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EFFECT OF SCAFFOLDING INSTRUCTIONAL STRATEGY ON STUDENTS' ACHIEVEMENT AND RETENTION IN MECHANICS IN NIGER STATE, NIGERIA

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ABSTRACT

This study investigated the effect of scaffolding learning strategy on students' achievement and retention in Mechanics in Niger State, Nigeria. Quasi-experimental pre-test-post-test, post-post-test control group research design was employed for this study. Four research questions guided the study and four hypotheses were tested at 0.05 level of significance. The population of this study comprises of 2,636 SS I Science students from 70 senior secondary schools in East senatorial district, Niger State, Nigeria for 2021/2022 academic session.

INTRODUCTION

Physics is a core science subject offered in schools whose importance and applications are a major pre-requisite for the achievement of scientific and technological development. It deals with the study of properties in relation to space and its interactions, time, matter and energy. It also deals with physical principles and laws governing the universe (Achor & Gbadamosi, 2020). In Nigeria, as well as some other developing countries of the world, Physics is considered as an important subject and is taught in the last three years of secondary school as a single subject. Physics is divided into two main branches namely classical Physics and modern Physics. Classical Physics consists of Mechanics, heat, optics, wave and sound, electricity and magnetism, while modern Physics covers the aspect of matter, energy and their relations at atomic and sub-atomic levels (Baran, 2016).

It is common knowledge that many students whose ambition have been to specialize in professions such as Engineering, Medicine, Architecture, Surveying, Town planning, and other related fields of human endeavors often change their careers because they are not able to secure even the lowest credits in Physics (Gambari, Yusuf & Thomas, 2015). Therefore, students who are unable to obtain the lowest credit in Physics cannot be given admission to study any of the above-mentioned courses in higher institutions of learning. Many students consider Physics as an abstract and difficult science subject. Specifically, some concepts in Physics such as; Mechanics which taught in a more theoretical than practical pattern, is considered difficult to students and so they do not attain to answer questions in those areas in examinations (Bello, Opaleye & Olatunde, 2018).

Multistage sampling procedure was employed to draw the sample for this study. The instrument for data collection is Mechanics Achievement Test (MEAT). Split-half reliability was used to determine the reliability and coefficient of 0.86 was obtained Means and standard deviations were used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the hypotheses. The findings from this study revealed that; There was a significant difference in the mean achievement of students taught Mechanics using Scaffolding Learning Strategy and the conventional method. $F_{1,120)}$ = ratio of 26.102 was obtained with associated exact probability value of 0.000, ($F_{1,120)}$ = 26.102; p = .000 <α = .05). There was no significant difference in the mean retention of students taught Mechanics using Scaffolding Instruction Strategy and the conventional method. $F_{1,120)}$ = ratio of 2.944 was obtained with associated exact probability value of 0.089, ($F_{1,120)}$ = 2.944; p = .089 >α = .05). Based on the findings of this study, it was recommended that; Physics teachers should adopt Scaffolding Instructional Strategy as it would go a long way in improving students' achievement and retention in Mechanics.

Keywords: Achievement, Mechanics, Scaffolding Instructional Strategy, Students, Retention

Mechanics is the science of the action of forces on material bodies. It forms a central part of all physical science and engineering. Beginning with Newton's laws of motion in the 17th century, the theory has since been modified and expanded by the theories of quantum mechanics and relativity. Newton's theory of mechanics, known as classical mechanics, accurately represented the effects of forces under all conditions known in his time. It can be divided into statics, the study of equilibrium, and dynamics, the study of motion caused by forces. Though classical mechanics fails on the scale of atoms and molecules, it remains the framework for much of modern science and technology (Espinoza, 2015).

Majority of the world's inventions, appliances, tools, and building construction are made possible through the application of the principles of Mechanics. The keyboard instrument, communication gadgets, clinical thermometer, x-rays machine, firing gun, bicycle, motor car, camera, radio and televisions are a few of the many inventions and discoveries of man which require deeply the knowledge of Mechanics for their understanding and how they operate (Rafiu & Adetona, 2019). The effect of Mechanics can be felt in all areas of human activity. In fact, whenever one is trying to take a step, trying to listen, catching a ball, sitting down, opening a door, whispering, or checking image in a mirror, he/she is unconsciously using the knowledge of Mechanics. Even though the physical world is very complex, Physicists usually use simple models to explain the most fundamental features of various phenomena. The world is surrounded by the principles of Mechanics. In fact, most people know much more about Mechanics than they realize (Bileya, Aliyu & Bulus, 2021).

