

EFFECT OF SCAFFOLDING INSTRUCTIONAL STRATEGY ON SENIOR SECONDARY STUDENTS' ACADEMIC PERFORMAMCE IN PHYSICS IN KOGI STATE, NIGERIA.

Friday Akubor¹; Lawrence Achimugu² PhD; Ayodele Gabriel Fasanya³ PhD;
and

Ojonoka Agah Oche⁴

^{1, 2, 3&4} Department of Science Education, Faculty of Education,
Prince Abubakar Audu University, Anyigba, Kogi State.

lawachi88@gmail.com

fasanya798@gmail.com

ocheojonoka@gmail.com

Corresponding author: akubof90@gmail.com

+2348054117109

Abstract

The study investigated effect of scaffolding instructional strategy on students' academic performance in Physics. Two research questions and two hypotheses guided the study. The population of the study consisted of 11,091 (5,916 male and 5,175 female) senior secondary school two (SS II) students who offers physics in Kogi State. The sample size for the study was 240 SSS II students offering Physics in the selected secondary schools. The instrument used for data collection was Physics performance Test (PPT) and Researcher adopted quasi-experimental design for the study. The instruments was face and content validated by three experts. The method of data collection was multi-stage sampling technique and simple random sample technique was used to select a total sample of one hundred and sixty five (165) students from the two secondary schools used for the study. Mean and standard deviation were used to answer the research questions while the hypotheses were tested at 0.05 level of significant using analysis of covariance (ANCOVA). The reliability of the PPT was calculated using Kuder-Richardson (K-R20) method, from which a reliability coefficient of 0.80 was obtained. The results of the analysis showed that there was a statistically significant difference between the academic performance mean scores of students in physics when exposed to scaffolding and conventional strategies. The findings showed that, there was no significant difference between the academic performance mean scores of male and female students' taught Physics using scaffolding strategy. Furthermore, the finding revealed that there was no statistically significant interaction effect of instructional strategy and gender on academic performance of students in physics. Based on the findings, it was recommended that Physics teachers should adopt

scaffolding instructional strategy in teaching and learning of Physics in order to improve students' academic performance in physics.

Keywords: Scaffolding, Instructional Strategy, performance, Gender, physics

Introduction

Science is an international discipline that encompasses several fields of knowledge, exploring the makeup and behaviors of the physical and organic worlds via observation and investigation. According to Esu (2014), science is a systematic, precise, and unbiased way of studying natural events. Science is used in many aspects of daily life, such as construction, communication, transportation, medical, and agriculture. Additionally, it has helped to raise public welfare, security, health, and living conditions. People can use science to solve issues, create new technologies, comprehend the natural world, and live better lives (Rull, 2014).

Among other things, Biology, Chemistry, and Physics are the subjects that comprise science. As a foundational subject that prepares students for postsecondary education and professions in the fields of science, technology, engineering, and mathematics (STEM), Physics plays a critical role in scientific education. This branch of science studies matter, things, energy, and how they interact in particular contexts or systems. According to Eryilmaz (2016), Physics is the most fundamental and important foundation for all other scientific fields. According to Achimugu et al. (2023), Physics is a discipline that involves laboratory work. It is an understanding of a natural phenomenon that involves investigation and learning through practical and theoretical experiments under the guidance of the instructor.

In spite of this, many students struggle with Physics and struggle to become proficient in Physics. These difficulties frequently result from students' lack of enthusiasm and interest, as noted by Balci (2020), as well as the sophisticated, theoretical, and nuanced nature of physics concepts as perceived by students. Therefore, one of the fundamental science subjects with the highest need in science, innovation, and technological advancement is physics. The application of science and technology has been formed through secondary school physics instruction, which has greatly benefited society.

Physics has been a persistent problem in Nigeria. From 2013 to 2023, the Chief Examiner for the West African Examination Council (WAEC) claimed that pupils' performance in Senior School Certificate Examination (SSCE) in Physics was continuously low. The Chief Examiner also noted that Nigerian secondary school pupils had difficulty grasping ideas like wave-particle duality. The pupils' passion for Physics is tempered by these, which results in disinterest and subpar performance. The traditional approach to teaching Physics is typically one that is teacher-centered. Since the teacher primarily imparts knowledge while the pupils passively absorb it, this approach is characterized by one-way communication.

