Abacus (Mathematics Education Series) Vol. 44, No 1, Aug. 2019

EFFECT OF CONSTRUCTIVIST TEACHING STRATEGY ON ALGEBRAIC PERFORMANCE OF SENIOR SECONDARY SCHOOL STUDENTS IN SOKOTO STATE, NIGERIA

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Abstract

This study investigated the effect of constructivist instructional strategy on the academic performance of senior secondary school two students' (SS II) of Sokoto State, Nigeria. The main objective of this study was to find out if teaching students algebraic equation using Constructivism approach differ significantly as against a Conventional Method. The SSII student population of the thirty eight selected senior secondary schools was 2,661 and the population sample of 377 SS II Students were drawn into two comparison groups. Pretest-posttest quasi-experimental design was used for the study. Purposive sampling technique was used to select 6 schools out of 38 secondary schools selected in the Sokoto state. Mathematics Achievement Test (MAT) was used to collect data. The reliability of Mathematics Achievement Test (MAT) was calculated using Pearson's Brown's Rank-Order Correlation Coefficient to be 0.81. One null hypothesis was tested at p<.05 level of significance using t-test.The following findings were obtained. Students exposed to Constructivism Instructional Strategy performed better than their counter part in Conventional Method. There was significant difference in students' performance between Constructivism and Conventional Method of teaching. On the basis of these findings recommendations were made for the improvement of teaching mathematics in secondary schools. One major recommendation is that mathematics teachers should incorporate Constructivist Instructional Strategy into the mainstream of pedagogy in the teaching of mathematics.

Introduction

Constructivism is an approach to teaching and learning based on the premise that learning is the result of mental construction. In other words, students learn by fitting new information together with what they already know. Constructivists believe that learning is affected by the context in which an idea is taught as well as by students' beliefs and attitudes. Constructivist learning has emerged as a prominent approach to teaching during this past decade (Driver, 1986).

The works of Dewey, Montessori, Piaget and Bruner among others provide historical precedents for constructivist learning theory. Constructivism represents a paradigm shift from education based on behaviorism to education based on cognitive theory. However, Fosnot (1996:29) had provided a summary of these theories and described constructivism teaching strategy as very effective.

Constructivist teaching practices in Science and Mathematics classrooms are intended to produce much more challenging instruction for students and thus, produce improved meaningful learning. These changes have led to instruction in which students are expected to contribute actively to mathematics lessons by explaining their mathematical reasoning to each other and constructing their own understanding of mathematical concepts. Research has shown such a constructivist-based approach to be promising (Driver, 1986) and its positive effects have been found for both students' performance and motivation. Such constructivist instruction appears to motivate students because they find it more pleasant to learn and more challenging to study in the constructivist classroom (Ames & Ames, 1989).

Constructivist pedagogy is a meta-learning strategy that can be used to develop students' capacity to learn mathematics independently.

Behaviorist epistemology focuses on intelligence, domains of objectives, levels of knowledge, and reinforcement. This is the concept in which conventional Method build its on roots.

Kim (2005: 39) revealed that students in the constructivist classroom had significantly higher learning skills in Mathematical computation. In such classroom, students change their learning strategies and show upon motivation to learn academic task and have preference for a constructivist classroom environment. Constructivist-based instruction is believed to be an effective means for increasing students understanding of mathematical skills and concepts (Gray, 2001) and therefore should be effective in increasing student performance as measured by the Florida Comprehensive Achievement Test (FCAT). In a recent study, constructivist instruction is found to be more effective than the direct instruction for achievers (Kroesbergen & Van Luit, 2012). Self regulated learning strategy in constructivist pedagogy improves achievement in mathematics and the level of confidence for middle school students (Cekolin, 2001).

Okebukola (2002:19) discussed the role of the teacher in a constructivist science classroom. According to him the role of the teacher in a typical constructivist science classroom should be that of a facilitator, who coaches, mediates, prompts and helps the students to develop and assess their understanding in order to aid learning process. Hence, the teacher facilitates learning by asking good questions that will prompt good thinking. This will result in meaningful learning, as the type of questions and problems the teacher poses as well as the nature of guidance he or she gives to the learner will enhance the learner to construct their own knowledge.

