

EFFECTS OF INSTRUCTIONAL SCAFFOLDING STRATEGY ON ACHIEVEMENT IN BIOLOGY AMONG STUDENTS OF UNITY COLLEGES IN NIGER STATE

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Abstract

The study investigated the effects of instructional scaffolding strategy on achievement in Biology among students of Unity Colleges in Niger State. Gender difference in the achievement of male and female students in Biology was also examined. Quasi-experimental design was employed for the study. Eighty-five (85) Senior Secondary (SSII) students from two intact classes in two co-educational Unity Colleges made up the sample of the study. The two schools were randomly assigned to Experimental and Control groups. The experimental group (n=40, 21 males, 19 females) was treated with instructional scaffolding strategy, while the control group (n=45, 27 males, 18 females) was taught with lecture method. The test instrument used for the study was a twenty-five (25) Biology Achievement Test (BAT) questions, which was validated and pilot tested using the Kuder Richardson formula 21(KR-21) and a reliability coefficient of 0.78 was obtained. The data collected were analyzed using mean, standard deviation and t-test. Two research questions were answered and two null hypotheses were tested at 0.05 level of significance. The treatment used had significant effects on students' Post-test achievement score. Students exposed to instructional scaffolding achieved and better than their counterparts who were taught with lecture method ($t(83) = 8.695, p(0.00) < 0.05$). There was no significant difference in the achievement of male and female students taught with instructional scaffolding strategy. Based on the findings it was recommended among others that the Secondary School Biology curriculum should be reviewed with a view to integrating instructional Scaffolding strategy into the curriculum.

Keywords: Instructional scaffolding, Achievement, Unity College, Gender

Introduction

The place of science in the development and fulfilment of the needs and aspiration of any country rest on success of its students in science related fields. Advances in science have helped nations promote their efficiency in determination of its citizenry satisfaction of socio-cultural demands in their environments. Success in sciences have brought changes through inventions/innovations in telecommunications, transportation, medical-health services, agro-allied industry and so on. In Nigeria, the National Policy on Education FRN (2009) clearly spells out the objectives of science teaching from pre-primary to the tertiary level. Specifically, at the secondary level it entails equipping students to live effectively in our modern age of science and technology.

Science is the study of nature or environment through which people can develop both enquiry and disciplined logical power of thought (Okorie, 2002). It can be seen as the area of knowledge that gives theoretic explanations based on observation and experiments about the natural phenomena. It spans a wide area of study and is basically divided into two major branches; the physical and natural sciences. Biology as one of the core branch of natural science is the science that studies life; it studies both the life of creatures around us and the life within us, thus making it one of the significant science area to human endeavour. It is a subject that teaches scientific facts relating to living things starting from the animal to plant kingdom. It takes into account interaction between living and non-living things and many other activities such as theoretical and experimental activities by which a human being tries to find solutions to

his every day's problems (Olatunji, 2004). Biology as a field of study offers opportunities for career after specialization. It promotes the actualization/attainment of individuals' abilities, it offers opportunity for improving our general health standards through proper sanitary behaviour and development of enquiry mind through making observations of nature and answering biological questions (Olutola, Daramola & Bamidele, 2016).

In spite of the importance and benefits of Biology, its teaching and learning has not been very successful. Over the last decade or more, there has been a gradual depreciation in the quality of teaching and learning, this is characterised by the fluctuation in the achievement of students in public examinations. For instance, in the breakdown of WASSEC Biology result from 2004-2014 in Nigeria shows that percentage grades (A₁-C₆) was highest in the year 2010 (49.65%), and lowest in 2004 (24.69%). Between the year 2004 and 2014, percentage grades (A₁-C₆) was between 24.69% and 49.65%. Percentage grades (D₇, E₈ & F₉) was between 51.40% and 75.34% and it was highest in 2004 at 75.34% and lowest in 2010 at 47.35%. The fluctuations in the result could be attributed to a number of factors including teachers' method of instruction (Bello, 2014). As a result of this there is need to adopt some instructional methods that are activity based and learner centered as they might improve the teaching and learning of Sciences and biology in particular, examples of such are instructional scaffolding, cooperative learning, peer tutoring and computer simulation. In the light of this, the research work is centered on instructional scaffolding strategy.

