

## EFFECT OF SCAFFOLDING STRATEGY ON BIOLOGY STUDENTS' ACADEMIC ACHIEVEMENT IN SENIOR SECONDARY SCHOOLS IN GOMBE STATE, NIGERIA

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### ABSTRACT

The study investigated the effect of scaffolding strategy on biology students' academic achievement in senior secondary schools in Gombe state. Two research questions and three hypotheses were tested at 0.05 level of significance. The study adopted quasi-experimental pretest, posttest, non-equivalent, experimental and control group. The target population of the study consisted of 18,460 SSII students' senior secondary schools in Gombe state. The sample comprised of 122 students in intact classes randomly assigned for two experimental groups and one control group. An instrument used for data collection was an Achievement Test tagged Biology Achievement Test (BAT) adapted from WAEC past questions from 2014 – 2017. The instrument was face and content validated by three experts and the reliability coefficient of 0.88 was obtained using Test retest method to determine the reliability of BAT. Data were analyzed using descriptive statistics for the research questions and Analysis of Covariance (ANCOVA) to test the three null hypotheses. The findings of the study revealed that scaffolding strategy enhanced students' achievement in biology. There was a significant difference in the academic achievement of the male and female students' in biology, The result also revealed that there was a statistically significant interaction effect of gender and treatment on students' academic achievement. It is recommended that Ministries of Education in conjunction with education Institutions in Nigeria should organize seminars and workshops to keep biology teachers abreast of the application of scaffolding instruction strategy for teaching and learning that could enhance students' academic performance.

**KEYWORDS:** Gender, scaffolding strategy, students' academic achievement, Gombe State.

### INTRODUCTION

Education is a fundamental human right and the structural key to sustainable development, peace and stability of a nation. In Nigeria, education is perceived as an instrument for achieving national objectives. According to the National Policy in Education (Federal Republic of Nigeria, 2004), education is an "instrument per excellence" for the achievement of national development. This explains the huge amount of money government earmarks for education in its annual budget. One major key of Nigeria vision 20-20 is to give students vibrant and modern science education system that will provide meaningful learning. This open opportunity to students to achieve maximum potentials and provide the nation with adequate and competent manpower needs. This goal may be achievable through effective teaching and learning of biology at the grass root level.

Biology is a science which deals with the study of living things (Ramalingam, 2000). Biology makes a huge contribution towards the realization of science objective because its knowledge is applied in many sectors of the economy, including agriculture, industry and medicine without this knowledge a nation will remain underdeveloped (Ugwuadu, 2010; Ibe, 2013; Joda & Abel, 2017). The subject has opened many careers for students such as in food technology, medicine, pharmacy and veterinary medicine. For instance, it has been applied in plant breeding to produce high yielding and disease resistant crops to ensure improved food production for the ever growing population. In industry, it has been applied in beer brewing, bread making and milk processing (UNESCO, 2004; Akpan, 2008; Ibe, 2013). In the same vein, another breakthrough in biology includes: the development of drugs and vaccines for preventing and curing diseases, increased food production, awareness of genetic diseases and their prevention (Ramalingam, 2000). Biology therefore contributes to national development through its various uses to mankind.

Despite investment in science education by Nigeria government and parents to meet up with the present challenge of the 21st century. Students' performance at SSCE had been recorded very low in biology when compared with the number of enrolment of students' over the years (Okoli, 2006; WAEC Chief Examiners report 2014 and 2015, Mohammed & Sakiyo, 2017). Similarly, performance of students in biology in Kenya at Kenya certificate of secondary examinations (KCSE) has been recorded in low achievement. In the year 2012, the percentage mean scores in biology, chemistry and physics were 26.21, 27.93 and 37.85 respectively in Kenya (Richard, 2013). In the year 2012, the percentage mean scores of girls in biology were 24.36, while those of the boys were 27.86 respectively. Recent studies in Nigeria, Ugwuadu and Joda (2011) and statistics from the West Africa Examination Council (WAEC 2009; 2013; 2014 & 2015) chief examiner's report on senior secondary school students' achievement in biology revealed that, the subject had both the highest enrolment relative to other science subjects and recorded poor achievement in the Senior School Certificate Examination (SSCE).

