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DEMONSTRATION AND ENHANCED LECTURE TEACHING METHODS, COMBINED WITH CARE OF EQUIPMENT AND STUDENTS' ACHIEVEMENT IN PRACTICAL PHYSICS IN SECONDARY SCHOOLS IN NSIT-UBIUM, AKWA IBOM STATE, NIGERIA

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Abstract

This study was designed to determine the students' achievement in Physics in secondary schools through the care of equipment, using demonstration and enhanced lecture methods in Nsit-Ubium, Akwa Ibom State, Nigeria. Three research questions and three hypotheses were formulated to guide the study. Pretest-posttest non-equivalent quasi-experimental group design was adopted for the study. The population of the study consisted of all 2426 students of 2023/2024 academic session in the 12 co-educational public secondary schools in the area of study. The study sample comprised 87 Physics students drawn from two SS2 intact classes of two selected secondary schools using a simple random sampling technique. One instrument and two treatment packages (one for the demonstration group and the other for the enhanced lecture group) were used to gather data for the study. The instruments were subjected to face validation. The reliability of the instrument was established using test-retest method and subjected to the Pearson Product-Moment Correlation Coefficient. A reliability coefficient of 0.75 was obtained for the instrument. Data collected were analyzed using descriptive statistics and analysis of covariance (ANCOVA) test statistics. Results of the study revealed that students taught the concept of electricity using demonstration teaching method with knowledge of laboratory care performed significantly better than those taught using an enhanced lecture 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. The researcher therefore recommends that Physics teachers should make effective use of the demonstration teaching method in teaching concepts in physics.

Keywords: Demonstration, enhanced lecture methods, achievement, Physics, gender

Introduction

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, FME, 2018). Any study of Physics done outside the laboratory is a cheat to the Physics 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 are in a deplorable state. The laboratory equipment are either broken down or abandoned for very minor reasons. The maintenance equipment needed in electricity are: Hammer, screwdrivers, pliers, pincers, engine oil, punches, spanners, wire cutters, electrical testers, pieces of wire, knives, wood, and iron saw among others (Utibe *et al.*, 2017). A survey

by the researcher reveals that the teachers give several reasons, ranging from breakdown of the 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 well equipped with laboratory equipment but should also be equipped with maintenance equipment, technicians and trained teachers in the knowledge of maintenance of Physics equipment. The performance of students in Physics is directly related to the way students are taught Physics in the schools. The Federal Ministry of Education clearly states that no teacher can give what the teacher does not have (FME, 2006). This reveals that the decimal performance of our students in public examinations (WASSCE, NECO-SSCE and NABTEB) is a reflection of what they were taught in school. This position leads the researchers to this study titled demonstration and enhanced lecture teaching methods, combined with care of equipment and students' achievement in practical Physics in secondary schools in Nsit-Ubium, Akwa Ibom State, Nigeria.

The analysis of the performance of students in Physics as published by WASSCE 2017 – 2023 revealed that the mean performance of students in this examination for the years 2017 – 2023 is below 50% (WAEC result portal 2025). This poor performance in Physics was earlier observed in the works of Utibe & Agah (2015), Utibe *et al.* (2017) and Utibe & Onwioduokit, (2019). With the above trends, this study is conducted to see the effect of teaching students using demonstration and enhanced lecture teaching methods, combined with care of equipment and students' achievement in practical Physics in secondary schools.

Physics, as a branch of science does not only deals with the fundamental questions on the structure of matter and the interaction of the elementary constituents of nature, which are susceptible to experimental investigation and theoretical inquiry, but also with the study of the societal needs and the related entrepreneurial skills. It is an important science subject taught at the senior secondary school level in the country.

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 & Agah, 2015).

The performance of candidates in Physics examinations conducted by WAEC is usually not encouraging, as reports often reveal (WAEC Chief Examiners Report CERs, 2020 - 2024). There has been a consistently poor performance in Physics over the years. For example, the failure rate in Physics in 2020 was 44.7%, 2021 was 45.1%, 2022 was 46.6%, 2023 was 41.9% and 2024 was 49.0% respectively. For the period 2020 - 2024 reported, the highest failure rate was recorded in 2024, with 49.0% of students failing in the examination.

Furthermore, WAEC CERs for June 2020 - 2024 point to a display of poor understanding and difficulty in electricity practical concepts as required in the senior school certificate examinations. For instance, most candidates are said to be unable to answer practical questions in electricity. 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 at the failure of many students to have practical knowledge of most of the equipment they used (Onwioduokit, 2013). These considerations have directed concerned science teachers to examine a variety of teaching methods in search of knowledge enhancement and enrichment in the science classroom. One such strategy is an attempt to enrich the classroom through the practical skills and entrepreneurial development strategy using Physics Education devised and

utilized for this study. Physics is one particular subject that is also a requirement for all science and engineering courses in the polytechnics and universities (FME, 2018).