Despite the importance and relevance of Mechanics and Physics in general to the technological development, researches over the years have shown that students' achievement in physics is low and even the few that enrolled perform poorly in physics examinations, especially in secondary

schools has been consistently deteriorating and very poor (Ennosho, 2013; Obi & Ewuzie, 2014; Mbamara & Eya, 2015; Okoronka & Taale, 2014). Similarly, in Nigeria, the evidence of low enrolment and massive failure in public examinations (Secondary School Certificate Examination) in Physics is indicative that poor achievements have consistently been reported in external examinations (West African Examinations Council, 2016-2020). Chief examiner's report of WAEC, 2016 to 2020, indicated that lack of understanding of concepts of Physics contributed to the awful performances of students in Physics. The conventional Physics instruction method, which is normally a teacher-centered approach, may also contribute to the observed low students' achievement in Physics and has created a gap between the use of appropriate learning strategy for impacting knowledge of Physics concepts. This study explored the utilization of scaffolding learning strategy to find out whether students' achievement and retention in Mechanics will be improved.

Scaffolding instructional strategy is a constructivist instructional approach in which students share the responsibility of teaching and learning through scaffolds (support) that require them to move beyond the skill and knowledge they acquired previously (Uduafemhe, 2015). Through this interaction, students are able to take possession of the learning event. Agu and Iyamu (2020) saw scaffolding as the assistance (parameters rules or suggestions) a teacher gives to the students in a learning situation. Scaffolding instructional strategy is a learning process intended to promote a vast level of learning. In scaffolding instruction, a more knowledgeable person (teacher) provides scaffolds to facilitate the learner's development and ability to build on prior knowledge and internalize new information (Aditi, 2017; Samuel & Oka, 2020). Scaffolding has the following advantages, it:

i. challenges students through deep learning and discovery;
ii. engages students in meaningful and dynamic discussions in small and large classes motivates learners to become better students (learning how to learn);
iii. increases the likelihood for students to meet instructional objectives; provides individualized instruction (especially in smaller classrooms);
iv. affords the opportunity for peer-teaching and learning; can be recycled for other learning situations;
v. provides a welcoming and caring learning environment.

Scaffolding is the support offer during the learning process which is geared towards meeting the needs of the learner with the intention of helping the learner to achieve the set learning objectives. It is also the process of building on what a learner already knows (Alake & Ogunseemi, 2013; An & Cao, 2014).

Academic achievement is a measurable construct, and the conventional way of measuring it is through testing. According to Achor and Gbadamosi (2020), Achievement is the level of success or performance students attained after test has been administered to them. Bajon (2015) regarded achievement as a task which has been accomplished successfully, especially by means of exertion, skill practice or perseverance. Students' achievement is attributed to students' personal progress which is an act of accomplishing an academic task productively. Some researchers (Bawaneh, Zain, Saleh, & Abdullahi, 2012; Saleh & Subramaniam, 2017) have indicated that inappropriate teaching methods and strategies utilized by teachers in teaching science students among other factors accounts for the poor achievement of science students. This by implication can lead to poor

achievement in Physics. In Nigeria, conventional teaching strategy indicates a strategy that is formal and has been in use for long. This strategy is one of the easiest to deliver instructions to students, which may be reasons why many teachers use it often without alternating to other innovative teaching strategies that can motivate students' understanding and achievement. The student-activity-based mode of teaching strategies has been recommended by the Federal Republic of Nigeria (FRN, 2018). Among these strategies is Scaffolding.

Retention is another variable in this study. It is the ability to keep and remember the concept learnt in the memory for a long time and so the instructional strategy and instructional materials are among the materials which teachers use to make instruction more effective, lasting and enjoyable (Saleh & Subramaniam, 2017). This implies that the amount of knowledge or skill learnt, kept, maintained and reproduced after a period of time reflects what is retained. For the purpose of this study, retention is defined as the amount of knowledge learnt in light waves which students can be able to retain and recall when required. Therefore, to improve students' achievement level in mechanics implies to improve the level at which they retain the concept of mechanics learnt. From all that have been discussed, the need to ascertain the efficacy of using Activity-Based teaching strategy on students' achievement and retention in light waves has become necessary. The focus of this study therefore, is to find out the effect of scaffolding learning strategy on students' achievement and retention in Mechanics.

