



Comparative Effects of Observation Instructional Strategy and Lecture Method on Physics Students' Achievement in Senior Secondary Schools in Delta State

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Abstract

This study investigated the comparative effect of observation in teaching physics in Delta State secondary schools. Three research questions and three hypotheses guided this study. Quasi-experimental pretest-posttest research design was adopted for this study. The study sample consisted of 280 secondary school Physics students drawn from a population of 39,904 using a simple random sampling technique. Data were collected using the Physics Achievement Test (PAT), which consisted of 20 items of multiple-choice questions from the Physics content taught. The PAT was duly validated, and the reliability coefficient of 0.82 was obtained using the Kuder-Richardson formula 21 (KR-21). Mean and standard deviation were used to answer the research questions, while t-test, at a significance threshold of 0.05, was used to test the hypotheses. The study found that students taught Physics using the observation instructional strategy performed significantly better than their counterparts taught using the lecture method, and there is no sex bias when the observation instructional strategy is adopted for the teaching of Physics. In the light of the findings, it was therefore, recommended among others, that all Physics teachers should be required to employ the observation teaching technique when instructing and learning the subject and that the Government at all levels should show commitment towards promoting innovative teaching in Physics and other science subjects by providing enabling environments and the required facilities in secondary schools to make students' centred learning activities a reality.

Keywords: Observation Instructional Strategy; Lecture Method; Physics; Students' Academic Achievement; Secondary Schools.



Introduction

Physics is one of the science subjects whose teaching-learning cannot be relegated all over the world because of its enormous importance in the life of mankind. Physics is the scientific study of the surrounding natural environment. It deals with the fundamental laws and principles that govern the behaviour of energy, matter, and the universe. As humans, we live in the environment. Consequently, we all need to have a knowledge of physics to function effectively in our environment. This is buttressed in the first objectives of the Physics curriculum as stipulated by the National Policy on Education (2013). This is to provide basic literacy in Physics for functional living in society, as well as stimulate and enhance creativity. Ovuworie (2024) noted that the concepts of Physics explain most human physical activities or phenomena. For example, the idea of gravity in Physics explains why if we jump, we come down; the concept of electricity explains the functionalities of electric bulbs in our homes; the idea of friction explains why we can walk on a rough surface and the tendency to slip on a smooth surface; the concepts of thermal expansivity explains the crack sound we hear on our rooftops on a sunny day. Furthermore, the bottom of a clear river or pond, which appears shallower than it is, and the rod or spoon which appears bent or broken when it is partially immersed in water or any liquid are phenomena that are explained by the concept of refraction in Physics.

All of these are basic principles in Physics which justify particularly the first goals of physics, as mentioned above. These also show how and why Physics is indispensable and its teaching in secondary schools cannot be relegated or neglected by any developing or developed nation that desires progress, socio-economically and technologically. Physics, being a fundamental science course, has numerous applications and constitutes the bedrock of the development of science and technology in any nation. Achieving proficiency in Physics, therefore, should be national concern. In Delta state, for instance, there has been a steady increase in the number of students registering and writing the examination in the West African Senior School Certificate Examinations (WASSCE) and National Examinations Council Senior School Certificate Examinations, respectively. However, Reports from the WAEC Chief Examiners and other science educators like Macmillan and Gana (2019) indicate an abysmal performance of Physics students at Nigerian secondary schools in the West African Senior School Certificate Examination (WASSCE) organized by the West African Examination Council (WAEC) over the past seven years.

On account of the above, different factors have been attributed to the abysmal performance of students in physics by different scholars. Amuche, Bello, and Marwan (2014) attributed the poor achievement among science students, particularly in Physics, to lack of qualified teachers, poor instructional strategies, poor infrastructure, non-availability of standard laboratories, and poor utilization of instructional materials. Furthermore, Oladejo, Olosunde, Ojebisi, & Isola (2011) attributed the poor and fluctuating achievements of students in Physics to the teacher's instructional strategy, which is considered a critical factor. Others are of the view that the instructional strategies used in teaching science subjects in schools have not brought about excellent performance because learners still view their teachers as being distant from them in authority, status, and knowledge. As a consequence, they are afraid to inquire and express their opinion, even though some of the instructional strategies claimed to be learner-centered.

