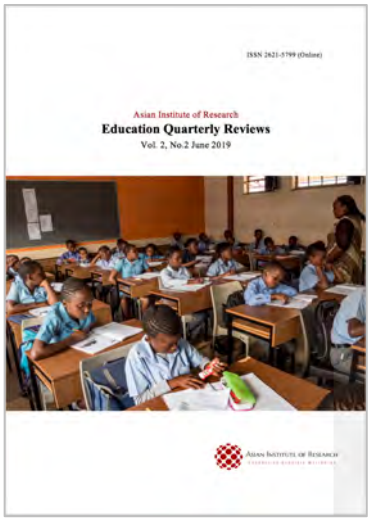

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Effects of Instructional Scaffolding Strategy on Senior Secondary Biology Students' Academic Achievement and Retention in Taraba State, Nigeria

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Abstract
The study determined the effect of instructional scaffolding strategy on senior secondary school Biology Students' academic achievement and retention of concepts. Two research questions and two hypotheses were formulated for the study. Quasi-experimental research design involving pre-test, the post-test control group was employed. The population of the study was all the senior secondary two (SSII) students in Jalingo education zone. Random sampling technique was used to select four intact classes with 240 students as the samples size for the study. A 50 item Biology scaffolding Achievement Test (BSAT) was the instrument used for data collection, and the same instrument tagged Biology scaffolding Retention Test (BSRT) but arranged differently in numbering and response option. Kuder Richardson's formula 20 (KR-20) was used in estimating the reliabilities for the BSAT and BSRT, and the reliability of 0.87 and 0.85 for BSAT and BSRT respectively were obtained. The experimental group was taught Genetics and Evolution through instructional scaffolding strategy while the control group was taught the same topics through lecture method. The treatment lasted for four weeks. The retention test was administered two weeks after the administration of the post-test. The mean and standard deviation was used to answer the research questions, and analysis of covariance (ANCOVA) was used to test the two hypotheses. The findings show that the students taught with instructional scaffolding strategy have a significantly higher academic achievement than those taught with lecture method. Equally, those taught through instructional scaffolding retained Biology concept more than those taught through lecture method. It was recommended that the teaching of Biology should be scaffolded for better understanding. Curriculum planners should adopt instructional scaffolding as an adequate teaching strategy for the teaching Biology.

Keywords: Instructional Scaffolding Strategy, Lecture Method, Biology Students' Academic Achievement and Retention.

Introduction

Biology as a science subject occupies a central position in the science curriculum (FRN, 2014). This is because Biology is a life science subject concerned with the study of living organisms with regards to their structure, function, growth, evolution, distribution, identification and taxonomy. Umaru (2011) explains that the study of Biology enables man to understand the diversity of life forms, conservation and sustainable use of natural resources. The benefits of Biology for the development of any nation are too numerous to mention, and this is

because Biology plays a key role in industrialization and other sectors of the economy. It also serves as a pre-requisite subject for most science and related professions like Biochemistry, Pharmacy, Medicine, Nursing, Environmental sciences amongst others. In addition, the basic knowledge and skills acquired from the subject can be of tremendous help to man and the society (Umoru & Onoja, 2017). The impact of Biology on the life of living organisms is wide; all ensuring that the required standard of living for both plants and animals are maintained (Uqwadu & Joda, 2015). There is no doubt about the immense contribution of Biology to the economic growth and development of a nation. However, research studies (Umaru, 2011, Joda & Mohammed, 2017, Joda, 2018) have shown that there is a persistent low achievement in SSCE and NECO Biology examinations annually. This low achievement in Biology could be attributed to poor instructional delivery approaches adopted by teachers, students' attitudinal problems, teachers' laxity towards teaching, concentration on few topics for examination purpose and students inability to recall previously learnt materials (Umoru & Onoja, 2017). The West African Examination Council (WAEC) chief Examiner's Report (2016) points out that among the factors that cause low achievement of students in Biology; poor instructional delivery approach to teaching by teachers is the most prominent factor.

In pursuance of the objectives, content, and context of Biology, curriculum developers had recommended some teaching approaches which are learned-centered for the effective teaching and learning of the subject so as to bring the expected desired learning outcomes. The recommended approaches include; inquiry, concept mapping, Laboratory techniques and discovery teaching/ learning amongst others. Despite the recommendation for the use of these approaches by curriculum developers in teaching Biology, students achievement in the subject is still not encouraging (Ugwuadu & Joda, 2015).

The persistent low achievement of students in Biology specifically in Genetics and Evolution concepts at senior secondary certificate examination raises doubt about the effectiveness of current teaching approaches in use by Biology teachers. More so the two topics are perceived as difficult topics by secondary school Biology students (Abubakar, 2013; Ugwuadu & Joda, 2015). Exposing learners to the understanding of basic concepts in Biology and achieving desirable outcomes requires the use of creative, innovative and interactive teaching approaches such as instructional scaffolding that may arouse the interest of the learners and demystify difficult concepts in core subjects like Biology. In addition, it is counter-productive to present ideas to learners without fully engaging them in the learning process.