Physics is divided into three basic sections in the external and final SSCE examinations. The sections are:

i. Objective examination
ii. Theory examination and
iii. Practical examination (WASSCE, NECO-SSCE and Utibe, 2015)

The practical examination is the area where most of the students are very scared and perform very poorly, too. The students are scared for reasons ranging from a lack of equipment in the laboratory, poor practical sessions occasioned by attitudes of teachers and students and the 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 do not have the practical skills of caring for the laboratory equipment, it becomes a more difficult problem to give it to the students what they do not have. This led the researchers to the concept of demonstration and enhanced lecture teaching methods, combined with care of equipment and students' achievement in practical Physics in secondary schools in Nsit-Ubium, Akwa Ibom State, Nigeria. The researchers in this study use the importance of care which laboratory staff give to functional or broken down equipment in the laboratory before seeking the attention of an expert to repair the equipment. In this study, the researchers also intend to produce students who would develop an interest in caring for laboratory equipment. The students would learn the following skills:

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

The responsibility of the teacher is to help students attain maximum achievement in their learning tasks. Several skills are expected of the teacher in order to achieve this goal. Some of the skills include the ability to care for the equipment under their watch and the use of appropriate strategies in teaching. Apart from the teachers' skills, the learner characteristics, such as interest in the equipment use in the laboratory, play a key role in the students' performance in a subject (Utibe & Agah, 2016). Soliu (2017) reveals a statistically significant difference in the achievement of senior school students in WASSCE Physics examinations based on gender from 2010-2014. Utibe (2009) reported a significant difference between the performances of students from male and female candidates in favour of male candidates. Inyang & Isaac (2023) reported that gender was an insignificant factor in students' performance in Biology. Akpan *et al.* (2023) reported a significant interaction effect of gender and instructional materials in the concept of geometry on students' achievement in mathematics. It is on these differences in findings that this study was conducted to determine the students' achievement in Physics in secondary schools through care of equipment using demonstration and enhanced lecture methods in Nsit-Ubium, Akwa Ibom State, Nigeria.

Statement of the Problem

As practicing Physics teachers, the researchers have personally observed a consistent poor performance of students in electricity concepts as well as general performance in Physics. The researchers have also observed students graduated out of schools without acquiring skills in Physics to care for the laboratory equipment in spite of the time they spent in the laboratory learning Physics.

The level of care of the Physics laboratory equipment in the school laboratory is very low, too. The level of performance of students in the WASSCE is very poor. It is on the basis of these observations that the researchers were motivated to carry out this study to examine the effect of demonstration and enhanced lecture teaching methods, combined with care of equipment, on students' achievement in practical Physics in secondary schools in Nsit-Ubium, Akwa Ibom State, Nigeria.

Purpose of the Study

The purpose of this study was to determine the effect of demonstration and enhanced lecture teaching methods, combined with care of equipment and students' achievement in practical Physics in secondary schools in Nsit-Ubium, Akwa Ibom State, Nigeria. 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 lecture methods.
2. Compare the mean achievement scores of male and female students in practical Physics.
3. Determine the interaction effect of teaching methods and gender on student's achievement scores in the concept of electricity in Physics.

Research Questions

In order to guide the researcher in the study, the following research questions were formulated:

1. What is the difference in the mean achievement scores of Physics students in electricity with knowledge of laboratory equipment care when taught using demonstration and enhanced lecture methods?
2. What is the difference in the mean achievement scores of male and female students in practical Physics?
3. What is the interaction effect of teaching methods and gender on students' achievement scores in the concept of electricity in Physics?

Hypotheses

To guide the researcher in the conduct of the study, the following null hypotheses were tested at 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 lecture methods.

2. There is no significant difference between the mean achievement scores of male and female students in practical Physics.
3. There is no significant interaction effect of teaching methods and gender on students' achievement scores in the concept of electricity in Physics.

Significance of the Study

The result of this study would be beneficial to the students, teachers, curriculum planners, government, textbook writers and researchers. This study, when published, will sensitize Physics teachers to encourage the students to have basic care/maintenance knowledge of the equipment at their disposal for improved students' understanding and achievement. It will serve 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 for improved performance among others. Finally, the results of the study would also contribute to the pool of research materials in the area of Physics education in particular and science education in general for the researchers.

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 2023/24 academic session because this concept in electricity is scheduled for this level of students in the Federal Ministry of Education Senior Secondary School Curriculum for Physics (FME, 2008). This study was also delimited to the concept of electricity with basic care of laboratory equipment. The electricity concept was taught with basic care and knowledge of laboratory equipment.