Literature Review

Onah (2022) investigated the effect of scaffolding teaching approach on students' academic achievement in secondary school Physics. The findings showed that students in scaffolding teaching approach group achieved better than their counterpart. Bileya, Aliyu and Bulus (2021) investigated the effect of instructional scaffolding on Physics students' achievement. The findings revealed that a statistically significant difference exists in the mean academic achievement scores of students taught physics using instructional Scaffolding and those taught using Conventional method in favor of instructional Scaffolding. Gender differences are not statistically significant in the mean academic achievement scores for instructional Scaffolding group. Okigbo and Anyanwumelu (2021) examined the effect of scaffolding instructional strategy (SIS) on secondary school students' Academic achievement in Mathematics. The findings of the study revealed that the use of SIS in teaching mathematics enhanced achievement scores of students more than the use of conventional method in favour of males. Oluwasegun and Niedderer (2020) investigated the 'Effect of Scaffolding Strategy on Waves among Low and High Ability Levels Secondary School Students' Achievement and Retention. The finding reveals a significant difference in the mean achievement scores of students taught waves using scaffolding and conventional method. Agu and Iyamu (2020) investigated the effect of metacognitive scaffolding teaching strategy on secondary school physics students' achievement and attitude to thermal energy. Findings from the study showed that physics students taught using metacognitive scaffolding teaching strategy performed better than those physics students taught using conventional teaching method. Also, physics students taught using metacognitive scaffolding teaching strategy had better attitude towards thermal energy than their counterparts in the control group. Atsumbe, Owodunni, Raymond and Uduafemhe (2018) carried out a study to determine the effects of scaffolding and collaborative instructional approaches on students' achievement in Basic Electronics. Results

revealed that a collaborative instructional approach is more effective in improving student achievement in Basic Electronics than a scaffolding instructional approach. Also, gender had no significant influence on students' achievement in Basic Electronics when taught using scaffolding and collaborative instructional approaches. It was concluded that the collaborative instructional approach is a viable teaching method for improving students' achievement in Basic Electronics.

Research Questions

The following questions guided the study:

1. What are the mean achievement scores of students taught Mechanics using scaffolding instructional strategy and the conventional method?
2. What are the mean retention scores of students taught Mechanics using scaffolding instructional strategy and conventional method?

Research Hypotheses

The following hypotheses are formulated to guide this study and were tested at 0.05 level of significance.

Ho_1: There is no significant difference between the mean achievement scores of students taught Mechanics using scaffolding instructional strategy and the conventional method.

Ho_2: There is no significant difference between the mean retention scores of students taught Mechanics using scaffolding instructional strategy and the conventional method.

The findings of this study might be beneficial to the following stakeholders: Physics teachers and students.

The findings of the study might help in improving the quality of Physics teaching in Nigerian secondary schools. It could sensitize and provide pedagogical interventions to Physics teachers especially those in secondary schools on the use of scaffolding instructional strategy in the teaching of Mechanics and other concepts perceived to be difficult by students. It is hoped that the findings might expose them to be more effective and professional in-service delivery. It is hoped that the findings might help students to become more alert and develop the ability of creative and reflective thinking and on their own study and correct misconceptions they may encounter. It is also hoped to help students build and develop interest in learning Mechanics and other concepts, retaining the concepts, improving achievement and making them better Physics students.

Methodology

The research design adopted for the study is quasi-experimental pre-test-post-test, post-post-test control group design. According to Tuckman (2015), this design is appropriate to this study because intact classes were used. The population of this study comprises of 2,636 SS I Science students from 70 senior secondary schools in East senatorial district, Niger State, Nigeria for 2021/2022 academic session. Multistage sampling procedure was employed to draw 123 (56 Males and 65Females) as sample for this study. Mechanics Achievement Test (MEAT) was used as instrument for data collection. The MEAT consists of 30-multiple choice items adopted from WAEC (2014-2019), based on mechanics related topics such as; elasticity properties of solid, kinetic theory, simple

harmonic motion and projectiles motion. The Split-half method was used to determine the reliability of the instrument. The reliability coefficient of 0.86 was obtained.

Result

The scores that were obtained from the pre-test, post-test and post post-test served as the data that were used for answering the research questions and testing the stated hypotheses. All the research questions were answered by computing the mean scores and the standard deviations of the subjects. All null hypotheses were tested using Analysis of Covariance (ANCOVA) at a Probability level of $P<0.05$ for rejecting or not rejecting the stated hypotheses.

Research Question One

What are the mean achievement scores of students taught Mechanics using scaffolding instructional strategy and the conventional method?

The data for answering this research question is presented in Table 1.

Table 1

Mean Achievement Scores and Standard Deviations of Students Taught Mechanics Using Scaffolding Instructional Strategy and the Conventional Method

Method		Pretest	Posttest
Scaffolding	Mean	22.97	32.00
	N	60	60
	Std. Deviation	5.330	3.813
Conventional	Mean	17.67	26.62
	N	63	63
	Std. Deviation	3.737	3.113

Table 4.1 reveals that for the students taught Mechanics using Scaffolding Instructional Strategy, mean achievement for the pre-test is 22.97 and the post-test is 32.00. Those taught using the Conventional Method, the mean score for the pre-test is 17.67 and the post-test is 26.62.

