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Effects of Practical Instructional Approach on Students' Performance in Physics in Nigerian Secondary Schools

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ABSTRACT

This study investigated the effects of practical instructional approach of teaching on students' performance in Physics in Ondo State, Nigeria. The study employed quasi-experimental research of pre-test post-test control group design. A total of 129 senior secondary school two students drawn out of four public secondary schools were randomly selected as samples. They were selected from the 18 Local Government Areas of Ondo State using simple random sampling technique. Two schools were used for each of the experimental and control groups. Students in experimental group were taught using practical instructional approach while the students in the control group were taught using the traditional classroom method. Physics Achievement Test (PAT) was developed, validated and used to generate data for the study. Results of the study showed that students taught using practical instructional approach performed better than those taught using the traditional classroom method. Gender has no effect on the students' academic achievement when exposed to the same teaching approach. It was therefore recommended that Physics teachers should be enlightened and made to recognize the potentials of using practical instructional approach of teaching. Teachers should be encouraged to employ practical instructional approach of teaching to improve students' performance in Physics. Government and school administrators should provide well-equipped laboratory and conducive learning environment to accommodate the use of practical instructional approach of teaching.

INTRODUCTION

Physics is an organized body of knowledge in form of concepts, laws, theories and generations. It is a science based on experiences and whose facts are found empirically (Micheal and Mollmann, 2012). It occupies a unique position in the national school curriculum in Nigeria. Physics is central to many science related disciplines because of its requirement for entry into many science professions and careers.

Physics is a cross-cutting discipline that has applications in many sectors of economy development including health, agriculture, water energy and information technology (Macmillan, 2012). The principles of radiation used in modern medicine for diagnosis and treatment, the production and use of many appliances such as electronic gadgets, computers, surgical and astronomical instruments are all traceable to the study of Physics (Ogunleye and Babajide, 2011). The effective learning of the subject in schools is therefore desirable.

Science teaching and learning cannot be called science without practicals. Physics is taught both in theory and practical in secondary schools. In both internal and external examinations, practical physics is assessed separately as an integral part of the subject. The primary objective of performing a physics experimental is to gain procedural as well as conceptual understanding. This aligned with the affirmation of Moeed, (2010) that practical work is about learning by doing and would confirm the theory presented in the textbooks.

Over the years, poor method of instruction has being observed to be one of the major factors that are responsible for observed poor performance of students. Jegede and Adedayo, (2013) as well as Owolabi and Oginni (2013) attributed the deterioration in students' achievement in Physics to ineffective method of teaching the subject.

A critical look at the content of Physics curriculum in Nigeria indicates that the teacher-centered approaches are not relevant and appropriate to promote efficient learning of the contents of the programme (Akinbobola 2011). The use of traditional classroom instructional approach alone does not encourage meaningful learning (Novak, 2002; Owolabi, 2011).

Effective teaching and learning largely depends on the varieties of method adopted by a teacher (Adegbola, 2011). According to Akinbobola (2011), the selection of appropriate and most effective teaching methods is very important to the success of lesson in Nigerian secondary schools.

The teacher is a facilitator, motivator, guide and a coach not a sage on a stage (Morrison, 2014). Physics instructions should involve the teacher actively encouraging the students to construct their own knowledge by gainfully engaging them with learning activities on classroom and laboratory. Jegede (2016) coined that students by nature, are curious. They are seen active in the learning process in which they are continuously enquiring, testing, speculating and building their own personal constructs of knowledge (Watts, 2013). According to Uhumuavbi and Okodugha (2014), the use of laboratory method of teaching science helps the students to develop manipulate skills. Practical helps the students understand concepts and acquire science process skills (Abraham and Millar, 2008; Afemikhe and Imobekhai, 2014) emphasized on the teacher's engagement of students in experimentation, questioning, discussion and problem-solving.

Gender differences have become critical issues of concern around the world. The affinities and links between students' gender and academic achievement when they are taught using different teaching strategies have been of interest to scholars and researchers. Okoro (2011) indicated the existence of a significant difference in the learning outcomes of male and female students in science while Adepeko (2018) and Oludipe (2012) inferred that there exist no significant difference in the learning outcomes of male and female students. Akanbi (2005) agreed that female students performed better than male students. This contradicts the work of Owolabi (2013) which revealed that gender is not the major issue in Physics practical work as male and female students performed equally in their practical works.