Method

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. This design, according to (Nworgu, 2015) 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 2023/2024 session in the 12 public Senior Secondary Schools in the Area. The population was estimated at 2426 students (Nsit Ubium Local Education Committee: LEC, 2025). The study sample comprised 87 Physics students drawn from two randomly selected schools and these schools were taught using demonstration and enhanced lecture teaching methods. One instrument and two treatment packages (one for the demonstration group and the other for the enhanced lecture 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 lecture teaching methods. The pretest and posttest contain the same set of items.

A Lesson Package on Measurement of Potential Difference Practical Test was conducted 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 knowledge of Physics laboratory equipment. The two experimental groups were different in the teaching methods, but with the same content of lesson notes.

The instrument and lesson packages were subjected to face validation by two Physics lecturers and one lecturer of Measurement and Evaluation, all 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 a test-retest method were subjected to Pearson Product-Moment (PPM) correlation coefficient (r). 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 researcher also adopts the WASSCE Physics practical marking guide. The test was marked on a total of 25 marks maximum and zero marks minimum, if the students' performance depicts it.

The following procedures were followed during the teaching and administration of the instrument: The researcher 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 would be used as research assistants in the study. In order to predict the effects of the treatments (test instrument) 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 researcher under the assistance of the physics teachers and laboratory technicians in each of the schools using the standardized lesson packages developed by the researcher for two weeks. Two days of review were allowed for the participants, after which the posttests: Measurement of Electrical Resistance Practical Test were administered to the students.

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

Results

Research Question 1: What is the difference in the mean achievement scores of physics students in electricity with knowledge of laboratory equipment care when taught using demonstration and lecture teaching methods?

Table 1:Summary of 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	x̄	SD	x̄	SD	
Demonstration method	47	7.43	4.60	17.86	3.95	10.43
Enhanced Lecture method	40	6.82	2.50	13.25	2.88	6.43

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

Research Question Two: What is the difference in the mean achievement scores of male and female students in physics in electricity with knowledge of laboratory equipment care?

Table 2: Summary of Mean and Standard Deviation Analysis of Physics Students' Pre-Test and Post-Test Scores Classified by Gender

Gender	N	Pre-test		Post-test		Mean Gain
		x̄	SD	x̄	SD	
Male	49	7.58	4.16	16.61	4.34	9.03
Female	38	6.54	2.9	14.02	3.37	7.48

Results as shown in Table 2 revealed that the mean gain scores of male and female students in physics taught the concept of electricity with knowledge of laboratory equipment care, are 9.03 and 7.48, respectively. This result indicates that male students in physics had a higher mean gain score when compared to their female counterparts.

Research Question Three: What is the difference in the interaction effect of teaching methods and gender on student's achievement scores in the concept of electricity in physics?

Table 3: Estimated Marginal Posttest Mean (Adjusted Mean) and standard Deviation Scores of the Interaction Effect of Teaching Methods and Gender Using Pretest as Covariate.

Treatment	Gender	N	Post-test	
			x̄	SD
Demonstration method	Male	27	19.68[a]	3.74
	Female	20	15.05[a]	2.94
Lecture method	Male	25	13.29[a]	3.07
	Female	15	13.25[a]	2.73

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

The results in Table 3 shows the mean of male students taught the concept of electricity in physics using demonstration and lecture teaching methods as 19.68 and 13.29, respectively, while those of their female counterparts are 15.05 and 13.25, respectively. This result indicates that no interaction exists between demonstration and lecture teaching methods since the mean value of male students taught using demonstration method is higher than that of their male counterparts taught using lecture method and the mean value of female students taught using lecture method is also lower than that of their female counterparts taught using demonstration method.

Hypothesis One: 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 lecture teaching methods.

Table 4: Summary of Analysis of Covariance (ANCOVA) of Students' Post-Test Scores Classified by Treatment Groups

Source		Type III Sum of Squares	df	Mean Square	F	P
Covariate	Pretest	177.171	1	177.171	17.393	.000
Main Effect	Methods	512.178	1	512.178	50.281	.000*
Error		1059.368	84	10.186		
Total		27341.000	87			
Corrected Total		1804.467	86			

** = Significant at P< 0.05 level of significance*

In Table 4, the calculated Probability value (P-value) of .000 of the main effects (Method) is less than the significance level (0.05). Therefore, the null hypothesis 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 lecture teaching methods in favour of those that were taught using demonstration teaching method.

Hypothesis Two: There is no significant difference in the mean achievement scores of male and female students in physics in electricity.

