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Scaffolding Assisted Instruction on Students' Academic Achievement in Basic Science and Technology

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Abstract. The poor performance of students in the core science subjects in the senior secondary school is often traced to the faulty foundation at junior secondary school basic science and technology. The major fault with this foundation among other things is the teaching strategy the teacher adopts while teaching basic science and technology. Therefore, this study examined the effect of scaffolding instructional strategy on students' achievement in basic science and technology. This study adopted the pretest-postest quasi experimental research design, The population of the study were all Basic Eight students in public secondary schools in Odeda Local Government in Ogun state. A total of 100 pupils formed the sample of the study. The instrument used for data collection was basic science achievement test. The data collected were analyzed using Analysis of Covariance (ANCOVA) and estimated marginal means. The findings revealed that students taught with scaffolding instructional strategy had a significantly better achievement than the students in the control group. Based on the findings of this study, it was recommended that teachers should teach basic science using scaffolding instructional strategy.

Keywords: Scaffolding, Students' academic achievement, Basic Science and technology.

1. Introduction

Science education contributes to the growth and development of individuals to become responsible members of the society and it is a domain which aims at identifying and describing the Physical and Biological World (Akcay&Yager, 2010). In the Nigerian education system, Basic Education, as the foundation requires a sound knowledge of science and technology. This is not only because science and technology has a tremendous impact on all social institutions but also because Science and Technology is very important to individual development. The nine-year Basic Education Programme stipulates Basic Science and Technology as a compulsory subject. Before the recent curriculum innovation in 2008, which has made Basic Science as theme in the Basic Science and Technology Curriculum, Basic Science has been a major science subject at

junior secondary level of education with the aim of making students develop interest in science; apply their basic knowledge and skills in science and technology to meet societal needs; take advantage of the numerous career opportunities offered by the study of science and technology and become prepared for further studies in science and technology.

It is important to note that in spite of the importance of Basic Science and Technology, achievement of students remains inconsistent. This is shown below:

Table 1. Students' Performance Analysis of 2011-2015 BECE

	YEAR	PERCENTAGE DISTINCTION	PERCENTAGE CREDIT	PERCENTAGE PASS	PERCENTAGE FAIL
1	2011	4458 6.16%	36353 50.23%	29116 40.23%	2453 3.39%
2	2012	4227 5.29%	38121 47.67%	34375 42.99%	3238 4.05%
3	2013	6889 7.16%	69750 78.21%	11041 12.38%	2003 2.25%
4	2014	5122 5.44%	51833 55.03%	34558 36.69%	2675 2.84%
5	2015	9119 9.42%	42156 43.55%	40628 41.97%	4894 5.06%

Source: *Ogun State Ministry of Education*

In addition, Alebiosu (2017) jingled the punching hazard of poor achievement in Basic Science and Technology.

Many scholars have attributed the poor performance of students in most science subjects at the senior secondary school level to the poor background of students in Basic Science (Adesoji,1999) Although, there are other factors such as low level of readability of the textbooks (Ivowi, 1983) unavailability of instructional materials (Opara &Etukudo, 2014), large class size, to mention a few. However, the most emphasized is the approach to teaching. It is important to scrutinize the claim, that there is low science background at the basic level of education. Therefore, the next thing to look at is the teaching method among other things.

It has been widely established that many teachers teach Basic Science using only the lecture method which is not a bad method on its own but which remains grossly inadequate for students at this level. This is because students are not meant to depend solely on oral instructions in science they should rather learn it by doing it. Silvia Bello and Rail Valdes (2004) in their work titled "Is it possible to learn chemical Equilibrium in High school" concluded and recommended demonstrations and game play while Alebiosu, Afuwape & Odukoya, (2012) advocated storyline teaching strategy as a facilitator of pupils' understanding of Basic Science and Technology concepts and principles more than conventional lecture/teaching method.

