

EFFECT OF CONCEPT MAPPING STRATEGY ON THE ACADEMIC ACHIEVEMENT OF POST BASIC STUDENTS' IN MATHEMATICS IN OBUDU EDUCATION AREA OF CROSS RIVER STATE, NIGERIA

By

Adie Emmanuel B, Inah Lovinah Idoko,

Ibu Priscilia Nkow & Anditung Peter Agbudu

Department of Science Education, Faculty of Vocational & Science Education
University of Calabar, Calabar.

&

Igyo C. O.

Department of Science and Mathematics Education,
Benue State University Makurdi.

Abstract

The study investigated the Effect of Concept Mapping Strategy on the academic achievement of Post basic two students in Mathematics in Obudu Education Area of Cross River State, Nigeria. Two research questions and hypotheses each were formulated to guide the study. A quasi-experimental design was used with a simple random sampling technique applied to select one hundred and ten (110) students only as sample. The population comprised of all the one thousand and eighty-seven (1,087) post basic two (PB II) students in the fourteen government owned schools in Obudu Education Area of Cross River State, Nigeria. Two groups were used in the study. The experimental group which was exposed to the Concept Mapping Strategy and the control group exposed to the Conventional Method. A Standardized Teacher Constructed 'Trigonometry Achievement Test (STCTAT) validated with reliability coefficient of 0.82 was used. Data collected were analyzed using mean and standard deviation for answering the research questions while Analysis of Covariance (ANCOVA) was used in testing the hypotheses at 0.05 level of significance. The result revealed that students taught trigonometry using Concept Mapping Strategy achieved significantly higher than those taught using the Conventional Method. Moreso, the result showed no differential effect of Concept Mapping Strategy on students' achievement in trigonometry with respect to gender. Hence, it was recommended that the use of Concept Mapping Strategy should be adopted by mathematics teachers' as to promote creativity, thoughtfulness, relating of ideas, and gender friendliness among students'

Keywords: Concept Mapping Strategy, Post basic students, Trigonometry.

Introduction

Mathematics is the study of measurement, properties and relationship of quantities and sets using numbers and symbols. Adie, in Adie, Anditung & Inah (2019) defined mathematics as a systematic science with a conscious or an unconscious, originality, practicability and applicability in the daily activities of human; since all human activities revolve around it. The functionality of mathematics to man's daily activities cannot be overemphasized. On this premise, most nations of the world have continued to seek innovative

approaches in the improvement of teaching and learning of mathematics at all levels of education. Moreover, in Nigeria mathematics is regarded as a core subject due to its indispensability in other disciplines. The primary purpose of teaching mathematics at the post basic level of education is to bring a fundamental change to the learner through preparations for useful living within the society, and for higher education (FRN, 2013). Additionally, this enables students to develop basic skills in problem solving in an organization (Telima, 2014). The teaching and

learning of mathematics in a classroom setting is called mathematics education. In line with this, Piu (2018) posed that mathematics education is the practice of teaching and learning mathematics in a way to solving problems involving teaching and learning the algorithms and formulae necessary for computations. This is a platform for the teaching and learning of mathematics in a better way to improve achievement. Nonetheless, mathematics teachers can barely say it is well with the teaching and learning of mathematics in Nigeria. The underachievement in mathematics especially in trigonometry as reported by WAEC Chief Examiner (2020-2021) have been attributed to the continuous use of conventional teaching method which have not yielded the required result. Therefore, there is an urgent need to introduce an innovative teaching strategy such as concept mapping strategy which will help to solve this menace. The conventional method of teaching mathematics is teacher centered driven, which makes the teacher an active participant and the learner merely passive; here the learner (students) is involve in an habitual repetition of something (lesson) instead of developing critical thinking ability, relating of ideas, and a personal problem solving skills.

Adie, Inah, & Anditung (2019) stated that conventional method of teaching encourages students to pass examination without gaining full knowledge of the subject. This does not motivate the students to gear up towards critical thinking and developing basic skills needed for problem solving.