Students will struggle to understand the topic being taught when Physics is presented to them in this way, which may lead to a lack of enthusiasm and subpar academic performance.

Academic performance can be measured, and tests are usually used to evaluate it. Achor and Gbadamosi (2020) describe performance as the degree of academic performance or performance that students achieve when exams are given. Performance, according to Bajon (2015), is the accomplishment of an objective, frequently including perseverance, skill improvement, or effort. According to Adulwaheed in Adulwaheed and Achimugu (2022), students' academic performance can be improved by switching from traditional to new teaching methods. Likewise, Achimugu (2023) said that students' low academic performance in science can be ascribed to a number of factors, but that using an effective teaching approach is one of the most frequently mentioned problems. Considering the aforementioned, academic performance is defined as the learning outcome that students demonstrate using any of the tools. such as tests and quizzes, exams, projects, and more. The Federal Republic of Nigeria (FRN, 2018) has proposed the creative method of instructional practices, which is student-activity-based. The use of scaffolding is one of these tactics.

The term scaffolding instructional approach describes the support a teacher gives a pupil during the learning process. Each student receives a customized concept map that precisely reflects this help. Compared to conventional teacher-centered techniques, this teaching strategy promotes student-centered learning, which is typically more successful (Boris, 2020). When it comes to secondary school, scaffolding encourages deeper learning than many other popular teaching strategies. Scaffolding is defined by Omoniyi and Toru (2018) as short-term assistance and direction given to students to help them comprehend and finish assignments. The article went on to say that in an educational setting, scaffolding refers to a variety of methods a teacher employs to help pupils gain confidence and comprehension as they progress through the learning process. In order to assist students gradually advance their knowledge and abilities while gaining greater independence and self-assurance, this entails providing them with organized direction, feedback, and modeling (Ding, 2022). The scaffolding teaching technique provides pupils with significant learning support while they are being introduced to new ideas and abilities. This assistance could take the form of materials, interesting exercises, templates and manuals, and direction for enhancing social and cognitive abilities. Task modeling, guidance, and coaching are ways to apply instructional scaffolding (Akani, 2015).

Another teaching technique that teachers use to help students at first and then progressively remove assistance as they grow more self-sufficient in their learning is called educational scaffolding. Lev Vygotsky's socio-cultural theory (1962) and his idea of the Zone of Proximal Development (ZPD) are the roots of

this tactic. According to Vygotsky's theory, a learner can advance to the next level with the help of peers, knowledgeable adults, and a variety of environmental tools and strategies. Through a variety of tactics used by educators, such as instructional materials, technology, and cooperative efforts with peers or adults, it recognizes the learner's starting level of development as well as the feasible level (Aditi, 2017 & Huda, 2019). The researcher sees educational scaffolding as the temporal educational support and guidance giving to the students and withdraw immediately changes are observed in the process of learning.

The social, cultural, and psychological characteristics and roles that come with being male, female, or non-binary are referred to as gender. It is not the same as biological sex, which is determined by physical and genetic traits such as chromosomes, reproductive organs, and hormone profiles. According to Williams et al. (2017), gender is a complicated, multidimensional notion that includes a variety of identities, experiences, and expressions. As Akumah (2014) highlights, scholars have long acknowledged that gender can have an impact on academic performance in physics and related subjects. Akumah continued by saying that there is a belief that men have historically dominated science, technology, and allied fields, while women have historically led the arts and humanities seen to be more in line with women. According to this widely held idea, girls are more drawn to the arts and humanities, while boys are more naturally inclined toward science and technical studies. Nonetheless, some researches contend that gender has little impact on students' performance in the sciences (Nwankwo, 2015; Orefor, 2016).

Therefore, the purpose of this study is to look into how gender affects students' interest in and academic performance in physics.

Research Questions

The following research questions were generated to guide the study

1. What is the effect of scaffolding, guided-inquiry and conventional lecture instructional strategies academic performance mean scores of students in physics.
2. What is the effect of scaffolding strategy on the academic performance mean scores of male and female students in Physics?

Hypotheses

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

H₀₁: There is no significant difference between the performance mean scores of students taught physics using Scaffolding and conventional lecture strategies.

H₀₂: There is no statistically significant difference between the performance mean scores of male and female students taught Physics using scaffolding instructional strategy.