Problem to the Study

Different methods and approaches to teaching algebraic equation have been proffered at different times. These methods and approaches have been found to be lacking. In realization of this, constructivism approach was studied and introduce in this study in comparison with Conventional approach. The WAEC Chief Examiner's Report (2013) indicated that 23.4% of the students who sat for WASSCE attempted questions on algebraic equation and only 11% got it right. This shows that conventional Method which usually employed in schools seized to work properly. As such there is a problem, so we need to find out where the problem lies, thus prompting this study?

Objectiveof the Study

The objective of this study is:

Examine the performance of students taught algebraic equation using Constructivism Method and Conventional Method.

Research Question: What is the difference between the mean performance of students taught algebraic equation using Constructivism Method and those taught Conventional Method?

This research seeks to answer the research question which has been stated that:

What is the difference between the mean performance of students taught algebraic equation using Constructivism Method and those taught Conventional Method?

Null Hypothesis

The hypothesis was tested at $P \leq 0.5$, level of significance.

There is no significant difference between the mean performances of students taught algebraic equation using Constructivism Method and those taught using Conventional Method.

Significance of the Study

The findings will be significant in many ways and at different levels. It will be of significance to mathematics teachers. It will provide them with effective methodologies in the teaching of the various skills of Mathematics. The findings will also be beneficial to educational planners in the process of curriculum planning. It will help the students to develop interest in mathematics as a result of effective use of probable teaching method.

Theoretical Framework

The works of Dewey, Usubel, Piaget, Driver and Bruner among others provide historical precedents for constructivist learning theory.They believe that thistheory(constructivist learning theory) is very effective when used properly in teaching. This gives rise to this study. Constructivist teaching strategy assumes that learners construct their own knowledge on the basis of interaction with their environment. Glasserfield (1995), outlined four epistemological assumptions of the constructivist perspective of learning in science and mathematics. These include the fact that:-

1. Knowledge is physically constructed by learners who are involved in active learning.
2. Knowledge is symbolically constructed by learners who are making their own representations of action;
3. Knowledge is socially constructed by learners who convey their meanings to others;
4. Knowledge is theoretically constructed by learners who try to explain things they do not completely understand.

Constructivism is basically a theory based on observation and scientific study about how people learn. It says that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on those experiences. When we encounter something new, we have to reconcile it with our previous ideas and experience, maybe changing what we believe, or maybe discarding the new information as irrelevant. In any case, we are active creators of our own knowledge. To do this, we must ask questions, explore, and assess what we know.

Research has shown such a constructivist-based approach to be promising (Giover, 2005) and its positive effects have been found for both students' performance and motivation. Such constructivist instruction appears to motivate students because they find it more pleasant to learn and more challenging to study in the constructivist classroom (Ames $ Ames, 1989). Constructivist pedagogy is a meta-learning strategy that can be used to develop students' capacity to learn mathematics independently.

Traditional theory of knowledge is of the view that knowledge is the learner's representation of things and events in themselves, as they ought to exist in the real world, world that is thought to be prior and independent of the learner's cognitive activity.

Review of Related Empirical Studies

Some of the literatures related to the study were cited as:

Kim (2005) revealed that students in the constructivist classroom had significantly higher learning skills in Mathematical computation. In such classroom, students change their learning strategies and show upon motivation to learn academic task and have preference for a

constructivist classroom environment. Constructivist-based instruction is believed to be an effective means for increasing students understanding of mathematical skills and concepts (Gray, 2001) and therefore should be effective in increasing student performance as measured by the Florida Comprehensive Achievement Test (FCAT). In a recent study, constructivist instruction is found to be more effective than the direct instruction for achievers Kroesbergen & Van Luit, (2012). Self regulated learning strategy in constructivist pedagogy improves achievement in Mathematics and the level of confidence for middle school students (Cekolin, 2001).

Driver and Bell (1986) conducted a research why some children found it difficult to develop knowledge that was in line with scientific thinking and why even when children had developed specific frameworks they were reluctant to use them. Using her extensive investigations to guide her conclusions, Driver's seminal work promoted the view that these initial or alternative frameworks form the foundation of all subsequent learning.

