 | .538                |
| Retention pretest | 72.189                  | 1  | 72.189      | 1.120   | .292 | .009                |



|                 |            |     |           |         |      |      |
|-----------------|------------|-----|-----------|---------|------|------|
| Group           | 22887.523  | 1   | 22887.523 | 355.210 | .000 | .737 |
| Error           | 8183.081   | 127 | 64.434    |         |      |      |
| Total           | 521091.000 | 130 |           |         |      |      |
| Corrected Total | 31118.992  | 129 |           |         |      |      |

a. R Squared = .737 (Adjusted R Squared = .733)

The data gathered were subjected to analysis of covariance (ANCOVA) to determine the significant efficacy of SS II students' retention in Physics. Table 4 shows that  $F(1,127) = 355.210$ ,  $P < 0.05$ . Since the p-value of .000 is less than the 0.05 level of significance, the null hypothesis failed to be retained. This indicates that there was a significant efficacy of practical Physics skills on students' retention in Physics. The result further revealed an adjusted R squared value of .733 which means that 73.3 percent of the variation in the dependent variable (students' retention) is explained by variation in the treatment (practical Physics skills); the remaining 26.7 percent of the variation in the in the dependent variable is attributed to other factors not included in this study. Hence, the implication is that practical Physics skills improve students' retention in Physics.

## Discussion

Findings from research question one and hypothesis one showed that practical Physics skills significantly affects students' achievement in Physics. These findings concur with those of Josiah (2013) and Musasia (2016) who reported greater achievement gains in the experimental group supporting the notion that practical skill enhance students' achievement by deepening conceptual understanding and connecting theory to observable phenomena. This implies that practical Physics skills have a significant positive effect on secondary school students' achievement in Physics. The observed post-test mean score gains suggest that practical Physics skills not only improve students' mastery of Physics concepts but also helps them to apply these concepts effectively in achievement tests.

Findings from research question two and hypothesis two showed that practical Physics skills significantly affects students' retention in Physics. This implies that the practical-based intervention, accounted for the improved ability of students to retain Physics concepts. The result corroborates Musasia (2016), Omeodu (2018) and Josiah and Pwols (2020) previous studies which found out that sustained exposure enhances students' retention.

## Conclusion

The findings of this study demonstrate that integrating practical Physics into classroom instruction is a highly effective in promoting the required skills which enhance students' achievement and retention in Physics. Practical Physics, which is hands-on activities, does not only make Physics more engaging and meaningful for learners but also leads to enhancement in students' achievement but brings about long-term recall of concepts. This implies that the transformative potential of practical skills in Physics and the need for schools to invest in laboratory facilities must not be underestimated.

### **Recommendations**

Based on the findings of this study, the following recommendations were made:

1. Policy makers and school authorities should mandate regular hands-on Physics experiments for students, as practical skills have been found to significantly improve students' achievement and retention.
2. Curriculum implementers should be encouraged by school proprietors to start teaching practical Physics to senior secondary one students as it will enhance the inculcation of practical skills in the students from the onset of learning Physics.



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