Comparative Effectiveness of Demonstration and Inquiry Methods of Teaching Physics on Academic Performance of Senior Secondary School Students in Biu Education Zone, Borno State, Nigeria

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Abstract

This study determined the comparative effectiveness of demonstration and inquiry methods of teaching physics on Academic performance of Senior Secondary School Students in Biu Education Zone, Borno State, Nigeria. Two objectives were formulated to guide the study, two research questions were answered and two hypotheses were tested at 0.05 level of significance. The study adopted the pre-test post-test quasi experimental design. Three Senior Secondary Schools were stratified based on gender (Male school, female school and mixed school) the study used nine intact classes using simple random sampling technique (Balloting) physics performance test (PPT) served as a research instrument. The instrument was validated to obtain reliability coefficient of 0.76 using Cronbach's Alpha. Data was analysed using descriptive statistics of mean and standard deviation and independent sample t-test. The findings of the study revealed that demonstration method was effective in teaching physics in senior secondary schools in Biu education, inquiry method was not effective in teaching physics in senior secondary schools in Biu education Borno State. There was significant difference between the academic performance of boys and girls exposed to demonstration method in teaching physics in favour of boys. The study concluded that the use of demonstration method as a teaching method enhances learning in which physics ideas and information are extended from the teacher to the learners without difficulties. The study recommended that education policy makers should develop up with policy framework to strategies the use of practicals and demonstration techniques when teaching physics lessons.

Keywords: *Demonstration, Inquiry, Methods, Teaching, Physics*

Introduction

Physics is a fundamental science subject that plays a crucial role in the development of science and technology. However, the academic performance of senior secondary school students in the study area has been a concern to parents and other stakeholders. The current teaching methods used in physics classrooms have been criticized for being ineffective, leading to poor student performance. The conventional method which is commonly used has been accused of promoting rote learning and not engaging student's activity in the learning process. The study will provide insight into the effectiveness of demonstration and inquiry methods of teaching physics, which can inform physics teachers and educators on the best approaches to use in teaching physics (Ahmed, 2021).

The concept of teaching at any level of Education is to bring a fundamental change in the learner (shuaibu & Tahir 2021) to facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods to impart knowledge to learners. Comparative to

student centred methods. Until today, questions about the effectiveness of teaching methods on students learning have consistently raised considerable interest in the thematic field of educational research (Aliyu, 2022) teaching is a continuous process that involves bringing about desirable changes in learners through the use of appropriate methods. Adebayo (2021) revealed that in order to bring about desirable changes to students teaching methods use by teachers should be best for the subject matter so as to achieve lesson objectives. Furthermore, to sustain learners participation and involvements teaching methods should suit learner's needs and interest since every learner interprets and responds to questions in a unique way (Adebayo, 2021). Teaching method is the series of action or activities planned by the teacher and systematically provided to the learner to enable him receive and process the information, retain and recall it in order to be enable to use it to tackle emerging life task and problems (Bamidele, 2019).

Demonstration Teaching Method is the practical way of showing demonstrating learning by doing, it is a sequential process of presentation of lesson to the learners. It is one of the methods that has bridged the gap between Theory and Practice (Kayode, 2022). Christopher (2023) stated that Demonstration method is always accomplished by explaining a concept by the handling and manipulating of real things, equipment or materials or showing pictures. Demonstration method is useful because they provide concrete reference for objects or events. Learners relates terms and concepts to those events which they have observed. Ahmed (2021) opined that demonstration method as a teaching method in which the teacher serve as facilitator while the learners watch and listen to the presentation made by the facilitator with the intention to practice skills. The teacher does whatever the learner is expected to do at the end of the instruction. Samuel (2022) found that Demonstration teaching method as a visible presentation of ideas, skills, knowledge and attitudes that enhance critical thinking and problem solving approach. Gilbert (2022) reported that for demonstration method to be effective, teachers must planned for their lesson in-line with content objectives and be supported with effective instructional media that will arouse learners attention and to achieve learning outcome. Learners should be given simple and clear lesson guide. He went further to add classroom setting arrangement should be organized so that all learners can see and hear what the teacher is demonstrating clearly. After the demonstration generally, in order to encourage learners participation they should be given the opportunity to practice either individually or in group. Hamza (2023) finding revealed that there was no significant difference in the achievement scores between Boys and Girls students taught Physics using demonstration method. Kazeem (2022) found that there was no statistically significant difference in the academic performance of students taught Physics with demonstration and inquiry methods. Iliyasu (2021) found that there was significant difference in the performance of students taught Physics using demonstration method similarly Olufemi (2022) found that students that were taught physics with demonstration method were found to have high achievement scores than their partners that were taught in control group.

