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Efficacy of instructional scaffolding strategy on senior secondary school students' achievement in biology in Makurdi metropolis, Benue state

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Abstract
The study examined the efficacy of instructional scaffolding strategy on senior secondary school students' achievement in Biology in Makurdi Metropolis, Benue State. Two research questions and two hypotheses guided the study. A quasi-experimental research design involving pre-test, post-test control group was adopted. The population of the study was all the senior secondary two (SSII) students in Makurdi Metropolis in all the Government-owned public schools with an estimation of 16321. Random sampling technique was used to select six intact classes with 217 students as the samples size for the study. A 50 item Biology Instructional Scaffolding Strategy Achievement Test (BISSAT) was used for data collection. The BISSAT was validated by three experts and a reliability coefficient of 0.84 obtained using Kuder Richardson's formula 20 (KR-20). The experimental group was taught Biology using instructional scaffolding strategy while the control group was taught the same topic using lecture method. The treatment lasted for four weeks. Descriptive statistics of mean and standard deviation was used to answer the research questions, and analysis of covariance (ANCOVA) was used to test the hypotheses at 0.05 level of significance. The study discovered among others that students taught with instructional scaffolding strategy have a significantly higher achievement than those taught with lecture method. Based on the finding, it was recommended among others that Teachers should employ instructional scaffolding strategy for effective teaching and learning of Biology.

Keywords: biology, instructional scaffolding strategy, lecture method, students' achievement and gender

Introduction
Biology as a science subject occupies a central position in the science curriculum. It is one of the core subjects offered at the senior secondary school level in Nigeria (Federal Republic of Nigeria, 2014) [9]. Sarojini (2013) [25] maintains that the word Biology is derived from the Greek word 'bios' meaning 'life' and 'logos' meaning 'study', thus it is defined as the study of life. The relevance of Biology to man cannot be over stated. For instance, in agriculture, Biology has helped agriculturists to produce high quality plants and animal products in large quantities as well as resistant varieties that boost food production. In the area of medicine, Biology has helped in the production of vaccines and drugs for preventing and curing many illnesses. Nowadays, we have medical breakthroughs such as organ transplant, test tube babies, and artificial limbs among others. The knowledge of genetics which is a branch of biology has revolutionalized determination of paternity disputes and identifies crime culprits with precision and certainty through Deoxyribo-Nucleic Acid (DNA) sequencing and profiling (Githae, Keraro, & Wachanga, 2018) [10]. It is therefore, pertinent for the teachers to select and utilize instructional strategy that will ensure effective teaching and learning of Biology.

Effective teaching and learning are the important parts of the process of education which are aimed at, among other, producing desired changes in the behaviour of the learner to become useful member of the society. Eriba and Samba (2012) [6] opined that the extent to which the set goals or objectives of a particular educational program are accomplished is termed effective teaching and learning. Effective teaching and learning to a large extent depends on the instructional strategy adopted by teachers. Instructional strategies are various ways through which teachers communicate and interact with students on academic content. Bannon (2012) [3] defined instructional strategies as ways in which information is made available to students. According to Nafees, Farouq, and Tahirkheli (2012) [18], the selection of the proper instructional strategy ensures the achievement of the stated objectives. However, science teaching, specifically Biology, over the years has been approached mainly through Lecture method. The lecture method is one of the conventional methods of teaching. It is the oldest method of teaching. It is otherwise known as talk and chalk or textbook method. Joda (2018) [13] observes that the lecture method is a one-way traffic flow of ideas.

The teacher spends most of the time on talking and writing on the chalkboard. The students on their part, sit silently, listen attentively and try to catch the points. Similarly, Eyayu and Meseret (2018) [7] affirm that in the lecture method, the teacher teaches the whole class as a unit. The teacher is the master source of knowledge and exercise control over students spending much time in narration, description and explanation. In the same vein, Kochhar (2012) [15] contends that in the lecture method, the teacher knows everything and that the learners are blank. Accordingly it is the teacher's role to impart knowledge merely by telling the students. Supporting this, Mohmmand (2019), submit that although a lot of materials could be covered within a short time using the lecture method however; it is an informational method that goes against the active participation of the learner in the teaching learning process hence the need for innovative instructional strategy that is learner centered.

