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# EFFECTS OF 5ES INSTRUCTIONAL MODEL AND REFLECTIVE DISCUSSION INSTRUCTIONAL STRATEGY ON ALGEBRA ACHIEVEMENT OF SECONDARY SCHOOL STUDENT IN NIGER STATE.

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# Abstract

This study determined the effects of 5Es instructional model and reflective discussion instructional strategy on algebra achievement of secondary school students in Niger State. Three research questions were raised and three corresponding null hypothesis were tested at 0.05 significant level. The study adopted a quasi-experimental design. A sample of three hundred and fourty nine (349) students from nine intact classes served as subjects in this study. Multi-staged sampling method was employed to select nine secondary schools for the research. The instrument for data collection was Algebra Achievement Test (AAT), a fourty item multiple-choice objective type questions with reliability coefficient (r) of 0.937. the results were analyzed using ANOVA test, hypothesis one was rejected indicating that there was significant difference in the achievement of students taught using 5Es instructional model (Exp.1), reflective discussion instructional strategy (Exp.2) and those taught using lecture method (contr). Scheffe post hoc test was preformed and mean gain was calculated, all in favour of the two experimental groups. Hypothesis two and three were retained indication that

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the treatment for Exp.1 and Exp.2 favoured student of different ability levels. It was recommended among others that teachers should employed 5Es instructional model and reflective discussion instructional strategy in teaching algebra to improve students performance in algebra.

**Keywords:** 5Es instructional model, reflective discussion instructional strategy, achievement, Algebra.

# Introduction

There is a widespread outcry over the level of students performance in Mathematics in Nigeria. This is as a result of low level mathematics achievement of students in external examination. Achievement of students in examinations, particularly in mathematics is worrisome. In this subject, the Nigeria society is getting frustrated concerning the low level of students achievement. A significant area when issue of poor performance in mathematics is tabled that attract attention of students and researchers is algebra. This is as a result of the mature of algebra in critical thinking, logical and systematic manner of approach that demand mental work by the leaner to enable the leaner grab, assimilate the concept and the ability to apply the concept learnt. Algebra is a branch of mathematics in which letters and other general symbols and signs are used in terms of numbers and quantities in formulae and equations.

Adeniji and Ibrahim (2015) described algebra as a branch of mathematics in which symbols represent numbers of a specified set and area used to represent qualities and to express general relationship that hold for all numbers of a set. The role of algebra among others includes; many companies uses algebra as tools to figure out their annual expenditure and predict the demand of a particular product and subsequently place their orders for various stores. Algebraic expressions and equations serve as models for interpretation and making inferences about data. Algebraic expressions and equations are largely involved in physics, chemistry, biology among others. This indicates that students overall mathematics achievement and its subsequent applications in today's world activities largely depend on algebraic concepts proficiency. Edwin and Douglas (2018), noted that many students are discontinuing tier study of higher-level mathematics because of their lack of success in algebra. Application of algebra is important in everyday life, is a critical tool, for the present world of science and technological advancement. Any nation that desire to attain reasonable level of development and compete with other nation of the world must ensure that her citizens are proficient in the application of algebra concepts to solve everyday challenges. Literature, review of studies conducted on causes of students' low achievement in algebra reveals that teachers predominantly adopted traditional instructional method (lecture method) in teaching algebra.

Many reports have been released on the need for a shift by researchers to instructional strategies that are activity based which allow the learners construct their knowledge based on their own understanding. These instructional strategies among others includes 5Es instructional model and reflective discussion instructional strategy.

5Es instructional model was developed in 1992 by the Biological Science Curriculum Study (BSCS). It involved five phases, these are; engage, explore, explain, extend or elaborate and evaluate (Kauli & Unsal, 2008). Sadi and Cakiroglu (2010); Alebiosu, Bukola and Shakirat (2017), described 5Es instructional model as a learning model consisting of five phases; engagement, exploration, explanation, elaboration and evaluation. These phases are described as follows: engagement phase involved teacher instructing a task, assess the previous knowledge of the learners, connect past learning experiences by asking a thought provoking questions. Exploration phase, here the students are provided with co-operative exploration activities, giving them common, concrete experiences that help them begin constructing concepts and development skills. Explanation phase, the learners articulate their ideas in their own words and listen critically to one another. The teacher clarifies their concepts, correct misconceptions and interprets the activities of the previous phases. Learners are guided to put down observations, questions and learnt items into simple language. At the elaborate spheres, the experiences gained by learners the previous phases are extended to real situation. The teacher introduces new information that linked to what the leaner's have learnt during their activities. At the evaluation phase, the leaner's are assessed to ascertain their level of progress.