One common factor identified by researchers, in addition to the WAEC Chief Examiners' Reports, to which poor Physics students' achievement is attributed, is the application of inappropriate instructional or teaching strategies or methods. The teacher's



techniques of instruction may go a long way in enhancing effective learning by the students. The conventional approach to scientific education (Physics inclusive) in schools involves “chalk and talk” fully teacher-centred activities. In this instance, the pupils in the classroom are passive “robots” who view the instructor as the repository of knowledge. There is a push to instill the 21st-century approaches to science teaching in Nigeria. 21st-century approaches to science teaching are innovative teaching strategies or methods that are learner-centred, to make students engage in the teaching-learning process, with the tendency to improve students’ ability to remember information for a longer period. However, Nwanze, (2016) noted that science teachers avoid more effective activity-oriented instructional methods and stick to inadequate traditional teaching methods. Practical activities that could enhance creative thinking in learners are given “lip service” in Nigerian schools (Ajayi, 2007). One such innovative strategy is the observation instructional strategy. It is a purely child-centred approach. Here, the students are guided to carefully observe and discover facts and construct their ideas and understanding of the concepts of the study. This could be effectively implemented at the senior secondary school level.

Observation is one of the basic science process skills that enables the deployment and application of critical thinking skills for optimal cognitive development. Observation is the process of watching, listening, and recording the behaviour, actions, or phenomena of interest in a systematic and controlled manner (Brown & Kumar, 2013). Observation involves the systematic collection of data through direct sensory experience (Adebayo & Olufunke, 2015). It is a method of data collection that involves directly observing and recording people's behaviour, actions, or events. Observation is a teaching strategy that involves students observing and recording phenomena to develop scientific inquiry skills geared towards solving a given problem. There are different types of observation. These are: Participant observation, non-participant observation, structured observation, unstructured observation, and Experimental observation. As an instructional technique, observation promotes active learning through direct experience. The observation instructional strategy has eight sequential stages or phases. The stages of the observation instructional technique are: Preparation (Pre-Observation), Orientation (Introduction), Observation (Data Collection), Recording (Data Recording), Analysis (Data Interpretation), Reflection (Debriefing), Application (Extension), and Evaluation (Assessment).

In the Preparation (Pre-Observation) stage, the teacher presents the topic to be learned and, in collaboration with the students, defines the learning objectives. Thereafter, the students prepare materials and equipment, which will include an observation guide or worksheet for clear procedures towards solving the problem. The Orientation (Introduction) stage is where the teacher orients the students on the subject matter, explains objectives and procedures, encourages student curiosity and questioning, in addition to providing background information to enable adequate solutions to the problem. The Observation (Data Collection) stage entails the teacher-student demonstration of the topic while students observe and record data. This stage encourages active participation of students and note-taking while the teacher facilitates the process. In the fourth stage, which is Recording (Data Recording), students are expected to record observations in terms of going through all relevant materials using various recording methods like notes, sketches, and photographs. This ensures accurate and detailed recording. Analysis (Data Interpretation) is the fifth stage of the observation instructional strategy. Here, the students analyze and interpret data they have collected or gathered to solve the problem. This stage encourages critical thinking and questioning while identifying patterns and relationships. The students also, under the guidance of the teacher, draw conclusions based on evidence and discuss their results. The reflection (Debriefing) stage is where the students begin



to carry out self-assessment in confirmation of the solution provided, as well as identify areas for further exploration. This stage necessitates the reinforcement of learning objectives as well as the provision of feedback and guidance. Application (Extension) is the seventh stage of the strategy. This stage involves relating newly acquired knowledge to new situations to real-world situations. In this phase, students apply knowledge in a new context and to their everyday life. This is the stage that involves relating the freshly gained knowledge and understanding to new situations within the domain. This encourages students to think creatively, develop problem-solving skills, integrate with other subjects or topics, and foster curiosity and lifelong learning. The last stage of the observation instruction strategy is the Evaluation (Assessment) stage. This stage provides a platform for students to examine or assess what they have learnt through tests or projects that would provide evidence that the topic has been adequately understood. Also, the teacher assesses learners' conceptual understanding both formatively and summatively. The teacher does this by determining how many instructional objectives have been attained.

