

Full Length Research Paper

Effect of ethnomathematics teaching approach on senior secondary students' achievement and retention in locus

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This study determined the effectiveness of ethnomathematics teaching approach, ETA on students' achievement and retention in Locus. The study was carried out in education zone B of Benue State of Nigeria using a sample size of 253 Senior Secondary 2 (SS 2) students. It was a non equivalent quasi-experimental study which was guided by two research questions and two hypotheses. Locus Achievement Test (LAT) instrument with a reliability coefficient of 0.78 was used as pre, post and delayed tests though reshuffled each time. Answers to the research questions were given using mean and standard deviation while the hypotheses were tested at 0.05 significant level using a 2-way analysis of covariance (ANCOVA). Results from the analysis revealed that students exposed to ETA were superior in achievement and retention than those taught with conventional approach. Thus there were significant differences between the mean score of the students taught Locus with ETA and those taught with the conventional approach in both achievement ($F_{1, 248} = 241.317, p = 0.000$) and retention ($F_{1, 248} = 270.421, p = 0.000$). The study therefore recommended training of mathematics teachers on the use of ethnomathematics in their daily lessons especially in Locus with a view to making learning meaningful, relevant and interesting.

Key words: Ethnomathematics, achievement, retention, teaching methods, locus in mathematics, geometry.

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 and 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

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 achievement in mathematics 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, the method of teaching mathematics in Nigeria is completely out of phase with background and local environments of the learners. Further, 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 and Imoko, 2007; Uloko and

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Ogwuche, 2007). One of the consequences of over dependence on foreign approaches to teaching mathematics is the seemingly lack of basic mathematical principles which results to rote-learning and low achievement 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 ethnomathematics 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 Locus.

Ethnomathematics 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 (e.g. Locus) being considered.

Locus can simply be explained as the path traced by a point under specific conditions (Osugwu, Anemalu and Onyeozili, 2000). This path may be a straight line; it may be a curve as parabola, trajectory or circle as ellipse. It is a concept that occupies a central place in the study of geometry. For instance, the study of conic sections in geometry is purely locus. Geometry is a branch of mathematics that deals with the measure and properties of points, lines, curves and surfaces. Geometry forms the building blocks of engineering and technical graphics. Further, the conic section of geometry which is purely locus is of great importance to astronomy, mechanics and technology (Aleksandrov, Kolmogorov and Lav-rent'ev, 2005). The repeated record of poor performance in geometry which locus is central, demands urgent attention if the country must have a breakthrough 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 ethnomathematics is considered appropriate.

Ethnomathematics 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 his immediate environment. To him the approach could be in a practical way. It is on this basis that this study investigates the effect of Ethnomathematics Teaching Approach (ETA) (employing its practical attributes) on achievement and retention of students in Locus. According to Kurumeh (2004), ETA is an approach used

to explain the reality of relationship between cultural environment and mathematics while teaching. For the purpose of this study, ETA 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. This study intends to employ the reach cultural environment of the study area especially their farming and building activities to teach Locus in Mathematics.

The secret behind the Japanese's and Chinese's success in mathematics, science and technology today is traceable to their use of ethnomathematics (Tereziaha, 1999; Obodo, 2000; Kurumeh, 2004; Uloko and Imoko, 2007). This study therefore, investigates whether the use of ETA (which combines indigenous with foreign mathematics backgrounds) will also help Nigerian students achieve high in Locus. In this study, all the present teaching approaches other than ethnomathematics put together is referred to as conventional approach.

It is one thing to be taught mathematics via a preferred approach such as ETA; 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. For the purpose of this study, retention is defined as the ability to keep or retain the knowledge of locus 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.

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 achievement and retention is as a result of non-utilization of appropriate teaching approaches in the subject. 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 ETA has not been tried out in Nigeria, particularly in locus to see if it could reverse this poor achievement. Therefore, the problem of this study is how to provide evidence on the effectiveness or otherwise of the use of ethnomathematics teaching approach

on students' achievement and retention in Locus.

Ethnomathematics and its practical application in locus

Ethnomathematics 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 technique which is also rooted in art and techniques. Thus according to Davidson (2000), Ethnomathematics is the art or technique of explaining, knowing and understanding diverse cultural contexts. Further, Shirley (1995) says that Ethnomathematics has come to include the documentation and the study of culturally related learning styles. It is found to facilitate development of learners in Mathematics especially women (Gilmer and Milwanke, 2001; Knijinik, 1997). In particular, Mogari (2002) found the use of ETA to be efficacious. In the present study, how the people roof their round hut thatch houses and mark their farms is particularly employed.