Reflective discussion instructional; strategy is a teaching strategy that involved students to reflects upon and interprets films, experiences, read or recorded stories or illustration. Annetta (2011) defined reflective discussion as approach where the teacher or learner initiate the discussion by asking a question that requires students to reflect upon and interprets films, experiences, read or recorded stories or illustrations.

Discussion methods are a variety of planned forums for collaborative exchange of ideas among a teacher and students or among students for the purpose of enhancing students thinking, learning, problem solving understanding and appreciation. Learners and teacher present multiple points of view respond to the ideas of others. Reflective discussion as an instructional strategy largely involved discussion of a written text.

Achievement refers to skills attained by a learner in a particular subject, It is measured by a numerical score obtained in a text. Ryan (2011) observed that achievement can be influenced by several factors, among these factors are; students

background, teaching method, interest, environment and motivation. Several research reports reveals that teaching method used by a teacher have significant effects on students' achievement irrespective of ability-level. Ability level is the skill differences that exist in between students subjected to a particular discipline. Students are generally classified as high ability level, medium ability students are those who obtained a score of 70% and above ( $\geq$  70%) in a test, the medium ability level students are those who scored between 50% and 60% (50%  $\leq$  60%) in a test and the low ability level students are those who scored less than fifty percent ( $\leq$ 49%) in a test.

Several research results have reported on learning cycle instruction model, most of these studies were conducted outside the country, but few have been conducted in Nigeria, particularly in biology and chemistry. Among those in biology are; Bulbul, 2010; Sadi & Cakiroglu, 2010; Ajaja, 2013; Gbemisola, 2015 in chemistry and Jibrin, babalola & Isaac, 2019 in ecology. None of these studies was on algebra, this create a gap intended to be filled in this study. Reflection activities have been reported in different situation, among these are; reflective reciprocal teaching and reflective thinking. It has not been applied in teaching algebra, hence this gap is intended to be filled in this study.

The desire to determine the effects if 5Es instructional model and reflective discussion instructional strategy is very important to determine what better instructional strategy will enhance high achievement rate of students in algebra. This informed the need for carrying out this research.

# **Statement of the Problem**

Observably, low achievement rate of students in mathematics is increasing continuously. Result available have shown that efforts geared towards improvement in teaching methods and the achievement of secondary school students in algebra are vet to produce the expected outcome. The recent results of secondary school students as in mathematics presented by west African Examination Council (WAEC) in chief examiners report shows that in 2013, 2014, 2015, 2016, 2017 and 2018 only 36.00%, 31.30%, 34.18%, 38.68%, 59.20% and 33.33% respectively obtained credits grade (A1 - C6) in mathematics this indicates that in 2013 to 2018 an average of less than 50% out of the total population of students that registered and sat for the examination passed at credit level (Chief Examiner's Report, 2013 - 2018). This ugly situation has been attributed to poor instructional approaches which is still dominated by traditional lecture method. The search light in mathematics education in order to enhance students better achievement in algebra is on better instructional strategy. The strategy that might salvage the problem may be the use of 5Es instructional model and reflective discussion instructional strategy. We need a modern way of teaching and learning so that students' achievement in algebra can be improved in all our institutions. The present study intends to examine the effects of 5Es instructional model and reflective discussion in

Niger State. However this study is among first studies in Nigeria that use these two strategies to overcome low mathematics achievement faced by students.

# Aims and Objectives of the Study

The aim of this study is to examine the effects of 5Es instructional model and reflective discussion instructional strategy on algebra achievement of secondary school students in Niger state specifically, the study will examine the:

- 1. Effects of 5Es instructional model and reflective discussion instructional strategy on algebra achievement of secondary school students in Niger State.
- 2. Effects of 5Es instructional model and Algebra achievement among secondary school students of different ability levels in Niger State.
- 3. Effects of reflective discussion instructional strategy on algebra achievement among secondary school students of different ability levels in Niger State.