Hypothesis One

Ho_1: There is no significant difference between the mean achievement scores of students taught Mechanics using scaffolding instructional strategy and the conventional method.

The data to test this hypothesis is presented in Table 2.

Table 2

Result of ANCOVA of Students Taught Mechanics Using Scaffolding Instructional Strategy and the Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1410.099[a]	2	705.050	90.142	.000	.600
Intercept	2373.562	1	2373.562	303.465	.000	.717
Pretest	520.273	1	520.273	66.518	.000	.357

Group	204.158	1	204.158	26.102	.000	.179
Error	938.584	120	7.822			
Total	107539.000	123				
Corrected Total	2348.683	122				
a. R Squared = .600 (Adjusted R Squared = .594)						

Table 2 reveals a significant difference in the mean achievement of students taught Mechanics using Scaffolding Learning Strategy and the conventional method. $F_{1,120)}$ = ratio of 26.102 was obtained with associated exact probability value of 0.000, ($F_{(1,120)}$ = 26.102; p = .000 <α = .05). Since the associated probability (0.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. This indicates that there was a significant difference in the mean achievement of students taught Mechanics using Scaffolding Instructional Strategy and the conventional method.

Research Question Two

What are the mean retention scores of students taught Mechanics using scaffolding instructional strategy and conventional method?

The data for answering this research question is presented in Table 3.

Table 3

Mean Retention Scores and Standard Deviations of Students Taught Mechanics Using Scaffolding Instructional Strategy and Conventional Method

Method		Posttest	Retention
Scaffolding	Mean	32.00	27.20
	N	60	60
	Std. Deviation	3.813	4.598
Conventional	Mean	26.62	21.84
	N	63	63
	Std. Deviation	3.113	3.543

Table 3 reveals that for the students taught Mechanics using Scaffolding Instructional Strategy, mean retention for the post-test is 32.00 and for the post-post-test is 27.20. Those taught using the Conventional Method, the mean score for the post-test is 26.62 and for the post-post-test is 21.84.

Hypothesis Two

Ho_2: There is no significant difference between the mean retention scores of students taught Mechanics using scaffolding Instructional strategy and the conventional method.

The data of the test of the hypothesis is provided in Table 4.

Table 4

Result of ANCOVA of Students Taught Mechanics Using Scaffolding Instructional Strategy and Conventional Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1744.171[a]	2	872.086	89.880	.000	.600
Intercept	6.667	1	6.667	.687	.409	.006
Posttest	861.680	1	861.680	88.808	.000	.425

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Group	28.563	1	28.563	2.944	.089	.024
Error	1164.333	120	9.703			
Total	76470.000	123				
Corrected Total	2908.504	122				
a. R Squared = .600 (Adjusted R Squared = .593)						

Table 4 reveals a significant difference in the mean retention of students taught Mechanics using Scaffolding Instructional Strategy and the conventional method. $F_{1,120)}$ = ratio of 2.944 was obtained with associated exact probability value of 0.089, ($F_{(1,120)} = 2.944$; $p = .089 > \alpha = .05$). Since the associated probability (0.089) is greater than 0.05 set as level of significance, the null hypothesis was not rejected. This indicates that there was no significant difference in the mean retention of students taught Mechanics using Scaffolding Instructional Strategy and the conventional method.

Discussion of Findings

Findings from this study revealed that there was a significant difference in the mean achievement of students taught Mechanics using Scaffolding Instructional Strategy and the conventional method. This is in agreement with the findings of Atsumbe, Owodunni, Raymond and Uduafemhe (2018); Oluwasegun and Niedderer (2020); Agu and Iyamu (2020); Nwoke (2020); Boris (2020); Egya (2021); Okigbo and Anyanwumelu (2021); Bileya, Aliyu and bulus (2021) and Onah (2022) who found out that students exposed to scaffolding instructional strategy achieve better than those exposed to the conventional method.

The reason for the better achievement experienced by the treatment groups could be because the students were more focused, attentive and interested in what they were doing. The treatment allowed the learners to take charge of their learning and offered opportunities to develop cognition.

From the findings of this study, it was revealed that, no significant difference in the mean retention of students taught Mechanics using Scaffolding Instructional Strategy and the conventional method. This is in agreement with the findings of Oluwasegun and Niedderer (2020) who found out that students exposed to scaffolding instructional strategy retain concepts better than those exposed to the conventional method.

Recommendations

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

1. Physics teachers should adopt Scaffolding Instructional Strategy as it would go a long way in improving students' achievement and retention in Mechanics.

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