Akinsola and Igwe (2002); Ugwuadu and Joda (2011); Joda and Abel (2017) opined that non-motivation among students, shortage of classrooms, teacher quality, teacher and students' interest, motivation, teaching resources and teaching approaches and methodology used in teaching biology are identified as some of the factors contributing to poor student achievement. In addition, students find some topics in biology abstract, difficult and uninteresting (Nwachukwu & Nwosu, 2007; Mohammed & Sakiyo, 2017). Topics in biology like respiration, gene, allele, mitosis, ecosystem, Mendelian ratio and evolution are perceived difficult by students (Okoli, 2006; Ugwuadu & Obi, 2009). Most of the teaching approaches practiced in Nigerian schools are mainly expository and fact oriented, assigning a passive role to learners. This implies that students are merely passive rather than active in the learning process which may not lead to meaningful learning. Biology teachers usually act as the dispensers of knowledge while learners listen and try to understand and remember. Teacher-centered approaches may not solve the challenges of the new demands and objectives of

Biology education because learners do not take charge of their learning activities. UNESCO (2004) argues that innovative teaching approaches should be employed especially students-centered methods to make learning meaningful. Therefore, there need to employed students-centred teaching strategies such as 5e learning cycle, constructivism, scaffolding strategy, concept map and cooperative strategy whether it would improve students' academic achievement in biology.

Scaffolding Instructional is a teaching strategies geared to support learning when students are first introduced to a new subject. Scaffolding is a form of coaching and support to students as they develop new skills or learn new concepts. This implies that when the learner achieves competence, the support is removed. Scaffolding was used by Jerome Brunerto describe the process in which a learner or novice could be assisted to achieve a task that they may not be able to achieve if unassisted, until they are able to perform the task on their own. This definition was influenced by Vygotsky's (1978) conception of the zone of proximal development which is the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. This implies that learners have learning potential that can be reached with scaffolding provided by tutors, teachers, and peers. Therefore, scaffolding gives students a context, motivation, or foundation to understand new information that will be introduced during the coming lesson. Scaffolding can also be seen as a temporary framework that supports a building under construction. When the structure is strong enough to stand on its own, the scaffolds are removed (Alake & Ogunseemi, 2013, Jibrilla 2017). Ertmer and Cennamo (1995) stated that scaffolds in building cannot completely explain the principle of retreat of support in teaching and learning process. Ertmer and Cennamo further explained that when learning;

1. The support does not reach the ground because some entry knowledge is expected.
2. That the support for learning cannot be precise to the right level as can be done with a building.
3. Retreating of support only occurs in the last stage of building, while learning retreat of support occurs gradually during the learning process.

The teacher offers assistance with only those skills that are beyond the students' capability. The student then continues to develop the skills or knowledge on his/her own. Lipscom, Swanson and West (2004) and Jibrilla (2017) further revealed that scaffolding allows students to perform tasks that would normally be slightly be beyond their ability without the assistance and guidance from the teacher. In order to carry out scaffolding strategy the teacher must first identify and determine:

- i) What students can accomplish independently;
- ii) What students can accomplish with guidance (in other words, the teacher determines the students' zone of proximal development)
- iii) The teacher then provides the instructions that are just enough to support the learner in task beyond reach without teacher's support.

Winnips (2001) and Adieze (2016) opined that scaffolding provides support for student learning and then retreating that support may lead to student self-reliant. Casem (2013) and Akani (2015) found that students exposed to scaffolding strategy performed significantly better than their counterparts who were exposed to the traditional method. On the contrary, Ibritam, Udofia and Onweh (2015) found that no significant difference in the mean achievement scores of the students taught using scaffolding instructional strategy and than those taught using the demonstration instructional method in site preparation. Uduafemhe (2015) revealed that there was no significant difference between the mean scores of male and female students when taught Basic Electronics using scaffolding and collaborative teaching approaches. This shows that there are still trend of contradicting findings on the effectiveness of scaffolding strategy to enhance students achievement in secondary schools.