Table 5: Summary of Independent t-test Analysis of Physics Students' Post-Test Scores Classified by gender

Location	N	Mean	SD	df	t-cal.	P
Male	49	16.61	4.34			
				85	3.38	.001*
Female	38	14.02	3.37			

** = Significant at P< 0.05 level of significance*

Table 5 revealed that the analysis of male and female students' posttest performance scores in physics when taught the concept of electricity with knowledge of laboratory equipment care is significant since the calculated t value of 3.38 at p-value (.001) of gender is less than the alpha level (0.05). Therefore, the null hypothesis is rejected. This implies that there is a significant difference in the mean achievement scores of male and female students in physics in electricity, with knowledge of laboratory equipment care in favour of male students.

Hypothesis Three: There is no significant difference in the interaction effect of teaching methods and gender on students' achievement scores in the concept of electricity in physics.

Table 6: Summary of Analysis of Covariance (ANCOVA) of students' Post-Test Scores Classified by Treatment Groups and Gender

Source		Type III Sum of Squares	df	Mean Square	F	P
Covariate	Pretest	76.553	1	76.553	8.680	.004
Main Effects	Methods	426.772	1	426.772	48.389	.000
	Gender	101.100	1	101.100	11.463	.001
2-Way Interactions	Methods * Gender	76.870	1	76.870	8.716	.004*
Error		899.600	82	8.820		
Total		27341.000	87			
Corrected Total		1804.467	86			

* = Significant at P < 0.05 level of significance

In Table 6, the calculated f-value of 8.716 at P-value of .004 of the interaction effect of methods and gender is less than the significance level (0.05). Therefore, the null hypothesis is rejected. This implies that at P < .05, there exists a significant interaction effect of teaching methods and gender on student's achievement scores in the concept of electricity in physics.

Discussion of Findings

Effect of Demonstration and Lecture Teaching Methods on Students' Achievement in the Concept of Electricity with Basic Knowledge of Care of Laboratory Equipment in Physics

Findings from the testing of hypothesis one, as shown in Table 4, showed that there is a significant difference in the mean achievement scores of physics students taught the concept of electricity using demonstration and lecture teaching methods. The academic achievement of students exposed to demonstration and lecture 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 lecture 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 were exposed to the lecture teaching method. The result of this finding is in line with the findings by Inyang *et al*. (2022), Utibe

(2015), who explains that a good demonstration exercise helps students to understand the lesson very clearly, since they combine the senses of sight, hearing and touching while learning.

Gender and Students' Achievement in Physics

The findings in testing of hypothesis three, as shown in Table 5, revealed that there is a significant difference in the mean achievement scores of male and female students in physics in electricity with knowledge of laboratory equipment care. The overall achievement of male and female students in physics was compared. The outcome of the comparison indicated that there is a significant difference in the achievement of male and female students in physics. Hence, male students achieve better than female students. This result may be attributed to the fact that male students learn better than female students due to the heavy mathematical content in Physics. This finding lean support to the study of Soliu (2017), who also reveals a statistically significant difference in the achievement of senior school students in WASSCE Physics examinations based on gender from 2010-2014. Also in support of this finding, Utibe (2009) reported a significant difference between the performances of students from male and female candidates in favour of male candidates.

Teaching Methods and gender on Students' Achievement in Physics

The findings in testing of hypothesis five as shown in Table 6 revealed that there exists a significant interaction effect of teaching methods and gender on student's achievement scores in the concept of electricity in physics with knowledge of laboratory equipment care. Thus, the use of demonstration and lecture teaching methods in teaching the concept of electricity was bias with respect to gender hence the result obtained. This result could be attributed to the fact that male students back up with superior mathematical ability achieve more than female students. This finding lean support to the work of Akpan *et al*. (2023) who reported a significant interaction effect of gender and instructional materials in the concept of geometry on students' achievement in mathematics.

Summary of the Study

This study investigated the effect of demonstration and enhanced lecture teaching methods, combined with care of equipment and 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. The study adopted a quasi-experimental design; specifically, a non-randomized pre-test, post-test design was used. The population of the study consisted of all the 2426 students of 2023/2024 academic session in the 12 co-educational public secondary schools in Nsit Ubium Local Government Area of Akwa Ibom State.

The study sample comprised 87 physics students drawn from two SS2 intact classes of two randomly selected secondary schools. One instrument and two treatment packages (one for the demonstration group and the other for the lecture group) was used to gather data for the study. The data obtained from the experimental procedure were collated, coded and analysed using mean, standard deviation and Analysis of Covariance (ANCOVA) statistics and tested for significance at a 0.05 level of significance.

Conclusion

Based on the findings of the study, the researcher hereby concluded that 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 demonstration teaching method had the best mean achievement scores.

Recommendations

Based on the findings and the conclusions reached, the following recommendations were made:

1. Physics teachers should make effective use of the demonstration teaching method in teaching concepts in physics.
2. Curriculum planners should ensure the incorporation of the demonstration teaching method as one of the recommended teaching methods to be used by teachers in schools for effective teaching and learning of physics.

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