Concept mapping is the process of visualizing the relationships between concepts and ideas using charts and diagrams. Concept mapping has three key elements:

- a) Concepts: usually represented by circles or boxes ○ □
- b) Relationships: known as “arcs” () or “links” / \ to show relationship between concepts using words or phrases that better explain the idea.
- c) Proposition: the combination of concept one, the relationship and concept two

According to Canas and Novak (2005) Concept Mapping can be used to organize idea while studying and synthesis information from a prior lesson in the classroom. There is need for mathematics teachers to stress the deeper conceptualization of mathematics topics like trigonometry as a prominent factor in the learning of mathematics by students. The quality and depth of knowledge of the mathematics themes are also necessary factors to look at when measuring the effects of this concept mapping among students during mathematics lessons. Many researches have pointed out that the under achievement in mathematics during internal and external examinations is a product of poor teaching approach adopted. Awolafa (2011) argued that concept mapping strategy as preferred to the conventional approach (lecture method) is an effective strategy that is inquiry based, activity based, students-centered and minds on approach that caters for individual needs and differences.

Gender refers to the condition of being male or female. The issue of gender difference in the academic achievement of students in science and specifically in mathematics have attracted a global concern as different researchers have varying opinions based on their findings, while some are of the opinion that there is gender equality in mathematics achievement (Omoroh, Ukpebor & Onyeka, 2019; Ginga, Usman & Mohammed 2019;; Tali & Peter 2019; Achor, Imoko & Jimin 2012).

Other researchers like Kurumeh, Jimin & Mohammed, (2012), Otor,(2011), Ogbonna,(2014), oppose to this notion and cited mathematics and science activities indulged in by boys and girls as having influence on their academic achievement. It is against this backdrop that this study investigated the effect of concept mapping strategy on the academic achievement of post basic mathematics students with respect to gender.

Statement of the problem

In recent times (2019-2021) it has been observed that post basic students' academic

achievement in mathematics has continue to dwindle. Evidence abound for this continuous decrease in mathematics achievement especially in external examinations like WAEC, NECO.. Worst still is that only few candidates attempted questions in trigonometry in particular, especially at this level. One notable factor that has been pointed out as responsible for this decline is the poor teaching method used by most teachers in delivery of this lesson (trigonometry). The concern for this underachievement by students' in the subject has prompted the researchers to experiment the effect of concept mapping strategy on post basic students' academic achievement in mathematics especially in trigonometry.

Purpose of the study

This study investigated the effect of concept mapping strategy on post basic mathematics students' academic achievement in trigonometry in Obudu Education Area of Cross River State. Specifically the study sought to determine the;

- i. Mean achievement score of students taught trigonometry using concept mapping strategy and those taught using the conventional teaching method.
- ii. Mean achievement score of students taught trigonometry using concept mapping strategy with respect to gender.

Research questions

The following research questions were posed to guide the study;

- i. What is the mean achievement score of students taught trigonometry using concept mapping strategy and those taught with the conventional teaching method?
- ii. What is the mean achievement score of male and female students taught trigonometry using concept mapping strategy with respect to gender?

Hypotheses

The following hypotheses were formulated to guide the study and were tested at 0.05 level of significance.

Ho1: There is no significant difference between the mean academic achievement score of mathematics students taught trigonometry using concept mapping strategy and those taught with conventional method.

Ho2: There is no significant difference between the mean achievement score of male and female mathematics students' taught trigonometry using concept mapping strategy.

Methodology

The study adopted a quasi-experimental pre-test post-test non equivalent design. Hence, there was no randomization (Eze, 2015). The population of the study comprised of all the post basic II students (PB II) students in the fourteen (14) government owned schools in Obudu Education Area of Cross River State, which was one thousand and eighty-seven (1087) in the 2021 session. There are five hundred and thirty male students and five hundred and fifty-seven female students in Obudu Education Area of Cross River State (PBSMB, 2022). The sample size consists of one hundred and ten (110) PBS II mathematics students from two (2) intact classes in two schools. Simple random sampling was used to select two (2) out of the fourteen (14) government owned schools in the area. The simple random sampling was done using the hat and draw method in which folded piece of papers were selected without replacement. In each of the two selected schools, one intact class with fifty-four (54) students having twenty-six (26) males and twenty-eight (28) females and the intact class with fifty-six (56) students from another school with twenty-nine (29) females and twenty-seven (27) males were sampled. With simple random sampling technique each school was assigned to as experimental group that is (concept mapping strategy) and the control group (conventional