From the description of the lecture method and the observation instructional strategy, it is visible that these methods are different in their principles of presentation of content to be learned. For the lecture method, the teacher is a reservoir of knowledge, while the students are passive. For the observation instructional strategy, students are active participants in the teaching-learning process. Based on these differences in the principles of presentation of concepts, it becomes necessary to determine if there will be differences in students' achievement when exposed to observation instructional strategy and lecture method. It is against this background, therefore, that this study determined the effectiveness of the observation instruction strategy in comparison with the lecture method in Physics, and also determined whether they are sex-dependent to isolate and recommend the most effective methods between them.

The persistent and fluctuating poor performance of students in science subjects in Nigerian senior secondary schools have been linked to their inability to; recall and apply correct formulas to solve problems, provide correct definitions and explanations of terms, read measurements made from instruments, express their calculations to the required number of decimal places or significant figures, express decimal figures to standard form, plot graph when values are negative, present graph with appropriate scales and so on. The abysmal achievements because of these weaknesses have been credited to the use of conventional instructional strategies among others, which cannot facilitate the acquisition of concrete knowledge and critical thinking skills in the students because they do not support the principles of learning by doing, as well as taking into consideration individual differences of the learners. This study, therefore, examined the efficacy of the observation instruction method in comparison with the lecture method in senior secondary school Physics in Delta State. Therefore, this study is aimed at comparing the efficacy of the observation instructional strategy with the traditional lecture method in Physics and to determine whether the observation instructional strategy is more or less effective than the lecture method in promoting student learning outcomes in Physics. It is worth noting that there are a plethora of studies concerning teaching methods that are effective for the instruction of Physics. Ranging from teacher-centred to student-centred methods. However, there is a serious gap in literature on observation as an instructional approach in Physics. This study filled this gap in the literature by showing the effectiveness of observation as an instructional approach to student learning outcomes in Physics. Empirically, another gap that this study filled is the provision of empirical evidence on the efficacy of observation in teaching Physics in Nigerian senior secondary schools. Geographically, to the best of the researcher's knowledge, no study has been carried out on the



effectiveness of observation in promoting student learning outcomes in Physics. This is another gap that this study filled in the literature on Physics education in Delta State, Nigeria

Research Questions

1. What are the effects of observation instructional strategy and lecture method on Physics students' achievement?
2. What is the difference between the average achievement scores of students exposed to Physics content using the observation instructional strategy and those exposed to Physics content using the lecture method?
3. What is the difference between the average achievement scores of male and female students exposed to Physics content using the observation instructional strategy and lecture method?

Hypotheses

1. There are no significant effects of observation instructional strategy and lecture method on Physics students' achievement.
2. There is no significant difference in the mean achievement scores of students exposed to Physics content using the observation instructional strategy and those exposed to Physics content using the lecture method.
3. There is no significant difference in the mean achievement scores of male and female students exposed to Physics content using the observation instructional strategy and lecture method.

Methods

The study adopted the pretest, posttest, planned variation quasi-experimental design. The reason for adopting this design is that there was no randomization of subjects; rather, intact classes were used to avoid disruption of class activities and /or the behaviour of research subjects. According to Dutra and Reis (2016), quasi-experimental design is a suitable alternative to experimental design when randomization of subjects is not possible. The population for this study consisted of thirty-nine thousand, nine hundred and four (39,904) Senior School Two (SS II) Physics students in the four hundred and seventy-four (474) Senior School. This population comprised fifteen thousand, six hundred and twelve (15,612) male students and fifteen thousand, two hundred and ninety-two (15,292) female students. The sample size for the study comprised two hundred and eighty (280) SS II Physics students from six (6) intact classes of six (6) mixed secondary schools in Delta State. The six (6) mixed secondary schools that were used in this study were selected using the simple random sampling technique of the "hat and draw" method with replacement. The rationale for adopting the simple random sampling technique was to ensure that all participants had equal chances of being selected.

