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ENHANCING ACADEMIC ACHIEVEMENT OF SENIOR SECONDARY SCHOOL STUDENTS IN MATHEMATICS THROUGH CONCEPT MAPPING TEACHING METHOD IN ANAMBRA STATE, NIGERIA

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ABSTRACT

The study dealt with the investigation on enhancing academic achievement of senior secondary school students in mathematics through concept mapping teaching method in Awka education zone of Anambra State, Nigeria. The research design adopted for the study was quasi-experimental. Intact classes of (40) SSS2 students formed the sample of the study. A Simple random sampling technique was used to select the sample of the study. Two research objectives, questions, and null hypotheses guided the study. The research instrument used for the study was Mathematics Achievement Test. The reliability of the research instrument was computed using Kuder Richardson formula (KR -21) which yielded a reliability coefficient of 0.85. The instrument was administered and the data obtained were analyzed using T- test to test the hypotheses while mean and standard



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deviation were used to answer research questions. The result of gender revealed that there is no significant difference between male and female students taught mathematics using the concept mapping teaching method. The findings of the study also, revealed there was a significant difference between the experimental and control group, in the favor of the experimental group. The study among others recommended that the concept mapping teaching method should be used in teaching mathematics to solve the problem of poor academic achievement in mathematics.

Keywords: Concept Mapping Teaching Method, Academic Achievement, Mathematics.

Introduction

Mathematics is one of the core subjects in senior secondary school in Nigeria. Mathematics as a branch of science is highly important in modern societies because of, its requirement as a prerequisite to the study of many science-oriented courses. It thus appears that for a nation to develop in science and technology, the methods of teaching mathematics need to be improved. It, therefore, becomes relevant that academic achievement in mathematics should be of high levels. Izuegbunam et al (2018) opined that mathematics is the branch of science concerned with the nature and interaction between the fundamental constituents of the observable universe. It gives the learner sound academic knowledge and skills. Yet, it is a subject that is mostly failing in schools, especially in secondary schools (Anibueze, 2017). However, government effort at improving mathematics appears inadequate because of students' persistent poor performance in the subject. There is a need to revisit the method used in the teaching of mathematics in senior secondary school in other to elevate the poor academic achievement of students. However, Nzewi (2018) asserted that diverse strategies of teaching have been proposed to improve student performance in mathematics such strategies include the use of analogy, cooperative learning, inquiry, the concept of the advance organizer, and so on.

The annual WAEC chief examiners report (2020) has it that there is an increase in students' failure in mathematics examinations. In the findings of Eniayeju (2020) students attributed underachievement in mathematics to the way it is taught in classes. It was found that students

perceived that many concepts in mathematics are abstract in nature thereby making learning relatively difficult. Due to this cause, Gbamaja (2019) pointed out that content, methodology, and techniques are some of the basic elements of teaching and concluded that good teaching requires sound and deep knowledge of pedagogical principles of conveying that knowledge to the learners.

However, the conventional method of teaching falls into a teacher-centered method whereby more emphasis was on learning the theory without any hands-on activities. Teachers are considered learned scholars who talk continuously to the students without getting any response or feedback, resulting in insufficient interaction between teachers and students, (Torre & Daley 2017). A student's talent will not be brought out completely as he or she will be afraid of the teachers. This results in not utilizing the full talent of the student, students' creativity and rational thinking are not utilized, and education is more of a burden and boring using the conventional method of teaching. Conventional methods are not enough to promote adequate levels and quality of students' learning. This triggered the researchers to embark on the study, enhancing academic achievement of senior secondary school students in mathematics through concept mapping teaching method in Anambra State, Nigeria.

Statement of Problem

The problem of poor academic achievement by Nigerian students in mathematics has been of concern to all mathematics educators in the country. At the school certificate level, the West African Examination Council, chief examiners' reports from WAEC, (2022) confirm this observation. However, a lot of variables may inhibit the effective dissemination of mathematical content to the students, such variables may be the lack of an appropriate method of teaching, inadequate use of instructional materials, negative attitude of students toward mathematics among others, students' lack of interest, and the inability of the students to retain the concept being learned since they learn by rote. Therefore, the problem investigated in this study put in question form therefore is; how can the academic achievement of senior secondary school students in mathematics be enhanced through the concept mapping teaching method in Awka South Local Government.

