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EFFECTS OF SCAFFOLDING AND JIGSAW I INSTRUCTIONAL STRATEGIES ON SENIOR SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN ECOLOGY IN NASARAWA STATE, NIGERIA.

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ABSTRACT
The study investigated the effect of Scaffolding and Jigsaw I instructional strategies on SS I students' achievement in Ecology in Nasarawa state, Nigeria. 13,526 (7,147 male and 6,379 female) were used as the population of the study. The sample comprised three intact classes with 150 SS I Students using multistage random sampling technique. The design used was a quasi-experimental pretest, posttest post posttest non-equivalent control design. Three research questions with correspondent hypotheses were used. The instruments used were: Ecology Achievement Test (EAT). Description statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of ANCOVA was used to test the hypothesis at 0.05 level of significant. The findings among others revealed that students who were taught Ecology using Scaffolding and Jigsaw I instructional strategies performed better than those taught using conventional method. The study therefore concludes that teaching students of Biology using Scaffolding and Jigsaw I instructional strategies improved students' academic achievement. Based on this finding, it is recommended among others that Biology teachers should be encouraged to develop and adopt the use of Scaffolding and Jigsaw I instructional strategies in teaching Biology. Government should endeavor to organize regular workshops to train Biology teachers on development and use of these strategies at SS I level.

Keywords: *Scaffolding, Jigsaw I, Strategy, Achievement, Ecology, Biology.*

INTRODUCTION

The teaching of science in general and Biology, in particular, required the active participation of students in the teaching-learning process, to enable students to connect scientific concepts and theories to real purposes and practices in the world in which they live (Dumela,.& Bree, 2016). Unfortunately, the majority of the teachers teach Biology without engaging the learner actively during the teaching-learning process. (Okoli &Azubuike, 2012: Ibe, 2015). Students' poor performance in external examinations could be as a result of poor teaching strategies and neglecting of students' learning styles.

Ecology deals with organisms, populations, communities, ecosystems and the biosphere. The place of living is the organism's environment. Hence, ecology is sometimes, called as environmental biology. In general, ecology is recognized as one of the natural sciences. It is considered to be a science concerned with the nature and the interrelations of living world. The term ecology has been derived from the Greek word "oikos" meaning 'habitation' or 'house' or 'living place' (Balasubramanian, 2019)

There are several approaches that can be used in delivering Ecology lessons in which Scaffolding and Jigsaw represents one of them. The need to therefore explore appropriate instructional approaches that could enhance students' achievement in Ecology has continued to be a critical issue to Biology educators. Andrianes (2013) in Omoniyi &Torru (2018) defines educational Scaffolding as a teaching method that enables students to solve a problem, carryout a task or achieve a goal through a gradual shedding of outside assistance. In education, Scaffolding and refers to variety of instructional techniques used to move a student progressively toward stronger understanding and, ultimately, greater independence in the learning process (Omoniyi &Torru, 2018). Alake and Ogunsoemi (2013) stated that students exposed to Scaffolding strategy perform significantly well than those who are taught with traditional/conventional method.

The jigsaw I teaching strategy is a teaching strategy of organizing students group work that help students collaborate and rely on one another to succeed. Jigsaw I strategy was originally developed by Aronson and his colleagues in

1971 (Sarah and Cassidy, 2006). Jigsaw I strategy breaks classes into groups and breaks the topic into pieces that the group assembles to complete the (jigsaw) puzzle. Teaching Ecology with scaffolding and jigsaw strategies could help students retain and learn the basic fundamentals of Ecology without engaging in memorization of complex information. Researchers such as Egbulefu, Amaele and Sunday (2015), Gambari and Yusuf (2017) revealed that jigsaw learning is capable of enhancing students' achievement in Ecology.