# **Research Questions:**

The following research questions were raised to guide the study:

- 1. What is the mean difference in algebra achievement between secondary school students taught using 5Es instructional model and those taught using reflective discussion instructional strategy.
- 2. What is the mean difference in algebra achievement among secondary school students of different ability levels when taught using 5Es instructional model.
- 3. What is the mean difference in algebra achievement among secondary school students of different ability levels taught using reflective discussion instructional strategy.

# **Research Hypotheses**

Based on the stated research questions the following null hypotheses were formulated and tested at 0.05 level of significant.

Hypothesis one (HO<sub>1</sub>): There is no significant difference in the mean achievement scores among secondary school students taught algebra using 5Es instructional model and these taught using reflective discussion instructional strategy.

Hypothesis two (HO<sub>2</sub>): There is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using 5Es instructional model.

Hypothesis three (HO<sub>3</sub>): There is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy.

#### Methodology

The study employed quasi experimental design, particularly the pretest-posttest non equivalent non randomized control group design. Infact classes were used, it involved two experimental groups that were taught using 5Es instructional model and reflective discussion instructional strategy and a control group that was taught using lecture method. Experimental group one (Exp. I) and experiential group (Exp. 2) were taught algebra using 5Es instructional model and reflective discussion instructional strategy while the control group was taught using lecture method.

Population of a study is the set of all elements, objectives, or events that are of interest for a particular study (Sambo, 2005). The population for this study is made up of all the fifty three thousand three hundred and fifty eight (53,358) senior secondary school two (SS II) students in Niger State, 2018/2019 session (ministry of education, statistic division). The sample for this study consist of three hundred and fourty nine students as subjects from nine (9) infact classes in nine (9) randomly selected secondary schools in Niger State. Multi-staged sampling technique was used to obtain the sample for the study. The multi-staged sampling was done in four stages; educational zones, local government level, school level and class level. Simple random by hat draw method was employed to select three educational zones out of the seven educational zones in Niger State at stage one, at stage two random sampling technique by hat draw method was employed to selects one local government area from each of the three randomly selected educational zones. Those are Gbako Local Government Area (Bida Educational zone), Gurara Local Government Area (Suleia Educational Zone), and Paikoro Local Government Area (Minna Educational Zone). In the third stage, random sampling technique using hat draw method was used to select three schools in each of the local government area given a total of nine sampled schools.

In each of the nine schools, a classes of SS II students was randomly selected and intact classes were used in each case to form the three hundred and fourty nine subjects for the study, the subjects were classified based on achievement level that is, low, moderate and high achievers.

The research instruments were categorized into two, these are; response instrument and stimulus instruments. The response instrument is Algebra Achievement Test (AAT) and the stimulus instrument are treatment instruments which includes; lesson guide using 5Es instructional model, lesson guide using reflective discussion instructional strategy and lesson guide using lecture method. AAT comprised of fourty (40) items objective questions covering the algebra concepts taught with a reliability coefficient of 0.937 (r=0.937) which indicates high reliability. The lesson guide were validated by experts, two lecturers not below senior lecture from Federal University of Technology Minna, Science Education Department, one lecturer in department of Mathematics (Associate Professor) and two teaching staff in secondary schools. The study lasted for eight (8) weeks, one week for pre-test, six weeks for treatment and one week for posttest.

In analyzing the data, the scores obtained from pretest and posttest were used to test the three null hypotheses using analysis of variance (ANOVA) statistics. Statistical Package for Social Science (SPSS) version 16.0 was used to analyze the data at 0.05 alpha level.

# Findings.

# Results

Results of data analyzed for this study are presented according to the research questions asked and their corresponding hypotheses that guided the study.

#### **Research Question One**

What is the mean difference in algebra achievement between secondary school students taught using 5Es instructional model and those taught using reflective discussion instructional strategy.

Table 1: Mean achievement and standard deviation scores for the experimental groups and control group.

