

## IMPACT OF INSTRUCTIONAL SCAFFOLDING ON STUDENTS' ACHIEVEMENT IN CHEMISTRY IN SECONDARY SCHOOLS IN EBONYI STATE OF NIGERIA

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**ABSTRACT:** *This study investigated effects of instructional scaffolding on achievement of senior secondary students in chemistry in Ebonyi State of Nigeria. It also studied the interactive effects of scaffolding and gender on achievement of senior secondary school students in chemistry. Three research questions and two hypotheses guided the study. The method of data collection was experimental, where simple random sampling technique was applied to select a total sample of ninety (90) students from the ten secondary schools used for the study. The instruments for data collection were chemistry scaffolding Achievement Test (CSAT) for the treatment group and Conventional Instructional Package (CIP) for the control group. Mean and standard deviation were used for the analysis of the data. The hypotheses were tested using ANCOVA at the level of significance of 0.05. The reliability of the instrument was calculated using Kuder-Richardson (K-R<sub>20</sub>) procedure, from which a reliability coefficient of 0.85 was obtained. Table 1 presented result on the effect of instructional scaffolding on senior secondary school students' achievement in chemistry. The result obtained from Table 2 on effect of gender on students' achievement using scaffolding method proved that the male students performed better than the female students. Table 3, which presented result on interactive effects of scaffolding and gender revealed that there is no significant interaction, as both performed well. The researcher made the following recommendations. Teachers should regularly apply instructional scaffolding method to enhance the effectiveness of their instructions; students should abide by scaffolding method of instruction when adopted by the teacher to enhance retention and long term learning; and the school authorities should on regular basis supervise classroom instructions to promote the application of instructional scaffolding by the teachers.*

**KEYWORDS:** Chemistry, Student, School, Instrumental Scaffolding, Apparatus, Nigeria

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### INTRODUCTION

Chemistry is a branch of science which tries to make people understand the nature, composition and usefulness of natural things and those materials made by human beings (Omiko, 2014). Baja, Teibo, Onwu and Obikwere (1992) observed that chemistry is not like some people feel; a dangerous subject which deals with smelling chemicals. Chemistry enables anyone who studies it to learn certain useful scientific skills like separation of mixtures, mixing of substances appropriately, using specialized pieces of apparatus like burettes, pipettes, distilled water, preparation of salts, acid solution, salt analysis and distillation of crude oil, among others. These skills enable an individual to become self-reliant and wealth creator and entrepreneur in the society.

The lack of adequate skills and experience observed on the part of the students in the operations and application of scientific machines or tools has been blamed on a number of factors. Chhidume (2005) and Nwali (2014) laid the blame on the teaching method adopted by the teacher in teaching chemistry and other science subjects.

Krill (2009) also blamed it on the teaching method, stating that using information communication technology (ICT) in schools would enhance students understanding and also increase skill acquisition in the subject. He also observed that the methods used by the teacher are predominantly teaching oriented methods (like lecture, explanation, demonstration), less teaching and learning-oriented methods like group work, practical work, project activities are rarely learning-oriented methods like (creative thinking, cooperation, discussion. Ezeudo (2004), Omiko and Ndem (2015) observed that lack of well equipped science and computer laboratories in schools contribute to low performance of students in the sciences.

In the views of Okorie (2003) as cited in Nwali (2014), all the accusing fingers are pointing to the teachers who adopt teacher-centred method of teaching which encourages rote learning strategy. Novak (2005) stressed on the students achievement in science and technology through scaffolding as a heuristic tool for the curriculum. He concluded that the use of instructional scaffolding by teachers for teaching science (chemistry, biology, physics) and computer science instead of rote memorization could change their view of curriculum contents with important implications for teaching and learning. Hartman (2004) noted that the education using the scaffolding makes sure that students become independent and self-regulating learners and problem solvers.

Margaret (2005) and Omiko (2013) in their studies saw scaffolding as the assistance (parameters rules or suggestions) a teacher gives to the students in a learning situation. Margaret added that instructional scaffolding is a learning process designed to promote a deeper level of learning. Scaffolding is the support given during the learning process which is tailored to the needs of the students with the intention of helping the students to achieve their learning objectives. Sawyer (2006) stated that instructional scaffolding is the provision of support to promote learning when concepts and skills are being first introduced to the students. He further expatiated that these supports may include; resources, a compelling task, templates and guidance on the development of cognitive and social skills. He added that these supports are gradually removed as the students develop autonomous learning strategies, thus promoting their own cognitive, affective and psychomotive learning skills and knowledge.