Kieran and Damboise (2007), created identical assignments for two classes with the only difference being one group was provided with calculators and the other was not. After a month, a paper-and-pencil posttest revealed that the experimental class (Constructivist) showed greater improvement both technically and theoretically.

Isah (2012) conducted a research on the Effect of a Constructivist Instructional Strategy on the Academic Achievement, Retention and Attitude to Physics Among Secondary School Students of Different Ability Levels in Kano State, and concluded that constructivist class played a very important role in the findings of the study.

Ishaku (2014) reported the impact of Constructivist Reading Strategy on Student's Academic Performance Retention and Attitude Towards Trigonometry Among Senior Secondary Schools in Kaduna State, Nigeria.

This paper is in agreement with all the researchers cited in this study that constructivist teaching strategy enhances learning if properly carried out.

Research Design

Quasi-experimental research design was adopted for the study. A pretest was administered to all the subjects (SS2 students) prior to the treatment in order to find out the homogeneity of the sample. The subjects were assigned to two groups,One (1) experimental and one (1) control. Experimental groups were exposed to the Constructivism method of teaching algebraic equation while control group is exposed to coventional approach. There has been a reduction in between-subject variation, which increases the power of the study to determine true treatment effects, (Sambo, 2005). The design is symbolically represented as:-

Table1: Summary of the Design

Group	Pretest	Treatment	Posttest
EG	O_1	X	P_1
CG	O_2	-	P_2

Source:McGahee (2009:3)

1-2 = random assignment into groups

0_1 to 0_2= pretest administered

X = treatment given

P_1 , P_2, = Post test administered

Population of the Study

The population of the study consists of 38 senior secondary school Two (SSII) class which were selected for the study. The SSII students in the selected secondary schools in

Sokoto state totaling 2,661 formed the population of this study (Table 2). The schools were distance apart so as to reduce interference and biasness in the study. In selecting these schools, certain criteria were considered. These include the availability of qualified mathematics teachers and basic infrastructural facilities in the schools. The asterisks in Table2 were not included in the study.

Table 2: Population of SSII Students in Sokoto State

S/NO	Educational Zones	Number of Schools	Population of SSII
1	Bodinga	11	604
2	*Goronyo	13	620
3	*Gwadabawa	12	464
4	S/North	8	830
5	S/South	19	1227
6	*Yabo	13	305
	Total	76	4050

Source: *Examination Unit, Ministry of Education, Sokoto (2016).*

Sample and Sampling Techniques

The sample is a subset of the population on which measurement has been done and from which generalizations are drawn to cover the entire population. Six schools were randomly selected for this study with one intact SSII from each school. The total sample selected in the six intact classes was 377. Three of the classes were used as experimental groups while the other three were assigned control groups.

Instrumentation

Mathematics achievement test on algebraic equation (MAT) Appendix I. was used for data collection. The MAT is a 10-item essay test developed by the researcher using West African Examination Council (WAEC)and National Examination Council (NECO) past question papers and mathematics text books based on the content taught in the lesson which were derived from SS2 mathematics curriculum. The reliability of coefficient of the instrument was determined using Spearman correlation coefficient.

Validity

The instrument was validated by experts in the Faculty of Education and Extension Services and Department of Science and Vocational Education of Usmanu Danfodiyo University, Sokoto. Content validation was done by the Oral Examination Committee (OREC) members and Mathematics experts with a rating of 4.03 which clearly revealed that the 10-item test was highly valid.

Reliability

The reliability of the instrument was carried out using test-retest method and the data collected were analyzed using Spearman Brown's Rank-Order correlation (r) co-efficient. A reliability co-efficient of 0.81 was obtained from Mathematical Achievement Test (content). A reliable instrument minimizes the error to some acceptable bounds. To test the reliability of the instruments, the items have been administered to the students. The test for the study have been pilot tested, which is then used for the calculation of the reliability of the tests. Those items with discrimination index of greater or equal 0.4 has been used in the study

(Sambo, 2015). The reliability coefficients of the instrument used in the study was found to be 0.81 (Appendix I).