GROUP	Ν	Х	SD
Ex. PI	117	57.73	9.53
Ex. P2	137	58.19	9.88
Ex. P3	95	44.43	9.44

Table 1: Revealed experimental group one and experimental group two had a mean score of 57.73 and 58.19 respectively, with score of standard deviation 9.53 and 9.88 respectively. While the control group got a mean score of 44.43 and standard deviation of 9.44. this is an indication that those taught with 5Es instructional model and those taught with reflective discussion instructional strategy got scores of 57.33 and 58.19 respectively, these are higher than the mean score of the control group with mean score of 44.43 and was taught using l;ecture method.

# **Hypothesis One**

There is no significant difference in the mean achievement scores among secondary school students taught algebra using 5Es instructional model and those taught using reflective discussion instructional strategy in Niger State.

Table 2: ANOVA table for testing the significance among mean achievement scores for the experimental groups and control group.

SUM OF SQUARES DF		MEAN SQUA	SIG.	
Between groups	11759.247	2	5879.623	63.219 .000
Within groups	32179.613	346	93.005	
Total	43938.860	348		

Significant at 0.05 Level.

Table 2 shows the post-test analysis of ANOVA between experimental groups and control group which showed a significant difference

Fcal = 63.219, P< 0.05. This means a P – Value of P = .001 less than 0.05 the mean difference of performance between the experimental group one, experimental group two and control group was significant. That is the mean achievement score of students taught using 5Es instructional model, the mean achievement score of students taught algebra using reflective discussion instructional strategy and the mean achievement score of student taught algebra using lecture method are significantly different. This implies that there is significant difference among the three groups. Hypothesis one was therefore rejected, hence there is significant difference among the mean achievement scores of students taught algebra using 5Es instructional model, reflective discussion instructional model, reflective discussion instructional model. Scheffe post-hoc test was employed to examine of the three groups was responsible for the observed difference in performance. The result is presented in table 3 below.

Table 3: Scheffe's post hoc test on performance between experimental groups and control group.

(i) GROUPS	(j) GROUPS	MEAN DIFFERENCE	STD	SIG
		(L-i)	ERROR	
Treatment 1	Treatment 2 group	- 46069	1,21399	.931
group	control group	12.78548	1.22188	.000
Treatment 2 group	Treatment 1 group control group	.46069	1.21399	.931
0		13.24617	1.28758	.000
Control group	Treatment 1 group	-12.78548	1.33188	.000
		-13.24617	1.28758	.000

Furthermore, mean gains statistic was employed to compare the experiential groups and control groups scores at pre-test and post-test to examine the groups that gained more. This is presented in table 4 below.

ĠĪÎĮĨĬ	PRETEST	POSTTEST	MEAN GAINS
Experiential 1	25.05	57.73	32.68
Experimental 2	30.28	58.19	27.91
Control group	33.02	44.94	11.92

Table 3 and 4 indicated that students exposed to treatment 1 (taught using instructional model) obtained a pretest mean score of 25.05.

Post test mean score of 57.73 with a mean gain of 32.68, students exposed to treatment 2 (those taught using reflective discussion instructional strategy scored 30.28 at pretest, 58.19 at posttest and main gain of 27.91. while students in control group (taught using lecture method) obtained means score of 33.02 at pretest, posttest of 44.94 and had a mean gain of 11.92. this implies that the significant difference in the mean score was in favour of the two experimental groups.

### Research Question Two

What is the mean difference in algebra achievement among secondary school students of different ability levels when taught using 5Es instructional model.

Table 5: Posttest mean achievement and standard deviation scores for students of different ability levels taught algebra using 5Es instructional model.

GROUP	Ν	Х	SD
High ability	13	58.41	10.31
Medium ability	53	57.81	9.74
Low ability	51	57.40	9.35

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Group	SUM (	OF SQUARES	DF	MEAN	I SQUARE	F	SIG.
Between grou .938	ıps	11.819		2	5.909		.064
Within group:	5	10580.300		114	92.810		
Total		10592.119		116			

Not significant at 0.05 level.

Table 5: Showed that students of high ability level obtained a score of 58.41 mean achievement score with 10.31 as standard deviation, students of medium ability got mean achievement score of 57.81 and standard deviation of 9.74. While students of low ability obtained 57.40 mean achievement score with 9.35 Standard Deviation. This is an indication that students of different ability levels taught using 5Es model obtained similar mean achievement scores.