Juce and Braz (2008) stated that it is best to think of uses of instructional scaffolding in an effective learning environment as one would think of the importance of scaffolding in the support of the construction of a new building or bridge. According to the Oxford Advanced Learner's English Dictionary 6<sup>th</sup> Edition (2005), scaffolding is a structure of planks and metal poles used while working on a building. In education sector, scaffolding can be said to be a help or assistance given to the students or pupils to enable them learn what they want to learn within a period of time. Scaffolding therefore represents the helpful interactions between a teacher and learners that enable the learners to learn something beyond their independent efforts.

### **Purpose of the Study**

The main purpose of this study was to find out the effect of instructional scaffolding on senior secondary school students achievement in chemistry. Specifically the study sought to find out:

- (1) The effect of instructional scaffolding and conventional teaching method on senior secondary school students' achievement in chemistry.
- (2) The effect of instructional scaffolding on the male and female students' achievement in chemistry.
- (3) The interactive effects of teaching methods and gender on senior secondary school students' achievement in chemistry.

### **Scope of the Study**

This study was based on the effect of instructional scaffolding on senior secondary school students' achievement in chemistry in Ebonyi State of Nigeria.

### **Research Questions**

This study was guided by the following research questions.

1. What are the effects of instructional scaffolding on senior secondary school students' achievement in chemistry?
2. What are the effects of gender on students' achievement in chemistry using scaffolding method?
3. What are the interactive effects of teaching methods and gender on student's achievement in chemistry?

### **Hypotheses**

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

- H<sub>01</sub>: There is no significant difference between the mean achievement scores of students taught chemistry using scaffolding and those taught using conventional teaching method.
- H<sub>02</sub>: There is no significant effect of gender on the mean achievement scores of students taught chemistry using scaffolding
- H<sub>03</sub>: There is no significant interactive effects between teaching methods and gender on students' achievement in chemistry.

### **METHODOLOGY**

The specific research methods used by the researcher are described here they include the research design, area of the study, population of the study, sample and sampling techniques

instrument for data collection, validity and reliability of the instrument, method of data collection and method of data analysis.

### **Research Design**

The research design adopted for this study was quasi-experimental design. This design was preferably chosen because it helps to select sample groups for the experimental study. In this quasi-experimental design the samples are considered the representatives of the total population. The classes were divided into control and treatment groups.

### **Area of the Study**

The research was carried out in Ebonyi state of Nigeria. Ebonyi State is located in the South-Eastern part of Nigeria, it is bounded to the North by Benue state, in the west by Enugu state, in the East by Cross River state and in the South by Abia state. The people of Ebonyi state are predominantly farmers, civil servants and traders.

### **Population of the Study**

The total population of the study was three thousand (3000) students of senior secondary two classes (SS2) in ten government owned secondary schools in Ebonyi state. The schools chosen were preferably mixed schools so as to enable the researcher sample both male and female students.

### **Sample and Sampling Techniques**

A sample of ninety (90) students were randomly selected from the ten schools drawn from each of the three Education zones in Ebonyi state (Abakaliki, Onueke and Afikpo Education Zones). A sample of thirty (30) students were randomly selected from each Education Zone, making a total of ninety (90) students. The classes used were senior secondary two (SS.2) classes in each of the schools. Each of the classes was divided into two during the experiment, one serving as the control group while the other served as the experimental group.

### **Instrument for Data Collection**

The instruments used for data collection were chemistry scaffolding Achievement Test (CSAT) for the treatment group and Conventional Instructional Package (CIP) for the control group. It was a multiple-choice objective question

### **Validity of the Instrument**

The instrument (CSAT) was face and content validated by three specialists, two in measurement and Evaluation and one in chemistry education; to ensure clarity of items, their arrangement and suitability in addressing the purpose of the study.

### **Reliability of the Instrument**

The data collected for the study were used for the computation of the reliability of the chemistry scaffolding Achievement Test (CSAT) using the Kuder-Richardson (K-R) procedure. A reliability coefficient of 0.85 was obtained at the end of the computation, the

high value of 0.85 of the coefficient indicates that the instrument was good for the test items and was also good for the study.

### Method of Data Collection

The instruments were administered by the researcher to the two groups at the same time. In each of the three schools sampled, each class was divided into two groups, treatment and control groups. The respondents answered the questions to the best of their knowledge. The data collected were used to analyze and answer the research questions and as well as test the hypotheses that guided the study.

