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Location, Demonstration, Enhanced Teaching Methods and Students' Achievement in Practical Physics in Public Secondary Schools in Nsit Ubium, Akwa Ibom State, Nigeria

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ABSTRACT

This study examined students' achievement in practical Physics in secondary schools, using school location, demonstration and enhanced teaching methods in Nsit Ubium, Akwa Ibom State, Nigeria. Three research hypotheses guided the study. The researchers adopted a pretest, posttest non-equivalent quasi-experimental group design. The population was all students of the 2024/2025 academic session in the 12 co-educational public secondary schools in the area. A sample of 143 Physics students was drawn from four SS2 intact classes of four selected secondary schools using simple random sampling. One instrument and two treatment packages were used to gather data, one for the location and demonstration group, and the other for the enhanced teaching group. The instruments underwent face and content validation. Reliability was established using the Kuder Richardson formula 21 statistics, yielding a coefficient of 0.75. The data were analyzed using descriptive statistics and analysis of covariance (ANCOVA). Results revealed a significant interaction between school demonstration and instructional strategies on students' academic performance in the concept of electricity in Physics. Therefore, the study concludes that the demonstration method would enhance students' academic performance in teaching electricity in both urban and rural schools. Consequently, Physics teachers should adopt the demonstration teaching method to improve students' academic performance in Physics.

Keywords: *School location, demonstration, enhanced teaching methods, students' achievement, Practical Physics*

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INTRODUCTION

Schools in Nigeria are located in both urban and rural areas (Federal Ministry of Education, 2018). The location of schools is a possible strong determinant of activities in the school and students' achievement. The urban centers are blessed with good schools, industries, technology centers, and a good electricity supply. Relatively, the rural schools in most cases might not be as blessed as they sometimes have an irregular supply of electricity, poorly equipped schools and insufficient teachers. The area in which a school is located can affect the academic achievement of a student. Uboh *et al*. (2024) state in a study that school location is one of the major factors that affect students' academic achievements. A school located in a rural area is usually faced with problems like a shortage of teachers, a lack of laboratories, and poorly equipped laboratories, among others, in Nigeria. Inyang *et al*. (2023) stated that the immediate environment of a student plays a major role in the academic achievement of the student. Umar & Samuel (2018) have pointed out that the relationship between the location of a school and students' academic achievements has been reported. Urban students perform better than their counterparts in rural schools.

These apparent differences in the school setting are a source of worry that motivated this study. Physics is an important school subject in Nigerian secondary schools. Its teaching is recommended to be carried out in the Physics laboratory (Federal Ministry of Education, 2018). Any study of Physics done outside the laboratory is a cheat to the students. Being a practical subject, the materials for Physics teaching are stored in the laboratory. A visit to the school laboratory anywhere in Akwa Ibom State will surprise the visitor, as most of the equipment is in a deplorable state. The laboratory equipment is either broken down or abandoned for very minor reasons. The maintenance equipment needed for electricity include a hammer, screwdrivers, pliers, pincers, engine oil, punches, spanners, wire cutters, electrical testers, pieces of wire, knives, wood and an iron saw, among others (Utibe *et al.*, 2017). A survey by the researchers reveals that teachers give several reasons, ranging from broken down equipment, malfunctioning, inability to operate, or lack of parts for the equipment.

Considering the importance of the laboratory in Physics teaching, the laboratory should not only be equipped with laboratory equipment but also with maintenance equipment, technicians and trained teachers with knowledge of Physics equipment. The performance of students in Physics might be affected by the teaching method in Physics. The Federal Ministry of Education clearly states that no teacher can give what the teacher does not have (FME, 2006). This implies that the poor performance of students in public examinations (WASSCE, NECO-SSCE and NABTEB) might be a reflection of what they were taught in school. This study investigates the impact of school location,

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demonstration and enhanced teaching methods on students' achievement in practical Physics in secondary schools in Nsit Ubium.