Based on the observation the ineffectiveness of the teacher as regards to the students'-centred strategies employed in the classroom interaction with the students may be responsible for the persistent poor academic achievement of biology students' in Nigeria. Therefore, there is need to investigate the effect of scaffolding strategy on students' whether it will improve their academic achievement in biology

## **PURPOSE OF THE STUDY**

The main purpose of this study is to investigate the effect of scaffolding strategy on students' academic achievement in biology. The specific objective is to determine

1. The effect of scaffolding strategy and lecture methods on students' academic achievement in biology.
2. The effect of gender of students on students' academic achievement in biology when taught using scaffolding strategy.
3. The interaction effect of gender and scaffolding strategy on students' academic achievement in biology.

## **Research Questions:**

The following research questions guided the study.

1. What are the pretest and posttest mean difference of students taught biology with scaffolding instructional strategy and those taught with conventional methods?
2. What is the mean pretest and post-test academic achievement scores of students taught biology using scaffolding instructional strategy by gender.

## **Research Hypotheses:**

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

**H<sub>01</sub>:** There is no significant main effect of scaffolding instructional strategy and lecture methods on Biology students' academic achievement in Gombe State.

**H<sub>02</sub>:** There is no significant effect of gender on students' academic achievement in biology when taught with scaffolding instructional strategy in Gombe State.

**H<sub>03</sub>:** There is no interaction effect of gender and treatment on Biology students' academic achievement in Gombe State.

## METHODOLOGY

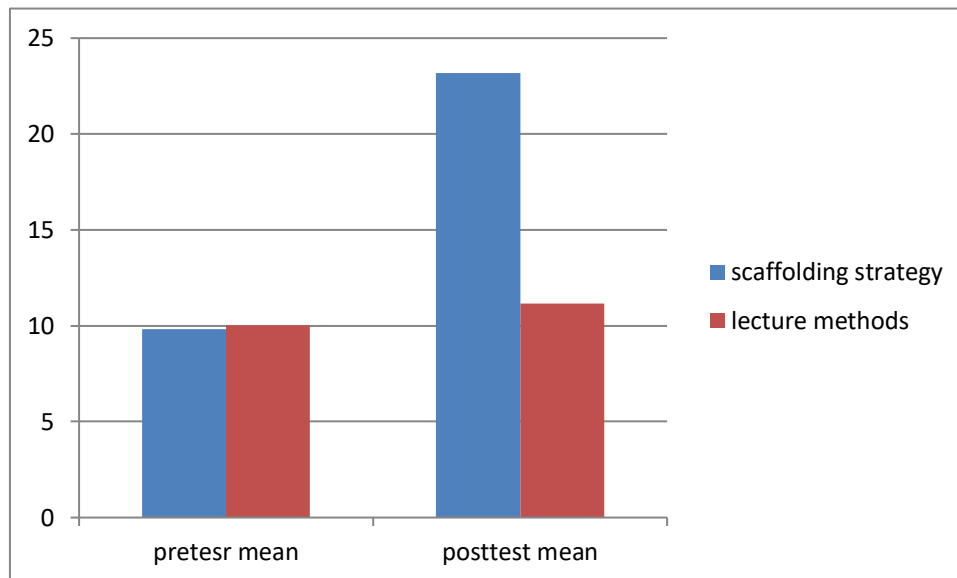
The research design of this study was the quasi-experimental design of pretest- posttest, non-equivalent non-randomized control design. This design was used because intact classes were used so that school activities would not be disturbed. This study was carried out in Gombe State. The population of this study consisted of all secondary schools (SSII) biology students in Gombe State. The targeted population of the students was 18,460. The random sampling technique was used to select four intact classes with 122 biology students as the research sample. The experimental group was taught with scaffolding strategy and the control group were taught with lecture method. The experimental group consisted of 64 while control consisted of 58 biology students respectively. An instrument was adapted from past biology questions WAEC 2016 -2018 were used. The instrument used to collect data for this study was: Biology Achievement Test (BAT). BAT contained 60 multiple – choice objective test on genetics, skeleton system, regulation of the internal environment and circulatory system. Three experts from School of Technology and Science Education, Modibbo Adama University of Technology, Yola validated the instruments (BAT) and made amendments where necessary in terms of face and content coverage of items and use of expressions to avoid ambiguity. Test retest method was used to determine the reliability of BAT. The reliability coefficient was determined by testing 36 students from GDSS Kaltungo LGA, Gombe State which is outside the main study and the reliability coefficient of 0.88 was obtained. Pretest was administered on the experimental and control groups using the Biology Achievement Test. This was done to ensure the two groups were homogeneous cognitively. The scores were obtained and recorded for each of the two groups. The experimental group was taught regulation of internal environment, genetic, skeleton system and circulatory system with scaffolding strategically. The control group was taught by the lecture method using the prepared lesson plan. After 6 weeks of teaching and learning, posttest was administered to experimental and control groups in different order. Data collected were analyzed using mean, standard deviation and ANCOVA. Research questions was answered using mean and standard deviation while for hypotheses testing, ANCOVA was used and the decision rule was that if p-value was less 0.05 level of significance, the null hypothesis was rejected ( $P \leq 0.05$ ) but if the p-value was greater than do not reject ( $P > 0.05$ ).