method) respectively. The instrument used for the study was a standardized teacher constructed trigonometry achievement test (TAT) and two lesson plans. A forty (40) items TAT instrument which was constructed in accordance with the topic “Trigonometry” was used for the pre-test and post-test. The post-test was administered to establish a statistical baseline for the experimental and control group. The post test was given after the teaching was carried out. The TAT and the two set of lesson plans were validated by two experts in the faculty of Educaon. The experts did a face validity and scrutinized the entire work by giving advice in terms of scope and coverage. A test blue print was developed with content relevance and ambiguity of expression corrected and suggestions made by experts were used to restructure the instrument, each question carrying 1 mark. Upon validation of the instrument a trial test was conducted on a sample of fifty two (52) post basic II students outside the study area to establish the reliability of the instrument. Data generated was used.

Kuder-Richardson Coefficient ($K-R_{21}$) was used to estimate the internal consistency reliability for the trigonometry Achievement test (TAT). It yielded reliability coefficient of 0.82 which showed a high reliability of the instrument.

Results

The data collected were analyzed and interpreted using mean and standard deviation to answer the research questions. Analysis of Covariance (ANCOVA) was used for testing the null hypotheses at 0.05 level of significance.

Research question one

What is the mean achievement score of mathematics students taught trigonometry using concept mapping strategy and those taught with the conventional method.

Table 1: Mean achievement scores and standard deviation of students taught using concept mapping strategy and those taught with conventional method.

Teaching Strategy	N	Pre-TAT Score		Post-TAT Score		Mean gain
		\bar{X}	S.D	\bar{X}	S.D	
Concept Mapping	54	30.21	9.52	56.44	11.54	26.23
Conventional method	56	30.46	8.66	52.80	10.46	22.34
Mean Difference		0.25		3.64		3.89

Table 1 shows the difference in the mean between the two groups at pre-TAT as 0.25. At Post-TAT, the table showed the difference as 3.64 in favour of the experimental group. The mean gains between the experimental and control groups were 26.23 and 22.34 respectively. The difference in their mean gains is 3.89 in favour of the experimental group.

Research question 2

What is the mean achievement score of male and female mathematics students taught trigonometry using concept mapping strategy

Table 2: Mean achievement scores and standard deviations of male and female students in the experimental group.

Gender	N	Pre-TAT Score		Post-TAT Score		Mean gain
		\bar{X}	S.D	\bar{X}	S.D	
Male Students	26	16.22	4.67	20.02	8.84	3.80
female Students	28	17.18	5.01	18.42	6.13	1.24
Mean Difference		0.96		1.60		2.56

Table 2 showed the difference in the mean between gender at Pre-TAT as 0.96 in favour of female students and at Post-TAT, the difference was 1.60 in favour of male students. The mean gain of male students was 3.80 while that of female students was 1.24. their differences between groups was 2.56 in favour of male students.

Hypothesis 1; There is no significant difference between the mean academic achievement score of mathematics students taught trigonometry using concept mapping strategy and those taught with the conventional method.

Table 3: One Way ANCOVA report on the effect of concept mapping strategy on mathematics students' achievement in trigonometry.

Source	Type III Sum of Squares	df	Mean Squares	F	Sig.
Corrected Model	4506.813	2	2253.406	42.603	0.00
Intercept	10246.031	1	10246.031	97.102	0.00
Concept Mapping Strategy	4506.813	1	4506.813	42.608	0.00
Error		102	106.342		0.00
Total		104			
Corrected Total		103			

From table 3 above, it was revealed that significant level of scores of students taught using concept mapping strategy and conventional method is 0.00 with probability (F) value of 42.603. this means that the null hypothesis which states there is no significant difference between the mean academic achievement score of mathematics students taught with concept mapping strategy and those taught with the conventional method was rejected. Hence, there is a significant difference

between the mean academic achievement score of mathematics students taught with concept mapping strategy and those taught with the conventional method.

Hypothesis 2: There is no significant difference between the mean academic achievement score of male and female mathematics students taught trigonometry with concept mapping.