The analysis of students' performance in Physics as published by WASSCE 2021 – 2025 revealed that the mean performance of students in this examination for the years 2021 – 2025 is below 50% (WAEC, 2025). This poor performance in Physics was earlier observed in the works of Utibe & Agah (2015), Utibe *et al.* (2017) and Utibe & Onwioduokit (2019).

The importance of Physics as a requirement for scientific and technological development of any nation cannot be overemphasized. The technological potentials, societal comforts and entrepreneurial skills and development of Nigeria depend on the quality of the Physics education provided (Utibe & Olah, 2024). Physics is also a requirement for admission into all science and engineering courses in the universities, polytechnics and colleges of education (FME, 2018).

The performance of candidates in Physics examinations conducted by WAEC is usually not very good, as published by WASSCE (WAEC, 2025). There had been a consistently poor performance in Physics over the years. For example, the failure rates in Physics were 45.71% in 2021, 46.17% in 2022, 49.64% in 2023, 43.29% in 2024, and 49.33% in 2025, respectively.

Furthermore, WAEC CERs for school-based candidates 2020 - 2024 display poor understanding and difficulty in electricity practical concepts in the Senior School Certificate Examinations. For instance, most candidates do not answer questions in the electricity practical. Illustrations with diagrams and electrical circuits in questions were also observed to be poorly attempted (WAEC CERs, 2020 - 2024). Science teachers have equally expressed concern for the failure of many students in practical knowledge of most equipment they used (Edem *et al*. 2023 and Utibe & Olah 2024). These poor performances motivated the researchers to examine other teaching methods that may likely enhance students' performance in public examinations. Physics is divided into three basic sections in the external and final SSCE examinations. The sections are objective, theory and practical examinations (WASSCE, 2025; NECO-SSCE, 2025 and Utibe, 2015).

The practical examination is the area where most students are not performing very well. The students are sometimes scared for reasons such as a lack of equipment in the laboratory, poor practical sessions occasioned by teachers' and students' attitudes, fear of damaging the few available equipment by either the teacher or the students. Indeed, most of the teachers cannot give what they do not have (FME, 2006). When the teachers may not have the practical skills of caring for the laboratory equipment, it becomes a more difficult problem to give the students what they do not have. In this

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study, the researchers intend to produce students with an interest in caring for laboratory equipment. The students are taught the following skills:

i. Basic cleaning of laboratory equipment
ii. Tightening of the loose ends of the equipment
iii. Lubrication of the moving parts of the equipment
iv. Replacement of simple parts of the equipment, among others.

The responsibility of the researchers is to help students improve their performance in public examinations.

Utibe (2009) analyzed the students' performances in Physics in rural and urban schools in the WASSCE. The results show a 59.82% decrease in registration in SS3 in urban schools, while a 61.22% increase was in SS3 in rural schools during the period under study. There is a significant difference in the students' performance between urban and rural secondary schools in favour of rural schools.

Ikechuku & Abamba (2021) examined the effects of School location on students' academic achievement in senior secondary Physics based on the 5E learning cycles in Delta State, Nigeria. The result amongst others showed there is no significant difference between rural and urban students' achievement taught using the 5E learning circle (Fcal (113) = Fcrit (0.005), $p>0.05$). Based on the findings, it was recommended, among others, that the 5E learning cycle be adopted in Nigerian secondary schools as a teaching method and that faculties of education in various schools of higher learning should ensure that the 5E learning cycle is included as a method of teaching Physics.

Ekpo *et al*. (2024) determined the students' achievement in Physics in secondary schools through the use of equipment, using demonstration and enhanced lecture methods in Nsit Ubium, Akwa Ibom State, Nigeria. Results revealed that students taught the concept of electricity using a demonstration teaching method, with knowledge of laboratory care performed significantly better than those taught using an enhanced teaching method. Findings also revealed a significant influence/interaction effect of gender and instructional strategies on students' academic performance in the concept of electricity in Physics. The researcher, therefore, concluded that using the demonstration method to teach the concept of electricity would help to enhance students' academic performance. It is on these differences in findings that this study was conducted to determine the students' achievement in Physics in secondary schools through the use of equipment, using demonstration and enhanced teaching methods in Nsit Ubium, Akwa Ibom State, Nigeria.