In education, scaffolding refers to a variety of instructional techniques used to move students progressively toward stronger understanding and, ultimately, greater independence in the learning process. The term itself offers the relevant descriptive metaphor: teachers provide successive levels of temporary support that help students reach higher levels of comprehension and skill acquisition that they may not be able to achieve without assistance. Like physical scaffolding, the supportive strategies are incrementally removed when they are no longer needed, and the teacher gradually shifts more responsibility over the learning process to the student. Scaffolding, as described by (Wood, Bruner, & Ross 2006), "consists essentially of

the adult 'controlling' those elements of the task that are initially beyond the learner's capacity, thus permitting [the learner] to concentrate upon and complete only those elements that are within his range of competence." Scaffolding in this sense is informal, such as mother-infant interactions. Today, the definition of scaffolding has expanded to include a broad range of formal structures, including conversational devices (e.g., guiding questions), curriculum design (e.g., direct instructions for students), and features of computer software (Pea, 2004).

Gender is another factor, which has been investigated as determinant of students' achievement and interest in basic science. Studies of Afuwape and Oludipe (2008) revealed gender gap in favor of the males among the pre-service integrated science teachers. Similarly, Becker (2006) examined data from 30 studies on the magnitude of gender differences in science achievement using modern method of meta-analysis. It is studies showed that male have significant advantage in Biology and Basic Science and Technology. On the other hand, Oludipe (2012) found that there is no significant effect of gender on students' achievement in basic science. It is therefore, important to determine the effect of gender on students' achievement given the inconsistency in research findings in this area; In consequence, this study will determine the moderating effect of gender.

2. Statement of the Problem

The importance of Basic Science at the secondary school level cannot be overemphasized. The poor performance of students in the senior secondary school certificate examination is traced profoundly to Basic Science. Students need to perform very well in Basic Science and Technology at junior secondary school level to enable them record excellent performance at senior secondary level and also to improve their interest in learning sciences.

Several studies have concluded that if the conventional teaching method used by teachers in teaching Basic science and Technology is assisted with other teaching strategies like Scaffolding Instructional Strategy, there could be improvement in the learning outcomes of students in the subject. Therefore, the need to embark on this research became imperative.

3. Hypotheses

H_o1: There is no significant main effect of treatment on pupils' achievement in Basic Science and Technology.
Ho2: There is no significant main effect of gender on pupils' achievement in Basic Science and Technology.
Ho3: There is no significant interaction effect of treatment and gender on pupils' achievement in Basic Science and Technology.

4. Methodology

4.1 Research Design

The study used the pre-test post-test quasi experimental research design. The design is 2x2x3 schematically represented as:

E: 0_1 X_1 0_2

C: 0_3 X_2 0_4

Where:

0_1, 0_3, represents pre-test observations for both experimental and control groups.

0_2, 0_4, represents post-test observations for both experimental and control groups.

$X_{1=}$ represents the only treatment; Scaffolding Instructional Strategy

X_2 = placebo treatment for control group

4.2 Target Population

The population for this study consist all public junior secondary schools in Ogun State.

4.3 Sample and Sampling Techniques

The research sample for the study consists of 100 students from two (2) randomly selected schools in Odeda Local Government Area of Ogun State. The two schools were drawn through random sampling technique.

4.4 Instrument

The instrument used in the study is Basic Science Achievement Test (BSAT) and

Instructional Guide on Scaffolding Instructional Strategy (IGSIS)

4.5 Basic Science Achievement Test

Basic Science Achievement Test contains seventy items constructed by the researcher on work, energy and power. The table of specification is drawn to guide the construction of items.

Table 2: Table of specification for Basic science achievement Test

Topics	Knowledge %	Comprehension%	Higher Order% Objectives	Total %
Work	8	11	5	24
Energy	8	10	4	22
Power	8	11	5	24
Total	24	32	14	70

4.6 Validity and Reliability of the Basic Science Achievement Test (BSAT)

The Basic Science Achievement Test of 70 multiple choice objectives was developed and presented to two doctoral students in Science Education with the table of specification for criticism and advice. Their advice was used to modify the items for adequacy, simplicity of language and relevance to the content. The structured test items were presented to two experienced Basic Science teachers for further scrutiny. Their suggestions were incorporated into the objective item questions.

The reliability was obtained by administering it to 20 students who were not part of the study and were retested after two weeks to determine the reliability of the instrument. The reliability coefficient was 0.80 using Split Half reliability method.

4.7 Method of Data collection

The researcher visited the schools used for the study and sought the permission of the school authority to be allowed to use their schools, teachers and students for the study.

The first week was used for training the participating Basic Science teachers in the selected schools and administration of pre-test by the teachers and researcher.

