

EFFECT OF ETHNO-MATHEMATICS TEACHING APPROACH ON PERFORMANCE AND RETENTION IN TRIGOMETRY AMONG SECONDARY SCHOOL STUDENTS IN ZARIA LOCAL GOVERNMENT AREA KADUNA STATE, NIGERIA

By

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Abstract

This study determined the effectiveness of Ethno-mathematics Teaching Approach on Performance and Retention in Trigonometry in Zaria LGA of Kaduna state, Nigeria. Using a sample size of 103 Senior Secondary 2 (SS 2) students out of (1350) SS2 students in 26 Public Senior Secondary School in the area. The study adopted quasi-experimental research design which involve experimental and control groups of which Experimental Group was exposed to Ethno-mathematics Teaching Approach and Control Group was exposed to Conventional Approach. The study was guided by two research questions and two research hypotheses. Trigonometry Concept Performance Test (TCPT) and Trigonometry Concepts Retention Test (TCRT) items with a reliability coefficient of 0.78 and 0.75 were used for pre-test and post-test. Answers to the research questions were given using Mean and Standard Deviation while the hypothesis one was tested at 0.05 level of significance using independent sample t-test analysis for performance and Man-Whitney u-test analysis for retention. The results from the analysis revealed that students exposed to Ethno-Mathematics Teaching Approach were superiors in performance and retention than those taught with Conventional Approach. Thus there were significant differences between the mean performance scores and retention scores of the students taught Trigonometry concepts with Ethno-Mathematics Teaching Approach and those taught with Conventional Approach. Recommendations were made among which is necessary attention should be accorded to application of concepts in Mathematics to real life situation in our environment or society by the Mathematics teachers

Keywords: *Ethno-Mathematics Teaching Approach*

Introduction

The need to acquire knowledge in Mathematics in the world over has become very obvious. This is because it is relevant to everyday living and in various disciplines. As a follow up, it has been a compulsory subject both at primary and secondary school levels in Nigeria. Its usefulness in technological development of the nation as well as to mankind (Azuka, 2003; Salman, 2003; Imoko, 2004; Uloko and Usman, 2008) further stresses the need for it. As important as the subject is, the tremendous and persistent failures of the Nigerian Students in it (Sanni and Ochepea, 2002; Uloko & Imoko, 2007; Abakpa and Agbo - Egwu, 2008) has remained a major threat to its learning. The failure rate was so high that Nigeria was found to occupy the second to the last position when *Corresponding author. E-mail: nuelachor@yahoo.com. compared with the eleven other English speaking West African countries in mathematics in School Certificate Examination (Abakpa and Agbo - Egwu, 2008). Attempts to find solution to this incessant failure have made researchers in mathematics education to consider a number of factors. One of such factors which is closely re-examined in this study is the inappropriate method of teaching. According to Harbor-Peters (2001), low performance in trigonometrical concepts is caused by the teachers' non

utilization of appropriate teaching approaches. The researchers in this study quite agree with the observations made in some certain quarters that, some method of teaching mathematics in Nigeria is completely out of phase with background and local environments of the learners. That this method is foreign in nature, has no bearing with the Nigeria culture, and purely derived from euro-centric culture (Obodo, 1997; Kurumeh, 2004; Uloko, 2006; Uloko & Imoko, 2007). One of the consequences of over dependence on foreign approaches to teaching trigonometrical concepts is the seemingly lack of basic mathematical principles which results to rote-learning and low performance in mathematics as could be seen in Nigeria today. Attempts to address this problem have necessitated the fact that teachers should evolve strategies that will ensure active participation of learners, practical oriented, project oriented and applicable (Obodo, 1997; D'Ambrosio, 2001; Kurumeh, 2004; Uloko, 2006). This seems to call for the option of giving ethno-mathematics a trial; being a teaching approach, which focuses students' background, their immediate environments integrated with the euro-centric mathematics in a practical way as demanded by the concept of trigonometry.