Instructional scaffolding is the support given during the learning process which is tailored to the needs of the student with the intention of helping the student achieve his/her learning goals. This support can be provided in a variety of manners including modelling, the posing of questions for different subjects at different stages, explanations, prompts, hand-out and real objects. (Sawyer, 2006)

Instructional scaffolding provides a supportive learning tool as it encourages students' interaction with instructors and also among themselves. In scaffolding, the scaffolds which is the temporal assistance given by the instructor to the learners to help and guide their understanding of any concept is gradually removed or fades naturally as the learners have a deep level of understanding or assimilation of the concept. The scaffold serves as a link between what students already know and are familiar with and what they do not know and are expected to know. (Brush & Saye, 2001).

A number of researchers believe that Instructional Scaffolding improves learning tremendously, Chang, Sung and Chen (2001), stated that 'Scaffolding has effectively promoted learning among different learners, for various learning goals, and in diverse learning environments'. Also, Ormrod (2004) opined that scaffolding plays an important role in enhancing student's learning and by extension it enhances students' academic achievement.

Academic achievement is the degree of success attained by students after being exposed to one form of learning or the other. It is the success achieved by students in some general or specific area of study or field work (Ezenwosu & Nworgu, 2013). Jimoh (2014) corroborates that academic achievement is the level of success attained by student in school subjects. In other words, it is the degree of success reached in some general or specific area of study. It is commonly measured using classroom exercise, assignment and continuous assessment as well as internal and external examination (Jimoh, 2014).

In the review of empirical studies on the effectiveness of instructional scaffolding strategy, Akani (2015) found out that instructional scaffolding enhances students' achievement. Okpeh

(2014) revealed from his findings that instructional scaffolding strategy is a better instructional method than conventional method of instruction. It was also revealed from the study of Alake and Ogunseemi (2013) that instructional scaffolding method is superior to the conventional teaching method in improving the achievement of students.

The effect of gender as a moderating variable on academic achievement was also investigated in this research. The term gender refers to the physical, mental, economic, social, political and cultural attributes and opportunities, associated with being male and female. (Vassiliou 2010). There are diverse views on the influence of gender on academic performance, some researchers are of the opinion that gender has no influence on academic performance (Ahiz & Nwosu, 2011), some others believe that gender influences academic performance. For instance, Abdu-Raheem (2012) reported that males performed better than females in Mathematics, Science and Social Science, while male and female students performed equally in English language. Aniodoh and Egbo (2013) recorded that female students performed better than their male counterparts in Chemistry. There is need for further study on the moderating effect of gender due to the diverse view on gender and academic achievement.

Over the last decades and more, the performance of students in Science oriented subject, Biology inclusive in Senior School Certificate Examination (S.S.C.E.); (W.A.E.C and N.E.C.O) has not recorded consistent upward improvement. Science teachers have continually used the conventional approach while jettisoning other methods that may be useful in transmitting the content matter of biology to students and this has failed to adequately address the need for upgrade in students' performances. Adesanya (2000) stated that the performance of students in any subject is based on the quality of instructional strategy employed by the teacher, also, Bello (2014) reported that poor performance of students in biology could be attributed to a number of factors including teachers' method of instruction.

Conventional teaching method can no longer be relied upon as the chief instructional strategy for abstract related concepts in biology. Therefore, the study was carried out to investigate the effect of instructional scaffolding strategy on achievement and in Biology among students of Unity colleges in Niger State.

Research Questions

The following research questions were raised to guide the study:

- (i) What is the difference in the mean achievement score of students taught Biology with instructional scaffolding strategy and those taught with lecture method?
- (ii) What is the influence of gender on the mean achievement score of students taught with instructional scaffolding strategy?

Research Hypotheses

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

HO₁: There is no significant difference in the achievement of students taught biology using instructional scaffolding strategy and those taught with conventional teaching method.

HO₂: There is no significant difference in the achievement of male and female students taught biology using instructional scaffolding strategy.

Methodology

The study adopted a quasi-experimental design, involving pre-test, post-test non-randomised experimental and control group. Fraenkel and Wallen stated that quasi-experimental design as a design does not include the use of random assignment. The design adopted one experimental group and one control group, achievement is the dependent variable, instructional scaffolding and lecture method were the independent variable while gender served as the moderating variable. The population of the study comprises all the 5,044 Unity College Senior Secondary School biology students of 2017/2018 academic session in Niger state, Nigeria. The target population comprised all Senior Secondary School two (SS II) biology students in the five (5) Unity colleges in Niger state in which three are co-educational. A total of 539 students made up the target population. The sample of the study was made up of 85 students (48 males & 37 females). The sample size for the experimental group was 40 (21 males & 19 females), while that of the control group was 45 (27 males & 18 females). Multi-staged sampling technique was used for the study. Firstly, the three co-educational unity colleges were purposively drawn out of the five unity colleges, the effect of gender as a moderating variable was experimented on in the study, and as a result, it called for the use of purposive sampling technique to draw out the three co-educational schools for this purpose. In the second stage, simple random sampling technique was used to select two schools from the three co-educational school, after which hat-draw method was used to assign the two selected schools into experimental and control groups. Lastly, one intact class each was randomly selected from the various arms of Senior Secondary School two (SS II) for both the experimental and control groups.