This indicates that the test had high reliability but the items were trimmed down to 10 from 20. The 20-item test was subjected to item analysis. There were only five items that were considered "very difficult" and four items with "poor" and three items with "unacceptable" discrimination indices. Since 10-item test is only required, the 20-item test was trimmed down to 10. Table3 shows a table of specification on a unit on algebraic equation.

Table 3: Tale of Specifications for a Twenty-Item Test on a Unit on Algebraic Equation

				Objectives				
Content	Know		Calulate	Identify	Construct	Solve	**Totals**	**Percentages**
	Definition	Properties	Value of x					
Simple equation	1	1	2	1	1	3	9	18
Simultaneous linear equation	1	1	1	1	2	4	10	20
In-equality	1	1	2	1	2	3	10	20
Quadratic Equation	1	2	6	4	3	5	21	42
Totals	**4**	**5**	**11**	**7**	**8**	**15**	**50**	**100**
Percentages	**8**	**10**	**22**	**14**	**16**	**30**	**100**	**100**

The research instrument that has been used for the study involved the following:
A comprehensive marking scheme that was prepared for the test (Appendix 2). Instructional packages made(Appendix 3).

Table 4 Distribution of Sampled Students

Groups	Schools	Total
EG	184(45, 66, 73)	184
CG	193(53, 70, 70)	193
Total	377	377

Source: Researcher's Field work (2016)

These 377 students completed the activities and tests for the study. All the sampled students were in the Senior Secondary Class two (SS 2) and are at the average age of seventeen (17) years. All the six schools that were used in the study are either public, federal or private schools so all the students were assume to have similar educational background. Senior Secondary School Two (SS II) students were used for this study because; most of the algebraic equations as topics were normally scheduled to be taught for the first term in SS II.

Administration of the Instrument

The instrument was administered to the students using research assistants in the six schools after giving them training on constructivism approach teaching methodology. The instrument was administered to the students for six weeks. School time-table was strictly adhered to. Data were collected and analyzed in tables 5 and 6.

Results Analysis

The data collected from the study were continuous and randomized within the distribution. They were analyzed using descriptive statistics to answer research question and inferential

statistics of t-test for hypothesis testing at $\alpha = 0.05$ level of significance. The Details were as follows:

What is the difference between students taught algebraic equations using Constructivism and those taught using Conventional Method?

Research Question: What is the difference between students taught algebraic equations using Constructivist Method and those taught using Conventional Method?

Table 5 presents the data in the difference of performance of students in algebraic equation taught using constructivism and conventional methods using descriptive statistics.

Table 5: Summary of Constructivism and Conventional Method

Variable	N	Mean	Std. Deviation	Mean Difference
Constructivism	184	17.18	3.33	10.74
Conventional	193	6.44	4.05	.

Source: **Source: Researcher's Field work (2016)**

Table 5 presents the data in the difference of performance of students in algebraic equation taught using constructivism and conventional methods. Results indicated that those taught using constructivism performed better with mean and standard deviation 17.18 (S.D=3.334) than their counterpart taught using conventional method with mean and standard deviation 6.44 (S.D=4.054). The mean difference was found to be 10.74 between constructivism and conventional in favor of constructivism. To confirm how significant the difference is, t-test was used and result is presented in Table 6.

Ho: There is no significant difference between the mean performance of those taught algebraic equations using Constructivism and those taught by Conventional Methods.

To test this hypothesis, t-test was used and the result is presented in Tables 6.

Table 6:Summary oft- test between Constructivism and Conventional

Variable	N	Mean	S.D	D.F	t-cal	P-Value	Remark
Constructivism	184	17.18	3.33				
				375	28.18	0.001	Significant
Conventional	193	6.44	4.05				

Source: Researcher's Field work (2016)