Ethno-mathematics was a coined term first introduced in 1986 by a Brazilian mathematics educator, Ubiratan D' Ambrosio. This concept is deeply rooted in the idea and philosophy of Paul Freire. Simply, ethno refers to the 'cultural context' while mathema refers 'to explain', 'to know' or 'to understand' and tics has to do with techne which is also rooted in art and techniques. Thus according to Davidson (2000), Ethno-mathematics is the art or technique of explaining, knowing and understanding diverse cultural contexts. Further, Shirley (1995) expressed that Ethno-mathematics has come to include the documentation and the study of culturally related learning styles. Ethno-mathematics is the study of mathematics which takes into consideration the culture in which mathematics arises (Kurumeh, 2004). She stresses further that if we conceptualize mathematics as the development of structures and systems of ideas involving number, pattern, logic and spatial configuration and then examine how mathematics arises and is used in various cultures, it is possible to gain a much deeper understanding of the subject. Perhaps such understanding may depend on the section of mathematics (for instance trigonometry concepts) being considered such include Angles, angle of elevation, Angle depression and bearing and distance. Effective teaching of trigonometry concepts in line with students own environment may be particularly important in the light of evidence suggesting that scientific literacy help prepare students to interpret scientific environment, enhance students' competency in science, technology and engineering and also improving critical thinking and problems solving skills.

Ethno-mathematics and its Practical Applications in Trigonometry

Applications of trigonometry in real life situation in our society are numerous, such includes: house gates, car triangle, ultra sound scan of a pregnant woman, police stop sign board, radian and time are used in timing for instance seconds, minutes, days, and years, in our daily activities, angles are essential, most importantly angles 90 degree and 180 degrees. In our every day construction that is built is based on some point on a perpendicular 90 degree angles, walls, doorframes, window frames and roofing. Trigonometry is commonly used in finding the height of towers and mountains in our society, it is used in navigation to find the distance of shore from a point in a sea, trigonometry sine and cosine functions are fundamental to the theory of periodic functions such as those that describe sound and light waves, Architect applies trigonometry to calculate structural load, roof, slopes, ground surfaces and many other aspects including sun shading and light angles. The bridges we use

today were built using an understanding of forces acting at different angles, construction of bridges involve many triangles; trigonometry was used when designing the lengths and strengths of those triangles. Trigonometry is used in our cars and cell-phone which has an inbuilt Global Positioning System (GPS) to tells you exactly where you are on the earth's surface. It also uses data from several satellites and earth geometry. Most people today listen to some music been recorded digitally (a process that requires fast- fourier Transformations, which uses trigonometry). Trigonometry is applied in towers such as MTN, GLO, AIRTEL, and Radio towers use triangles. The knowledge of bearing is vital tool for the pilots, sailors and solders. The process helps soldiers to locate the position of enemies during wars and range of shelling. It also enables the students to transfer the knowledge of trigonometry in latitudes and longitudes in locating a country, cities, towns, and villages in his community.

The repeated record of poor performance in trigonometry concepts which is a central concept in Mathematics syllabus demands an urgent attention if the country wants to succeed in Science and Technology. Since the study of the field in focus calls for practical activities, the use of the environment with its loaded cultural contents or simply ethno-mathematics is considered appropriate. Ethno-mathematics is the cultural utility of mathematics as a science (Harbor-Peters, 2001). To D'Ambrosio (2001), it is an approach of teaching and learning mathematics which builds on the students' previous knowledge, background, the role his environment plays in terms of content and method, and his past and present experiences of immediate environment. To him the approach could be in a practical way. It is on this basis that this study investigates the effect of Ethno-mathematics Teaching Approach (EMTA) on performance and retention of students in trigonometry concepts.

