

EFFECT OF ELABORATIVE INTERROGATION ON ACHIEVEMENT IN PHYSICS CONCEPTS AMONG SECONDARY SCHOOL STUDENTS IN AGUATA LOCAL GOVERNMENT AREA ANAMBRA STATE, NIGERIA

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Abstract

This study investigated the effect of Elaborative interrogation on secondary school students' academic achievement in Physics concepts. The study adopted a quasi-experimental research design. A sample size of 70 Secondary School II students drawn from two public co-educational Secondary Schools in Aguata Local Government area of Anambra State was used for the study. Purposive sampling technique was used for the study. The researcherS developed an instrument for data collection: Physics Achievement Test (PAT) which was face and content validated by three experts from the departments of Physics, measurement and evaluation and psychology, all from Michael Okpara University of Agriculture Umudike. The reliability test analysis of PAT was determined using Kuder Richardson (K-R₂₀) formula to determine the internal consistency which yielded an index of 0.81. Mean and standard deviation was used to answer the research questions, while the Analysis of Covariance (ANCOVA) was used to test the null-hypotheses at 0.05 level of significance. Major findings of the study were elaborative interrogation teaching method had statistically significant effect on students' achievements in Physics. It was recommended among others that teachers should use elaborative interrogation in teaching Physics concepts.

Key Words: *Elaborative Interrogation, achievement, gender, teacher*

Introduction

Physics is widely regarded as the bedrock of Science and Technology. It deals with the study of matter, energy, and the fundamental forces of nature. In the Nigerian Secondary School Curriculum, Physics is not only introduced as a theoretical subject but also as a practical one, aimed at equipping students with both conceptual knowledge and scientific skills. Physics plays an important role in all the natural sciences, however, and all such fields have branches in which physical laws and measurements receive special emphasis, bearing such names as astrophysics, geophysics, biophysics, and even psychophysics. Students who want to acquire higher educational qualifications in the fields of engineering or medical sciences must

have strong background knowledge of physics. So, providing secondary students with clear and standard basic physics knowledge which they can utilize in their future studies has broad value. There is a common saying that Physics is the mother of all science subjects whose principles drive advancements in energy production, transport systems, telecommunications, health care technologies, and environmental management. Hence the emphasis on students developing interests in learning fundamental physics concepts and then achieving the desired educational objectives.

Achievement in education signifies the degree to which students attain specific academic goals, often measured through performance in tests, assessments, and practical tasks. Within the science domain particularly Physics, achievement goes beyond mere scores to include a student's competence in conducting experiments, recording observations, interpreting data, and drawing logical conclusions.

Achievement encompasses not only test scores and grades but also mastery of content, practical skills, and problem-solving abilities in real-life contexts. In Science Education, student's achievement is often regarded as a central indicator of the effectiveness of instruction and curriculum delivery (Okeke & Nwankwo, 2021). Bossaert and Doumen (2011) defined achievement as the extent to which a student, teacher, or institution achieves short- or long-term educational goals.

Okoli and Ubah (2021) linked low Physics achievement to the widespread reliance on rote learning and the absence of student-centered, inquiry-based methods that foster deep understanding and engagement. The challenge is further compounded by overcrowded classrooms, limited instructional materials, and insufficiently trained teachers, which hinder effective implementation of the science curriculum and result in poor student outcomes. Consequently, this trend has raised concerns among educators and policymakers, especially as Physics remains a gateway subject for numerous science-related careers.

The use of elaborative interrogation can be applied on male and female students to determine the influence this innovative teaching method under study may have on gender; since according to (Morgenroth & Ryan, 2018) gender is a non-essential category which instead is repeatedly performed based on societal norms. Gender continues to influence science achievement in Nigeria, particularly in Physics. Reports from

WAEC and NECO show that male students consistently outperform female students in both theory and practical Physics examinations (WAEC Chief Examiner's Report, 2021; NECO, 2022)..