Inquiry Teaching Method is an instructional strategy in which the learner tends to learn more or have better understanding of physics concepts by themselves. Inquiry learning when encouraged in the science class also aids problem solving because learning by inquiry starts with problem solving (Akambi and Opansina 2000). Inquiry also lead creativity in the student which is one of the major objectives of science teaching. Teaching methods such as inquiry teaching, problem solving, problem based learning and project based relies heavenly on the effective use of the science process skills by students to complete an investigation. (Umar, 2021). The method is based on the assumption that the subject is to be learnt actively by full participation in the learning task. It is a method that leads to effective learning outcome that is meaningful to the Learner. For the students to meaningfully engaged in inquiry method there

is need for the teacher to practically involve the students from the planning stage to the Evaluating stage. This could be done or achieved by the students and the teacher in locating and gathering information from many sources like reading materials, specimens and community resources (Musa, 2022).

From a Science perspective, inquiry method engages students in the investigative nature of science. Inquiry method involves activity and skills, but the focus is on the active search for knowledge or understanding to satisfy a curiosity. According to Ibrahim (2023), inquiry teaching Method affect student's performance for example in solving problems, reflecting on their work, drawing conclusions, and generating prediction. These qualities are necessary for high achieving students. Inquiry method is one way of making sense out of what we experienced and therefore requires thinking, (Ademola, 2021). This implies that the method requires putting learners into a situation in which they must be engaged in intellectual operation that constitutes investigation.

Ifeanyi, (2022) found that there was no significant difference between inquiry and demonstration method on the academic performance of students in Physics. Demonstration being teacher centered is more practical when compared to other methods of teaching. Briggs (2021). Stated that there was significant difference between the academic performance of students taught Physics using inquiry method and control group in favour of inquiry method. In the same vein Abdulrashed (2022) found that there was significant difference in the mean score of students taught Physics using inquiry and control group in favour of inquiry method.

Statement of the Problem

The persistent poor academic performance of senior secondary school students in physics over the years has raised concern among stakeholders. The chief Examiners' report of the National Examination Council (NECO) and the West African Examination Council (WAEC) have consistently highlighted student's weaknesses in physics, citing factors such as inadequate teaching methods, lack of resources and poor student attitudes. The problem of the study, therefore is to investigate the comparative effectiveness of demonstration and inquiry methods of teaching physics on the academic performance of senior secondary schools in Biu Education, education zone, Borno State.

Many students find Physics to be a hindrance in attaining their aims, Poor performance of students in science subjects, particularly Physics, has assumed a serious dimension as observed by the researchers. In the light of this science teachers need to seek suitable ways of tackling the current massive failure in Physics, if they are to halt the drifts of science students to Art and Social Science subjects.

Objectives of the Study

Objectives of the study were to determine:

1. Performance of Senior Secondary School students taught Physics using demonstration method in Biu Education zone, Borno State.
2. Performance of Senior Secondary School students taught Physics using inquiry method in Biu Education zone, Borno State.
3. Gender difference in Performance of senior secondary School students taught Physics using demonstration method in Biu Education zone, Borno State.
4. Difference in Performance of Senior Secondary School students taught Physics using demonstration method and inquiry method in Biu Education zone, Borno State.

Research Questions

The following research Questions were answered

1. What is the Performance of Senior Secondary School Students Taught Physics using Demonstration Method in Biu Education Zone, Borno State?
2. What is the Performance of Senior Secondary School Students Taught Physics using Inquiry Method in Biu Education Zone, Borno State?