The people of Benue State of Nigeria especially Education zone B which comprise of the Tiv speaking tribe mainly have very rich cultural practices that could be used to advantage to teach Locus in Mathematics. They dwell in hut thatch houses mainly in all rural areas and are predominantly farmers. Consequently how they roof their houses and mark or map out their yam farms in interesting.

Let us consider their roofing style. The people begin roofing of their round hut houses on plain ground starting by knotting loosely a syrup rope (that is, a circle or an ellipse). Thereafter, two sticks of a required length are pushed through the circle. The sticks are then made to stand erect on flat ground and separated from one another by a required distance at the base, that is, the part touching the ground. The angle can then be measured. Further, more sticks are pushed through the loosely tied knot to enable further works on the roofing and to allow the cone-shaped roof stand on its base.

The students were brought out of the class to do this practically. This was accompanied by measurements such angles, diameter and radius of circle as well as the length of sticks used.

In farm mapping, boundaries are created with straight lines which sometimes are imagined and in recent time determined with rope. In the process pegs are used to ensure that the shape expected (e.g., rectangular, square, etc) is obtained. The practical approach was used in the preparation of the lesson plans and as well the teaching of the experimental group.

Research questions

These research questions guided the study:

1. What is the relative effect of the use of ETA and conventional teaching method on students' mean achievement scores in Locus?
2. What is the relative effect of the use of ETA and conventional teaching methods on students' mean retention scores in Locus?

Hypotheses

These null hypotheses were tested at 0.05 level of significance:

1. There is no significant difference in the mean achievement scores of students taught Locus using ETA and those taught using the conventional approach.
2. There is no significant difference in the mean retention scores of students taught Locus with ETA and those taught with the conventional approach.

RESEARCH METHOD

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). Intact classes were therefore used.

The population comprised of all the SS 2 students in education zone B of Benue State, Nigeria. The choice of this population was because the concept of Locus is taught in SS 2.

The sample for this study was 253 SS 2 students. Multi stage sampling was involved. First four schools were sampled out of the rest schools in the zone for the study. Thereafter, two intact classes were selected from each of these schools. Two schools were randomized and assigned experimental and control groups respectively. The experimental group was taught with ETA while the control group was taught with the conventional approach. The experimental group comprised 131 male and female students while the control group comprise of 122 male and female students, making a total of 253 students used for the study.

The instrument used in the study was Locus Achievement Test (LAT) which was both face and content validated. The validation was done by two experts in measurement and evaluation and three experts in mathematics education.

LAT was used for pre, post and delayed tests to collect data but reshuffled each time. A 20 items LAT was comprehensively developed based on a table of specification. The instrument was then administered on students as pre test before commencement of the teaching. After two weeks of teaching, LAT was reshuffled and re-administered on the students as post test. After another two weeks it was again reshuffled and administered as retention test. The reliability coefficient of Lat using Cronbach Alpha was 0.78. This was considered reliable enough to be used for data collection in this study.

Two regular mathematics teachers from each of these four schools were used to teach the students. These research assistants were trained by the researchers one week 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 LAT as well as general conduct of the study. These teachers were trained to teach both the experimental and control groups. The teachers to teach the experimental groups used ethnomathematics teaching approach. Those to teach the control groups used the normal class teaching- called conventional in this study.

Ethnomathematics teaching approach as used in this study in-

Table 1. Mean achievement scores and standard deviation of subjects in the experimental and control groups.

Teaching method	Type of test	N	Mean	SD
Ethnomathematics	Pre-Test	131	12.1374	5.8188
	Post-Test	131	45.3435	9.8487
Conventional	Pre-Test	122	11.1475	7.4630
	Post-Test	122	25.9426	11.1216

volves taking the students out of class to practically undertake some culturally loaded activities like house roofing and farm layout. Specifically, students were made to roof houses, lay out some farms and in the process take measurements to be further used in calculation. Since the focus is Locus, emphasis was on straight line, circle/ellipse, trajectories and parabolic shapes. It was ensured that all the teachers used equal length of time (two weeks) to teach the concept to both groups. Throughout the exercise, the researchers went round to supervise and ensured smooth teaching in all classes.