An independent samples t-test was conducted using SPSS (statistical package for social sciences) to examine whether there is a significant difference between constructivism and conventional in relation to samples selected with the overall samples. From table 6 the calculated t-value is 28.18. This is greater than the theoretical (table) value of 1.97 at 95% confidential level ($\alpha = 0.05$) with a degree of freedom df = 375. This revealed that there is significant difference between constructivism and conventional in posttest performance scores. This finding answered the research question. It is empirically established that constructivism strategy has positive effect on student performance than conventional. The null hypothesis is thus rejected. It is also clear from table 6 that P-value is 0.001 at alpha = 0.05 with df = 375. This means that there is significant difference between constructivism and conventional. Thus the null hypothesis which stated that there is no significant difference between the mean performance of those taught algebraic equations using constructivismand those taught by conventional method is rejected. It is concluded that there is significance

difference in the performance of students in algebraic equation taught via constructivism and conventional methods in favor of constructivism.

Summary of Major Findings

The main aim of this research was to investigate the effect of Constructivism Teaching Strategy on Performance in Algebraic Equation among Secondary School Students in Sokoto State, Nigeria. From the results obtained in this research it was found that:

There is significant difference in student's performance using constructivism in schools than conventional method.

Discussion of Finding

This study investigated the effect of constructivism teaching strategy on academic performance on senior secondary school students (SS II) in Sokoto State. The explanation of the findings obtained from the hypothesis tested and acknowledges the published works of other authors in the related studies.There was significant difference in the mean academic performance scores of students taught using constructivism strategy. This confirms the findings of Gales & Yan (2001); and Meriam (2000) which observed the participation of students in the classroom and their ability to become active learners performs significantly better using constructivism strategy.

Fuson (2000:39); concluded that the everyday mathematics students were able to do better on the constructivist mathematics problems that involved computation and problem-solving. Furthermore, this research supports the change of educational curriculum that is more constructivists in its teaching and involves hands on curriculum and cognitive thinking processes.

Clark (2000); Simon &Schifter (2000); Bay (2001) recorded that students achieved positive attitudes towards mathematics when they are taught using constructivism method of teaching. Alsup (2004 :17) found that students experienced increase in autonomy performance and decrease in mathematics anxiety when engaged in constructivist method of teaching mathematics.

It was confirmed that students taught algebraic equation using constructivism instructional approach performed better than those taught using conventional method. This implies that constructivism instructional approach was effective in enhancing and facilitating students' performance in algebraic equation. The findings of this study support the findings ofprevious researchers, such as Bajah & Asim(2002); Madu (2004); Mandor (2002); Moemeka (2002) & Obonna (2003) that confirmed that appropriate teaching method leads to students' improved achievement in mathematics.

Conclusion

From the findings of this study, it is possible to make the following conclusions:-

1. There was significant difference in the mean academic performance scores of students taught using constructivism strategy.
2. The above findings revealed the existence of effectiveness of constructivism methods of teaching algebraic equations in mathematics class. This is a pointer that good teaching method improves students understanding of mathematics.

Since constructivism recognizes that students are at different levels of understanding and presents a variety of ideas, teachers have to start to encourage more student-centered learning in their teaching methodologies.

Recommendations

The researcher made the following recommendations as drawn from the findings and conclusion made from the paper:

1. One major recommendation is that mathematics teachers should incorporate constructivist instructional strategy as one of the methods used in teaching mathematics into the mainstream of pedagogy in the teaching of mathematics as it seems to have high potentials for enhancing learning, and achievement on the part of the learners.
2. Government should continue to utilize the services of various bodies such as Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigeria (STAN); All Nigerian Conference of Principals of Secondary Schools (ANCOPSS) and National Union of Teachers (NUT) to organize seminars, workshops, conference and in-service training to inform and train mathematics teachers on the use of innovative teaching methods specifically constructivism instructional approach.
3. The teacher training institutions should include the constructivism instructional techniques in the mathematics method course content. This will ensure that the mathematics teachers are adequately trained on how to use the technique.
4. Societal and School Based Management Committee role serves as an important factor in the school and therefore demand the use of recent teaching methods in Mathematics so as to bring the desired change in conveying the curriculum to the students.

Limitations of the Study

There are many factors that hinder the effective use of good instructional strategies in Nigerian secondary schools like Constructivist Teaching Strategy. These factors include: class size, teachers' qualification and class organizations which affect the study though, this intervening variables could be controlled.

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