Instructional scaffolding strategy emphasizes the teaching of new skills by engaging students collaboratively in tasks that would be too difficult for them to complete on their own. The teaching strategy emphasizes on the role of teachers and other more skillful persons in supporting the learner's development and providing support structures to get to the next stage or level. The strategy is rooted in Vygotsky socio-culture theory. According to Vygotsky (1978), social interaction plays an important role in the development of cognitive. In his view, the learner does not learn in isolation, rather learning is strongly influenced by social interactions, which take place in meaningful contexts. Instructional scaffolding strategy depends heavily on the ideas that learners come to any educational setting with a great deal of pre-existing knowledge, some of which may be incorrect. It is the process of building on what a learner already knows that makes scaffolding an effective instructional strategy (Nonye & Nwosu, 2011) [20]. In instructional scaffolding strategy, a more knowledgeable person provides scaffolds to facilitate the learner's development. The form of support includes resources, a compelling task, templates, and guides, guidance on the development of cognitive and social skills. The scaffolds facilitate a student ability to build on prior knowledge and internalize new information. The activities provided in scaffolding instruction are just beyond the level of what the learner can do alone. An important aspect of scaffolding is that the scaffolds are temporary. In line with this Ibritam, Udofia, and Onweh (2015) [11] assert that as the learners' abilities increases, the scaffolding provided by the more knowledgeable person is progressively withdrawn. Finally, the learner is able to complete the task or master the concept independently which might improve students' achievement.

Students' achievement has been one of the most important goals of the educational process. According to Ogundokun and Adeyemo (2012) [22], achievement in the school setting refers to exhibition of knowledge attained or skills developed in a school subject indicated by students' test scores or marks assigned by teachers. Neji and Joda (2016) [19] informed that achievement is the attainment of set objectives measured from the scores obtained through a test. In the same vein, Nuhu, Suleman and Dauda (2017) [21] defines achievement as the outcome of education which reveals the extent to which a student, teacher or institution have achieved their educational goals. Academic achievement is commonly measured by examinations or continuous assessment. There has been decline in the achievement of students in public examinations in Biology across the country (Samba & Eriba, 2012) [6]. Research studies (Umaru, 2011, Joda & Mohammed, 2017, Joda, 2018) [13, 12] have shown that there is a persistent poor achievement in SSCE and NECO Biology examinations annually. Similarly, Eyayu and Meseret (2018) [7] affirm that students' achievement in Biology has been poor over recent years. In support of this, Umoke and Nwafor (2014) [28] reveal that students' achievement in Biology has been consistently discouraging. According to Liga, Garba and Emaikwu (2015) [16] the poor achievement of students in Biology may be influenced by the teaching strategy adopted by teachers.

Science teaching and learning Biology in particular is dependent on the learner's ability to achieve prescribed concepts meaningfully. Casem (2013) [3] studied the effects of scaffolding strategy on students' performance in Mathematics. The study revealed that the students taught mathematics concepts through scaffolding performed better than those taught through lecture method. Olatubosun (2013) investigated the effects of using scaffolding strategy on the academic achievement of students in integrated science in Junior Secondary School (JSS). Results showed that students exposed to scaffolding strategy performed significantly better than their counterparts who were exposed to the traditional method. Akani (2015) [2] conducted research on the effects of instructional scaffolding on the achievement of senior secondary students in Chemistry. The result obtained revealed that there is a significant difference in the mean score of students exposed to instructional scaffolding strategy and conventional method of instruction.

Ibritam, Udofia, and Onweh (2015) [11] conducted a study to determine the difference in students' achievement in Block-laying and concreting using Scaffolding and Demonstration instructional methods in technical colleges. The result showed that there is no significant difference in the mean achievement scores of the students taught using scaffolding instructional strategy and those taught using instructional demonstration method. Uduafemhe (2015) [26] undertook a study to determine the comparative effects of scaffolding and collaborative instructional approach on secondary school students' psychomotor achievement in Basic Electronics. Findings revealed that instructional scaffolding and collaborative instructional approaches are effective in improving students' achievement in Basic Electronics. However, the collaborative instructional approach was more effective then instructional scaffolding strategy. Adamu (2017) studies the effects of Analogy and scaffolding instructional strategies on senior secondary school Physics students' academic achievement. The two experimental groups were taught using Analogy and Scaffolding instructional strategies while the control group was taught using the lecture method. The finding of the study showed that there is a significant effect of treatment on students' academic achievement.

The influence of gender on students' achievement has for a long time been of concern to many researchers. Eka (2015) [5] encapsulates gender as socially, culturally constructed characteristics and roles which are ascribed to males and females in the society Some research has shown contradictory evidence in achievement in sciences particularly Biology due to gender. For instance, Kipkemoi, Mukwa and Too (2019) [14] found no significant difference in the achievement of male and female students in Mathematics when collaborative concept mapping is used. Similary, Ajangem, Okwara and Jirgba (2021) discovered that there is

no significant difference between mean achievement of boys and girls taught using collaborative concept mapping instructional strategy. However, Okoro (2011) [23] found that male students' achievement was better than that of their female counterparts when taught using cooperative learning strategy. The inconsistent results on gender generated the need for further study.