According to Kurumeh (2004), EMTA is an approach used to explain the reality of relationship between cultural environment and Mathematics while teaching. For the purpose of this study, EMTA is defined as the use of familiar and immediate environments of a learner in teaching him mathematics. It is an approach that translates the foreign or euro-centric Mathematics to suit the background and familiar environment of the learner for meaningful teaching and learning. Of particular interest is the practical approach. The study intends to employ the reach cultural environment of the study area especially their man made and building activities to teach trigonometry concepts in Mathematics. The secrete behind the Japanese's and Chinese's success in mathematics, Science and Technology today is traceable to their use of ethno-mathematics (Tereziaha, 1999; Obodo, 2000; Kurumeh, 2004; Uloko and Imoko, 2007). This study therefore, investigates whether the use of EMTA (which combines indigenou with foreign Mathematics backgrounds) will also help Nigerian students achieve high in trigonometrical concepts. In this study, all the present teaching approaches other than ethno-mathematics put together is referred to as conventional approach. It is one thing to be taught Mathematics via a preferred approach such as EMTA; it is another thing to remember it after some reasonable period of time must have elapsed, that is retention. Retention as defined by Hornby (2001) is the ability to remember things. In another word retention is defined as the ability to keep or retain the knowledge of trigonometrical concepts learnt and to be able to recall it when required. Retention in mathematics is not acquired by mere rote-memorization but through appropriate teaching method (Iji, 2002; Chianson, 2008). According to the findings of Iji (2002), and Chianson (2008), those students in the experimental group retained more of the learnt mathematics than those in the control group although for Iji the noted difference was not statistically significant.

2. Statement of the problem

Students, parents, educators, government and the populace are worried because of the persistent poor achievement of students in Mathematics. Evidence shows that this condition is deplorably high, to the point that Nigeria students start competing for the last position instead of first in Mathematics in School Certificate Examination among the eleven English-speaking West African Countries. Also there is evidence to lend support to the fact that this poor performance and retention is as a result of non-utilization of appropriate teaching approaches in the subject (Waec, 2016 & Fakayode, 2017). One wonders why all the methods used so far are not capable of reversing this ugly trend. It is however noted that the use of EMTA has not been tried out in Nigeria, particularly in trigonometry concepts to see if it could reverse this poor performance. Therefore, the problem of this study is how to provide evidence on the effectiveness or otherwise of the use of ethno--mathematics teaching approach on students' performance and retention in trigonometry concepts.

3. Objectives of the Study

The main objectives of this study are to investigate the effect of ethno-mathematics teaching approach on performance and retention in trigonometry concepts among senior secondary school students in Zaria Local Government Area kaduna State, Nigeria.

Specifically therefore, the following are the objectives of the study:

1. To investigate whether the EMTA has effect on performance of secondary school students' taught trigonometry concepts.
2. To verify whether the EMTA has an effect on retention of secondary school students' taught trigonometry concepts.

4. Research questions

In order to carry out the investigation, the following research questions were formulated as a guide to the study:

1. In what way does the performance of students taught trigonometry concepts with EMTA and those taught trigonometry concepts with lecture method differ?
2. To what extent does the retention of students taught trigonometry concepts using EMTA and those taught the same concept using lecture method differ?

5. Research Hypotheses

From the research questions, the following null hypotheses were formulated and were tested at 0.05 level of significance using SPSS package 20.0 version.

H₀₁: There is no significant difference in performance of students taught Trigonometry concepts using EMTA Instruction and those taught with lecture method.

H₀₂: There is no significant difference in the retention of students taught Trigonometry concepts using EMTA Instruction and those taught with lecture method.

6. Methodology

This study was a non equivalent quasi-experimental design. The reason for adopting this design was that the researchers found it difficult to randomize every subject (Ezeh, 2005) and have no absolute control over the subject intact classes were therefore used.

The population comprised of (1350) SS 2 students in 26 public senior secondary school students in Zaria Local Government Area of Kaduna State, Nigeria. The choice of this population was because the concept of trigonometry is mostly taught at SS 2 level.