Conventional in this study is lecture method. It is a teacher- controlled and information centered approach in which the teacher works as a sole-resource in classroom instruction. Ikitde and Edit (2013) described a lecture method of teaching as a one-way communication pattern in which the teacher is the dominant figure and students' participation is virtually non-existence, rather they listen, ask questions and take notes. To arrest students' attention, interest, curiosity and promote their achievement in Ecology, the use of activity stimulating and student-centered approaches like Scaffolding and Jigsaw strategies instead of depending on the conventional approach need to be embraced.

Student achievement refers to what students were able to learn in a determined period of time (*Vanessa,* 2021*).* Achievement is the action of accomplishing a task successfully. Achievement is useful in testing the retention of information and stills. The purpose of achievement is to find out the stand of students in a given task (Akani, 2017). Despite numerous methods/strategies or approaches used in teaching Ecology, reports are still raging on concerning persistent upward trend in students' poor achievement on the subject. In other words, the widely acclaimed deteriorated standard of education in Nigeria, to a large extent, depends on factors resident in learning strategy (Gibbs, 2011).

Gender is a socially ascribed attribute which differentiate feminine from masculine. The difference in biology achievement due to gender has caused a lot of concern to educationist. Hence, the need to study the differential influence of gender and cognitive styles on students' achievement in Ecology. Gender-related studies on secondary school students' achievement in Ecology contains contradictory results. While some studies (Ndirika, 2013; Aniodoh & Eze, 2014) reported that boys did better, other studies (Nwaiwu and Audu, 2005; Lorchugh, 2006) did not find either performing better. The need arises for new studies to take these variables into consideration in an attempt to build a body

of more consistent evidence on the influence of gender and cognitive styles on students' achievements in biology this call for the research on the effect of Scaffolding and Jigsaw Instructional Strategies on SS I Students' Achievement in Ecology in Nasarawa State, Nigeria.

Theoretical frame work

This study is anchored on Lev Vygotsky social learning theory (1978) which states that knowledge is co-constructed and that individual learn from one another. In Vygotsky's opinion the learner must be engaged in the learning process. Learning happens with the assistance of other people. Vygotsky (1978:90) stated that "as essential feature of learning is that it creates the zone of proximal development (ZPD). That is learning awakens a variety of internal development processes that are able to operate only when the learner is interacting with others in his environment. Once this processes are internalised, they becomes part of the learner's independent developmental achievement.

Literature Review

Joda (2019) observed that students taught using instructional Scaffolding had a significantly higher academic achievement and retained Biology concepts than those taught using lecture method. The researcher recommended that Biology teachers should teach with Scaffolding and Jigsaw strategies for better understanding. Olubunmi and Ese (2018) reveal that students taught addition reaction of unsaturated organic compounds using scaffolding performed better than those taught using conventional approach. Odo and Nwachukwu (2020) observed that students taught science using jigsaw instructional strategy had higher achievement mean score than students taught science using peer tutoring strategy. Male students in the jigsaw group achieved higher than male students in the peer torturing group. Also female students taught science using jigsaw instructional strategy achieve significantly higher than female students taught science using peer tutoring instructional strategy. Mmegwa (2019) revealed that Jigsaw Collaborative Learning Approach (JCLA) enhanced better achievement and retention of genetic concepts than the conventional method.

Statement of the Problem

Poor achievements in Biology have been attributed to a number of factors, among which is teaching methods. The prevalent instructional strategies that Biology teachers' use for teaching in Nigerian secondary schools is the

conventional lecture method to the neglect of activity - based instructional strategies. Some activity - based strategies like concept mapping, guided discovery, game instructional strategy, Scaffolding instructional strategy and jigsaw I instructional strategy have been shown to enhance achievement of students in difficult science concepts. On the basis of the foregoing, the researcher explored the effect of Scaffolding and Jigsaw I Instructional Strategies on SS I Students' Achievement in Ecology in Nasarawa State, Nigeria.