Statement of the Problem

Biology is one of the core subject taught in Nigerian Senior secondary schools. It plays a central role in human life. For instance, in the area of medicine, Biology has helped in the production of vaccines and drugs for preventing and curing many illnesses. Biology is a pre-requisite to other disciplines such as environmental biology, microbiology, biochemistry, biotechnology and genetics among others. Despite these benefits of Ecology, there is a continuous poor achievement of students in West African Examination Council (WAEC) conducted in Benue State over the years (Mohammed, 2019). The implication of this poor achievement in Biology is there will be shortage of man power in science and technology-related disciplines and this can affect the attainment of Sustainable Development goals (SDGs). The poor achievement of students in Biology may be influenced by the teaching strategy adopted by teachers. The National Educational Research and Development Council (NERDC) recommends some instructional strategies such as guided enquiry method, discovery method and outdoor activity method to curb the trend of poor achievement in Biology yet the problem still persist. It is against this background that the study sought to investigate the efficacy of instructional scaffolding strategy on senior secondary school students' achievement in Biology in Makurdi Metropolis, Benue State.

Objectives of the Study

The main purpose of this study was to investigate the efficacy of instructional scaffolding strategy on senior secondary school students' achievement in Biology in Makurdi Metropolis, Benue State. Specifically, the study sought to:

1. Determine the mean achievement scores of senior secondary school students taught Biology using instructional scaffolding strategy and those taught with lecture method.
2. Find out if male and female senior secondary school students' mean achievement scores will differ after being taught Biology using instructional scaffolding strategy.

Research Questions

The following research questions were asked to guide the study:

1. What are the mean achievement scores of senior secondary school students taught Biology using instructional scaffolding strategy and those taught with lecture method?
2. What are the mean achievement scores of male and female senior secondary school students' taught Biology using instructional scaffolding strategy?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance guided the study:

H_{O1}: There is no significant difference between the mean achievement scores of senior secondary school students taught Biology using instructional scaffolding strategy and those taught with lecture method.

H_{O2}: There is no significant difference between the mean achievement scores of male and female senior secondary school students' taught Biology using instructional scaffolding strategy.

Research Methods or Methodology

A quasi-experimental research design involving pre-test, post-test control group was employed. The population of the study comprised of 16332 senior secondary II Biology students in government grant aided schools in Makurdi metropolis. Simple random sampling techniques were used to select six intact classes with 217 Biology students as the research sample. Three of the intact classes formed the experimental group with 104 students, and the other three formed the control group with 113 students. A researcher developed 50 items Biology Instructional Scaffolding Strategy Achievement Test (BISSAT) was used as instrument for data collection. The instruments were subjected to face and content validity by three experts. The reliability coefficient was determined by trial testing on 50 students from a school (GSS Koti) outside the main study area but with similar characteristics. Kuder Richardson's formula 20 (KR-20) was used in estimating the reliability coefficient of the instrument and yielded 0.84. The experimental group was taught Ecology using the instructional scaffolding strategy, and the control group was taught the same topic through lecture method. The treatment lasted for four weeks. The research questions were analyzed using mean and standard deviation while the hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance.

Results

The data collected were analyzed using mean and standard deviation for the research questions while the hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 significant level.

Research Question 1: What are the mean achievement scores of senior secondary school students taught Biology using instructional scaffolding strategy and those taught with lecture method? The answer to research question one is contained in Table 1.

Table 1: Mean Achievement Scores, Standard Deviations and Mean Difference of Senior Secondary School Students of the Experimental and Control Groups

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Experimental	104	20.09	5.24	33.99	5.76
Control	113	13.23	3.53	23.15	4.53
Mean Difference		6.86		10.84	
Total	217				

KEY: N = Number, SD = Standard Deviation

Table 1 shows that in Pretest, the experimental group had a mean achievement score of 20.09 with a standard deviation of 5.24 while the control group had a mean achievement score of 13.23 with a standard deviation of 3.53 respectively. The results further shows that in the Posttest, the experimental group had a mean achievement score of 33.99 with a standard deviation of 5.76, while the control group had a mean achievement score of 23.15 with a standard deviation of 4.53. The mean difference between the achievement scores of the

experimental and control group in pretest was 6.86 while the mean difference in posttest was 10.84.

Hypothesis 1: There is no significant difference between the mean achievement scores of senior secondary school students taught Biology using instructional scaffolding strategy and those taught with lecture method. The ANCOVA test to hypothesis 1 is presented in Table 2.