Methodology

The design of the research study was quasi-experimental. For this investigation, a pretest-posttest control group was employed. An experimental study that assesses the impact of a treatment paradigm in a non-randomized population is known as a quasi-experimental study (Achimugu et al., 2024). Because the study included intact classes, this design was adopted. A lucky dip was used to divide the classes into the experimental and control groups. The study was conducted in Kogi East education zone. The sampling technique used was a multistage sampling technique. Simple random sampling was used to choose the Dekina local government area from among the two local government areas in the education zone that was the subject of the study. Two Co-educational schools owned by the government were randomly chosen. Then, using random sampling, one intact classroom was selected from each of the sampled schools, for a total of two complete classrooms. Of the two entire classes, one was allocated to the experimental group and the other to the control group. The study included 240 physics students, 132 of whom were male and 108 of whom were female, selected from the two entire classes. There were 150 students in the experimental group, 80 of whom were male and 70 of whom were female, and 90 students in the control group, 53 of whom were male and 38 of whom were female. The researchers created the tool that was used to gather data. 30 multiple-choice questions with four options (A–D) taken from previous WAEC exams from 2013–2022 are used to gauge students' performance on the Physics Performance Test (PPT). It was discovered that the instrument's Kuder Richardson coefficient of internal consistency was 0.80. To account for potential pre-existing disparities in overall ability between the experimental and control groups, a pretest was given to the group prior to the trial testing in their respective schools. While the control group was taught the identical material using a traditional approach, the experimental group was instructed on utilizing a scaffolding teaching strategy. The mean and standard deviation were used to answer the research questions, and analysis of covariance (ANCOVA) was used to analyze the hypotheses at the 0.05 alpha level of significance. The figure below shows the schematic representation of the design stated above.

The schematic design of the study is as shown;

Group	Pre-test	Treatment	Post-test
Experimental Group 1(E_1)	O_1	X_1	O_2
Control (C_1)	O_1	- X	O_2

Where E_1 = Experimental group 1 (Scaffolding)
 C_1 = Control Group (conventional method)

X = Treatment
-X = No treatment
O₁ = Pretest for both
O₂ = Posttest for group groups

Results

1. What is the academic performance mean scores of students' taught physics using scaffolding and conventional lecture instructional strategies?

Table 1: Pretest/Posttest Academic Performance Mean Scores of Students Taught Physics in the Experimental and Control Groups

Method	Pre test		Post-test		SD	Mean gain
	N	\bar{X}	SD	\bar{X}		
Scaffolding	132	34.57	9.333	65.21	3.366	30.64
Conventional Method	108	37.16	9.040	49.88	1.984	12.72
Total	240					

Result in Table 1 showed that students who were taught Physics using Scaffolding, had pretest performance mean scores of (= 34.57, SD = 9.333) and post-test performance mean scores of (= 65.21, SD = 3.366) with mean gain score of 30.64. More so, students who taught Physics using conventional method had a pretest performance mean score of (= 37.16, SD = 9.040), and post-test performance mean scores of (= 37.16, SD = 49.88) with mean gain of 12.72. Meanwhile, scaffolding have higher mean gain scores of 30.64. This means that scaffolding improved students' performance more than conventional method.

Research Question two

2. What is the difference between the academic performance mean scores of male and female students' taught physics using scaffolding strategy?

Table 2: Pretest/Post-test of the performance Mean Scores of Male and Female Students in the Experimental Group.

Gender	N	Pretest		Post-test		Mean Gain
		\bar{x}	SD	\bar{x}	SD	
Male	39	35.00	9.541	65.64	3.572	30.64
Female	43	34.19	9.320	64.81	3.157	30.62

Result in Table 2 showed effect of gender on students' performance mean scores when taught physics using scaffolding Strategy. The results showed that the male students had pre-test mean performance scores of ($\bar{x} = 35.00$, $SD = 9.541$) and a post-test performance mean scores of ($\bar{x} = 65.64$, $SD = 3.572$), while the female students had a pre-test performance mean scores of ($\bar{x} = 34.19$, $SD = 9.320$) and a post-test performance mean scores ($\bar{x} = 64.81$, $SD = 3.157$). The result also showed that the male students performed higher than their female counterparts with mean gain scores of 30.64 while the female students had mean gain scores of 30.62 resulting to insignificant mean gain difference of 0.02 in favour of the male counterpart students.