Instructional scaffolding is the teaching strategy that 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 that next stage or level (Nonye & Nwosu, 2011). The teaching strategy originated from Lev Vygotsky socio-culture theory and his concept of Zone of Proximal Development (ZPD). His socio-cultural theory spelt out that 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. The Zone of Proximal Development (ZPD) is that area between what a learner can do independently (mastery level) and what can be accomplished with the assistance of a competent adult or peer (Instructional level). It is believed that any learner could be taught any concept effectively using instructional scaffolding techniques by applying the scaffolding at the ZPD.

Instructional scaffolding as a teaching 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 technique. According to Olson and Prath (2000) and Casem (2013) that in instructional scaffolding, a more knowledgeable other provides scaffolds to facilitate the learner's development. These can be in the form of support which may include 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. Ibritam, Udofia, and Onweh (2015) asserted

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.

Lecture method is a common method teacher employed in the teaching of Biology. It is referred to as talk and chalk or textbook method (Gbamanja in Joda, 2018). In the course of employing the method, the teacher dominates the teaching with little participation on the part of the learners. Here the teacher is seen as the repository of all knowledge while the students are passive recipients of knowledge transmitted by the teacher in the process of learning. The method has the advantage of covering a wider area within a short time but it is not learned-centred, and students do not gain mastery of concepts.

Odediran as cited in Joda (2017) asserted that the lecture method could be an effective and successful method in science teaching if the teacher does the following in his lecture process; repeats and emphasizes main points, encourage questions from students, relate content to previous and subsequent topics, stresses ideas, avoids racing through the lecture process and prepares adequately for each lesson delivery. In support of the above Joda (2018) also pointed out that an effective lecture method. In science, teaching requires extensive research, preparation, and effective delivery skills to maintain learners' retention of concepts.

Udogu in Neji and Joda (2016) stated that academic achievement is the attainment of set objectives measure from the score obtained through a test. If a learner accomplished a task successfully and attained the specific goal for a particular learning experience, he/she is said to have achieved. Retention of scientific concepts are products of teaching strategies that take into cognizance the learner-readiness which include current knowledge, stage of cognitive development and mode of intellectual functioning. Coffey in Joda and Mohammed (2017) argues that anything which aids learning should improve retention and anything that leads to confusion or interference among learned concept decreases the speed and efficiency of learning and accelerates forgetting. Thus the success of science teaching and learning is dependent on the learner's ability to achieve and recall prescribed concepts meaningfully.

Casem (2013) 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. Equally, 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) 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) 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) 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.

Statement of the Problem

There has been the continuous poor academic achievement of students in science subjects generally and Biology in particular. Chief examiner's report on senior secondary school students' academic achievement has consistently revealed poor achievement in Biology in senior secondary school certificate examination conducted by the West African Examination Council (WAEC) from 2002-2018 in Nigeria. The instructional strategy adopted by Biology teachers, inadequate laboratory and Biology instructional materials, large class size among others contribute to students poor academic achievement in Biology (WAEC, 2018; Osuafor & Okonkwo, 2013; Joda & Mohammed, 2017; Joda, 2018). Therefore there is the need to explore other ways of presenting Biology concepts to the students to enhance meaningful learning, academic achievement, and retention of concepts. This calls for the use of learned-centered strategies such as instructional scaffolding, Guided inquiry, Problem-solving, Cooperative Instructional strategy. This study will, therefore, determine the effect of instructional scaffolding strategy on Biology students' academic achievement and retention of concepts.

Research Question

The following research questions were formulated to guide the investigation.

1. What is the effect of instructional scaffolding and lecture method on Biology students' academic achievement?
2. What is the effect of instructional scaffolding and lecture method on Biology students' retention of concepts?

Hypotheses

The following null hypotheses which were tested at an alpha level of 0.05 guided the study.
Ho.: There is no significant main effect of instructional scaffolding and lecture method on students' academic achievement in Biology.
Ho.: There is no significant effect of instructional scaffolding and lecture method on Biology students' retention of concepts.

Methodology

A quasi-experimental research design involving pre-test, the post-test control group was employed. The population of the study comprised of the entire senior secondary school students (SSII) in Jalingo education zone. Random sampling techniques were used to select four intact classes with 240 Biology students as the research sample. Two of the intact classes formed the experimental group with 121 students, and two of the classes formed the control group with 119 students. A 50 item Biology scaffolding Achievement Test (BSAT) was adopted from WAEC past question papers 2002-2017 used as instrument for data collection and the same instrument was used for Biology Scaffolding Retention Test (BSRT) but the items in the later was arranged differently in serial numbering and response options with one correct answer (key) and four distractors. The instruments were subjected to face and content validity by experts. The reliability coefficient was determined by testing 50 students from a school (GSS Bali) outside the main study area. Kuder Richardson's formula 20 (KR-20) was used in estimating the reliabilities for Biology scaffolding Achievement Test (BSAT), and Biology scaffolding Retention Test (BSRT) and the reliability coefficient of 0.87 and 0.85 for BSAT and BSRT respectively were obtained. The experimental group was taught Genetic and Evolution through the instructional scaffolding strategy, and the control group was taught the same topics through lecture method. The treatment lasted for four weeks. Two weeks after the administration of the post-test, a retention test was administered. The research questions were analyzed using mean and standard deviation while the hypotheses were analyzed using Analysis of Covariance (ANCOVA)

Results

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

Research Questions

1. What is the effect of instructional scaffolding and lecture method on Biology students' academic achievement?
2. What is the effect of instructional scaffolding and lecture method on Biology students' retention of concepts?