RESULTS

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

Question 1

What is the relative effect of the use of ETA and conventional teaching method on students' mean achievement scores in Locus?

Answer to research question 1 is found in Table 1.

Table 1 shows that the mean achievement scores of students taught with ETA was 45.34, standard deviation was 9.84 while that of the students taught with conventional approach was 25.94 with standard deviation of 11.12. This implies that ETA is more efficacious than the conventional approach.

Hypothesis 1 was therefore tested to confirm this answer.

Hypothesis 1

There is no significant difference in the mean achievement scores of students taught Locus with ETA and those taught using conventional approach.

The analyzed data for testing hypothesis 1 is found in Table 2.

Results in Table 2 reveal that the noted difference between the mean achievement scores of those taught with ETA and those taught with the conventional approach is significant at .05 alpha level. The null hypothesis was therefore rejected.

Question 2

What is the relative effect of the use of ETA and conven-

tional method on students' mean retention scores in Locus?

Answer to research question 2 is found in Table 3.

Table 3 shows that the mean retention scores of students taught with ETA was 58.0142, standard deviation was 5.3215, while that of the student taught with conventional approach was 21.4501 with standard deviation of 12.3522. This implies that ETA is more effective than the conventional approach in teaching locus. Hypothesis 2 was further tested to confirm this answer.

Hypothesis 2

There is no significant difference between the mean retention scores of students taught with ETA and those taught with the conventional approach. Result for testing hypothesis 2 is contained in Table 4.

Result in Table 4 shows that the noted difference between the mean retention scores of those taught with ETA and those taught with the conventional approach is significant at .05 alpha level. The stated null hypothesis was therefore rejected.

DISCUSSION

This study has shown that students taught with ETA had a higher mean achievement score (45.34) in Locus than their counterparts taught with conventional approach with (25.94) mean achievement score. This was further confirmed by the results in Table 2 which reveals that the difference in achievement between the experimental and control groups was significant ($F_{1,248} = 241.317$, $p < 0.000$). The reason for this higher achievement by the ETA 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 Locus. 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 ethnomathematics by D'Ambrosio (2001) who states that it is an approach of teaching and learning of mathematics that builds on the background, the role his environment play

Table 2. Two-way ANCOVA result on subjects achievement scores in LAT.

Source of variance	Type III sum of square	Df.	Mean square	F	Sig.	Result
Corrected model	33927.279	4	8481.757	120.70	.000	S
Intercept	38217.279	1	38217.279	543.895	.000	S
PRELAT	6672.535	1	6672.535	241.317	.000	S
Method	16956.346	1	16956.346	241.317	.000	S
Error	17425.988	248	70.266			
Total	379025.000					
Corrected Total	51352964.00					

S = Significant at $p < 0.5$

Table 3. Mean Retention Scores and Standard Deviation in LAT of subjects in the Experimental and control groups.

Teaching method	Type of test	N	Mean	SD
Ethnomathematics	Post – Test	131	45.3435	5.8188
	Retention	131	58.0142	5.3215
Conventional	Post – Test	122	25.9426	11.1216
	Retention	122	21.4501	12.3522

Table 4. Two-way ANCOVA Result of Retention Scores in LAT of Subjects in Experimental and Control groups.

Source of variance	Type III sum of square	Df	Mean square	F	Sig.	Result
Corrected model	36051.426	4	9261.352	125.52	.000	S
Intercept	40114.426	1	40114.426	640.536	.000	S
PRELAT	7840.625	1	7840.625	270.421	.000	S
Method	18396.421	1	18396.421	270.421	.000	S
Error	19145.683	248	75.472			
Total	396136.000					
Corrected Total	66094788.00					

S = Significant at $p < .05$

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 achievement of students in this study also shows that when ETA 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 ETA 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 3 shows that the retention mean scores (58.01) of students taught using ETA is higher than the retention mean scores (21.35) 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 means scores of experimental and a control groups is statistically significant ($F_{1, 248}=270.421$, $p < .000$). This disagrees with Iji (2004) who in his study found that the difference was not significant statistically.

Conclusion and Recommendation

Achievement and retention in Locus in this study depend on the approach of instruction. The students exposed to ETA were superior in achievement and retention than those exposed to conventional teaching method. In general, ETA has proved to be a viable option in promoting meaningful learning in Locus. Hence, it is recommended that mathematics teachers should be trained on

the use of ethnomathematics teaching approach in their lessons.

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