Consequently, as practicing Physics teachers, the researchers have personally observed a consistently poor performance in electricity concepts as well as general performance in Physics examinations. The researchers have also observed students who graduated from schools without knowing how to care for the laboratory equipment,

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despite the time they spent in the laboratory learning Physics. The level of care of the Physics laboratory equipment in the school laboratory is probably very low. The level of performance of students in WASSCE is very poor. Based on these observations, this study aims to examine the impact of school location, demonstration and enhanced teaching methods on students' achievement in practical Physics in secondary schools in Nsit Ubium, Akwa Ibom State, Nigeria.

Purpose of the Study

The study was designed to achieve the following specific objectives to:

1. Compare the mean achievement scores of Physics students in electricity with knowledge of laboratory equipment care when taught using demonstration and enhanced teaching methods.
2. Compare the mean achievement scores of urban and rural students in practical Physics.
3. Determine the interaction of teaching methods and school location on students' achievement scores in the concept of electricity in Physics.

Research Hypotheses

To guide the conduct of this study, the following null hypotheses were tested at a 0.05 level of significance:

1. There is no significant difference between the mean achievement scores of Physics students in electricity with knowledge of laboratory equipment care when taught using demonstration and enhanced teaching methods.
2. There is no significant difference between the mean achievement scores of urban and rural students in practical Physics.
3. There is no significant interaction of teaching methods and school location on students' achievement scores in the concept of electricity in Physics.

Significance of the Study

This study would be beneficial to students, teachers, curriculum planners, government, textbook writers and researchers. This study sensitizes Physics teachers to encourage students in basic care and maintenance of the equipment at their disposal to improve students' understanding and achievement. It serves as an eye opener to students in Physics and other fields of learning to acquire basic care knowledge of the equipment at their disposal, as this may provide a guide for handling abstract and difficult topics and concepts in their own area of study, improved performance, among others. Finally, the study also contributes to the research materials in the area of Physics education and science education in general for researchers.

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Scope of the Study

This study covered Senior Secondary two (SS2) Physics students in public secondary schools in Nsit Ubium Local Government Area of Akwa Ibom State for the 2023/24 academic session. This is because the electricity concept is scheduled for these students in the Federal Ministry of Education Senior Secondary School Curriculum for Physics (FME, 2023). The study was also limited to the school location and the concept of electricity, with attention to basic care of laboratory equipment. Electricity was taught along with basic care and knowledge of laboratory equipment.

METHODS

This study adopted a quasi-experimental research design using a pretest and posttest non-randomized control group design. Students from two randomly selected schools were used to form the two experimental groups. According to Nworgu (2015), this design is used when there is no randomization of the samples.

This study was conducted in Nsit Ubium Local Government Area of Akwa Ibom State. The population for the study comprised all the Senior Secondary two (SS2) Physics students for the year 2024/2025 session in the 12 public Senior Secondary Schools in the Area. The population was estimated at 1426 students (Nsit Ubium Local Education Committee: LEC, 2025). The study sample comprised 143 Physics students drawn from four randomly selected schools, and these schools were taught using demonstration and enhanced teaching methods. One instrument and two treatment packages (one for the demonstration group and the other for the enhanced teaching group) were used to gather data for the study.

This instrument, the Measurement of Potential Difference Practical Test, was adopted from the WASSCE Physics practical examination for school-based candidates. The items were used to compare the students' achievement in Physics when taught electricity with basic care knowledge of Physics laboratory equipment using demonstration and teaching methods. The pretest and posttest contain the same set of items.

Lesson package on measurement of potential difference, practical test, with basic care knowledge of Physics laboratory equipment was used. This lesson package contained details on the physics practical to determine the electrical resistance of wire and other electrical components with basic care and knowledge of the Physics laboratory equipment. The two experimental groups were different in the teaching methods, but had the same content of the lesson notes.