Based on the various findings of these researchers, it is therefore imperative to give both boys and girls the same opportunity of getting fully involved in practical instructional teaching and learning in order to bridge the gap in achievement in Physics.

If Physics is to be learned effectively, it must be experienced and closed to the students through practical activities and the world around. In order to maximize the performance of students in Physics and to close the gender gap in achievement in Physics, there's need to adopt practical instructional approach to the teaching and learning of the subject.

Statement of the Problem

Physics as one of the most important core science subjects offered in Nigerian secondary schools studies the properties of matter and energy and their mutual interaction. Its role in broadening the frontier of scientific and economic advancement in developed and developing nations cannot be over-emphasized.

However, observations have shown poor performance of secondary school students in Physics. Reports from the Chief Examiner of West African School Certificate Examination (WASCE) as well as the researcher's personal experience as an examiner in external examinations indicate that lack of proper exposure to practical activities and the use of ineffective and inappropriate teaching methods contribute to the observed poor performance of Physics students.

The allocation of marks to theoretical and practical aspects of WAEC and NECO Physics examinations is such that it will be very difficult for a student to make a credit pass if he/she performs poorly in Physics practical. Since the use of effective instructional strategy is perceived to enhance better understanding of Physics concepts and improve students' performances in the subjects, this study thus aimed at investigating the effect of practical instructional approach on students' understanding of Physics concepts in Nigerian secondary schools.

Research Questions

1. Will, there be any difference in the academic performance of students taught Physics using practical instructional approach and traditional classroom method?

Research Hypotheses

1. There is no significant difference in the pre-test achievement mean scores of students taught Physics using practical instructional approach and traditional classroom method.

2. There is no significant difference in the post-test achievement mean scores of students taught Physics using practical instructional approach and traditional classroom method.

3. There is no significant difference in the pre-test and post-test achievement mean scores of male and female students taught Physics using practical instructional approach.

MATERIALS AND METHODS

Research Design

This study employed quasi-experimental design of pre-test, post-test non-randomized control groups.

Sample and Sampling Techniques

The sample for the study comprised 129 senior secondary school 2 (SSS 2) students offering Physics in 2019/2020 academic session. They were randomly selected from four co-education public secondary schools across the 18 Local Government Areas of Ondo State using multistage sampling procedure.

The first stage involved the selection of 4 Local Government Areas from the 18 Local Government Areas of Ondo State using simple random sampling technique. The second stage involved the selection of one co-education public secondary school from each of the selected Local Government Areas using simple random sampling technique. The last stage involved the purposive selection of one intact SSS 2 class from each of the selected schools.

Research Instrument

The instrument titled "Physics Achievement Test (PAT)" was used for the study. Section A elicited information on students' bio-data such as name of school, class and sex of students while Section B contained 50 items of multiple choice standard structured questions which were drawn from the West African Senior School Certificate Examination (WASSCE). It measured the students' performance in the Physics concepts taught during the study. The instrument was administered on both the experimental and control groups.

Validity of the Instrument

Face and content validities of the instrument were ensured by experts in Physics Education and Science Education. Their comments and suggestions were strictly adhered to and the corrected version was used for data collection.

Experimental Procedure

At the pre-treatment stage, the research instrument was administered to Physics students in the selected schools to determine their homogeneity. The students were randomly selected and assigned to experimental and control groups respectively.

At the treatment stage, students in the experimental groups were taught Physics concepts using practical instructional approach while the students in the control groups were taught using the traditional classroom method.

The post-treatment stage involved the re-arrangement and administration of the PAT items on all the students.

Data Analysis

The data collected were analyzed using descriptive statistics of mean, standard deviation and bar chart. The hypotheses were tested using t-test and ANOVA.

RESULTS AND DISCUSSION

Research Question:

In order to answer this question, pre-test and post-test achievement scores of the students were computed and presented in Table No. 1 and Figure No. 1 below.

Table No. 1: Academic achievement of students taught Physics using practical instructional approach and traditional classroom method

Methods	N	Pretest		Post-test		Mean	%
		Mean	SD	Mean	SD	Difference	Improvement
Practical Instructional Approach	64	12.44	2.24	18.65	1.97	6.21	49.9
Traditional Classroom method	65	12.06	2.11	13.81	1.41	1.75	14.5
Total	129	12.25	2.18	16..23	1.69		

Table No.1 showed that the pre-test achievement mean scores for students taught Physics using practical instructional approach and traditional classroom method were 12.44 and 12.06

with standard deviations of 2.24 and 2.11 respectively. The mean difference was 0.38 while the deviation of each group's scores from their respective mean scores were nearly the same. This indicated the homogeneity of the sample before treatment.

