JOURNAL OF RESEARCH IN SCIENCE AND VOCATIONAL EDUCATION (JRSVE)
Volume 2; Issue 1; May, 2022
Official Publication of Science and Vocational Department
Godfrey Okoye University, Ugwuomu- Nike, Enugu-Nigeria
Published by K-Injo | Kobia Data Limited

EFFECT OF CONCEPT MAPPING INSTRUCTIONAL STRATEGY ON ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS' IN MATHEMATICS

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Abstract: *In this paper we examined the effect of concept mapping instructional strategy on students' academic achievement in senior secondary school Mathematics. The study adopted quasi-experimental design which involves a pretest, posttest, non-randomization, and non-equivalent control group. The population of the study consists of thirty- four thousand three hundred and twelve (34 312) SS2 students in all the senior secondary schools in Enugu Education Zone of Enugu state. The sample was made up of three hundred and ninety -five (395) SS2 students from the five secondary schools purposively sampled from the thirty-one (31) secondary schools in the zone. There were two treatment groups: experimental group (strategy) and control group (traditional). Data were analyzed using ANCOVA and the result showed that students taught using concept mapping instructional strategy achieved higher than students taught without. The findings of the study point out that students taught using concept mapping instructional strategy performed higher, help learners learn independently and show superiority over students taught by traditional methods. A major implication of this study is that mathematics teachers should avoid dominating the teaching and learning in the Mathematics classroom as this may be harmful to students. The researcher recommended among others that the government should encourage and mount workshops for serving teachers on the use of concept mapping instructional strategy in their instructions. Also, this instructional strategy should be improved upon so as to reduce students' mass failure in Mathematics examination.*

Keywords: *concept maps, lecture strategy, achievement and mathematics.*

How To Cite
Ozomadu, E. A., & Edeoga, B. O. (2022). Effect Of Concept Mapping Instructional Strategy On Academic Achievement Of Senior Secondary School Students' In Mathematics. *Journal Of Research In Science And Vocational Education (Jrsve), 2*(1). Retrieved From Https://Jrsve.Com/Index.Php/Jrsve/Article/View/15

Introduction

Mathematics is an activity subject. The way it is being taught is important in helping students to acquire basic mathematical knowledge, skills and attitude to solving different human problems. It is expected that the instructor should use appropriate teaching methods that will give students ample opportunity to be actively involved during teaching and learning session. The National Policy on Education (NPE,2013) had advocated for improvement in the teaching and learning of science related subjects especially Mathematics in order to create the foundation of oriented workforce in line with the needs of learning of

Mathematics. Mathematics of course is of immense importance to national development, no wonder the national policy on education has given it the statutes of a core (compulsory) subject at the primary and secondary levels of education in Nigeria (FGN,2014).

Despite the importance attached to Mathematics and a compulsory subject at the primary and secondary levels of education, yet student's performance in both internal and external examinations has remained poor and unsatisfactory (Omoro&Adiri, 2019). The continued poor achievement has remained an issue of concern to stake holders in education including parents, researchers, teachers and educational administrators among others. The chief examiner's report f (2015) observed that the percentage of students who failed Mathematics at the senior secondary certificate Examination (SSCE) was attributed to poor attempt on Geometry related questions. Also, Oledele (2014) observed that the poor performance in Mathematics Examination at SSCE from 2014 to 2016 is due to inappropriate instructional strategies used in teaching Mathematics.

This study will consider concept mapping instructional strategy to see the adoption can improve students' performance in Mathematics especially Geometry.

In science education especially Mathematics, there is an increasing awareness of the importance of learner-centeredness in the teaching- learning situation which has attracted a lot of attention in relation to understanding how learners learn and how to help them learn about concepts in Mathematics. These efforts according to Salam, Akinyola and Akula(2015) assist learners to learn more effectively and have also led to the development of meta-cognitive strategies to enhance meaningful learning. Nova cited in Jibrin and Zayum (2012) opined that meta-cognitive strategies are meta-knowledge and meta-learning which are strategies that empower a learner to take charge of his/her own learning in meaningful ways.

Therefore, concept mapping instructional strategy is a strategy that helps learners organize their cognitive frame works into more powerful integrated patterns. Many researchers such as Usman and Musa (2019), Omoro and Adiri (2019) have observed that concept mapping can improve meaningful learning and help learners learn independently.

Lecturing is the most common and established method of teaching. It is the means of passing over knowledge to students whose role in the learning process is passive. This method has the limitation of little or no student participation or activity (Ajaja, 2014). This limitation experienced in this method led to the development of other views of teaching Mathematics like concept mapping strategy. Rotimi and Kenni(2011) discovered significant effect of concept mapping on students achievement in mathematics and that the strategy has a lingering effect that prompts retention of learned materials.