Semerzier (2020) in describing Holland's theory stipulated that male and female individuals pursue certain academic discipline based on their likes, attitude, personality type, values, and abilities. Some studies reveal that women show less interest or negative attitude towards Physics than men. More studies reveal that females are known to be less represented in physics and the more representations are found in males (Semerzier, 2020). In Godpower-Echie and Ihenko (2017) research work, female students had a fairer understanding of science process skills than males. They suggested that any view that establishes that boys are better than girls in science should be threaded and interpreted with caution. A critical evaluation of this method elaborative interrogation and interaction on gender will give the researcher a certain breakthrough in instructional strategies used.. Gender is therefore seen as a moderator variable in the study

Academic achievement refers to how well students perform in their work based on educational goals. It shows the level to which learners have successfully understood and mastered the knowledge and skills taught in school subjects. Academic achievement refers to students' performance in physics as determined by the scores they obtain in achievement tests administered during and after instruction (Ogbaga, et.al., 2024). It is also an important indicator of the quality of education students receive which suggests high academic achievement to be as a result of when students learn effectively but poor academic achievement may be attributed with teaching methods, learning environment or student motivation. Therefore, a student who can explain physics concepts clearly and apply them correctly in different situations is considered to have high academic achievement.

Elaborative interrogation is a learning strategy that strengthens students understanding and retention of the information they are trying to learn by asking "Why" and "How" questions and finding answers to their question independently, in group or by the teachers help. It always works on the bases of activating previous knowledge so as to establish a connection between the new and old information. Elaborative interrogation is a new learning strategy that involves the student in generating an explanation for why an explicitly stated fact or concept is true (Cerbin, 2015). This technique may be best suited for students with higher cognitive ability

(higher classes) not younger students because this method helps one remember, retain, comprehend, connect information and activate memory through interrogation.

Research has shown that Elaborative interrogation has been effectively used on students with mathematics anxiety, learning disabilities, and in reading comprehension. Omer (2019) has used Elaborative interrogation to show its effects on the synthesis of information from multiple sites. Nickson, C. (2020) made it clear that elaborative learning techniques are among the more powerful innovative learning strategies and should be encouraged among learners. Kuhl & Bertrams (2019) made his research on Elaborative interrogation, and was of the opinion that learning with elaborative interrogation requires that learners need to be actively involved in their learning process and gain a better understanding of the instructional materials. Learners using elaborative interrogation by means of prompts generate part of their study materials. These prompts help learners to ask themselves questions or be asked questions that relate to the relevant aspects of the learning content. Since elaborative interrogation has been seen to improve on the self-efficacy and mathematics achievement of low achieving students, it is on this premise the study sought to investigate the effect of elaborative interrogation on students' achievement in Physics.

Statement of the problem

Improved academic achievement of students may have been established to be the major proof of effective teaching and learning strategy. When students are taught with good instructional strategy, conducive learning environment and effective teaching facilities and devices, they tend to be improvement in academic achievement.

Physics play a very important role in the development of science and technology in every society. It provides the basic principles that explain how the natural world works and serves as the foundation upon which many scientific discoveries and technological innovations are built, but there is a generalized low achievement in Physics by these young people.

Many people have attributed low achievement, to students' perception of physics as a difficult and abstract subject, and the inappropriate teaching techniques that reduce the students to passive participants, together with intense difficulty students experience in learning on their own. The implication of this is that the students do not get deeply involved in learning, do not think critically, organize, monitor and direct their own learning processes. Poor academic achievement has been linked to the use of traditional teacher-centered teaching method which do not actively involve students in learning. When students are passive during lessons, they may find it difficult to understand abstract physics concepts and apply them correctly. Hence the need for this study.

Researchers have emphasized that student-centered approaches, such as the elaborative interrogation teaching strategy, can improve academic achievement by actively engaging students in the learning process and promoting deeper understanding (Gomez, 2025).

A research has been conducted on the Effect of Elaborative Interrogation on Interest and Achievement in Chemistry Concepts, thus the researcher sought to investigate the effect of elaborative interrogation on students' achievement in Physics concepts, specifically on low achieving male and female students.

Objective of the study

Specifically, the study sought to:

1. find out the mean achievement scores of secondary school students taught physics concepts using elaborative interrogation and those taught using conventional method.
2. find out the mean achievement scores of male and female secondary school students taught physics concepts using elaborative interrogation

Research Questions

The following research questions guided the study;

1. What is the mean achievement scores of secondary school II students' taught physics concepts using elaborative interrogation and those taught using conventional method?
2. What is the mean achievement scores of male and female secondary school II students taught physics concepts using elaborative interrogation?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance.