The sample for this study was (103) SS 2 students. Simple random sampling technique was used were sampled out of the 26 schools in Zaria local Government Area for the study. Thereafter, one intact class was selected from each of the school. Two schools were randomized and assigned experimental and control groups respectively. The experimental group was taught with EMTA while the control group was taught with the conventional approach. The experimental group comprised 57 students while the control group comprise of 46 students, making a total of 103 students used for the study.

The instrument used in the study was Trigonometry concepts Performance Test (TCPT) which was both face and content validated. The validation was done by two experts in measurement and evaluation and two experts in mathematics education at Mathematics Department FCE Zaria. TCPT was used for pre, post and delayed tests to collect data but reshuffled each time. A 20 items TCPT was comprehensively developed based on a table of specification. The instrument was then administered on students as pre test (mean 16.34) before commencement of the teaching. After three weeks of teaching, TCPT was reshuffled and re-administered on the students as post test (mean 28.31). After another two weeks it was again reshuffled and administered as retention test. The reliability coefficient using PPMC was 0.78. This was considered reliable enough to be used for data collection in this study. One regular mathematics teachers from each of the two schools were used as an assistant in the teaching process of the students. These research assistants were trained by the researchers before the commencement of the study. The training exercise was based on the purpose of the study, the topic to be taught, the use of the lesson plans, the use of the TCPT as well as general conduct of the study. The researcher teach the experimental groups using ethno mathematics teaching approach and control group were exposed to normal class teaching-called conventional approach in this study.

7. RESULTS

The results of the study were presented according to the research questions and hypotheses.

Research Question 1: What is the difference in the mean performance of students taught trigonometry concepts using EMTA and those taught the same concepts using lecture method?

Table 1: Mean and Standard Deviation for performance between Experimental and Control Groups

Group	n	x	S.D	M.D
Experimental	57	28.31	6.12	13.10
Control	46	15.21	5.02	

It can be seen from Table 1 that, experimental group exposed to EMTA has a mean score of 28.31 over 40 percent, while control group exposed to lecture method has a mean score of 15.21 over 40 percent. This indicates that the students exposed to EMTA performed higher than those exposed to lecture method. It is empirically established that experimental group students that were exposed to EMTA respectively performed higher than their counterparts in the lecture

method. To establish if the difference is statistically significant inferential statistic was used to test the Null hypotheses

Research Question 2: What is the difference in retention between Experimental and Control Groups students taught trigonometry concepts using EMTA?

Table 2: Mean Rank and Sum of Rank for Retention between Experimental and Control Groups

Group	n	Mean Rank	Sum of Rank
Experimental	57	43.11	15326.50
Control	46	173.32	56304.50

From Table 2, it can be seen that retention change of Experimental Group exposed to EMTA is 43.11 (mean rank) and those exposed to conventional approach is 173.32 (Mean Rank) and sum of rank for experimental group is 15326.50 while control group is 56304.50. This indicates a great difference in the retention of students toward learning of Trigonometry concepts.

Hypothesis 1

There is no significant difference in the mean performance of students taught Trigonometry concepts using EMTA and those taught with CA.

To test H_{01} , Independent Sample t-test was used, summary of the analysis is shown in Table 3.

Table 3: t-test Analysis for Performance between Experimental and Control Groups

Group	N	x	S.D	df	t	P
Experimental	57	28.31	6.12	101	25.95	0.000
Control	46	15.21	5.02			

Significant level at 0.05

From Table 3, the result showed that p-value 0.000 is less than the alpha value of 0.05 level of significance at df 101. Since the p-value observed is less than alpha value it means the difference is significant. Therefore, the null hypothesis 1 which states that there is no significant difference in the performance of secondary school students taught trigonometry concepts using EMTA and those taught with conventional approach is rejected.

Hypothesis 2

There is no significant difference in retention of students taught Trigonometry concepts using EMTA and those taught with lecture method.