The instrument used for data collection in this study was the Physics Achievement Test (PAT), which comprised two sections: A and B. Section A contained questions on students' bio-data, while Section B consisted of fifty (50) multiple-choice objective items developed by the researcher. These items were drawn from past WAEC and SSCE examination questions and aimed to measure students' academic achievement in Physics based on the SSII Physics instructional units covered in Waves, including Ripple Tanks, Springs, Strings, Reflection, Refraction, and Diffraction. Each question was structured with four options (A–D), featuring one correct answer and three distractors. A correct response was awarded one mark, while an

incorrect response attracted zero marks. The Physics Achievement Test (PAT) was validated by three experts: one Science Educator in Physics from Delta State University, Abraka, one experienced Physics teacher, and one expert in Measurement and Evaluation. The reliability of the PAT was determined using Kuder-Richardson Formula 21 (K-R-21), which is appropriate for multiple-choice objective test items. The PAT was administered to a sample of 20 Physics students outside the selected schools for the study, yielding a reliability coefficient of 0.86 after analysis.

Before the commencement of the treatment, the six (6) schools randomly selected for the study were randomly assigned into two groups: the Observation Instructional Strategy (OIS) group and the Lecture Method (LM) group. Both groups were pre-tested to establish equivalence and to ensure that any observed changes post-treatment could be attributed to the treatment administered. Following the pre-test, the groups underwent the treatment, where one group was taught using the Observation Instructional Strategy (OIS) and the other with the Lecture Method (LM). Post-tests were then conducted immediately after the treatment. Data analysis and hypothesis testing were performed at a 0.05 level of significance using mean and standard deviation, independent samples t-test, and Analysis of Covariance (ANCOVA). Research questions were answered using mean and standard deviation, while hypotheses were tested with independent samples t-test and ANCOVA.

Results

Research Question 1: What are the effects of observation instructional strategy and lecture method on Physics students' achievement?

Table 1: Descriptive Statistics of Mean and Standard Deviation Showing the Pre-test and Post-test Achievement Score of Students Instructed Physics Utilizing Observation Instructional Strategy and Lecture Method

Group	Testing	$\bar{X}$	$\bar{X}\text{Diff}$	SD
OIS	Pre-Test	16.51	18.93	4.33
	Post-Test	35.44		4.53
LM	Pre-Test	15.79	13.05	3.14
	Post-Test	28.84		4.86

N = 140

Table 1 shows the mean pre-test and post-test achievement scores of 16.51 and 35.44, with a corresponding standard deviation score of 4.33 and 4.53, respectively, for students taught Physics using the observation instructional strategy. The mean difference is 18.93. Also, the Table shows that students instructed Physics using the lecture method had a pre-test and post-test mean achievement scores of 15.79 and 28.84, with a corresponding standard deviation score of 3.14 and 4.86, respectively. The mean difference is 13.05. This indicates that there exists a difference between the pre-test and post-test mean achievement scores of students taught Physics using the observation instructional strategy and lecture method. To determine if this difference is significant, H_0 was tested, and the result is shown in Table 2.

Hypothesis 1: There is no significant effect of observation instructional strategy and lecture method on physics students' achievement.

Table 2: T-test Comparison of Pre-test and Post-test Mean Achievement Scores of Students Instructed Physics Utilizing Observation Instructional Strategy and Lecture Method

Group	Testing	$\bar{X}$	$\bar{X}$ Diff	SD	df	t_{cal}	Sig. (2-tailed)	Decision
OIS	Pre-Test	16.51		4.33				
	Post-Test	35.44	18.93	4.53	139	46.76	0.000	H₀₁ Not Accepted
LM	Pre-Test	15.79		3.14				
	Post-Test	28.84	13.05	4.86		32.85	0.000	

Table 2 indicates a significant difference between the pre-test and post-test mean achievement scores of students taught Physics using observation instructional strategy and lecture method: $t_{cal} = 46.76$, $P(0.000) < 0.05$; $t_{cal} = 32.85$, $P(0.000) < 0.05$. This indicates that there is a positive effect of observation instructional strategy and lecture method on Physics students' achievement. Therefore, the null hypothesis is not accepted. Thus, there is a significant effect of observation instructional strategy and lecture method on Physics students' achievement.