In a study to to determine the effect of concept mapping strategy on students' academic achievement, the study revealed a difference in the posttest mean achievement scores of male and female students in favour of the male students. The result of Nwoke (2015) agrees with the work of Ahmed (2014) whose result revealed no statistical significant difference observed between gender due to concept mapping strategy.

Gender according to revealed literature has significant effect on achievement and male retention with reported difference between male and female students' academic achievement. Some researchers reported in favour of males while others reported in favour of females in academic achievement. The inconsistent results on students' achievement have generated the need for this study. This is the gap this study intends to fill.

Statement of the Problem

The role of Mathematics in the overall development of Science, Technology, Arts and Humanity is indispensable. Its knowledge and application in everyday activities help in no small measure in solving our problems. In spite of the enormous role and importance attached to the study of Mathematics, there is still persistence poor achievement of students in that area. Many methods have been used in the past by Mathematics teachers in teaching Mathematics, but students' performance is still poor as reported by WAEC Chief Examiner report of 2012 and 2017 that students cannot solve and interpret problems in construction and 3-D problems. Since concept maps offers a means to create necessary "mind on" environment and the ability to teach topics using cross links and hierarchical structures, there is the need to examine the effect of concept mapping instructional strategy and observe students' achievement in Mathematics.

Purpose of the Study

The main purpose of the study is to investigate the effect of Concept mapping instructional strategy on the academic

achievement of senior secondary school 2 students in Geometry. Specifically, the study sought to find out:

1. whether the use of concept mapping instructional strategy to teachGeometry will enhance SS2 Geometry achievement.
2. if the use of concept mapping instructional strategy will bridge the gap in gender of SS2 students' achievement in Geometry.

Research Questions

The following research questions guided the study.

1. What is the mean academic achievement score of SS2 students taught Geometry using concept mapping instructional strategy?
2. What are the academic achievement scores of male and female SS2 students taught Geometry using concept mapping instructional strategy?

Hypotheses

The following null hypotheses were formulated and tested at 0.05 alpha level.

Ho_1: There is no significant effect in mean achievement scores of SS2 students taught Geometry using the concept mapping instructional strategy and those taught with the traditional strategy.

Ho_2: There is no significant effect in the mean achievement scores of male and female SS2 students taught Geometry using concept mapping instructional strategy.

Ho_3: There is no significant interaction effect of method and gender.

Methodology

The researchers adopted quasi-experimental design which involves a pretest, post-test, non-randomization and non-equivalent control group. Intact classes were used to avoid disrupting the normal school programs for experimental purpose. According to Nwankwo (2013), quasi-experimental study is one in which some threats to validate cannot properly controlled owing to the fact that situations involves human being that are being used for the experimental study. Specifically, the study is a pretest, posttest control group design. One group were taught using concept mapping strategy (experimental) while the other group was taught using traditional method (control).

$Q_1 E X Q_2$

_ _ _ _ _ _ _

Q_1 _ _C _ Q_2

Where Q_1 = pretest, Q_2= post-test, X= treatment, _ _ _ _ = non-treatment,

E = Experimental group, C = control group, (__ __ __) = intact class.

The population of the study consists of thirty -four thousand three hundred and twelve (34,312) SS2 students in Enugu Education Zone (post primary school Management Board, PPSMB, 2019) which comprised of thirty -one (31) senior secondary schools. A purposive sampling technique was used to select five schools for the study. Criteria for the sampling include: presentation of candidates for the senior secondary certificate Examination for at least ten consecutive years and each school must have at least three mathematics teachers of which one teaches Mathematics at the senior secondary school 2 class. The sample comprised five co-educational senior secondary schools involving a sample of 395 (three hundred and ninety-five) senior secondary school 2 Mathematics students from the five schools. The samples were grouped into two groups.The sample had 215 students for the experimental (120 males& 95 females) and 180 of the control (90 males & 90 females) for the control groups respectively.The instrument designed for the data collection titled "Geometry Achievement Test (GAT)" which consists of 25 multiple choice items. The instrument was developed by the researchers taking into consideration the different aspects of Geometry. Face validation of the instrument was done by three specialists one from Measurement and Evaluation, and the other two from Mathematics of Godfrey Okoye university, Enugu. The instrument was drawn from WAEC past questions which were standardized. Test-retest stability method was used and correlated the students' responses after a period of two weeks using Pearson Product Moment Correlation coefficient statistics. The reliability index of 0.78 was obtained. The GAT was therefore, judged reliable for the study. The posttest question was reshuffled although retaining the content in order to avoid labeling by the students, when the test was administered again as internal consistency of the instrument.

The research questions were answered using mean and standard deviation while analysis of covariance (ANCOVA) at $P < 0.05$ probability level was used for testing the hypotheses. The use of ANCOVA is appropriate due to the influence of some uncontrolled variables

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(covariate or the concomitant variables) which the researchers may wish to control.