The 2nd to 5th weeks, were used for the application of treatment to experimental group (SIS) and conventional Method (CM) in the control group.Week six was used for the administration of post-test by the teachers and researcher.

4.8 Method of Data Analysis

The data collected was analyzed using Analysis of Covariance (ANCOVA). This was adopted to test the hypotheses using pre-test scores as covariates. Estimated Marginal Means (EMM) analysis was used to determine the magnitude of performance of the various groups. Scheffe's post-hoc test was also used when significant differences were observed to show the pairs of groups that were significantly different.

5. Results

H_o1: There is no significant main effect of Treatment on Students' achievement in Basic Science

Table 3Analysis of Covariance of Students' Achievement in Basic Science by Treatment by Gender Using Pretest as Covariates

Dependent Variable: postach

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	2453.906[a]	7	350.558	68.011	.000	.838
Intercept	111.603	1	111.603	21.652	.000	.191
Preach	265.640	1	265.640	51.537	.000	.359
Treatment	307.853	1	307.853	59.726	.000	.394
Gender	2.426	1	2.426	.471	.494	.005
Treatment * Gender	1.568	1	1.568	.304	.583	.003
Error	474.204	92	5.154			
Total	14657.000	100				
Corrected Total	2928.110	99				

a. R Squared = .838 (Adjusted R Squared = .826)

Table 3 indicates that there is a significant main effect of treatment on students achievement in basic science ($F_{(1,92)}$=59.726;p<0.05; η^2=0.394) hence the null hypothesis Ho1 is rejected. This implies that the treatment had a significant effect on students' achievement in Basic Science with an effect size of 39.4%. Estimated marginal mean was computed so as to ascertain which of the treatments is responsible for the observed main effect.

1. Treatment

Table 4

Dependent Variable: postach

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
scafolding	14.536[a]	.593	13.357	15.714
Control	6.105[a,b]	.815	4.485	7.724

a. Covariates appearing in the model are evaluated at the following values: preach = 6.4900.

b. Based on modified population marginal mean.

The table 4 reveals that students' exposed to scaffolding had a higher mean (14.536) score compared to those in the control group (6.105). This implies that students taught with scaffolding instructional strategy were significantly better in terms of achievement in Basic Science than their counters parts.

Ho2: There is no significant main effect of gender on students' achievement in Basic Science

Table 3 shows that gender has no significant main effect on pupils' achievement ($F_{(1,92)}$= 0.471;p>0.05) ; hence the null hypothesis Ho3 is not rejected. This implies that gender has no significant main effect on the students' achievement in Basic Science.

Ho3: There is no significant interaction effect of treatment and gender on students' achievement in Basic Science

Table 3 shows that there is no significant interaction effect of treatment and gender on students' achievement in Basic Science ($F_{(1,92)}$=0.304; p>0.05); hence the null hypothesis Ho7 is not rejected. This implies that the gender of the students does not give them any advantage or disadvantage when it comes to benefiting from the effect of the treatment in terms of the achievement of students in Basic Science.

Treatment * Gender

Table 5

Dependent Variable: postint

Treatment	Gender	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Scaffolding	Male	58.427[a]	2.840	52.786	64.067
	female	63.812[a]	3.341	57.177	70.447
Control	Male	64.556[a]	4.826	54.971	74.140
	female	57.406[a,b]	1.420	54.587	60.225

The table 5 reveals that female students in the experimental group (Scaffolding Instructional Strategy) had a higher mean (63.812[a]) Basic Science post- test interest score than their male counterparts in the same group.

6. Summary of Findings

The treatment has a significant main effect on students' achievement in Basic Science

The gender of students has no significant main effect on the achievement in Basic Science

The interaction effect of treatment and gender was insignificant on the achievement of students in Basic Science.

7. Conclusion

Based on the findings of this study, it could be concluded that Scaffolding Instructional Strategy improves the students' achievement in Basic Science significantly.

8. Recommendation

It is recommended that science teachers should be trained in the use of scaffolding instructional strategy because it is cheap and effective in improving the students' achievement in Basic Science and Technology.

The Nigerian Education Research and Development Council (NERDC) should make recommendation for scaffolding instructional strategy in the production and implementation of Basic Science and Technology curriculum.

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