Table 4: One Way ANCOVA report of the effect of concept mapping strategy on male and female mathematics students' achievement in trigonometry.

Source	Type III Sum of Squares	df	Means Squares	F	Sig.
Corrected Model	162.32	2	81.16	2.35	0.00
Intercept	4236.04	1	4236.04	127.18	0.00
Pretest	112.78	1	112.78	3.19	0.00
Gender	74.01	1	74.01	2.03	0.21
Error	5816.30	169	36.00		
Total	52378.40	172			
Corrected Total	5935.64	171			

Table 4 revealed that ($F_{(1,169)} = 2.03$ and $P = 0.21$) with $P > 0.05$. The null hypothesis was not rejected. This implies that the mean difference between male and female students who were taught trigonometry with concept mapping strategy was not significant. This means that both male and female students performed better with the use of this strategy.

Discussion of findings

The results showed that students taught trigonometry using concept mapping strategy significantly achieved higher mean scores in trigonometry compared to those taught with the conventional method. These findings were anchored on the fact that concept mapping strategy which is activity base enhances students creativity and skills that makes learning more meaningful.

These finding agrees with Omoroh; Ukpebor and Onyeka (2019), Awolafa (2011), who found out that there was a significant difference in the academic achievement of students in mathematics taught geometry using concept mapping strategy and those taught with the traditional approach.. The finding also corroborates the report of Ihejiamazu, Ekon, & Neji (2017), Ariaga & Nwanekezi (2018), Adah (2019), Ntibi, Agube & Neji (2020), Omenka, Ogbe & Onah (2016), Ogonnaya, Okafor, Abonyi & Ugama (2016) which revealed that students taught sciences using concept mapping strategy achieved significantly higher than those taught with the conventional method.

The findings also showed that the mean achievement scores between male and female

students who were taught trigonometry using concept mapping did not significantly differ. These findings indicate that concept mapping strategy is not gender sensitive. This finding is in tandem with Obande, Kurumeh, & Imoko (2019), Ugwuanyi, Mmadubugwu & Ezugwu (2019) who reported that there was no significant difference in the mean achievement score of male and female students taught mathematics using innovative teaching strategy. This also agrees with the findings of Ihejiamazu, Ekon, & Neji (2017), Ntibi, Agube & Neji (2020), Omenka, Ogbe & Onah (2017) which shows that there was no significant difference in the mean achievement score of male and female students taught in related field of sciences.

Conclusion

Based on the findings of this study, the followings were established:

- I. That concept mapping strategy is an effective way of improving achievement in trigonometry and mathematics in general, because it allows for inquiry, active class participation, and minds- on involvement of the students'..
- II. That there was no significant statistical difference in the achievement of male and female students taught using concept mapping strategy. Hence showing gender unbiasedness in the strategy.

Recommendations

The following recommendations were made based on the research findings.

- I. Firstly, mathematics teachers should be well trained on how to use and apply this strategy in the school through organizing of workshops, and conferences.
- II. School authorities should endeavour to provide related instructional aids that can encourage students to learn actively, since it is an activity based strategy.