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Purpose of the study

The purpose of this study is to investigate enhancing the academic achievement of senior secondary school students in mathematics through concept mapping teaching method in Awka south local government area in Awka education zone of Anambra State, Nigeria. Specifically, it seeks to determine:

1. The mean achievement scores of students taught mathematics using the concept mapping teaching method and lecture teaching method.
2. The mean difference between the academic achievement of male and female students taught with the concept mapping teaching method

Research Questions

The following research questions guide the study:

1. What is the mean achievement score of students taught mathematics using the concept mapping teaching method and lecture teaching method?
2. What is the mean difference between the academic achievement scores of male and female students taught with the concept mapping method?

Research Hypotheses

The following null hypotheses were tested at a 0.05 level of significance guided study:

1. There is no significant difference in the mean achievement score of students taught mathematics using the concept mapping teaching method and lecture teaching method.
2. There is no significant difference in the mean academic achievement scores of male and female students taught mathematics with the concept mapping teaching method.

Research Method

Research Design: A quasi-experimental design, specifically a non-equivalent control group design was employed. The design is considered appropriate for the study because intact classes were used to avoid disruption of normal class lessons.

Area of the study: The study was carried out in Awka South Local Government Area in Awka education zone of Anambra State Nigeria.

Population of the study: The population of the study consisted of all SS2 students in 18 government senior secondary schools in Awka south local government area of Anambra State. As of the time the research was done (2019/2020 academic

session), there were 481 students made up of 85 male students and 396 female students.

Sample and Sampling technique: Intact class which comprised 40 SS2 students formed the sample for the study. A simple random sample technique was used to select two senior secondary schools in Awka south local government area in which one school was used as an experimental and the other school was used as a control group. A further simple random sampling technique was used to select one SS2 class in the selected school. The experimental group consisted of 18 students made up of 7 males and 11 females. The control group consisted of 22 students made up of 4 males and 18 females.

Instrument for data collection: The researchers developed an instrument titled Mathematics Achievement Test (MAT) which was used for the study and consisted of 25 multiple-choice test items with options A to D. Each item was awarded 5 marks making a total of 100% for the 20 items the content of the test items were derived from the topics that were taught. The instrument consisted of two Sections, A and B. Section A was meant to elicit information on the student's personal data, whereas Section B consisted of 20 multiple-choice questions. The students were required to answer all the questions from each section. The instrument was used for both the pre-test and post-test. The items of the instrument were re-shuffled before the administration of the posttest to reduce memory effect.

Validation of the Instrument: To ensure the validity of the instrument, the MAT was subjected to both face and content validation. The face validation was done by administering the instrument to one expert from the department of science Education, one expert from measurement and evaluation all from the faculty of Education Nnamdi Azikiwe University, Awka, and one experienced mathematics teacher in senior secondary school, to check the clarity of items, its suitability, and appropriateness of the language used in order to suit the learners involved. After validation, some modifications were made by the experts on the content and the corrections were affected by the researchers.

Reliability of the Instrument: The trial testing of the MAT was done by administering twenty-five (25) copies of the instrument to SS2 students in the secondary school, which were not part of

the study. This was done to determine the time it will take to complete the test and how reliable the items in the instrument are. The data was used to estimate the reliability of the instrument using Kuder Richard formula (KR-21) and yield a reliability index 0.85 which means that the instrument of 85% reliable and 15% unreliable. The test consists of multiple-choice objectives questions.

Experimental Procedure: The researchers visited the selected schools and trained the class teachers of the experimental and control group class as research assistants. They taught their class for four weeks; the experimental group was taught using the concept mapping teaching method while the control group was taught using the lecture method. Copies of the Mathematics Achievement Test (MAT) were given to each group. Pre-test was given before the treatment and was collected on the spot. The teaching lasted for four weeks after which a post-test was given to the two groups and was collected on the spot. The Mathematics Achievement Test (MAT) was marked and scored. The scores were collected and subjected to analysis.

Method of Data Collection: Instrument was used to generate data on two different occasions during the study, namely pretest, and posttest. Participants of the experimental and the control groups were given a pretest before treatment and a posttest after treatment respectively.