### Method of Data Analysis

The research questions were answered using mean and standard deviation, while the hypotheses were tested using analysis of co-variance (ANCOVA) at a level of significance of 0.05.

### Results

The results of the data analysis were organized and presented in tables according to each research question that guided the study.

#### Research Question 1

What is the effect of instructional scaffolding on the mean achievement scores of senior secondary school students in chemistry?

**Table1: The Effects of Instructional Scaffolding Method on Senior Secondary School Students' Achievement in Chemistry**

Group	No of Students	$\bar{x}$	Standard Deviation (SD)
Treatment	60	26.67	5.13
Control	30	18.21	3.94

From table 1 above, the students exposed to instructional scaffolding method (treatment group) had a mean score of 26.67 and standard deviation of 5.13, while those exposed to conventional instructional method (Control group) had a mean score of 18.21 and standard deviation of 3.94. These results indicate that a clear mean difference of 8.46 exists between the treatment and the control group in favour of the treatment group. As such, instructional scaffolding method enhances students learning and achievement more than the conventional method of instruction.

#### Research Question 2

What is the effect of gender on the mean achievement scores of senior secondary school students in chemistry using instructional scaffolding method?

**Table 2: Shows the Effect of Gender on Students' Achievement in Chemistry using Scaffolding Method of Teaching.**

Gender	No of Students	$\bar{x}$	Standard Deviation (SD)
Male	50	22.46	4.66
Female	40	19.84	4.35

Table 2 above shows that the male students had a mean score of 22.46 and standard deviation of 4.66, while the female students had a mean of 19.84 and standard deviation of 4.35. A mean difference of 2.62 is observed between the male and the female students and a difference of standard deviation of 0.31 in favour of the male students. The above results indicate that instructional scaffolding method facilitates the achievement in male students more than it does in the female students.

### Research Question 3

What are the interactive effects of instructional scaffolding and gender on the mean achievement scores of students in chemistry?

**Table 3: Illustrates the Effect of Scaffolding and Gender on Students' Achievement**

Gender	Group	No of Students	$\bar{x}$	Standard Deviation (SD)
Male	Treatment	35	22.34	4.53
	Control	15	16.66	3.85
Female	Treatment	27	20.79	4.21
	Control	13	15.83	3.18

From table 3, the treatment group for the male students had a mean score of 22.34 and a standard deviation of 4.53, and the control group had a mean score of 16.66 and standard deviation of 3.85. On the other hand, the treatment group for the female students had a mean score of 20.79 and standard deviation of 4.21, and the control group had a mean score of 15.83 and standard deviation of 3.18. These results indicate that there is no significant interaction between gender and scaffolding. From table 3, it could be observed that instructional scaffolding steps up the achievement of both male and female students as both performed very well, with the male students performing slightly above the female students.

### Test of Hypotheses

**H<sub>01</sub>:** There is no significant difference in achievement of students taught chemistry using scaffolding method and those taught using conventional method.

**Table 4: ANCOVA Result Based on Methods of Teaching**

Source of Variation	Sum of Squares	df	Mean of square	F-Cal	Sign of F.	F-Crit
Covariates	12207.775	1	12207.775	81.639	0.000	
Pretest	12207.775	1	12207.775	81.639	0.000	
Main effect	1905.058	1	1905.058	12.740	0.001	1.658
Methods	1905.058	1	1905.058	12.740	0.001	
Explained	14112.833	2	7056.417	47.190	0.000	
Residual	13009389	87	149.533			
<b>Total</b>	<b>27122.222</b>	<b>89</b>	<b>304.744</b>			

Significant at  $p. < 0.05$

The data were analyzed using ANCOVA with pretest values as covariates. The result according to table 4 is significant, so Hypothesis 1 ( $H_{01}$ ), is accepted. Based on this result, multiple classification analysis (MCA) was carried out to determine the degree of contribution of each treatment

**Table 5: Multiple Classification Analysis of Significance**

**Grand Mean = 60.56**

Variable + category	No of Students	Unadjusted Deviation	Eta	Adjusted for Independents Covariates Deviation	Beta	
Methods	Scaffolding	60	1.86	0.15	3.30	0.27
	Conventional	30	-3.72		-6.60	0.520
Multiple R Squared					0.721	
<b>Multiple R</b>						

From table 5 above, the grand mean for students exposed to scaffolding method had an adjusted mean score of 53.96. This implies that there is a significant difference in the grand mean scores of students exposed to those two methods of instruction.

