CONCEPT MAPPING INSTRUCTIONAL STRATEGY AND SENIOR SECONDARY STUDENTS' PERFORMANCE AND INTEREST IN ALGEBRA IN BAUCHI STATE

By

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Abstract

The study which is a quasi experimental design examined the effect of concept mapping instructional strategy on SS 2 students' academic performance and interest in Algebra. Three research questions were answered and three null hypotheses were tested. Two secondary schools were randomly selected, one of which served as the control group and the other as the experimental group. The experimental group was taught using the concept mapping instructional strategy while the control group was taught using the conventional strategy. The two groups were given a pre-test before the experimental group was taught using the concept mapping strategy while the control group was taught with the conventional strategy. Eighty- eight senior secondary school two students (52 boys and 36 girls) were used. The Algebraic Performance Test (APT) which had a reliability coefficient of 0.86 was used to determine the academic performance of the two groups while the Algebraic Interest Scale (AIS) with was used to determine the interest of the students. . The responses of the subjects to the two instruments were scored and analyzed using mean, standard deviation and the Analysis of Covariance (ANCOVA). The posttest achievement scores for the experimental group taught using the concept mapping strategy was higher than those taught using the conventional strategy. The posttest interest rating scores of the subjects in the experimental group was also higher than those in the control group. It is therefore recommended that Mathematics teachers should be encouraged to use the concept mapping strategy to teach algebra as it improves the students' performance in algebra and makes the students have more interest in learning the topic.

Keywords*: Instructional Strategy, Interest, Performance*

Introduction

Mathematics remains a service provider for all disciplines and it contributes immensely in deciding directions of activities in all areas of human activities such as economy, banking, marketing, transactions, industries, research, legal jurisprudence, leadership, engineering, agriculture and others too many to mention. Iji (2014) says Mathematics is the logical language for expressing ideas, shapes, quantities, sizes, other changes and dynamism in the education system and explaining the complexities of modern society in the business, economic, academic, engineering and industrial setting for lifelong learning. As such without Mathematics there is no science, without science there is no modern technology and without technology there is no national development

Despite the roles that Mathematics play, the West African Examination Council (WAEC) Chief Examiner's report of 2010-2018 as illustrated in Table 1 in Nigeria indicates that students' performance in Mathematics has been poor and always below 50%.

Table 1: Total number of students and those with credit pass from 2010-2018 in WASSCE

YEAR	TOTAL NUMBER WHO SAT FOR WASSCE	NUMBER OF STUDENTS THAT OBTAIN CREDIT A1-C6	PERCENTAGE OF STUDENTS WITH CREDIT A1-C6
2010	1,351,557	453,447	33.55
2011	1,540,250	581,630	38.93

2012	1,675,224	819,390	49.00
2013	1,543,683	555,726	36.00
2014	1,692,435	529,738	31.30
2015	1,593,442	544,638	34.18
2016	1,544,234	597,310	38.68
*2017	1,559,162	923,424	59.22
*2018	1,471,151	786,016	49.98

Source-: Chief Examiner Report West African Examination Council (WAEC)
* Number of students including those with credit pass in Mathematics and English

Algebra is a branch of Mathematics in which symbols usually letters or alphabets represent numbers or numbers of a specified set are used to represent quantities and to express general relationship that hold for all number of a set. It is considered as one of the most important areas of school Mathematics; it does not only play an important role in Mathematics but functions as a gatekeeper to future educational and employment opportunities (Amadi & Chales-Organ, 2015). Many historically developed algebraic concepts can be observed in the current secondary school curricula throughout the world (Egodawatte, 2011). For students to understand and possess the mathematical skills of problem-solving, communication, reasoning and making connections that are necessary for human daily living, they need algebra. This is because algebra is the language through which most concepts in Mathematics are communicated (Iji, Abakpa & Takor, 2015).