Hypotheses

H₀₁: There is no significant difference in the academic performance mean scores of students taught physics using Scaffolding instructional (SI) and conventional lecture strategies.

Table 3: Analysis of Covariance (ANCOVA) of Differences in the Mean Academic Performance Scores of Students in Physics When Exposed to Scaffolding Instructional (SI), and Conventional Instructional Strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	12121.615 ^a	3	4040.538	452.449	.000	.852
Intercept	55410.273	1	55410.273	6204.698	.000	.963
Pretest	1.983	1	1.983	.222	.638	.001
Strategy	11588.776	2	5794.388	648.840	.000	.846
Error	2107.568	233	8.930			
Total	867940.000	240				
Corrected Total	14229.183	239				

a. R Squared = .852 (Adjusted R Squared = .850)

The results in Table 3 showed the ANCOVA of the difference in the academic mean performance scores of students in Physics when exposed to scaffolding and conventional method. The result was statistically significant at $F(2, 236) = 648.840$; $p = 0.000 < 0.05$. Since $p < 0.05$, the null hypothesis was rejected. Thus, inference drawn is that there was a statistically significant difference in the mean academic performance scores of students in Physics when exposed to scaffolding and conventional method in favour of the treatment groups with high means. The result further showed the effect size of (0.846), which indicates that 84% of students'

academic performance scores of students in Physics can be accounted for by the strategies used.

H₀₂: There is no statistically significant difference between the performance mean scores of male and female students taught Physics using scaffolding instructional strategy.

Table 4: Analysis of Covariance (ANCOVA) of Difference between the Academic Performance Mean Scores by Gender in the Experimental Group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	19.528 ^a	2	9.764	.859	.428	.021
Intercept	22668.698	1	22668.698	1994.355	.000	.962
Pretest	5.538	1	5.538	.487	.487	.006
Gender	13.203	1	13.203	1.162	.284	.014
Error	897.948	79	11.366			
Total	349581.000	82				
Corrected Total	917.476	81				

a. R Squared = .021 (Adjusted R Squared = -.003)

The result in Table4 showed the ANCOVA of the difference between the mean performance scores of male and female students' taught Physics using scaffolding strategy. The result was statistically not significant at $F(1, 79) = 1.162$; $p = 0.284 > 0.05$. Since $p > 0.05$, the null hypothesis was not rejected. Thus, inference drawn is that there was no significant difference between the mean performance scores of male and female students' taught Physics using scaffolding strategy. The result further showed the effect size (.014), which indicates that 1.4% of male and female students' performance can be accounted for by gender when taught Physics using scaffolding strategy.

Discussion of Findings

The study's findings demonstrated that students exposed to physics instruction through scaffolding techniques did better than those exposed to the traditional approach. Additionally, there was a substantial difference in the treatment group's adjusted mean performance, was significant in favour of the treatment group. The study's findings are consistent with those of Onah and Achufus (2022); Van Meter and Edmondson (2014); Bileya et al. (2021); and Samuel and Oka (2020), who have demonstrated in their disparate studies that the use of scaffolding as an instructional method has a more positive impact on academic performance. The results of this study support the notion that using scaffolding as an instructional method does not discriminate against women when teaching subjects like Physics. The results of a

number of other research that looked into how gender affects male and female students' performance in the sciences are consistent with this one. For instance, according to Akpan and Uko (2021), Ugwu and Nnadi (2015), Hill et al. (2014), and Abuh (2020), there was no discernible difference in the academic performance of male and female students when exposing to Scaffolding strategy. The scaffolding instructional strategy allows for unrestricted gender interaction, allowing male and female students to perform equally in Physics.

Conclusion

Based on the findings of the study, students' performance mean scores in physics when exposed to scaffolding and traditional teaching methods statistically differed with the scaffolding instructional strategy outperforming the conventional teaching method. The mean academic performance of male and female students who were taught Physics utilizing the scaffolding technique did not differ.

Recommendations

The following recommendations were made based on the findings of the study.

1. Physics teachers should make use of scaffolding strategy to teach Physics in order to improve students' academic performance in Physics.
2. Physics teachers can use scaffolding strategy to bridge the gender gap in students' academic performance in Physics in senior secondary schools.

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