Instructional scaffolding strategy was used on the experimental group under two the sub-topics. The first is reproductive system in flowering plants structures and functions of reproductive organs in plant and the second is types of flower and position of ovary. This topic was selected because secondary school students perceives topics in plant biology to be difficult.

The scaffolds consisted of relevant materials that could help students understand the concepts that were taught, they included; examples, explanation, visual scaffolds, prompts and lesson notes. Examples were made up of real flowers of different species during and after budding stage. Explanation was made alongside the given examples, visual scaffolds in the form of illustrative diagrams, and flex banners were used, prompts were also given to the students when necessary and lastly, lesson notes was given to the students at the end of each lesson.

Biology Achievement Test (BAT) was used for data collection. It was made up of twenty-five (25) multiple choice objective items consisting of four options (A-D) with one correct answer and three distractions. The marks obtained were converted to percentage. The items were researcher developed from Essential Biology text book for Senior Secondary Schools by Michael (2017).

The validity of the research instrument (face and content) was established by two lecturers from Science Education Department, Federal University of Technology Minna and a biology teacher from Federal Government College Minna. Corrections and suggestions made by the validators were used to modify the instruments.

The reliability of the BAT was obtained by administering the test to an intact class which was randomly selected from the SS II arms of one of the Unity Colleges, this school was not among the sampled school but was within the population of the study. The reliability coefficient was gotten using the Kuder Richardson formula ($K-R_{21}$) and the value of 0.78 was obtained.

The period of data collection lasted for six (6) weeks. In the first week, pre-test was administered to both groups. The second to the fourth week was used for the administration of the treatment to the experimental group while lecture method was used on the control group, one week waiting period was observed before the post-test which was the reshuffled BAT was administered to both the experimental and control groups in the sixth week. Data obtained was analysed using descriptive and inferential statistics. Mean (\bar{x}) and standard Deviation (SD) were used to answer the research questions, while t-test was used to analyze the research hypotheses at 0.05 level of significance.

Results

Research Question one 1: What is the difference in the achievement of students taught biology with instructional scaffolding strategy and those taught with conventional teaching method?

Table 1: Mean and standard deviation comparison of pre-test and post-test score of students in experimental and control groups

Group	Pre -test		Post -test		Mean Gain	Mean Diff
	\bar{x}	SD	\bar{x}	SD		
Experimental	23.68	2.36	72.96	3.16	49.28	24.76
Control	27.00	1.99	51.52	2.54	24.52	

Table 1 shows the Mean, standard deviation and Mean gain score of students in the experimental and control groups. The experimental Mean for pre-test and post-test are 23.68 and 72.96 respectively with Standard Deviation of 2.36 and 3.16 respectively, while the Mean gain from pre-test to post-test is 49.28. The control group pre-test and post-test are 27.00 and 51.52 respectively with Standard Deviation of 1.99 and 2.54 respectively and the mean gain is 24.52 indicating that the experimental group performed better than the control group. The Mean difference between the two groups is 24.76 in favour of the experimental group.

Research Question Two: In what way will gender influence the achievement of students taught with instructional scaffolding strategy?

Table 2: Mean and standard deviation comparison of male and female students score at pre-test and post-test in the experimental group

Group	Pre -test		Post test		Mean gain	Mean Diff
	\bar{x}	SD	\bar{x}	SD		
Male	25.44	2.41	74.80	2.74	49.36	0.08
Female	21.68	2.26	71.12	3.58	49.44	

Table 2 shows the Mean and Standard Deviation of male and female students taught using instructional scaffolding. The Mean for male students pre-test and post-test are 25.44 and 74.80 respectively, with Standard Deviation of 2.41 and 2.74 respectively, while the Mean for female students pre-test and post-test is 21.68 and 71.12 respectively, with Standard Deviation of 2.26 and 3.58 respectively. This implies that there is a mean difference of 0.08 between the post-test Mean achievement score of male and female students in the experimental group.