Table No.1 also showed that the post-test achievement mean score of students taught Physics using practical instructional approach change to 18.65 with standard deviation of 1.97 while those taught using traditional classroom method change to 13.81 with standard deviation of 1.41. The mean difference of 6.21 in the experimental group of 1.75 in the control group indicated 14.5% improvement. This implies that practical instructional approach which effected 49.9% was more effective in improving students' performance in Physics over traditional instruction method which had 14.5%. This is further illustrated pictorially on the bar-chart shown in Figure No.1 below.

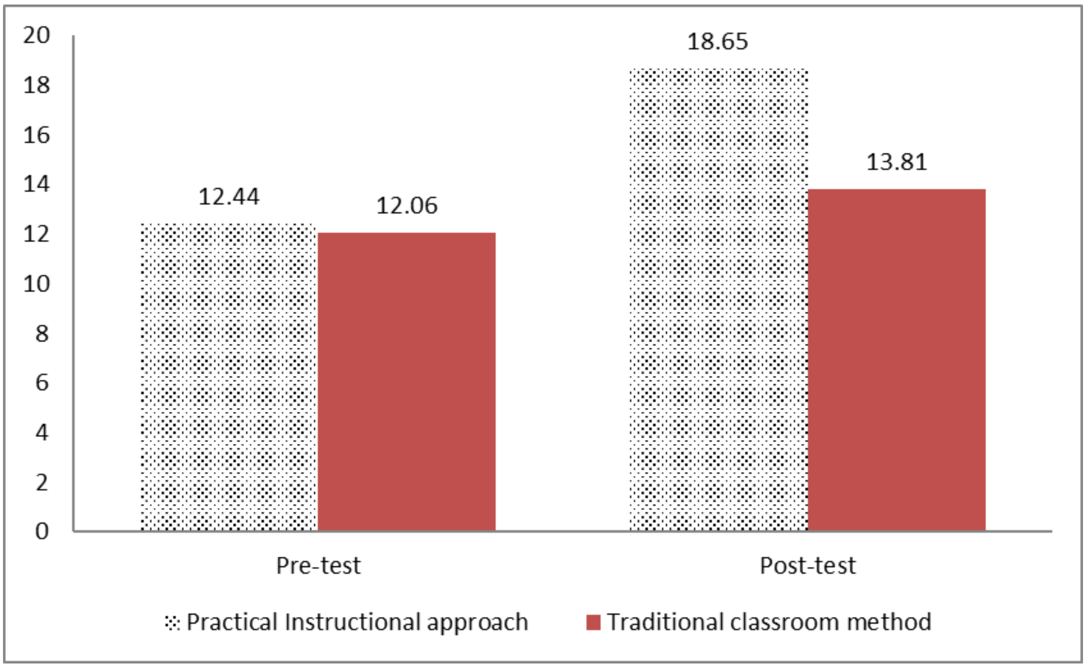

Figure No. 1: Bar-chart showing the effect of practical instructional approach on students' performance in Physics in Nigerian Secondary Schools.

Testing of Hypotheses

Hypothesis 1: In testing the hypothesis, pre-test achievement mean scores of students exposed to practical instructional approach and traditional classroom methods were computed and compared using t-test as shown on Table No. 2.

Table No. 2: t-test comparing pre-test performance mean scores of students taught using practical instructional approach and traditional classroom method.

Groups	N	$\bar{X}$	SD	df	T	p	Result
Practical Instructional approach	64	12.44	2.24	127	0.99	0.098	Not Sig.
Traditional classroom method	65	12.06	2.11				

P > 0.05

Table No. 2 showed that t = 0.99, $P_{(0.098)} > 0.05$. The hypothesis was therefore not rejected. This implies that there was no significant difference in the pre-test achievement mean scores of students taught Physics using practical instructional approach and traditional instructional method. It showed the homogeneity of the samples before treatment.

Hypothesis 2: In testing the hypothesis, post-test achievement mean scores of students exposed to practical instructional approach and traditional classroom methods were computed and compared using ANOVA.