Research Questions

The following questions guided the study:

1. What are the mean achievement scores of students taught Ecology using Scaffolding and Jigsaw I instructional strategies over conventional strategy?
2. What are the mean achievements scores of male and female students taught Ecology using Scaffolding instructional strategy and conventional strategy?
3. What are the mean achievements scores of male and female students taught Ecology using Jigsaw I instructional strategy and conventional strategy?

Objectives of the Study

The purpose of this study was to find out The Effects of Scaffolding and Jigsaw I Instructional Strategies on SS I Students' Achievement in Ecology in Nasarawa State, Nigeria.

Specifically, the study sought to achieve the following objectives:

1. To determine the effect of Scaffolding and Jigsaw I instructional strategies over conventional instructional strategy on student achievement in Ecology.
2. To determine the effect of Scaffolding strategy and conventional instructional strategy on male and female student in Ecology.
3. To determine the effect of Jigsaw I instructional strategy and conventional instructional strategy on male and female student in Ecology.

Statement of Hypotheses

The following hypotheses were formulated to guide this study.

1. There is no significant difference between the mean achievement scores of students taught Ecology using Scaffolding and Jigsaw I and conventional strategy.
2. There is no significant difference between the mean achievement scores of male and female students taught Ecology using Scaffolding and conventional strategy.
3. There is no significant difference between the mean achievement scores of male and female students taught Ecology using Jigsaw I and conventional strategy.

METHODOLOGY

This study adopted a quasi-experimental research of pre-test, post-test, post-post-test, non-equivalent, non-randomized control group design. This represents two treatment group and one control group Scaffolding and Jigsaw and control group. All students in the three intact classes were pre-tested to determine their entry level behaviour or status. The experimental group received treatment on Scaffolding and Jigsaw strategies, while the control group did not receive any treatment. Also, all the groups were subjected to post-test to determine the effect of the treatment on students' achievement and post-posttest (to determine the effect of the treatment on their retention ability). 13,526 (7,147 male and 6,379 female) students were used as the population of the study. The sample comprised three intact classes with 150 SS I (68 male and 82 female) Students using multistage random sampling technique. The design used was a quasi- experimental pre-test, post-test and post-posttest non-equivalent control design. Three research questions with correspondent hypotheses were used. The instruments used were: Ecology Achievement Test (EAT). Descriptive statistics of mean and standard deviation were used to answer the research questions, while inferential statistics of ANCOVA was used to test the hypothesis at 0.05 level of significant. The choice of ANCOVA was because of the nature of the design of the study i.e. Quasi-experimental (specifically non-equivalent control-group design). This is because the design permitted the use of pre-test, which acts as covariate; therefore, ANCOVA helped to establish the homogeneity or equivalence of the three groups before treatment. Besides this, since intact

classes were used for the study, ANCOVA also helped to increase the power of the test because of error that might have occurred because of non-randomization of the subjects of the study (i.e. Type1 error was reduced). Statistical Package for Social Science (SPSS-Version 22) was used to run the analysis.

RESULTS

Research Question One

What are the mean achievement scores of students taught Ecology using Scaffolding and Jigsaw and conventional strategies?

Table 1.0: Means, Standard Deviations of Achievement of Ecology Students Exposed to SIS, JIS and CM

Group	N	Pre-test		Post-test	
		Mean	SD	Mean	SD
SIS	50	25.68	8.353	68.10	8.662
JIS	50	25.90	8.202	67.16	8.054
CM	50	26.06	7.681	54.14	7.407

Table 1.0 shows mean scores and standard deviations in achievement of Ecology students exposed to SIS, JIS and CM. It was observed that the mean scores of students in the SIS group were 25.68 and 68.10 in pretest and posttest respectively. While, their standard deviations were 8.353 and 8.662, respectively. Students in the JIS group had mean scores of 25.90 and 67.16 in pretest and posttest respectively. And their standard deviations were 8.202 and 8.054 respectively. The students in CM group had 26.04 and 54.14 in pretest and posttest and their standard deviations were 7.681 and 7.407 respectively.