References

- Achor, E. E., Imoko, B. I. & Jimin, N. (2012). Improving some Nigeria Secondary School Students' Achievement in Geometry: A field report on team teaching. *New York Science Journal, (STAN) Annual Conference Proceeding, Ibadan, 183-187.*
- Adah, S. A. (2019). Effect of concept mapping instructional strategy on secondary school students' achievement and interest in chemistry. *Journal of Science, Engineering and Technology, 6(1), 77-84.*
- Adie, E. B., Anditung P. A. & Inah, L. I. (2019). Students' Variables and their Academic Achievement in Technical Colleges in Mathematics in Ogoja Education Zone, Cross River State. *Interdisciplinary Journal of Science Education., 1(1), 71-78.*
- Ariaga, B. A. & Nwanekezi, E. (2018). Concept mapping strategy and its effects on students' performance in senior secondary school organic Chemistry. *International Journal of Scientific Research in Education, 11(4), 797-809.*
- Awofala, A. O. (2011). Effect of concept mapping strategy on students' achievement in junior secondary school mathematics. *International Journal of Mathematics Trends and Technology, 4(3) 11-16.*
- Canas, A. J. and Novak, J. D. (2005). The theory of underlying concept maps and how to construct and use them. Technical report: Institute for Human and Machine Cognitive. C map tools.
- Ezeh, D.N (2015). Writing research proposal and report without tears. 2A Menkiti Lane, Ogui, Enugu, Nigeria .TIMEX ENTERPRISES.,
- Federal Republic of Nigeria (FRN), (2013). *National Policy on Education: Yaba, Lagos, NERDC.*
- Ginga, U. A., Usman, N & Mohammed, B. (2019). Effect of Think-Pair-Share Instructional Strategy on Performance in Statistics Among Senior Secondary School Students in Zaria-Kaduna State, Nigeria. *Proceeding of 56th Annual National Conference of Mathematical Association of Nigeria (MAN).* 468-472.
- Ihejiamaizu, C. C., Ekon, E. E., & Neji, H. A. (2017). Comparative Effectiveness of Concept Mapping, 5E' Learning Cycle and Lecture method on students' achievement in Biology. Proceedings of the ISTEAMS Multidisciplinary Research Nexus conference Caleb University, Lagos.
- Kurumeh, M. S., Jimin, N., & Mohammed, A. S. (2012). Enhancing senior secondary school students in algebra using inquiry method of teaching in Onitsha Educational Zone of Anambra State, Nigeria. *Journal of Emerging Trends in Educational Research and Policy Studies, 3(6), 863-868.*
- Ntibi, Agube & Neji (2020). Effect of concept mapping, gender and school location on students' academic achievement in physics in Calabar, Nigeria. *interdisciplinary Journal of Science Education, 2(1), 90-102.*
- Obande, O. E., Kurumeh, M. S. & Imoko, B. I. (2019). Effect of Concrete-representational-abstract-strategy on Upper Basic Two Students' Achievement in Fraction in Education Zone of Benue State. *Proceeding of 56th Annual National Conference of Mathematical Association of Nigeria (MAN).* 702-708.

- Ogbonna, E.C. (2014). Effect of concept mapping on students' achievement and interest in selected concepts in organic chemistry. Unpublished M.Ed Thesis, University of Nigeria, Nsukka.
- Ogonnaya, U. P., Okafor, G., Abonyi, O. S., & Ugama, J. O. (2016). Effect of concept mapping instruction approach on students' achievement in basic science. *Journal of Education and Practice*, 7 (8), 43-56..
- Omenka, J. E., Ogbe, A. O. & Onah, F. O. (2017). Effect of concept mapping teaching strategy on secondary school students' achievement in science and mathematics. *Global Journal of Education*..
- Omoroh, P. Ukpebor, N. & Onyeka, P. (2019). Gender issues and its effect on students achievement with concept mapping instructional approach. *Proceeding of 56th Annual National Conference of Mathematical Association of Nigeria (MAN)*. 808-810.
- Otor, E.E. (2011). Effects of concept mapping strategy on students' attitude and achievement in difficult chemistry concept. A Ph.D. thesis submitted to the post graduate school, Benue State University, Makurdi. S
- Piu, A (2018). Simulation and gaming for Mathematics Education: Epistemology and teaching strategies. Retrieved on June 17, 2022 from <https://www.igi-global.com/book/simulation-and-gaming-mathematical-education/5785/>
- Tali, D. J., & Peter, D. (2019). Effect of Collaborative Learning Approach on Upper Basic Two Students' Interest in Geometry in Pankshin Education Zone. *Proceeding of 56th Annual National Conference of Mathematical Association of Nigeria (MAN)*. 444-451.
- Talima, A. (2014). Problem of teaching and learning geometry in secondary schools in River State, Nigeria. *International Journal of Emerging Science*, 1(2), 143-152.
- Ugwuanyi, C. C., Mmadubugwu, C. M., & Ezugwu (2019). Effect of Cooperative Learning Strategy on Senior Secondary School Students' Academic Achievement in Mathematics. *Proceeding of 56th Annual National Conference of Mathematical Association of Nigeria (MAN)*. 773-779.
- WAEC, (2019-2021). *Chief Examiner's Annual Report of West African Examination Council*. Lagos: Yaba.