Pre-testing

The pre-test was aimed at establishing a basis for comparison between the two groups (experimental and control) both before and after the treatment. The data collected as pre-test scores using Biology Achievement Test (BAT) was analysed using t-test. The result of the pre-test analyses is represented in table three (3)

Table 3: Summary of t-test result of pre-test scores of students in the experimental and control groups

Variable	N	df	\bar{x}	SD	t-value	P-value
Experimental group	40	83	23.68	2.36	1.756 ^{ns}	0.083
Control group	45		27.00	1.99		

NS: Not significant at 0.05

Table 3 shows the t-test result of pre-test between the experimental group (students taught using scaffolds) and the control group (students taught using conventional were teaching method). There was no statistical significant difference between pre-test Mean of the experimental group and the control group $t(83) = 1.756, p(0.08) > 0.05$. The pre-test Mean of the experimental group is 23.68 and that of the control group is 27.00 this indicates that the two group were similar or equivalent before the treatment was administered.

Testing of Null Hypotheses

H_{01} : There is no significant difference in the achievement of students taught biology using instructional scaffolding strategy and those taught with conventional teaching method.

Table 4: t-test analysis of post-test achievement score of students in experimental and control groups

Variable	N	df	\bar{x}	SD	t-value	P-value
Experimental group	40	83	72.96	3.16	8.695*	0.00
Control group	45		51.52	2.54		

* Significant at $P < 0.05$

Table 4 presents the t-test post-test scores of the experimental and control groups. The table reveals a significant difference in the post-test scores of the two groups [$t(83) = 8.695, p(0.00) < 0.05$]. Hence, hypothesis one which states that there is no significant difference in the achievement of students taught biology using instructional scaffolding strategy and those taught with lecture method was rejected. This implies that significant difference exists between the achievement of students taught using instructional scaffolding strategy and those taught using lecture method, in favour of those taught using instructional scaffolding strategy.

H_{02} : There is no significant difference in the achievement of male and female students taught biology using instructional scaffolding strategy.

Table 5: t-test analysis of post-test achievement scores of male and female students in the experimental group

Variable	N	df	\bar{x}	SD	t-value	P-value
Male	21	38	74.80	2.74	.922 ^{ns}	0.362
Female	19		71.12	3.58		

NS = Not Significant at $P > 0.05$

The table 5 presents the t-test post-test result of male and female students taught with instructional scaffolding. The calculated t-value of 0.922 was not significant at 0.05 level. This indicates that there is statistically no significant difference between the male and female students taught with instructional scaffolding strategy, ($t=0.922$, $df=38$, $P=0.362$). Hence, hypothesis two was accepted. Therefore, there is no significant difference between male and female students taught with instructional scaffolding strategy.

Discussion

The result of the t-test analysis on the achievement of students taught using instructional scaffolding strategy and those taught with lecture method revealed that there was significant difference in the achievement of the experimental group taught with instructional scaffolding strategy. This finding is in line with the finding of Akani (2015) who found that students exposed to instructional scaffolding strategy performed significantly better than their counterparts who were exposed to conventional teaching method. It is also in agreement with the findings of Okpeh (2014) which revealed that instructional scaffolding strategy is a better instructional method than conventional method of instruction. Furthermore, it agrees with the finding of Alake and Ogunseemi (2013) which revealed that instructional scaffolding method is superior to the conventional teaching method in improving the achievement of students.

The result of the t-test analysis on of post-test achievement scores of male and female students in the experimental group revealed that no significant difference existed in the achievement of male and female students taught with instructional scaffolding strategy. The result corroborates the findings of Ahiz and Nwosu (2011) which revealed that there was no significant difference in students' gender and students' achievement when taught with instructional scaffolding strategy. The finding was however contrary to that of Abdu-Raheem (2012) which revealed that males performed better than females in Mathematics, Science and Social Science, were as male and female students performed equally in English language. It is also contrary to that of Aniodoh and Egbo (2013) in which female students performed better than their male counterparts in chemistry.

Conclusion

This study investigates the effect of instructional scaffolding strategy on achievement and in Biology among students of Unity Colleges in Niger State. It can be deduced from this study that teaching and learning can be enhanced through the use of instruction scaffolding strategy and that the approach is gender friendly as both male and female student were affected positively by the approach.

Recommendations

Biology teachers should be encouraged to use instructional scaffolding strategy in teaching as it is a more effective method to improve students achievement than lecture method and. It is also of more advantage than the lecture method in that it is gender friendly. The secondary school Biology curriculum should be reviewed with a view to integrate instructional scaffolding strategy into the curriculum, there should be organized workshops, seminar, and symposiums for teachers on the importance of using instructional scaffolding strategy in teaching. Also, Biology lessons should be scaffolded irrespective of the gender of the students.

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