Null Hypothesis One

There is no significant difference between the mean achievement scores of students taught Ecology using Scaffolding and Jigsaw and conventional strategy.

The data test for the hypothesis are provided in table 1.1

Table 1.1: Results of ANCOVA on Ecology Students' Achievements Taught Ecology using SIS, JIS and CM

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9483.327	3	3161.109	75.069	.000	.607
Intercept	29844.508	1	29844.508	708.734	.000	.829
Pretest	3395.234	1	3395.234	80.628	.000	.356
Group	6238.161	2	3119.081	74.070	.000	.504
Error	6148.006	146	42.110			
Total	613504.000	150				
Corrected Total	15631.333	149				

Table 1.1 reveals a significant difference in the mean achievement scores of chemistry students exposed to SIS, JIS and CM. F - ratio of 74.070 was obtained with associated exact probability value of 0.000. (F = 74.070; P = .000 < .05) Since the associated probability (.000) is less than 0.05 set as level of significance, the null hypothesis was rejected. The result implies that the SIS and JIS produced a significant effect on the post-test achievement scores of students when covariate effect (pre-test) was controlled. Hence, there was a significant difference among the three groups.

Based on the established difference in the achievement scores of the groups, Bonferroni Multiple Comparisons was used to determine the direction of the difference. The result of this analysis is shown in Table 1.2

Table 1.2: Bonferroni Multiple Pairwise Comparison Results of Students' Mean Achievement Scores of SIS, JIS and CM

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.b	95% Confidence Interval for Differenceb	
					Lower Bound	Upper Bound
SIS	JIS	1.071	1.298	1.000	-2.073	4.214
	CM	14.186*	1.298	.000	11.042	17.330
JIS	SIS	-1.071	1.298	1.000	-4.214	2.073

	CM	13.115*	1.298	.000	9.972	16.258
CM	SIS	-14.186*	1.298	.000	-17.330	-11.042
	JIS	-13.115*	1.298	.000	-16.258	-9.972

Based on estimated marginal means

*. The mean difference is significant at the .05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 1.2 shows that there was no significant difference in the mean achievement scores of students exposed to SIS and those exposed to JIS. There was a significant difference observed between the mean achievement scores of those exposed to SIS and CM. Likewise, a significant difference was observed between the mean achievement scores of those exposed to JIS and CM.

Research Question Two

What are the mean achievements scores of male and female students taught Ecology using Scaffolding instructional strategy and conventional strategy?

The mean achievement scores, standard deviations of male and female Ecology students taught Ecology using SIS are presented in Table 1.3.

Table 1.3: Means and Standard Deviation of Male and Female Ecology Students Exposed to SIS

Group	Gender	N	Pre-test		Post-test	
			Mean	SD	Mean	SD
SIS	Male	29	26.79	8.691	70.00	8.602
SIS	Female	21	24.14	7.806	65.48	8.232

Table 1.3 shows mean achievement scores of male and female chemistry students exposed to SIS. The male students had a mean score of 26.79 and 70.00 in pretest and posttest respectively. While their standard deviations stood at 8.691 and 8.602 respectively. The mean scores of the female students were 24.14 and 65.48 in pretest and posttest respectively. Their standard deviations were 7.806 and 8.232. The standard deviation scores for the pre-test and posttest

based on gender were not much variance implying that the efficacy of the treatment is sustainable.

Null Hypothesis Two

There is no significant difference between the mean achievement scores of male and female students taught Ecology using Scaffolding and conventional strategy.

The data tests for the hypothesis are provided in Table 1.4.