In view of the aforementioned, it is obvious that students' overall achievements and subsequent application in today's world activities largely depend on algebraic concepts proficiency. However many efforts to improve students' algebraic competency have not translated to greater achievement especially at secondary school level. Many are even discontinuing their study of higher level Mathematics because of lack of success in algebra (Egodawatte, 2011). The role of algebra in development of Science, Technology and even Art and Humanity is highly indispensible. As a result of this, it becomes imperative that improvement in the teaching of algebra will bring about general improvement in the performance of students in Mathematics.

Concept mapping instructional strategy is a metacognitive strategy used in measuring individual knowledge structure and organization in specific variety of context in science and has been proved to be effective in the teaching of science and Mathematics inclusive (Salman, Akinjola and Akula, 2015). In concept mapping those parts of the knowledge structures that are new can be readily differentiated from those that are old, and the degree of integration (between the old and the new) can be measured thus leading to greater performance, hence the need to use this method to see how students' academic performance and interest in algebra and Mathematics in general can be improved.

Statement of the Problem

The role of algebra in development of Science, Technology and even Art and Humanity is highly indispensable. The knowledge of it and its correct application help both individuals and nations to solve everyday problems. In spite of the role played by algebra in the development of Science and the current efforts in Mathematics instruction, there is still persistent poor performance of students in that area. Many approaches have been used in the past for teaching algebra at the senior secondary school level but students' performance in algebra is still low as reported by WAEC Chief Examiner report of 2012 and 2017 that some students could not properly interpret word problems in algebra nor could they solve algebraic fractions.

Aim and Objectives of the Study:-The aim of the study is to examine the effect of concept mapping instructional strategy on SS 2 students' academic performance and interest in Algebra. Specifically the objectives are:-

1. Find out whether the use of concept mapping instructional strategy to teach algebra will enhance SS2 Mathematics students' performance and interest.
2. Find out if the use of concept mapping instructional strategy will bridge the gap in gender of SS 2 students' performance and interest in algebra.
3. Investigate whether the use of concept mapping instructional strategy to teach algebra will enhance SS2 students' interest

Research Questions

The following research questions guided the study.

(i) What is the mean performance score of SS2 students taught algebra using the concept mapping instructional strategy and those taught with the conventional strategy?

(ii) What are the mean performance scores of male and female SS2 students taught algebra using the concept mapping instructional strategy?

(iii) What is the difference in the mean interest scores of students taught algebra using concept mapping strategy and conventional strategy?

Hypotheses

The following hypotheses were tested.

(a) There is no significant difference in the mean performance scores of SS2 students taught algebra using the concept mapping instructional strategy and those taught with the conventional strategy.

(b) There is no significant difference in the mean performance scores of male and female SS 2 students taught algebra using concept mapping instructional strategy

(c) There is no significant difference in the mean interest scores of students taught algebra using concept mapping strategy and conventional strategy?

Methodology

The design employed for this study was quasi experimental design. The students' classroom setting was not distorted. The researcher used the existing intact classroom setting the way it was. For instance the researcher used two groups in different classes using different strategy. This design was used to establish cause effect relationship between concept mapping strategy and performance and interest in Mathematics. There was a pretest in both the experimental and control groups respectively. The experimental group was given the experimental stimulus that is teaching using concept mapping strategy. The control group was taught using the conventional strategy. At the end of the treatment period, posttests were then administered to the groups of students in order to evaluate the effectiveness of the treatment received by the subjects.

Instrumentation

The first instrument for the research was a multiple choice questions containing 60 objective questions with five options, one key and four distracters, referred to as the Algebraic Performance Test (APT) and this covered all the units taught by the researcher. The APT was developed by the researcher using a table of specification and it has a reliability index of 0.86. A pretest was administered to the chosen students using the Algebraic Performance Test (APT) and the test papers were marked and scored. The experimental group was

exposed to concept mapping strategy by the researcher while the control group was taught using the conventional strategy by their Mathematics teacher. The SS 2 topics in algebra taught are quadratic equations, Simultaneous, linear and quadratic equations, and algebraic fractions. The Mathematics teacher was given lesson notes prepared by the researcher to ensure uniformity in teaching. A posttest was administered after the teaching using the APT and the test papers were also scored.