Results:

Research Question 1:

What is the mean academic achievement score of SS2 students taught Geometry using concept mapping instructional strategy and those taught without concept mapping instructional strategy?

Table 1: Mean and standard deviation of pretest and posttest achievement scores of students taught geometry using concept mapping and lecture instructional strategy

Group	Pretest		posttest		Mean gain
	N	mean	SD	Mean	SD
Exp.	215	29.55	17.30	65.14	13.54	35.59
Control	180	25.71	16.25	57.15	14.05	31.44
Total	395	27.6.3	16.78	61.15	13.80	33.52

Table 1 shows a pretest mean achievement score of 29.55, with a standard deviation of 17.30, for students taught geometry using concept mapping instructional strategy and a pretest mean achievement score of 25.71, with a standard deviation of 16.25, for students taught geometry using lecture instructional strategy. As indicated in Table 1, students taught geometry using concept mapping instructional strategy had a posttest mean achievement score of 65.14, with a standard deviation of 13.54, while students taught geometry using lecture instructional strategy had a posttest mean achievement score of 57.15, with a standard deviation of 14.05. Table 1 shows that the two groups (concept mapping and lecture instructional strategy)) had a higher posttest mean achievement scores. This is an indication that concept mapping and lecture instructional strategies have effect on students' academic achievement in geometry.

Research Question 2:

What are the achievement scores of male and female SS2 students taught Geometry using concept mapping instructional strategy?

Table 2: mean and standard deviation of male and female students taught Geometryusing concept mapping instructional approach

Gender		Pretest		Posttest		Mean gain
	N	Mean	SD	Mean	SD	
Male	120	18.17	3.15	25.42	5.64	7.25
Female	95	17.11	2.22	24.65	4.23	7.54

Table 2 shows that the mean achievement scores of male students taught in the experimental group in post-test achieved slightly better (mean=25.42, S= 5.64) than their female counterparts (mean= 24.65, S=4.23).

Null hypothesis One: There is no significant difference in the students' academic achievement in geometry for the concept mapping group and lecture group.

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Table 3: **ANCOVA of the effect of instructional strategies on students' achievement scores on methods and gender. An analysis of covariance was conducted to determine the difference in achievement scores of students based on the instructional strategies used.**

Source	Type 111 sum of square	DF	Mean square	F Sig
Corrected model	846.938	4	211.735	65.581 .000
Intercept	46.242	1	46.242	12.358 .010
Covariate	545.140	1	545.140	145.691 .000
Strategy	8.556	1	8.556	.086 .000
Gender	.322	1	.322	2.287 .026
Strategy *Gender	.948	1	.948	.253 .618
Error	130.961	36.425	3.742	
Total	12470.00	395		
Corrected total	977.900	394		

The result as presented in table 3 shows that after adjusting for the effect of the pretest scores, there was a significant difference between the teaching strategies (concept mapping group and the lecture group) on their posttest scores on geometry (F-value of 0.086) for treatment is significant at 0.00 which is less than 0.05 alpha level of significance. Thus, the null hypothesis is rejected. Conclusion was then that there is significant main effect of concept mapping instructional strategy on students' achievement in senior secondary schoolGeometry. This also indicates a significant difference in the mean achievement scores of students taught using concept mapping instructional strategy and those taught with lecture.

Hypothesis 2. There is no significant difference in the mean achievement scores of male and female SS2 students taught geometry using concept mapping instructional strategy.

From table 3, the F-value of 2.287 for gender difference is significant at 0.026 which is less than 0.05 alpha levels and thus the null hypothesis is rejected. The conclusion was that there is significant main effect of gender on students' academic achievement in geometry when taught using concept mapping instructional strategy.

Discussion

The study revealed that there is a significant effect of concept mapping and lecture instructional strategies on students' achievement in geometry. This is due to the increased-on posttest compared to their pretest scores. This suggests that both teaching strategies (concept mapping and lecture) have the capacity to cause learning to occur at varying degrees (Ajaja, 2013). This finding further agrees with Usman and Musa (2019) who reported that concept mapping instructional strategies improve meaningful learning of mathematics and at the same time show superiority over students taught using lecture method. The higher mean achievement scores earned by students in the concept mapping group may be due to the active participation of the students in the concept mapping group unlike the lecture group where the students are passive.

Conclusion

Concept mapping and lecture instructional strategies significantly enhanced students achievement in Mathematics. Concept mapping group had a higher mean achievement scores than the lecture group.

Recommendation

Mathematics teachers should as a matter of necessity adopt the use of concept mapping instructional strategy in the teaching of Mathematics in our secondary schools as it ensures students' active participation and understanding of complex concepts.

Workshops and seminars should be organized periodically to train mathematics teachers on the use and development of concept maps in teaching of mathematics concepts.

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