1. There is no significant difference between the achievement scores of students who were taught physics concepts using elaborative interrogation and those taught using conventional method.
2. There is no significant difference between the mean achievement scores of male and female students who were taught physics concepts using elaborative interrogation.

Methodology

The study adopted quasi experimental pre-test, post-test, non-equivalent control group that involves intact classes. Population of this study is 920 Senior Secondary Physics Students II from (20) secondary schools in Aguata local government Area. The sample size for this study was 70 (45 males and 25 females) Physics students, classified into experimental and control group. Purposive sampling was used to select two schools which are co-educational public secondary schools since the study compared variables such as gender of students. The classes were purposively assigned to treatment and control groups since students of the intact classes were used for the study. Group A consist of the treatment group while group B consisted the control group. The treatment group was assigned Elaborative interrogation teaching/learning technique as the means of teaching while group B was the control group using the conventional method to measure the effect of elaborative interrogation on achievement in Physics concepts among secondary school II students in Aguata Local Government Area. The instrument for data collection was a researcher-developed Physics Achievement Test (PAT) used to test the student's achievement in Physics before and after the treatment. Physics Achievement Test (CAT) is a 30 item multi choice questions with four options A-D on which only

one is the correct option. A table of specification was constructed to the allocation of questions into the cognitive learning outcomes. The instrument was validated by three experts, one in Physics and one in measurement and evaluation and one from psychology, all from Michael Okpara University of Agriculture Umudike, Abia State Nigeria. The corrections made by the experts were effected as the final version of the instrument. The PAT instrument was subjected to item analysis to determine the content validation. The reliability test analysis of PAT was determined using Kudder Richardson (K-R₂₀) formula to determine the internal consistency which yielded an index of 0.81. Before and after the treatment that lasted for six weeks, the copies of the instrument were administered to the students by their regular Physics teachers who carried out the treatments. The data collected from the students were analyzed using mean and standard deviation to answer the research questions, while the Analysis of Covariance (ANCOVA) was used to test the null-hypotheses at 0.05 level of significance.

RESULT

The data were analyzed in line with the research questions and hypotheses and results presented in tables as shown below

Research Question 1

What is the mean achievement scores of secondary school II students taught Physics concepts using elaborative interrogation and those taught using conventional method?

Table 1: Pretest and Posttest achievement mean scores of students taught Physics concepts using Elaborative interrogation and those taught using conventional method

Method	N	Pretest		Posttest		Mean gain scores
		$\bar{X}$	SD	$\bar{X}$	SD	
EIM	35	21.03	1.84	34.86	2.18	13.43
CTM	35	20.97	1.79	25.17	1.65	6.20
Effect						7.23

EIM= Elaborative Interrogation Method, CTM. = Conventional Teaching Method

The data in Table 1 show that the students taught Physics concepts using Elaborative interrogation had a Pre-test achievement mean score of 21.43 with standard deviation of 1.84 and a Posttest mean score of 34.86 with standard deviation of 2.18. Their counterpart in the conventional method (Control group) had a Pre-test achievement mean score of 20.97 with a standard deviation of 1.79 and a posttest achievement mean score of 25.17 with the standard deviation of 1.65. The result further showed that the students taught Physics concepts using Elaborative interrogation had achievement mean gain of 13.43 while those taught with the conventional method had achievement mean gain of 6.20. This showed that students taught Physics concepts using Elaborative interrogation had higher mean achievement scores than their counterparts taught using conventional method. In other words, the use of Elaborative interrogation resulted to a higher effect on mean achievement scores of students than the using of conventional teaching method.

Corresponding hypothesis that addressed the above research question 1:

Hypothesis 1

Table 2: Analysis of Covariance (ANCOVA) on the mean achievement scores of students taught Physics concepts using elaborative interrogation and those taught using conventional method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision Rule
CorrectedModel	1852.41	2	926.21	41.52	.000	
Intercept	1120.35	1	1120.35	50.23	.000	
Pretest	78.16	1	78.16	3.51	.065	
Group	1726.38	1	1726.38	77.39	.000	Sig
Error	1494.27	67	22.30			
Total	42351.00	70				
Corrected Total	3346.68	69				

Significant at 0.05 level of significance

Table 2 shows that a significant Probability (P)-value of 0.000 was obtained which is less than 0.05 alpha level. This implies that the null hypothesis was rejected. Therefore, there was a significant difference between the mean achievement scores of students who were taught Physics concepts using Elaborative interrogation and those taught using conventional method.