## RESULTS

Research Questions 1: What are the pretest and posttest mean difference of students taught biology with scaffolding instructional strategy and those taught with conventional methods?

**Table1. Descriptive Analysis of Students’ Pretest and Posttest of Experimental and Control Groups.**

Teaching methods	Pretest			Posttest			Mean difference
	N	$\bar{X}$	SD	$\bar{X}$	SD		
Scaffolding	64	9.81	3.34	23.17	6.81		13.36
Lecture	58	10.09	2.29	11.15	2.60		



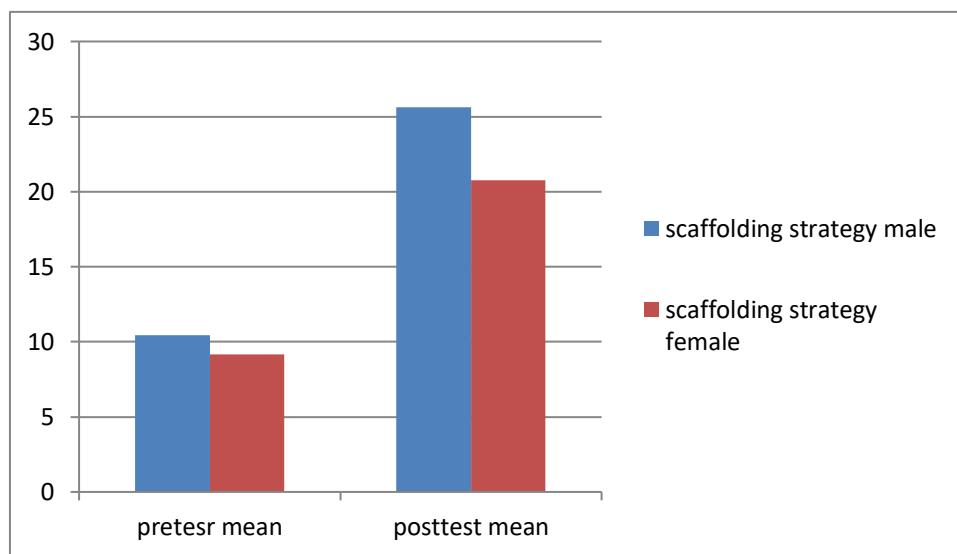
The descriptive statistics in table 1 show that, the study was carried out on 122 biology students’ divided into experimental and control groups. The scaffolding instructional strategy had a pre-test mean score of 9.81, with a standard deviation of 3.34. The post-test of scaffolding has a mean of 23.17, with a standard deviation of 6.81. The lecture group had a pre-test mean score of 10.09, with a standard deviation of 2.29 and post-test mean of 11.15, with a standard deviation of 2.60 for the lecture group.

This indicated that, the mean difference between pre-test and post-test is higher in favor of scaffolding instructional strategy with mean difference of 13.36, which is better than the lecture method of teaching. The difference may be due to the support given by the biology teacher during lesson delivery in the treatment group and this may improve their academic achievement.