Hypotheses

The following null hypotheses were tested:

Ho_1 There is no significant difference between the Performance of Boys and Girls when Taught Physics using Demonstration Method.

Ho_2 There is no Significant Difference between the Performance of Students Taught Physics using Demonstration Method and those Taught by Inquiry Method.

Methodology

Research Design

This study used quasi experimental design which determined Comparative Effectiveness of Demonstration and Inquiry Methods of Teaching Physics on Senior Secondary School Students Academic Performance in Biu Education Zone, Borno State. Umoru (2004) stated that quasi experimental design is used in investigating the cause and effect between independent and dependent variable. The research Design used two experimental and one control groups to measure the effect of treatment in experimental groups.

Population and Sample

The target population for this study was Seven Thousand Five Hundred and Eighteen (7,518) SSII Physics Students from sixteen (16) public Senior Secondary Schools in Biu Education zone, Borno State. For the 2022/2023 academic session. Howey, stratified random Sampling technique was used to select a sample of three (3) public Senior Schools in Biu Education Zone, Borno State. The used of Stratified Random Sampling Method according to Cohen, Manion and Marrison (2013) Stratified Random Sampling involves selecting a population in the homogeneous groups, each group containing subjects with similar characteristics. Simple Random Sampling (balloting) was used to select intact classes. Three intact classes from each of the three schools were selected as samples in each of the school, two classes were assigned as experimental classes while the other class was the control class.

Research Instrument

The Instrument for this study was researchers designed Performance Test in Physics (PTP) which consists of 30 items of multiple choice type. The items were drawn carefully within the scope of Physics SSII syllabus. The Instrument was scrutinized for content (face) validity by experts in the subject area. A pilot study of the instrument was conducted in one school which was not used in the main study to test the validity and reliability index of the instrument using test retest techniques. A reliability coefficient of 0.80 was obtained using Cronbach's Alpha value.

Procedure for Data Collection

The researchers engaged nine (9) research assistants three from each School and to control the effect of teacher variation all the teachers are specially Physics oriented with Bachelor's Degree in Physics Education with not less than five years of teaching experience. The research

assistants were trained for three (3) days on the need to maintain professionalism throughout the treatment phase.

Method of Data Analysis

The data collected was analysed using descriptive statistics of mean and standard deviation and independent sample t-test.

Results

Research question one: What is the Performance of Senior Secondary School Students taught Physics using Demonstration method in Biu Education Zone, Borno State?

The summary of the Descriptive statistics of the demonstration and the control groups were presented in the table below.

Table 4.1 Descriptive Statistics of the Students' Performance in Demonstration and Control Groups.

Teaching Methods	PRE- TEST			POST TEST		
	N	Mean	SD	N	Mean	SD
Demonstration Method	158	53.17	12.83	158	70.55	8.44
Control	135	53.41	11.83	135	56.20	11.90
Total	**293**					

The result from table 4.1 above revealed that on pre-test results there was no significant difference between the demonstration group and the control group. On post-test due to the effect of the treatment, the mean of demonstration group was 70.55and standard deviation of 8.44 while the mean of control group was 56. 20 and the standard deviation of 11.90 which shows there might be significant difference on post test result and the pre-test.

Research Question Two: What is the Performance of Senior Secondary School Students taught physics using inquiry method in Biu Education Zone, Borno State?

The summary of the descriptive statistics of the inquiry and control groups were presented in the table below

The result from table 4.2 above revealed that there was no slight difference between the Inquiry group and the control group on both pre-test and post-test. On post-test result the mean of the inquiry group was 61.37 and standard deviation of 9.26 while the mean of control group was 56. 20 and the standard deviation of 11.90 this shows that there was no significant difference on post test result and the pre-test result.

Hypothesis One: There is no significant difference between the performance of students taught Physics using demonstration method and those taught by inquiry method.

Summary of the independent sample t-test between demonstration and inquiry methods was presented below:

Table 4.2 Descriptive Statistics of the Students Performance on Inquiry and Control Groups.