The instrument and lesson packages were subjected to face and content validations by two Physics lecturers and one lecturer of Measurement and Evaluation, all

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from Akwa Ibom State University. The corrections from the evaluators were incorporated into the study. To further strengthen the validity of the instrument used, the instrument was administered to a trial testing group of 30 Physics students who were not part of the main subjects for the study but who were found to be equivalent in all respects to the subjects in the study. The results obtained in this administration using the Kuder Richardson formula 21. The result showed a reliability coefficient of 0.75. Based on the above reliability index, the instrument was deemed suitable for use in conducting the study.

The research also adopts the WASSCE Physics practical marking guide. The test was marked on a total of 25 marks, with a maximum and minimum of zero marks; the students' performance is depicted.

The following procedures were followed during the teaching and administration of the instrument: The researchers informed the Director of Schools, Nsit Ubium Local Education Committee (LEC), of the use of the four selected schools in the LEC for the conduct of the study. The researcher met with the Principals of the selected schools for proper arrangement for use of the Physics students, Physics teachers, technicians, and relevant facilities in the school Physics laboratory for the conduct of the study, having briefed the Principal of the purpose of the study and the benefit of the study to the students and the school. Four professional Physics teachers and four technicians (one each from the selected schools) were selected and briefed using the lesson packages and the test. These teachers and laboratory technicians were used as research assistants in the study. To predict the effects of the treatments (test instrument), a pretest was administered to the students (intact classes) at the beginning of the study, and the results were used to test a possible effect of the treatment and as covariates in subsequent analysis. The actual teaching and training of the students on the concepts of measurement of electrical resistance, with basic care/maintenance knowledge of Physics laboratory equipment, was done by the regular classroom teachers and laboratory technicians in each of the schools using the lesson packages developed by the researchers for two weeks. Two days of review were allowed for the participants, after which the posttests: Measurement of Electrical Resistance Practical Test was administered to the students.

The data collected in the course of the study were analyzed using descriptive and Analysis of Covariance (ANCOVA) statistics, using pretest scores as covariates. All hypotheses were tested at a 0.05 alpha level of significance.

RESULTS

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Table 1: Mean and standard deviation analysis of students' pre-test and post-test scores classified by treatment groups

Treatment Groups		Pre-test		Post-test		Mean Gain
	N	$\bar{X}$	SD	$\bar{X}$	SD	
Demonstration method	47	7.43	4.60	17.86	3.95	10.43
Enhanced teaching method	40	6.82	2.50	13.25	2.88	6.43

Table 1 shows that the mean gain scores of students taught the concept of electricity with knowledge of laboratory equipment using demonstration and teaching methods are 10.43 and 6.43, respectively. This result indicates that students taught using the demonstration teaching method had the highest mean gain score compared with those who were taught using other teaching methods. Hence, there is a mean difference in favor of those who were taught using the demonstration teaching method.

Table 2: Mean and standard deviation analysis of physics students' pre-test and post-test scores classified by school locations

School location	N	Pre-test		Post-test		Mean Gain Score
		$\bar{x}$	SD	$\bar{x}$	SD	
Urban	59	7.58	4.16	16.61	4.34	9.03
Rural	48	6.54	2.9	14.02	3.37	7.48

Table 2 revealed that the mean gain scores of urban and rural schools' physics students taught the concept of electricity, with care and knowledge of laboratory equipment being 9.03 and 7.48, respectively. This result indicates that physics students in urban schools had a higher mean gain score when compared to their counterparts in rural schools.

Table 3: Estimated marginal posttest mean (adjusted mean) and standard deviation scores of the interaction effect of teaching methods and school location using pretest as covariate

Treatment	Location	N	Post-test	
			$\bar{X}$	SE
Demonstration method	Urban	31	19.68[a]	0.565
	Rural	20	15.05[a]	0.486
Teaching method	Urban	28	13.29[a]	
	Rural	28	13.25[a]	

a. Covariates appearing in the model are evaluated at the following values: Pretest = 7.11.