The second instrument is the Algebra Interest Scale (AIS) which was adapted and the purpose of this in this study is to determine whether students have increased interest or decreased interest towards algebra. The interest Scale was constructed based on the Likert type four point scale of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD). Numerical value of 4, 3, 2, and 1 respectively was allotted to the responses. Negative items were however, scored in the reverse order and it has a reliability index of 0.82. The scores obtained from the responses of the strongly agree and agree groups as well as from strongly disagree and disagree was used for analysis.

Data Collection and Analysis

Descriptive statistics which include mean, standard deviation and variance were used to answer the research questions. Inferential statistics of Analysis of covariance was utilized in testing the hypotheses.

Results

Research Question 1-: What are the mean performance scores of SS2 students taught algebra using the concept mapping instructional strategy and those taught with the conventional strategy?

Table 2: The mean scores and standard deviations in APT of students in the Experimental and Control Groups

Method	Type of Test	N	Mean	SD	Mean Gain
Concept mapping strategy	Pre-test	88	19.91	6.09	11.64
	Post-test	88	31.55	9.24	
Conventional strategy	Pre-test	88	21.29	6.52	0.87
	Post-test	88	22.16	6.53	

Table 2 shows the mean scores and standard deviation of the students in the experimental and control groups. From Table 2, it could be seen that the mean scores of the students taught with concept mapping strategy was 19.91 and 31.55 in pre-test and post-test respectively and standard deviation of 6.09 and 9.24 in the performance test. For the students who were taught with Conventional strategy, it was observed that they had mean scores of 21.29 and 22.16 in pre-test and post-test respectively and standard deviations of 6.52 and 6.53 in that other. It was further observed that the mean gain scores for the experimental and control groups stood at 11.64 and 0.87 respectively. This implies that the Concept mapping strategy is more efficacious than the Conventional strategy.

Hypothesis 1: - There is no significant difference in the mean performance scores of SS2 students taught algebra using the concept mapping instructional strategy and those taught with the conventional method.

Table 3:- ANCOVA Result of mean performance scores of students taught algebra using concept mapping strategy and the conventional strategy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Result
Corrected Model	1796.85	2	898.43	19.57	0.00	S
Intercept	547.49	1	547.49	11.92	0.00	S
Pretest	1240.45	1	1240.45	27.02	0.00	S
Group	108.83	1	108.83	2.37	0.13	
Error	1882.06	82	45.90			
Total	47464.00	88				
Corrected Total	3678.91	86				
Computed using alpha = 0 .05						

The table above shows that there is a significant difference in the level of students' performance using the concept mapping strategy over those using the conventional strategy. If the P value is greater than 0.05, we say it is not statistically significant. The output above shows a P value of 0.13, thus we say it is not statistically significant. In other word we fail to reject the null hypothesis.

Research Question 2- : What are the mean performance scores of male and female SS2 students taught algebra using the concept mapping instructional strategy?

Table 4: The mean scores and standard deviations of male and female students in the Experimental Group

Gender	Type of Test	n	Mean	SD	Mean Gain
Male	Pretest	28	21.75	5.19	13.04
	Posttest	28	34.79	7.86	
Female	Pretest	16	17.68	6.47	9.97
	Posttest	16	27.65	9.46	

Table 4 shows the mean scores and standard deviation of the male and female students in the experimental group. From Table 4, it could be seen that the mean scores of the male students taught with Concept mapping strategy were 21.75 and 34.79 in pre=test and post-test respectively and standard deviation of 5.19 and 7.86 in the achievement test. For the female students, it was observed that they had mean scores of 17.68 and 27.65 in pre-test and post-test respectively and standard deviations of 6.47 and 9.46 in that other. It was further observed that the mean gain scores for the male and female students stood at 13.04 and 9.97 respectively. This implies that the male students perform better than their female counter part when exposed to concept mapping instructional strategy.