Research Question 2: What is the mean pretest and post-test academic achievement scores of students taught biology using scaffolding instructional strategies by gender?

**Table1. Descriptive Analysis of Students’ Pretest and Posttest of Experimental Group.**

Teaching methods	Gender	Pre-test			Post-test			Mean difference
		N	$\bar{X}$	SD	$\bar{X}$	SD		
Scaffolding	Male	35	10.45	3.45	25.60	6.55	15.15	
	Female	29	9.17	3.47	20.75	7.07	11.58	



The study also revealed that males taught with scaffolding have a pre-test and post-test mean score of 10.45 and 25.60 respectively while females have a pre-test mean of 9.17 and post-test 20.75. Therefore the post-test mean score of male and female have a difference of 3.57 in favour of males. The difference may be due to males students become active when stimulated, supported and motivated to learning of biology with the help of the teacher.

**Hypotheses Testing**

The hypotheses were tested using ANCOVA at 0.05 level of significance:

**H<sub>01</sub>:** There is no significant main effect of scaffolding instructional strategy and lecture methods on Biology students’ academic achievement in Gombe State.

**Table 2: Two-way ANCOVA Summary of Students’ Academic Achievement when taught Biology using Scaffolding Instructional Strategy and Lecture Method  
Dependent Variable: STUDENTS ACHIEVEMENT**



Source	Type III Sum of Square	Df	Mean Square	F	Sig.
Corrected Model	8378.596	4	2094.649	72.509	0.00
Intercept	1855.365	1	1855.365	64.226	0.00
PRETEST	54.319	1	54.319	1.880	0.173
Methods	7706.936	1	7706.936	266.784	0.00*
Gender	159.371	1	159.371	5.517	0.021
Methods *gender	149.453	1	149.453	5.173	0.025
Error	3379.929	117	28.888		
Total	41912.000	122			
Corrected total	11758.525	121			

R. Square = 0.713 (Adjusted R-squared = 0.703)

The result in table 2 shows that there was a statistically significant effect of scaffolding instructional strategy on students’ academic achievement,  $F(1, 121) = 266.78, p < 0.05$ . Since the computed p-value (0.000) is less than 0.05 level of significant, therefore, the null hypothesis of no significant difference was rejected, which means there was a statistically significant effect on students’ academic achievement when taught biology with scaffolding instructional strategy and lecture method of teaching in favour of scaffolding instructional strategy.

**H<sub>02</sub>:** There is no significant effect of gender on students’ academic achievement in biology when taught with scaffolding instructional strategy in Gombe State.

From table 2 above, there was a statistically significant effect of gender on students’ academic achievement when taught biology using scaffolding instructional strategy,  $F(1, 121) = 5.517, p < 0.05$ . Since the computed p-value (0.021) is less than 0.05 level of significant, therefore, the null hypothesis of no significant difference was rejected, which means there was a statistically significant effect of gender on students’ academic achievement when taught biology with scaffolding instructional strategy. This means that gender has statistically significant effect on scaffolding instructional strategy, hence gender may cause improvement in students’ academic achievement when scaffolding strategy is utilized effectively.

**H<sub>03</sub>:** There is no interaction effect of gender and treatment on Biology students’ academic achievement in Gombe State.



Table 2 indicated that, there was a statistically significant effect of gender and treatment on students' academic achievement,  $F(1, 121) = 5.173, p < 0.05$ . Since the computed p-value (0.025) is less than 0.05 level of significant, therefore, the null hypothesis of no significant difference was rejected, which means there was a statistically significant effect of gender and treatment on students' academic achievement when taught biology. This implies that the effect of scaffolding instructional strategy and gender have significance on students' academic achievement. The improvement in students' academic achievement may due to assistance received from their biology teacher during teaching and learning processes.