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Table 3 shows that the adjusted mean score of urban school students taught the concept of electricity in physics using demonstration and teaching methods is 19.68 and 13.29, respectively, while those of their rural school counterparts are 15.05 and 13.25, respectively. This result indicates that there is an interaction impact of treatments and school location, since the plotted graph lines are not parallel to each other, as shown in Figure 1.

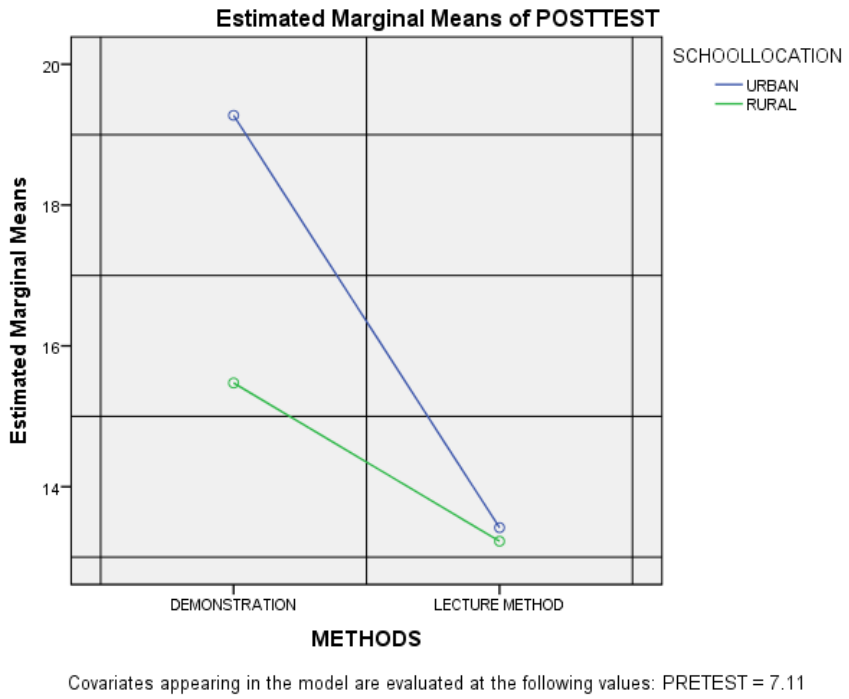

Figure 1: Graph plot showing the interaction of school location and teaching methods on students' achievement in physics

Table 4: Analysis of Covariance (ANCOVA) of students' post-test scores classified by treatment groups and school location

Source		Type III Sum of Squares	df	Mean Square	F	P
Covariate	Pretest	59.063	1	59.063	6.643	.011
Main Effects	Methods	405.554	1	405.554	45.611	.000
	School location	97.010	1	97.010	10.910	.001
2-Way Interactions	Methods * School location	76.653	1	76.653	8.621	.004

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Error	871.373	139	8.892
Total	27341.000	143	
Corrected Total	1804.467	142	

In Table 4, the calculated Probability value of .000 for the main effects (Method) is less than the significance level (0.05). Therefore, the null hypothesis that there is no significant difference in the mean achievement scores of physics students in electricity with knowledge of laboratory equipment care when taught using demonstration and teaching methods is rejected. This implies that at $P < 0.05$, there is a significant difference in the mean achievement scores of physics students when taught the concept of electricity with knowledge of laboratory equipment care using demonstration and teaching methods in favor of those who were taught using the demonstration teaching method.

Table 4 revealed that the analysis of urban and rural school students' posttest performance scores in physics when taught the concept of electricity with knowledge of laboratory equipment care is significant since the calculated F-value = 10.910 at p-value = 0.001 of school location is less than the alpha level (0.05). Therefore, the null hypothesis that there is no significant difference in the mean achievement scores of urban and rural physics students in electricity with knowledge of laboratory equipment care is rejected. This implies that there is a significant difference in the mean achievement scores of urban and rural school physics students in electricity with knowledge of laboratory equipment care.