Teaching Methods	PRE- TEST			POST TEST		
	N	Mean	SD	N	Mean	SD
Inquiry Method	154	59.40	10.38	154	61.37	9.26
Control	135	53.41	11.83	135	56.20	11.90
Total	**289**	**16.96**				

Table 4.3 Summary of t-test, Comparison of Demonstration and Inquiry Methods.

Methods	PRE- TEST			POST TEST			
	N	Mean	SD	N	t	p-value	Remark
Demonstration Method	158	70.55	8.44	312	10.30	0.00	S
Inquiry Method	154	61.37	9.26				
Total	**314**	**19.84**					

The result from table 4.3 shows that there was significant difference between the performance of students taught physics using demonstration method and those taught by Inquiry method because the p-value (0.00) is less than the level of significance (a= 0.005). the mean scores indicated that student for the demonstration group recorded mean of 70.55 as against the 61.37 for the inquiry group. Therefore, the null hypothesis is rejected.

Hypothesis Two: There is no significant difference between the performance of male and female students when taught physics by the demonstration method.

Summary of the Independent Sample t-test on students' performance when taught physics using demonstration method based on gender.

Table 4.4 Summary of t-test, Comparison of Gender Difference in Performance using Demonstration Method.

Gender	PRE- TEST			POST TEST			
	N	Mean	SD	df	t	p-value	Remark
Male	76	70.67	8.49	157	6.84	0.00	S
Female	83	50.83	10.31				
Total	**159**	**P<0.05**					

The result from table 4.4 above revealed that there was significant difference between the performance of male and female students when taught physics using demonstration methods, because the p-value (0.00) is less than the level of significance (a=0.005), therefore, the null hypothesis is rejected. The result also showed that the performance of male students is higher than the performance of female students with mean scores of 70.67 and 50.83 respectively.

Discussion of findings

Findings on Performance of Senior Secondary School Students taught physics using demonstration method in Biu Education Zone, Borno state. Research question one revealed that there was significance difference between the demonstration group and the control group on post test result due to the effect of treatment on their performance, in favour of demonstration method. This finding is in-line with Iliyasu (2021) who reported that there was significance difference between the performance of students taught physics using demonstration method. Olufemi (2022) reported that students taught physics with demonstration method were found to have high achievement scores than their counterparts that were taught in the control group.

Finding on performance of senior secondary school students taught physics using inquiry method in Biu Education zone, Borno state. (Research Question two) revealed that there was no significant difference between performance of students taught physics using inquiry method and control groups. Briggs (2021) reported that there was significant difference between academic performance of students taught physics using inquiry and discussion methods in favour of inquiry method. Also in the same vein Abdulrasheed (2022) found that there was significant difference in the mean scores of student taught physics using inquiry and those taught by discussion method in favour of inquiry method?

Finding on difference in performance of senior secondary school students between those taught physics using demonstration method and inquiry method in Biu education zone, Borno state. (Research question three) findings of this study showed that demonstration method was more effective than inquiry method in teaching physics in senior secondary schools in Biu Education zone. The finding of this study is in line with Kazeem (2022) found that there was statistically significant difference in the academic performance of students taught physics with demonstration method.

Finding on students' performance when taught physics using demonstration method based on gender (hypothesis two) revealed that there was significant difference between the performance of male and female students when taught physics using demonstration method, because the performance of male students is higher with mean scores of 68.33 while the mean scores of female students is 57.13. This finding is in contrast with Hamza (2023). Finding revealed that there was no significant difference in the achievement scores between Boys and Girls students when taught physics using demonstration method.

Conclusion

The study concludes that superiority of the demonstration method could be attributed to its ability to provide clear and concise explanations, illustrations and examples, which facilitate students' understanding of complex physics concepts. Gender-related factors influencing physics learning, this disparity could be due to various factors, including cultural and societal expectations, prior knowledge and experience or learning style preferences.

Recommendations

1. Physics teachers should be encouraged to use the demonstration method in teaching physics, as it has been shown to be more effective.
2. Further research should be conducted to investigate the factors contributing to the gender difference in physics performance.

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