Hypothesis two (HO<sub>2</sub>): There is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using 5Es instructional model in Niger State.

Table 6: ANOVA table for testing the significance among mean achievement scores for students of different ability levels in experimental group one.

GROUP	Ν	X	SD
High Ability	9	59.94	6.86
Medium Ability	68	59.26	10.74
Low Ability	60	58.19	9.14

Table 5: Shows the post test ANOVA analysis among students of different ability levels in experimental group one (taught using 5Es instructional model) which indicated Fcal = .064, P > 0/05, this implied that P - Value of P = 0.938 is greater than 0.05 indicating that there is no significant difference among the mean achievement scores of students taught algebra using 5Es instructional model that are of different ability levels. Therefore hypothesis two was not rejected, that is there is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using 5Es instructional model in Niger State. This implies that 5Es instructional model is not bias in respect to ability levels.

#### **Research Question Three**

What is the mean difference in algebra achievement among secondary school students of different ability levels taught using reflective discussion instructional strategy.

Table 7: Post test mean achievement and standard deviation scores for students of different ability levels taught using reflective discussion instructional strategy.

Group	SUM OF SQUARES	dF	MEAN	SQUARE	F	SIG.
Between grou .299	ps 237.014		2	118.507		1.218
Within groups	13040.318		134	97.316		
Total	13277.331		136			

Table 7: Show that is experimental group two, students of high ability level obtained mean achievement score of 59.94 and standard deviation of 6.86, students of medium ability level obtained mean achievement score of 59.26 with standard deviation of 10.76 while students of low ability levels obtained mean achievement score of 58.19 with standard deviation of 9.14. the results in table 7 indicates that the groups of students in high ability level, medium ability levels and in low ability level had similar mean achievement scores taught using reflective discussion instructional strategy.

Hypothesis Three (HO<sub>3</sub>): There is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy.

Table 8: ANOVA table for testing the significant the among mean achievement scores for students of different ability levels in experimental group two.

Table 8: Show post test result of ANOVA analysis among students of different ability levels in experimental group two (taught using reflective discussion instructional strategy) which shows Fcal = 1.215, P = 0.938 > 0.05 indicating that there is no significant difference among the mean achievement scores of students taught algebra using reflective discussion instructional strategy that are of different ability levels. Hypothesis three was therefore retained, hence there is no significant difference in mean achievement scores among secondary school students of different ability levels taught algebra using reflective discussion instructional strategy.

# Discussion

This study revealed that 5Es instructional model has a positive effect on students achievement in algebra, it has also indicated the effectiveness of reflective discussion instructional strategy on students' achievement in algebra. This was observed in the achievement of senior secondary school students taught with 5Es instructional model and those taught using reflective instructional strategy compared to those taught using lecture method. The two experimental groups obtained a better achievement in the AAT than the control group. This implies that both 5Es instructional model and reflective discussion instructional strategy can be employed in teaching algebra.

This study is in support of the finding of Abu Atta (2013), whose study compared the effect of learning cycle model on thinking skill in mathematics at with grade students in Gaza, Palestine with control group and reported the effectiveness of learning cycle model. Similarly this work is in agreement with the finding from Ajaja and Eravwoke (2012) on effects of learning cycle strategy on the achievement of students in biology and chemistry.

Furthermore, the finding supported Paula (2009) and Gbemisola (2015) that reported effectiveness of reflective practice in effective teaching.

Summary of Major Findings

In this study, 5Es instructional model had the highest positive effect on the achievement of secondary school students in algebra closely followed by reflective discussion instructional strategy. The results also indicated that both 5Es instructional model and reflective discussion instructional strategy are in favour of students irrespective of ability levels in algebra achievement.

Conclusion

Based on the variables in this study, 5Es instructional model and reflective discussion instructional strategy has positive effects on students' achievement in algebra compared to those taught by lecture method.

Recommendations

- 1. The use of 5Es instructional model and reflective discussion instructional strategy should be encourage by algebra teachers to aid better understanding and performance of secondary school students in algebra.
- 2. The two methods should be popularized by organizing seminars for mathematics teachers on how to use the methods to promote meaningful learning of difficult topics in algebra for better academic achievement.

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