Method of Data Analysis: At the end of the teaching, copies of MAT were administered to the students in both groups as pre-test and post-test scores were collected and subjected to analysis The research questions were answered using mean and standard deviation, while independent sample t-test was used for the testing of the hypotheses. $P \leq 0.05$ level of significance was set for rejecting or not rejecting the null hypotheses.

Presentation of Results

Research Question One: What is the mean achievement score of students taught mathematics using the concept mapping teaching method and lecture teaching method?

Table 1: Mean and standard deviation of mean achievement score of students taught mathematics using concept mapping teaching method and lecture teaching method.

Group		Pre-test		Post-test		
	N	Mean	SD	Mean	SD	Mean Gain
Experimental group (Concept Mapping)	18	16.22	5. 29	49.35	17.69	33.13
Control groups (Lecture Method)	22	13.25	4.69	22.27	6.91	9.02

From the table1 above, the data showed that students who were taught mathematics using the concept mapping teaching method had a post-test mean of 49.35 and a pre-test mean of 16.22 while those that were taught using the lecture method had a post-test mean of 22.27 and pre-test mean of 13.25. Therefore, the students taught using concept mapping had a mean gain of 33.13 while those taught with the lecture method had a mean gain of 9.02. So, the students that were exposed to the concept mapping teaching method achieved higher than those taught using the lecture method.

Research Question Two: What is the mean difference between the mean achievement scores of male and female students taught with the concept mapping method?

Table 2: Mean (X) and standard deviation (SD) scores of male and female students taught mathematics using concept mapping.

Group		Pre-test		Post-test		
	n	Mean	SD	Mean	SD	Mean Gain
Male	7	3.01	.74	3.27	0.52	0.26
Female	11	2.79	.56	3.40	0.38	0.61

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From the table 2 above, the data on students' achievement revealed that the male student had a pre-test mean of 3.01 in a pre-test and post-test mean of 3.27, while female students had a pre-test mean of 2.79 and a post-test mean of 3.40. Male students had a mean gain score of 0.26 while female students had a mean gain score of 0.61. Therefore, female students had a slightly higher achievement score in the concept mapping teaching method than male students.

Research Hypothesis One: There is no significant difference in the mean achievement score of students taught mathematics using the concept mapping teaching method and lecture teaching method.

Table 3: mean scores, standard deviation, and t-test of experimental and control group

Statistical Table	Number of students	Mean (X)	Standard deviation (SD)	T-calculated	T- critical	Degree of freedom (DF)	Alpha level
Experimental group	18	15.79	5.48	1.65	1.01	26	0.05
Control group	22	14.13	4.96				

From table 3 above, because the computed test statistic value exceeded the critical value (t- calculated= 1.65> t-critical =1.01), the researchers concluded that there is a significant difference between the mean achievement score of students taught mathematics using concept mapping and those taught using lecture method in the post-test. Therefore, the null hypothesis was rejected.

Hypothesis Two: There is no significant difference in the mean academic achievement scores of male and female students taught mathematics with the concept mapping teaching method.

Table 4: Mean score, standard deviation, and t-test of male and female students taught mathematics using concept mapping.

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Statistical Table	Number of students	Mean (X)	Standard deviation (SD)	T- calculated	T- critical	Degree of freedom (DF)	Alpha level
Male	11	2.79	0.55	0.97	1.55	17	0.05
Female	29	2.95	0.71				

From table 4, because the computed test statistic value is less than the critical value (t- calculated =0.97< t- critical= 1.55), the researchers concluded that there is no significant difference between the mean achievement score of male and female students taught mathematics using concept mapping in the post-test. Therefore, the null hypothesis was accepted. Thus, gender has no significant effect on the achievement of students in mathematics.