Research Question 2: What is the difference in the mean achievement scores of students exposed to Physics content using the observation instructional strategy and those exposed to physics content using the lecture method?

Table 3: Descriptive Statistics of Mean and Standard Deviation Showing the Post-test Mean Achievement Scores of Students Instructed Physics Utilizing Observation Instructional Strategy and Lecture Method

Group	N	$\bar{X}$	$\bar{X}$ Diff	SD
OIS	140	35.43		4.53
Lecture	140	28.84	6.59	4.86

Table 3 shows that at post-test, students exposed to Physics contents using observation instructional strategy had a mean score of 35.43 with a standard deviation of 4.53, while students taught with the lecture method had a mean score of 28.84 with a standard deviation of 4.86. The mean difference is 6.59. To determine if this difference is significant, Hypothesis Two was tested using t-test.

Hypothesis 2: There is no significant difference in the mean achievement scores of students exposed to Physics content using the observation instructional strategy and those exposed to physics content using the lecture method.

Table 4: Independent Sample t-test showing the Difference in Post-Test Mean Achievement Scores of Students Instructed Physics Utilizing Observation Instructional Strategy and Lecture Method

Groups	N	$\bar{X}$	$\bar{X}$ diff	SD	df	t	Sig. (2-tailed)	Decision
OIS	140	35.43		4.53				
LM	140	28.84	6.59	4.86	278	11.76	0.000	H₀₂ is Not Accepted

Table 4 shows the result of independent sample t-test indicating the difference in the mean achievement scores of students taught Physics using the observation instructional strategy and those taught with the lecture method. The result showed that the calculated sig. value of 0.000 is less than 0.05 alpha level of significance ($P < 0.05$). This indicates that there

is a significant difference in the mean achievement scores of students taught Physics using the observation instructional strategy and those taught with the lecture method. Therefore, hypothesis 2, which states that there is no significant difference in the mean achievement scores of students exposed to Physics content using the observation instructional strategy and those exposed to physics content using the lecture method, is not accepted.

Research Question 3: What is the difference in the mean achievement scores of male and female students exposed to Physics content using observation instructional strategy and Lecture Method?

Table 5: Descriptive Statistics of Mean and Standard Deviation Showing the Post-test Mean Achievement Scores of Male and Female Students Instructed Physics utilizing Observation Instructional Strategy and Lecture Method

Groups	Sex	N	$\bar{X}$	$\bar{X}_{diff}$	SD
OIS	Male	72	36.35	1.13	4.56
	Female	68	35.22		4.73
LM	Male	60	31.10	1.31	5.80
	Female	80	29.79		6.52

Table 5 shows the posttest mean achievement scores of male and female Physics students taught with the observation instructional strategy, and lecture method. For observation instructional strategy, the male Physics students had a posttest mean achievement score of 36.35 with a standard deviation of 4.56, while their female counterparts had a posttest mean achievement score of 35.22 with a standard deviation of 4.73. This indicates that there is a difference in the mean achievement scores of male and female Physics students taught with observation instructional strategy in favour of male Physics students. For the lecture method on the other hand, the male Physics students had a posttest mean achievement score of 31.10 with a standard deviation of 5.80, while their female counterparts had a posttest mean achievement score of 29.79 with a standard deviation of 6.52, in favour of male Physics students. This indicates that there is a difference in the mean achievement scores of male and female Physics students taught with the lecture method. To determine if these differences are significant, H_{03} was tested using independent sample t-test, and the result is shown in Table 6.

Hypothesis 3: There is no significant difference in the mean achievement scores of male and female students exposed to Physics content using the observation instructional strategy and Lecture Method.