## FINDINGS

1. The post-test mean scores of students' are better than the pre-test mean scores of scaffolding instructional strategy and lecture method. Therefore, post – test mean score difference of 13.36 was in favor scaffolding instructional strategy.
2. The post-test mean score of male and female have a difference of 3.57 in favor of males.
3. There was a statistically significant effect of scaffolding instructional strategy on students' academic achievement,  $F(1, 121) = 266.78, p < 0.05$ .
4. There was a statistically significant effect of gender on students' academic achievement when taught biology using scaffolding instructional strategy,  $F(1, 121) = 5.517, p < 0.021$ .
5. There was a statistically significant interaction effect of gender and treatment on students' academic achievement,  $F(1, 121) = 5.17, p < 0.025$ .

## DISCUSSION OF FINDING

The findings of this study showed that students taught with scaffolding instructional strategy were more effective than the lecture method of teaching students in biology. The post – test mean score difference of 13.36 was in favor scaffolding instructional strategy. This shows the effectiveness of scaffolding instructional strategy which allowed teacher's assistance and support during lesson delivery over the lecture method of teaching. Scaffolding instructional strategy help learners to seek for assistance at any time, thereby removing students' misconceptions regarding abstract concepts in biology and this help can be withdrawn small by small until the students can stand alone. These finding agree with Casem (2013); Akani (2015); Adieze (2016) and Jibrilla (2017), who found out that students taught using scaffolding instructional strategy significantly performed better than the students in the lecture method. Based on the results, scaffolding instructional strategy may improve students' academic achievement when supported by the teacher may lead to meaningful learning of biology.

The result shows that post - test scores of male and female have a difference of 3.57 in favor of males when taught using scaffolding instructional strategy. This result agree with the findings of UNESCO (2004) which revealed that male students performed better than the female students in the sciences using scaffolding strategy. This result disagrees with that of Sakiyo (2008): Osu and Ekpen

(2014); Omiko (2015) who reported that female students performed better than the male students counterparts in their various studies.

The result also shows that there was a statistically significant difference between scaffolding instructional strategy and lecture method on students' academic achievement,  $F(1, 121) = 266.78, p < 0.05$ . This result agrees with Shilly (2006), Nonye, and Nwosu (2011), Uduafemhe (2015), Aditi (2017) and Jibrilla (2017) who in their various studies revealed a significance difference in the mean scores of students' academic achievement of the two groups. This implies that students taught by scaffolding strategies performed much better than those taught by traditional methods. Therefore, scaffolding method was superior to the conventional method in improving academic achievement of biology students

The result also found out that there was a statistically significant difference between gender on students' academic achievement when taught biology using scaffolding instructional strategy,  $F(1, 121) = 5.51, p < 0.021$ . However, the result disagrees with that of Nonye, and Nwosu (2011); Ozlem and Ali (2011); Ibritam, Udofia and Onweh (2015) who found out that there was no significant difference between gender in their various studies. The result also indicates that gender is a significant factor in students' achievement in biology due to scaffolding strategy.

The result revealed that there was a statistically significant interaction effect of gender and treatment on students' academic achievement,  $F(1, 121) = 5.17, p < 0.025$ . This result agrees with Nonye, and Nwosu (2011), Aditi (2017) and Jibrilla (2017) who in their various studies revealed that there was a significant interaction effects of scaffolding strategy and gender. This implies that the scaffolding instructional strategy is gender friendly because teachers give guidance and assistance to students over time, which may lead to improvement in students' academic achievement in biology.

## CONCLUSION

This study applies scaffolding instruction strategy into the teaching and learning of biology, which made students' learning meaningful and also increase their academic achievement in biology. The experimental group taught with scaffolding instruction strategy showed more positive changes than the control group in their academic achievement. This leads to an increased in their academic achievement. Meaningful learning was attained as a result of help and guidance given by the biology teacher during lesson delivery. In addition, gender indicates a significant factor in students' achievement in biology.

Therefore, if biology teachers will utilize scaffolding instruction strategy effectively may enhance students' academic achievement and this could pave way for students' in the developing countries like Nigeria to meet up with the scientific challenges of the 21st century.

## RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

1. Teachers should endeavor to make teaching more learner-centered by encouraging them to take charge of their learning experience and by helping learners through scaffolding instruction strategy.
2. Ministries of Education in conjunction with education Institutions in Nigeria should organize seminars and workshops to keep biology teachers abreast of the application of scaffolding instruction strategy for teaching and learning.

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