Discussion of the Findings

An insight into table 1 revealed that the students taught mathematics using concept mapping achieved better than those taught using the lecture method. This was evidenced by the scores obtained in both the pre-test and post-test. This could be because concept mapping provided the opportunity for active involvement of students in their learning process and enhance their thinking ability. Results from table 3 showed that there is a significant difference between the mean achievement score of students taught mathematics using concept mapping and those taught using the lecture method. This led to the rejection of the null hypothesis in favour of the alternative hypothesis having the t-calculated (t-cal) to be 1. 65 While the t-critical (t-crit) is 1.01. The findings of the present study are in consonance with the finding from the work of, Ezekannaya (2017) who carried a study on the effect of concept mapping and cognitive styles on the performance of students in integrated science and, the results indicated that those taught with concept mapping significantly achieved more than those taught with the conventional teaching method. Same way, the study conducted by Ekwueme & Umedo (2018), revealed that the students who were taught mathematics using computer-based concept mapping

(CBCM) achieved significantly better than those taught using the problem-based learning method (PBLM). Similarly, Chiou (2018) conducted research on the effect of concept mapping on students' learning achievements and interests and concluded that those exposed to accounting using concept maps performed better than those exposed to accounting using the expository method. Also, the study of Ezudu (2015) on the effect of concept mapping on students' performance and Retention in selected units of Physics, showed that concept mapping had a significant effect on students' overall performance.

Results from table 2 showed that females had mean achievement scores slightly higher than males. This is evidenced in both pre-test and post-test scores. However**,** results from table 4 showed that there was no significant difference between the mean performance score of male and female students taught mathematics using the concept mapping method. This led to why the null hypothesis was accepted having t-calculated (t-cal) to be 0.97 while the t-critical (t-crit) is 1.55. The findings of the study showed that gender has no significant influence on the achievement of students in mathematics. The findings of this study are consistent with the findings from the work of Ekwueme & Umedo (2018), whose results showed that CBCM has no effect on gender. And, Mamman & Isa (2018) in their study on the effectiveness of geogebra software on performance and attitude in mathematics among senior secondary school students in Municipal Zonal Education Area of Kano State, Nigeria revealed**,** a significant difference was also observed among students (male and female) within the experimental group. The male students performed slightly better than the female students even though the female students compete reasonably with the male students in obtaining higher grades. Similarly, Bilesaami-Awoderu (2012) found that male and female students have equal performance in physics in their studies. Moreso, Abimbola (2019) find out that male and female students achieved equally when taught with concept mapping strategy in their study. Likewise, Nnubia, (2019) conducted a study on the effect of gender on students' performance in Secondary School results revealed that gender (male/female) had no significant effect on student performance in social studies. However, the findings of this present study contradict the finding of, Ezeudu,

(2015). who observed that the average scores of male students in physics were constantly higher than those of the female students when taught with three different innovative methods. This present study agreed with the assertions that gender differences may exist but a good method of teaching should be capable to neutralize the difference.

Conclusion

From the study, it was concluded that the concept mapping teaching method is one of the effective methods of teaching mathematics at Senior Secondary Schools since it shows the potential of improving student's academic achievement

Concept mapping teaching method neutralizes the differences in male and female students' academic achievement in mathematics.

Implication of the study

The findings of this study have implications for teaching mathematics in Nigeria. The findings of the study showed that the use of the concept mapping teaching method enhances the achievement of students in mathematics more than the lecture method. This, by implication, means that the use of the lecture method of teaching cannot lead to effective teaching of mathematics as well as students' achievement.

Also, the findings indicated that gender is not a significant factor in the achievement of students in mathematics. The implication is that equal attention should be given to both male and female students during the teaching and learning of mathematics.

There is a need to move from using the teacher-centered method to the student-centered since it could enhance students' understanding of mathematical activities.

Recommendations

From the findings of the study, the following recommendations were made:

Teacher educators in Universities and Colleges of Education should be focused on preparing mathematics teachers to acquire appropriate skills and competence needed for concept mapping teaching method.

The ministry of education should through seminars, workshops, and conferences equip serving mathematics teachers with requisite knowledge and competencies on the utilization of concept maps in teaching and learning.

Mathematics teachers should be encouraged to use the concept mapping method in teaching and learning. This could be done by organizing seminars, workshops, and conferences for teachers by the Government or relevant professional bodies like the Mathematical Association of Nigeria (MAN), Science Teachers Association of Nigeria (STAN), and the teaching method Curriculum Association of Nigeria (CON) on how to adopt the use of concept mapping in the teaching and learning of mathematics in the classroom.

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