Research Question 2

What is the mean achievement scores of male and female secondary school students taught Physics concepts using elaborative interrogation?

Table 3: Pretest and Posttest achievement mean scores of Male and Female Students taught Chemistry concepts Using Elaborative interrogation method

Gender	Pretest			Posttest		Mean gain scores
	N	$\bar{X}$	SD	$\bar{X}$	SD	
Male	20	21.00	1.86	34.05	2.15	13.05
Female	15	21.07	1.91	34.07	2.05	13.00
Effect						0.05

The results in Table 3 revealed that male students taught Physics concepts using Elaborative interrogation had Pretest mean achievement score of 21.00 with standard deviation score of 1.86 and posttest mean achievement score of 34.05 with standard deviation score of 2.15. Their female counterparts also recorded a pretest mean score of 21.07 with standard deviation score of 1.91 and a posttest mean achievement score of 34.07 with standard deviation of 2.05. The table further indicated that the male students recorded a mean gain of 13.05 while the female students had a mean gain score of 13.00. This implies that the male students taught physics concepts had a slight higher mean gain score of 0.05 over their female counterparts.

Corresponding hypothesis that addressed the research question 2 is:

Hypothesis 2

There is no significant difference between the mean achievement scores of male and female students who were taught Chemistry concepts using elaborative interrogation.

The data for testing hypothesis 2 were analyzed with ANCOVA and the results presented in Table 4.

Table 4: Analysis of Covariance (ANCOVA) of Achievement scores of Male and Female Students taught Chemistry concepts using Elaborative interrogation method

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision Rule
Corrected Model	8.64 ^a	2	4.32	0.93	.403	
Intercept	1347.00	1	1347.00	289.96	.001	
Pretest	8.62	1	8.62	1.86	.180	
Gender	0.02	1	0.02	0.04	.951	NS
Error	148.50	32	4.64			
Total	1504.14	34				
Corrected Total	157.14	34				

Significant at 0.05 level of significance

The results in Table 4 indicate that a significant P-value of 0.951 was obtained which is greater than the alpha value of 0.05. This however means that the null hypothesis stated was not rejected. Therefore, there is no significant difference between the mean achievement scores of male and female students who were taught Physics concepts using Elaborative interrogation method.

Discussion of findings

The use of elaborative interrogation in teaching Physics concepts resulted to higher achievement in Physics among students, than those taught with conventional method. Also, there was a significant difference between the achievement scores of students who were taught Physics concepts using elaborative interrogation strategy and those taught using conventional method. This finding is in agreement with Kuhl & Bertrams (2019) who reported that elaborative interrogation strategy enhances student's achievement than conventional method. The finding also showed that male students recorded a slightly higher achievement score than their female counterparts; the achievement of the male students over female in physics concepts was not significant. It therefore supports the report of Semerzier, (2020) who reveal that females are known to have less representation in Physics which leads to underperformance in comparison to the males. On the other hand Godpower-Echie and Ihenko (2017) in their research work reported that female students had a fairer understanding of science process skills than males. In this study there was no significant difference in

the achievement of male and female students in Physics when taught with elaborative interrogation strategy and difference observed was as a result of probability.

Conclusion

The use of elaborative interrogation teaching method in teaching Physics concepts resulted to higher achievement in Physics among students, than those taught with conventional method and there was a significant difference between the achievement scores of students who were taught Physics concepts using elaborative interrogation and those taught using conventional method.; The achievement of the male students over female students in Physics concepts was not significant as the male students recorded a slightly higher achievement score than their female counterparts.

Recommendations

Based on the findings the following recommendations were made.

1. Organization of workshops, trainings, conferences by the government should be conducted regularly train Physics teachers on the effective ways of using the Elaborative interrogation teaching method to enhance students' academic achievements in Physics.
2. Teachers should be encouraged to make adequate use Elaborative interrogation regularly in teaching Physics to increase the overall academic achievement of students in Physics and minimize the frequent use of conventional method in order to reduce gender bias in achievement.

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