Table 2: Summary of ANCOVA for Mean Achievement Scores of Senior Secondary School Students of the Experimental and Control Groups

Source of Variance	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected Model	7162.737	2	3581.369	155.574	.000
Intercept	6480.531	1	6480.531	281.514	.000
Achpretest	799.092	1	799.092	34.713	.000
Group	2085.305	1	2085.305	90.586	.000
Error	4926.341	214	23.020		
Total	186443.000	217			
Corrected Total	12089.078	216			

Table 2 reveals that $F_{1, 216}$=90.58, P=0.000<0.05. This implies that there is a significant difference between the mean achievement scores of senior secondary school students taught Biology using instructional scaffolding strategy and those taught with lecture method. Hence the null hypothesis 1 of no significant deference between the mean achievement scores of students taught Ecology using instructional scaffolding strategy and those taught with lecture method is therefore rejected.

Research Question 2: What are the mean achievement scores of male and female senior secondary school students' taught Biology using instructional scaffolding strategy? The answer to research question two is contained in Table 3.

Table 3: Mean Achievement Scores, Standard Deviations and Mean Difference of Male and Female Senior Secondary School Students of the Experimental Group

Groups	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
Male	45	19.60	5.50	34.04	7.37
Female	59	20.47	5.04	33.94	4.21
Mean Difference		-0.87		0.1	
Total	104				

KEY: N = Number, SD = Standard Deviation

Table 3 shows that in Pretest, the male students in the experimental group had a mean achievement score of 19.60 with a standard deviation of 5.50 while female students had a mean achievement score of 20.47 with a standard deviation of 5.04 respectively. The results further shows that in the Posttest, the male students had a mean achievement score of 34.04 with a standard deviation of 7.37, while the female students had a mean achievement score of 33.94 with a standard deviation of 4.21. The mean difference between the achievement scores of male and female students in the pretest was -0.87 while the mean difference in posttest was 0.1.

Research Hypothesis 2: There is no significant difference between the mean achievement scores of male and female senior secondary school students' taught Biology using instructional scaffolding strategy. The ANCOVA test to hypothesis 2 is presented in Table 4

Table 4: Summary of ANCOVA for Mean Achievement Scores of Male and Female Senior Secondary School Students in the Experimental Group

Source of Variance	Type III Sum of Squares	df	Mean Square	F	Sig
Corrected Model	159.414[a]	2	79.707	2.465	.090
Intercept	5603.052	1	5603.052	173.295	.000
Achpretest	159.182	1	159.182	4.923	.029
Gender	2.333	1	2.333	.072	.789
Error	3265.577	101	32.332		
Total	123581.000	104			
Corrected Total	3424.990	103			

Table 4 reveals that $F_{1=103}$=0.072, P=0.789>0.05. This implies that there is no significant difference between the mean achievement scores of male and female senior secondary school students taught Biology using instructional scaffolding strategy. Hence the null hypothesis 2 of no significant deference between the mean achievement scores of male and female senior secondary school students taught Biology using instructional scaffolding strategy is therefore not reject.

Discussion

The mean achievement of students taught Biology using instructional scaffolding strategy differed significantly from those taught using lecture method. These findings agree with the finding of Casem (2013) [4]; Olatubosun (2013); Akani (2015) [2]; Ibritam, Udofia, and Onweh (2015) [11]; Uduafemhe (2015) [26] and Adamu (2017) that instructional scaffolding strategy improved students' achievement. Furthermore, the study discovered that the mean achievement

scores of male and female senior secondary school students' taught Biology using instructional scaffolding strategy do not differ significantly. the finding lends support to the study of Ajangem, Okwara and Jirgba (2021) [1] and Kipkemoi, Mukwa and Too (2019) [14] who found no significant difference in the achievement of male and female students in Mathematics however, at variance with Okoro (2011) [23] who found that male students' achievement was better than that of their female counterparts when taught using cooperative learning strategy. The significant difference in the achievements between the experimental and control group is because instructional scaffolding strategy reduces the abstract nature of Biology concepts and facilitates proper understanding of Biology.

Conclusion

Instructional scaffolding strategy is an innovative teaching strategy that gives students opportunity to be at the centre of learning and solve academic problems independently, with pairs and with whole class for effective teaching and learning. This study has provided empirical evidence that: instructional scaffolding strategy improved students' achievement in Biology in Makurdi Metropolis. The achievement was not influenced by gender.

Recommendation

Based on the findings of the study, the following recommendations are made:

1. Teachers should employ instructional scaffolding strategy for effective teaching and learning of Biology.
2. Curriculum planners should recommend instructional scaffolding strategy for effective teaching and learning of Biology.
3. The ministry of education should organize workshops, seminars and conference for Biology teachers on the use of instructional scaffolding strategy for effective teaching and learning of the subject.

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