To test H_{02} Mann-Whitney u-test was used to analyse the post test retention scores for the two Groups (Experimental and Control). This provided the means of testing the Null hypothesis as shown in Table 4.

Table 4: u-test Analysis for Retention between Experimental and Control Groups

Group	n	Mean Rank	Sum of Rank	u-value	z- value	p- value
Experimental	57	43.11	15326.50	448.50	-16.344	0.000
Control	46	173.32	56304.50			

Significant level at 0.05

From Table 4, it can be seen that the p-value for EG and CG is 0.000 is less than the alpha value of 0.05 in favour of Experimental Groups. This result shows that there is a significant difference in the retention of students exposed to EMTA and conventional approach method respectively. However, the null hypothesis 2 which states that there is no significant difference is therefore rejected.

8. Discussion

This study has shown that students taught with EMTA had a higher mean performance score (28.31) than their counterparts taught with conventional approach with (15.21) mean achievement score. This was further confirmed by the results in Table 2 which reveals that the difference in retention between the experimental (43.11) and control (173.32) groups was significant. The reason for this higher achievement by the EMTA group could be that the students were able to integrate or link their background of study and their immediate environment with the foreign aspect of the learning of trigonometrical concepts. This finding is in agreement with that of Uloko and Usman (2008). The teaching was done in a practical way and as such it flows from home to school and from school to one's trade and to everyday living (Uloko and Ogwuche, 2007). Thus the abstract nature of teaching and learning of mathematics seemed to have been reduced. This agreed with the definition of ethno-mathematics by D'Ambrosio (2001) who states that it is an approach of teaching and learning of trigonometry that builds on the background, and environment in terms of content and method, and his past and present experiences. This also agrees with earlier observations that failure in mathematics in Nigeria is due to the fact that the teaching and learning is purely foreign in nature (Obodo, 1997; Kurumeh, 2004; Uloko, 2006; Uloko and Imoko, 2007; Uloko and Ogwuche, 2007). The high performance of students in this study also shows that when EMTA is used in a practical way it could be an effective teaching approach. This agrees with the view of D'Ambrosio (2001) which states that EMTA can also be used in a practical way. Thus as Harbor - Peters (2001) stated, low achievement of students in mathematics could therefore be attributed to non-utilization of appropriate teaching approach.

Table 2 shows that the retention scores (43.11) of students taught using EMTA is higher than the retention scores (173.32) of those taught with the conventional approach. This agrees with the results of Iji (2004) and Chianson (2008) who found that students in the experimental group retain better than those in the conventional group. Table 4 reveals that the difference between the retention scores of experimental and a control groups is statistically significant. This disagrees with Iji (2004) who in his study found that the difference was not significant statistically.

9. Conclusions

The study focused on Effect of EMTA on performance and attitude in trigonometry among senior secondary schools students in Zaria local government area of Kaduna state. This section dealt with the conclusion of the study which was based on the findings presented in the result. The findings were based on descriptive and inferential statistics of data collected.

Experimental Group exposed to EMTA performed significantly better academically than Control Group exposed to conventional method

Students exposed to EMTA had significantly higher retention change than their counterparts that were exposed to conventional approach.

10. Recommendations

Based on the findings of the study, the following recommendations were made:

1. Necessary attention should be accorded to application of concepts in Mathematics to real life situation in our environment or society by the Mathematics teachers in Zaria Kaduna state to enhance the students retention toward trigonometry concepts and Mathematics in general
2. The teaching of Mathematics in general should be conducted in such a way that students should be actively involved in the learning processes, which enable them to see Mathematics as part of their daily life activities and thereby enhance the students' performance and retention academically.
3. The students exposed to EMTA were superior in performance and retention than those exposed to conventional teaching method. In general, EMTA has proved to be a viable option in promoting meaningful learning in trigonometry. Hence, it is recommended that Mathematics teachers should be trained through workshops, conferences, and seminars on the use of ethno-mathematics teaching approach in their lessons.

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