Table No. 3: ANOVA of students' performance in experimental and control groups after treatment

Source of variation	SS	Df	MS	F	P	Result
Corrected Model	1244.46	2	620.73	145.02	0.000	
Intercept	500.95	1	500.95	117.04	0.000	
Covariate	2.32	1	2.32	0..54	0.463	
Group	1228.21	1	1228.21	286.95*	0.000	*Significant
Error	539.30	126	4.28			
Total	57583.00	129				
Corrected Total	1780.76	128				

* P < 0.05

Table No. 3 showed that $F_{(1,127)} = 286.95$; $P_{(0.000)} < 0.05$. The hypothesis was therefore rejected. This implies that there was significant difference in the post-test achievement mean scores of students exposed to practical instructional approach and traditional classroom method. The source of the significant difference was determined using Multiple Classification Analysis as shown in table 4 below.

Table No. 4: Multiple Classification Analysis showing the effect of treatment on students' achievement in Physics

Grand mean = 20.83					
Variable + Category	N	Unadjusted Dev.	Eta2	Adjusted for Independent + Covariate	
Practical Instructional approach	64	3.09	.836	3.11	0.04
Traditional classroom method	65	-3.10		-3.13	
Multiple R Multiple R^2	0.04 0.002				

Table No. 4 revealed that students exposed to practical instructional method had higher adjusted mean score of 23.94 (20.83 + 3.11) than those taught using traditional classroom method; 17.70 (20.83 + (-3.13). This implies that the use of practical instructional approach enhanced the students' achievement in Physics. About 83.6% of the observed variance in students' achievement was due to the effectiveness of the treatment.

Hypothesis 3: In testing the hypothesis, pre-test and post-test achievement mean scores of male and female students taught Physics using practical instructional approach were computed and compared using ANOVA as shown in Table 5 below.

Table No. 5: Summary of ANOVA of students' achievement in Physics by gender

Source of variation	SS	Df	MS	F	P	Result
Corrected Model	5.056	2	2.528	0.388	0.680	*Not Sig.
Covariate	0.245	1	0.245	0.038	0.847	
Sex	2.572	1	2.572	.248	.619	
Sex *Group	5.048	1	5.048	0.775	0.382*	
Error	397.554	126	3.155			
Total	34563.600	129				
Corrected Total	402.61	128				

* P > 0.05

Table No. 5 showed that $F_{(1,126)} = 0.775$; $P_{(0.382)} > 0.05$. The hypothesis was not rejected. This implies that there was no significant difference in achievement mean scores of male and female students taught Physics using practical instructional approach.

DISCUSSION

Findings from the study revealed that students' performance in Physics in both experimental and control groups in pre-test did not differ statistically. This established the homogeneity of the two groups involved in the study prior to the use of treatment. This implies that the knowledge baseline for the groups involved in the study were equal.

It was revealed from the study that there was significant difference in the achievement mean scores of the groups after the treatment. This implies that there was improvement in the performance of the students resulting from their exposure to the treatment. This means that the use of practical laboratory approach is a teaching strategy for enhancing students' achievement in Physics. This result aligned with Uhumuavbi and Okodugha (2014) as well as Afemikhe and Imobekhai (2014) and several other researchers who were of the opinion that the use of laboratory teaching approaches to teach science help the students to increase their interest and ability to grasp relevant underlying concepts thereby exposing them to certain experience and providing the required learning activities.

The findings from this study further revealed that gender has no significant effect on achievement means scores of Physics students. This implies that female students are found to be as good as their male counterparts when they were expose to practical instructional approach of teaching and learning of Physics. This is in agreement with the findings of Owolabi (2013) which inferred that gender is not the major issue in Physics practical work.

CONCLUSION

The study revealed that there is significant difference in students' achievement mean scores in the two groups after treatment. The use of practical instructional approach was effective for the teaching and learning of Physics. Gender is not a major issue in Physics class as female students performed as good as their male counterparts when they were exposed to the same teaching method i.e practical instructional approach of teaching and learning of Physics.

RECOMMENDATIONS

Based on the findings of this study, it was recommended that:

1. Physics teachers should be enlightened and made to recognize the potentials of using practical instructional approach of teaching and learning.

2. Physics teachers should be encouraged to employ practical instructional approach of teaching and learning to improve the students' performance in Physics.

3. Government and school administrators should provide schools with well-equipped laboratories, as well as conducive learning environment to accommodate the use of practical instructional approach.

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