Research Hypothesis 2:- There is no significant difference in the mean achievement scores of male and female SS 2 students taught algebra using concept mapping instructional strategy.

Table 5: - Analysis of Covariance of mean performance **ratings of male and female students taught algebra using concept mapping instructional strategy.**

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision		
Corrected Model	1748.97	2	874.49	143.31	0.00	S		
Intercept	0.77	1	0.77	0.12	0.72			
Pretest	1666.97	1	1666.97	273.18	0.00	S		
Gender	1.90	1	1.90	0.31	0.58	NS		
Error	250.18	42	6.10					
Total	21953.00	42						
Corrected Total	1999.15	42						
Computed using alpha = 0 .05								

The Table 5 above shows there is significant difference in the mean performance scores of male and female students taught algebra using the concept mapping instructional strategy. When the P value is greater than 0.05, we say it is not statistically significant. The output above shows a P value of 0.58, thus we say it is not statistically significant. In other word we fail to reject the null hypothesis.

Research Question 3:- What is the difference in the mean interest score of students taught algebra using Concept mapping strategy and conventional strategy?

Table 6: The mean interest scores and standard deviations in AIS of students in the experimental and control Groups

Teaching Method	**Type of Interest**	**No.of students**	**Mean**	**SD**	**Mean Gain**
Concept mapping strategy	Pre Interest	88	36.65	12.37	23.24
	Post Interest	88	59.89	38.17	
Conventional strategy	Pre Interest	88	37.37	15.54	0.02
	Post Interest	88	37.39	28.98	

Table 6 shows the mean interest scores and standard deviation in AIS of the students in the experimental and control groups. From Table 6, it could be seen that the mean interest scores of the students taught with Concept mapping strategy was 36.65 and 59.89 in pre interest and Post Interest respectively and standard deviation of 12.37 and 38.17 in the AIS. For the students who were taught with Conventional strategy, it was observed that they had mean scores of 37.37 and 37.39 in pre interest and Post Interest respectively and standard deviations of 15.54 and 28.98 in that other. It was further seen that the mean gain interest scores for the experimental and control groups stood at 23.24 and 0.02 respectively. This implies that students have increased interest in algebra when taught with concept mapping strategy than when taught with conventional strategy.

Research Hypothesis 3: There is no significant difference in the mean interest score of students taught algebra using concept mapping strategy and conventional strategy?

Table 7: One way Analysis of Co-variance of mean interest ratings of students taught algebra using the concept mapping and the conventional strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Result
Corrected Model	1611.12	2	805.56	146.94	0.00	S
Intercept	42.44	1	42.44	7.74	0.01	S
Pretest	1497.66	1	1497.66	273.19	0.00	S
Group	6.73	1	6.73	1.23	0.27	
Error	224.77	42	5.48			
Total	23441.00	42				
Corrected Total	1835.89	42				
Computed using alpha = 0 .05						

The result above shows that there is a significant difference in the Mean interest rating of SS2 students taught using concept mapping method over those using conventional strategy.

Conclusion

The results of the study show that teaching using the concept mapping strategy reduced poor performance and interest in Mathematics among senior secondary school students. This is clearly shown from the results of the analysis of data obtained from the study. The students taught algebra during the period of this study using concept mapping strategy improved in their performance and interest in algebra and therefore it is recommended for use by Mathematics teachers.

Recommendations

1.) Mathematics educators should be encouraged to adapt concept mapping strategy as part of their teaching methods
2.) Those teaching Mathematics should be encouraged to attend workshops through sponsoring by stakeholders in education.
3.) The Mathematics teachers should encourage their students to practice and learn the act of drawing concept maps. This will go a long way in helping them solve other Mathematics topics.

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