Table 1.4: Results of ANCOVA on Ecology Students' Achievement on BAT on Gender and SIS

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	872.701	2	436.350	7.315	.002	.237
Intercept	14957.865	1	14957.865	250.738	.000	.842
Pretest	623.439	1	623.439	10.451	.002	.182
GenderSIS	135.479	1	135.479	2.271	.139	.046
Error	2803.799	47	59.655			
Total	235557.000	50				
Corrected Total	3676.500	49				

Table 1.4 shows an F – ratio = 2.271 with associated exact probability value of 0.139 which is greater than the bench mark probability value of 0.05 (F = 2.271; P = .139 > .05). This indicates that there was no significant difference in the mean achievement scores of male and female students exposed to SIS. The null hypothesis was therefore not rejected.

Research Question Three

What are the mean achievements scores of male and female students taught Ecology using Jigsaw I instructional strategy and conventional strategy?

The mean achievement scores, standard deviations of male and female Ecology students taught Ecology using JIS are presented in Table 1.5.

Table 1.5: Means Standard Deviation of Male and Female Ecology Students Exposed to JIS

Group	Gender	N	Pre-test		Post-test	
			Mean	SD	Mean	SD
JIS	Male	21	27.29	8.521	68.00	7.887
	Female	29	24.94	7.961	66.55	8.257

Table 1.5 shows mean achievement of male and female Ecology students exposed to JIS. The male students had a mean score of 27.29 and 68.00 in pretest and posttest respectively. While their standard deviations were 8.521 and 7.887 respectively. The mean scores of the female students were 24.94 and 66.55 in pretest and posttest respectively. While their standard deviations were 7.961 and 8.257 respectively. The standard deviation scores for the pretest and posttest based on gender were not at much variance implying that the efficacy of the treatment is sustainable.

Null Hypothesis Three

There is no significant difference between the mean achievement scores of male and female students taught Ecology using Jigsaw I and conventional strategy. The data tests for the hypothesis are provided in Table 1.6.

Table 1.6: Results of ANCOVA on Ecology Students' Achievement on BAT on Gender and JIS

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	1644.469	2	822.235	25.188	.000	.517
Intercept	10286.005	1	10286.005	315.100	.000	.870
Pretest	1618.921	1	1618.921	49.594	.000	.513
GenderJIS	.710	1	.710	.022	.883	.000
Error	1534.251	47	32.644			
Total	228702.000	50				

Corrected Total	3178.720	49				

Table 1.6 shows an F – ratio = 0.022 with associated probability value of 0.883 which is greater than the bench mark probability value of 0.05. (F = .022; P = .883 > .05). This indicates that there was no significant difference in the mean achievement scores of male and female students exposed to JIS. Therefore, the null hypothesis was not rejected.

Discussion of Findings

The findings of this study reveal the effect of SIS and JIS in enhancing teaching and learning Ecology in SS I. There was significant difference among student' achievements in scaffolding instructional strategy, jigsaw I instructional strategy and the conventional method in favour of scaffolding instructional strategy and the jigsaw I instructional strategy.

The finding on students' achievement in SIS group are in agreement with the earlier finding of Joda (2019), Olubunmi and Ese (2018). The findings of JIS group are in agreement with the earlier findings of Odo and Nwachukwu (2020), Mmegwe (2019). These findings reported that students taught Chemistry, Biology, Physics and Biology using scaffolding and Jigsaw I instructional strategies achieved better than those taught using conventional method.

Conclusion

The findings of this study showed that the Scaffolding Instructional Strategy and Jigsaw I instructional strategies are more effective than the conventional method. These results imply that the teaching methods employed by Biology teachers might have been responsible for the persistent under-achievement of students in Biology. The implication of the study is that Biology teachers should make a paradigm shift from conventional method of teaching to teaching approaches' that promote creative thinking, interactive and are activity based.

Recommendation.

The following recommendations were made based on the findings of this study.

1. Biology teachers should adopt activity – based method such as Scaffolding and Jigsaw I instructional strategies during workshop,

seminars as this encourages and motivates the students in the learning process, promote learning by doing, allows the students to discover fact for themselves and aid achievement in Biology.

2. Biology students should always be encouraged to work together and learn from each other, whether male or female to promote understanding and as well as to reduce gender gap during Biology lesson.

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