Table 1. Mean and Standard Deviation for Achievement and Retention Test based on treatment

Variable group	N	Pre-test $\overline{X}$	SD	Post-test $\overline{X}$	SD	Retention $\overline{X}$	SD	Ach.	Gain Ret gain
Experimental	121	19.25	6.97	37.67	16.80	36.14	18.29	19.25	1.55
Control	119	14.11	3.63	26.56	19.29	22.94	20.02	12.45	4.02

Table 1 shows that the experimental group taught using Instructional scaffolding strategy had a higher mean achievement score of 37.67, and also a higher retention score of 36.14 while the control group taught with the lecture method had the least mean achievement score of 26.56 and mean retention score of 22.94. This implies that the subject in the experimental group achieved higher and also had higher retention of Biology concepts than those in the control group.

Hypotheses testing

Ho.: There is no significant main effect of instructional scaffolding and lecture method on Biology students' academic achievement.

Table 2: Summary of Analysis of Covariance of treatment on Biology students academic achievement.

Source of Variation	**sum of square**	**DF**	**mean square**	**F**	**sig level**	**partial Eta Square**
Corrected Model	59325.414	2	29662.707	556.811	.000*	.825
Intercept	292335.333	1	29235.333	548.788	.000*	.698
Pretest	2283.748	1	2283.748	42.869	.000*	.153
Treatment	55796.641	1	55796.641	1047.381	.000*	.815
Error	12625.586	237	53.273			
Corrected Total	321566.000	240				
	71951.000	239				

R-square = .825 (adjusted R=.823) F=critical = 3.86 * p<.05

The calculated F-ratio 1047.381 was found to be far greater than the critical F-ratio of 3.86 needed to reject the null hypothesis at 0.05 alpha level and with 1 and 237 degrees of freedom. This implies that there is a significant effect of Biology students' academic achievement when taught through instructional scaffolding strategy and lecture method.

Ho.: There is no significant effect of instructional scaffolding and lecture method on Biology students' retention of concepts.

Table 3: Summary of ANCOVA of Treatment on Biology students' retention of concepts

Source of Variation	sum of square	DF	mean square	F	sig level	partial Eta Square
Corrected Model	76244.066	2	38122.033	758.096	.000*	.865
Intercept	27339.517	1	27339.517	543.675	.000*	.696
Pretest	1266.716	1	1266.716	25.190	.000*	.096
Treatment	73849.918	1	73849.899	1468.581	.000*	.816
Error	11917.918	237	50.287			
Corrected	300458.000	240				
Total	88161.983	239				

R-square = .825 (adjusted R=.864) F=critical = 3.86 * p<.05

The result in table 3 shows that the F-calculated was 1468.581 while the F-critical was 3.86. Due to the significant value of the F-Calculated, the null hypothesis was rejected. The implication of this result is that there is a significant difference between the retention scores of Biology students taught through instructional scaffolding and those taught through lecture method.

Biology students taught through instructional scaffolding strategy have a significantly higher academic achievement and retention of concepts than those taught with lecture method.

Discussion

The findings of the research questions imply that the subject in the experimental group achieved and retent higher Biology concepts than those in the control group 37.67 and 36.4 respectively. While the subjects in the control group had the least achievement and retention of Biology concepts of 26.56 and 22.94 respectively. Also, the findings show that Biology students taught with instructional scaffolding strategy had a significantly higher achievement and retention of Biology concepts than those taught through lecture method. This result is in line with the findings of Case (2013); Olatubosun (2013); Akani (2015); Uduafemhe (2015) and Adamu (2017) who asserted that instructional scaffolding strategy was significantly better than lecture method in enhancing cognitive achievement. The findings of this study are at variance with that of Ibritam, Udofia, and Onweh (2015) who found out that there is no significant difference in the mean achievement scores of students taught through instructional scaffolding strategy and other methods of teaching.

Recommendations

The following recommendations were made:

1. The teaching of Biology should be scaffolding for better understanding, academic achievement, and retention of concepts.
2. Curriculum planners should adopt instructional scaffolding strategy as an adequate teaching strategy for teaching Biology which should be emphasized in students textbooks and teachers guide.
3. There should be organized workshops, seminars and conferences for teachers on the importance of using instructional scaffolding strategy and as innovation in teaching Biology.

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