Table 6: Independent Sample t-test showing the Posttest Mean Achievement Scores of Male and Female Physics Students exposed to Physics content using the Observation Instructional Strategy and Lecture Method

Groups	Sex	N	$\bar{X}$	$\bar{X}$ diff	SD	df	t	Sig. (2-tailed)	Decision
OIS	Male	72	36.35	1.13	4.56	138	1.435	.153	H₀₃ is Accepted
	Female	68	35.22		4.73				
LM	Male	60	31.10	1.31	5.80		1.234	.219	
	Female	80	29.79		6.52				

Table 6 presents the results of independent sample t-test showing the posttest mean achievement scores of male and female Physics students taught with the observation instructional strategy and lecture Method. For observation instructional strategy, the result

showed that the calculated sig. value of 0.153 is greater than the alpha value of 0,05 ($p > 0.05$). This indicates that there is no significant difference in the mean achievement scores of male and female Physics students taught with observation instructional strategy. For lecture method on the other hand, the result showed that the calculated sig. value of 0.219 is greater than the alpha value of 0,05 ($p > 0.05$). This indicates that there is no significant difference in the mean achievement scores of male and female Physics students taught with lecture method. Therefore, the null hypothesis, which states that there is no significant difference in the mean achievement scores of male and female students exposed to Physics content using the observation instructional strategy and lecture method is accepted.

Discussions

Results from Table 2 reveal a significant difference between the pre-test and post-test mean achievement scores of students taught Physics using the Observation Instructional Strategy (OIS), with $t_{cal} = 46.76$, $p = 0.000 < 0.05$, and those taught using the Lecture Method (LM), with $t_{cal} = 32.85$, $p = 0.000 < 0.05$. This indicates that both instructional strategies are effective in improving students' achievement, albeit to varying extents. The difference in mean achievement scores between the two groups suggests that the Observation Instructional Strategy has a greater positive impact. This is attributed to the fact that the OIS promotes full student participation in the learning process, enhancing academic achievement and problem-solving skills by providing opportunities for hands-on activities. This finding supports the conclusion of Ogunleye and Babajide (2010), who found that observation, as part of a comprehensive instructional strategy, significantly influences student achievement.

Table 4 further demonstrates a significant difference in mean achievement scores favoring students instructed with the Observation Instructional Strategy over those taught by the Lecture Method. This can be explained by the OIS's encouragement of active learning, where students engage directly through observation and hands-on activities. Additionally, students taught via the OIS are more likely to ask questions and seek clarification, leading to deeper understanding and improved retention. The OIS also offers scaffolding by breaking down complex concepts, thereby reducing cognitive load and fostering critical thinking through observation, analysis, and interpretation of data. In contrast, the Lecture Method tends to promote passive learning, with students primarily listening to the teacher. The enhanced engagement in the OIS translates into higher achievement and retention, consistent with findings by Al-Rawi (2013) and Nana, Muhammad, and Dewi (2014), who reported that students taught using observation methods outperformed those taught by lectures in science education.

Table 6 shows that there is no statistically significant difference between male and female students' achievement scores regardless of whether they were taught using the Observation Instructional Strategy or the Lecture Method. This suggests that both instructional approaches positively impact students of both sexes equally, indicating no gender bias in learning outcomes. The equal participation of male and female students during instruction likely accounts for this parity. This finding corroborates the results of Oluwatosin and Terfa (2017) and Olaniyan, Omosewo, and Nwankwo (2015), who also found no significant gender differences in academic achievement scores.

Conclusion

In comparison with the lecture method, the Observation instructional strategy significantly enhanced students' academic achievement in Physics more. In addition, the



Observation instructional strategy does not discriminate based on sex when it comes to enhancing the achievement of Physics students.

Recommendations

The findings led to the recommendations that Physics teachers should adopt the Observation instructional strategy for the teaching/learning of Physics and that educational administrators and the government should host workshops and seminars through the Ministry of Education to train physics teachers on how to implement the Observation instructional strategy in teaching. Additionally, schools should be provided with the necessary educational materials to support the implementation of observation instructional strategy.



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