**H<sub>02</sub>:** There is no significant effect of gender on the achievement of students taught chemistry using scaffolding method.

**Table 6: ANCOVA Result Based on Gender**

Source of Variation	Sum of Squares	df	Mean Squares	F-Cal	Sign of F.	F-Crit
Covariates	12207.775	1	12207.775	72.862	0.000	
Pretest	12207.775	1	12207.775	72.862	0.000	
Main Effect	337.921	1	337.921	2.017	.159	
Gender	337.921	1	337.921	2.017	.159	1.658
Explained	12545.696	2	6272.848	37.439	.000	
Residual	14567.526	87	167.546			
<b>Total</b>	<b>27122.222</b>	<b>89</b>	<b>304.744</b>			

Significant at  $p. < 0.05$

The data were analyzed using ANCOVA with pretest values as covariates. The result obtained from table 6 is significant, so  $H_{02}$  is accepted. Therefore, multiple classification analysis (MCA) was carried out to determine the degree of contribution of each variable

**Table 7: Multiple Classification Analysis of Significance.**

**Grand Mean = 60.56**

Variable	category	No of Students	Unadjusted Deviation	Eta	Adjusted for independents Covariates Deviation	Beta
Gender						
Male		50	3.54	0.23	1.76	0.11
Female		40	-4.43		-2.20	
Multiple R Squared						0.463
Multiple R						0.680

From the table 7 above, the adjusted grand mean for male students is 62.32 and the adjusted grand mean for the female students is 58.36. This therefore indicates that there is significant effect of gender on the mean achievement scores of students taught chemistry using scaffolding method.

**H<sub>03</sub>:** There is no significant interactive effect between teaching methods and gender on students' achievement in chemistry.

**Table 8: ANCOVA Result Based on Interaction of Gender and Instructional Methods**

Source of variation	Sum of Squares	df	Mean Squares	F-Cal	Sign of F.	F-Crit
Covariates	12207.775	1	12207.775	81.812	.000	
Pretest	12207.775	1	12207.775	81.812	.000	
Main Effect	2090.417	2	1045.209	7.005	0.002	
Methods	1905.058	1	1905.058	12.767	0.001	1.658
Gender	185.359	1	185.359	1.242	0.268	
2-way interaction	140.712	1	140.712	0.942	0.335	
Method x Gender	140.520	1	140.520	0.942	0.335	
Explained	14438.712	4	3609.678	24.191	0.000	
Residual	12683.510	85	149.218			
<b>Total</b>	<b>27122.222</b>	<b>89</b>	<b>304.744</b>			

Not Significant at  $p < 0.05$

The data were analysed using ANCOVA with pretest values as covariates. The result obtained was not significant, therefore  $H_{03}$  was rejected. Therefore Multiple Classification Analysis (MCA) was not carried out.



## Findings

Table 1 is concerned with the effect of instructional scaffolding on students' achievement in chemistry. From the data analysis, it was found that instructional scaffolding steps up students' achievement in chemistry more than the conventional method of instruction. This is in consonance with the assertion of Shilly (2006) that instructional scaffolding provides a sufficient support that promotes deeper learning.

Table 2 was concerned with gender on students' achievement in chemistry using scaffolding method of instruction. The result obtained from the table indicates that the male students were favored by scaffolding more than the female students. This is because there were observed significant difference in the mean achievement of both parties by the application of scaffolding method of instruction. This was corroborated by the findings of UNESCO (2004) which proved that male students performed better than the female students in the sciences.

Table 3 focused on the interactive effect of instructional scaffolding and gender on the achievement of students in chemistry. The result obtained showed that there was no significant interaction between scaffolding and gender, as both male and female students performed very well. This is a clear indication that instructional scaffolding method facilitates better achievement of students in chemistry than the conventional method.

## RECOMMENDATIONS

1. The chemistry teachers should on regular basis apply an effective method of instruction like scaffolding to enhance better performance
2. The female students should rise up to the expectation by developing the sense of competition with their male counterparts to improve in their performances in science subjects at large and chemistry in particular.
3. The school authority and ministry of Education should ensure adequate and regular supervision of schools and instructions to ensure that suitable instructional strategies are used to improve students' performance

## CONCLUSION

Instructional scaffolding is a formidable and highly effective instructional strategy in the domain of chemistry. Therefore, for student's achievement in the subject to be improved, chemistry teachers should imbibe the spirit of regular use of instructional scaffolding in the classroom. Students should on their own establish a sense of competition in the classroom so as to effectively utilize the teacher's instructions through scaffolding

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