In Table 4, the calculated F-value = 8.621 at P-value = 0.004 of the interaction effect of methods and school location is less than the significance level (0.05). Therefore, the null hypothesis that there is no significant interaction effect of teaching methods and school location on students' achievement scores in the concept of electricity in physics is rejected. This implies that at $P < .05$, there exists a significant interaction effect of teaching methods and school location on students' achievement scores in the concept of electricity in physics.

Findings from the test of hypothesis one in Table 4 show a significant difference in the mean achievement scores of physics students taught the concept of electricity using demonstration and teaching methods. The academic achievement of students exposed to demonstration and teaching methods while learning the concept of electricity in physics was compared. The outcome of the comparison indicated that the use of the demonstration teaching method in teaching the concept of electricity in physics significantly improved the academic achievement of students more than those who were exposed to the teaching method. This result could be attributed to the fact that students taught using the demonstration teaching method engaged more in hands-on activities, which gives them a better insight and understanding of the concept taught, more than

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those who were exposed to the teaching method. The result of this finding is in line with the findings by Inyang *et al*. (2023), Utibe (2015), who explain that a good demonstration exercise helps students to understand the lesson very clearly, since they combine the senses of sight, hearing, and touch while learning. School location and students' achievement in physics

The findings in testing of hypothesis two, as shown in Table 4, revealed a significant difference in the mean achievement scores of urban and rural school physics students in electricity with knowledge of laboratory equipment care. The overall achievement of urban and rural school students in physics was compared. The outcome of the comparison indicated that there is a significant difference in the achievement of urban and rural school students in physics. Hence, students in urban schools achieve better than students in rural schools. This result may be attributed to the fact that urban schools have better learning facilities and functional laboratories than rural schools. This allows students to have their first exposure and experience in learning physics practical. This finding supports the study of Utibe (2009), which reported a significant difference between the performances of students from Urban and Rural Secondary Schools in favour of rural schools.

The findings in testing of hypothesis three, as shown in Table 4, revealed a significant interaction effect of teaching methods and school location on students' achievement scores in the concept of electricity in physics, with knowledge of laboratory equipment care. Thus, the use of demonstration and teaching methods in teaching the concept of electricity was biased with respect to school location, hence the result obtained. This result could be attributed to the fact that urban schools have good learning facilities and other amenities that foster quality learning more than rural schools. This finding supports the work of Ekpo *et al.* (2024), who revealed a significant interaction effect of instructional strategies and gender on students' academic performance in the concept of electricity in Physics.

This study investigated the impact of school location, demonstration and enhanced teaching methods on students' achievement in practical Physics in secondary schools in Nsit Ubium, Akwa Ibom State, Nigeria. Three research questions and corresponding hypotheses were formulated to guide the study. Relevant learning theories and literature related to the main variables of this study were reviewed. A quasi-experimental design, specifically, a non-randomized pre-test, post-test design was used. The population consisted of all the students in the 2024/2025 academic session at the 12 urban and rural public secondary schools in Nsit Ubium Local Government Area, Akwa Ibom State.

The study sample comprised 143 physics students drawn from four SS2 intact classes of four randomly selected secondary schools. One instrument and two treatment

packages (one for the demonstration group and the other for the teaching group) were used to gather data for the study. The data obtained from the experimental procedure were collated, coded, and analysed using descriptive statistics and Analysis of Covariance (ANCOVA) to test for significance at a 0.05 level of significance.

CONCLUSION AND RECOMMENDATIONS

Based on the study, the researchers hereby concluded that the demonstration teaching method is the most effective in facilitating students' academic achievement in the concept of electricity in physics. This is because students taught using the demonstration teaching method had the best mean achievement scores. The following recommendations were made:

i. Physics teachers should make effective use of the demonstration teaching method in teaching concepts in physics.
ii. Curriculum planners should ensure the incorporation of the demonstration teaching method as a recommended teaching method for teachers in schools for effective teaching and learning of physics.

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