Greener Journal of Educational Research
Vol. 2(3), pp. 054-062, October 2012
ISSN: 2276-7789 ICV: 6.05

DOI Link: http://doi.org/10.15580/GJER.2012.3.10051286
http://gjournals.org/GJER

Improving Students' Retention in Junior Secondary School Statistics using the Ethno-mathematics Teaching Approach in Obi and Oju Local Government Areas of Benue State, Nigeria

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ARTICLE INFO

Article No.: *10051286*
***Type*:** *Research*
DOI: *10.15580/GJER.2012.3.10051286*

Submitted: *05/10/2012*
Accepted: *15/10/2012*
Published: *22/10/2012*

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Keywords:
Ethnomathematics, ethnomathematics approach, retention, teaching methods, statistics, teaching mathematics, conventional approach

ABSTRACT

This study was designed to determine the effect of the ethnomathematics teaching approach on Junior Secondary three (JS3) students' retention in statistics. It is also aimed at determining whether any of the sexes (male and female) would retain statistics concepts more than the other from the teaching. The study was carried out in Obi and Oju education areas of zone C in Benue state of Nigeria using a sample size of 248 junior secondary three (JS3) students. The study employed Quasi- experimental design of non-equivalent but culturally homogenous group. Intact classes were used for both the experimental and control groups. The experimental group was taught using the ethnomathematics approach while control group was taught using conventional approach. Two research questions and two research hypotheses were formulated to guide this study. Statistics Retention Test (SRT) instrument with the reliability coefficient of 0.80 was used as pre, post and retention tests though reshuffled each time for data collection. Mean and Standard deviation were used to answer the research questions while an ANCOVA was used to test the null hypotheses at a 0.05 level of significance. The results revealed among others that the ethnomathematics teaching approach was more effective in facilitating and improving students' retention in statistics than the conventional approach. The ethnomathematics teaching approach did not significantly differentiate between the sexes (male and female) retention scores in statistics. These findings have implications for all Mathematics teachers and stakeholders in mathematics education. Based on the findings, it was recommended among others that the ethnomathematics teaching approach be adopted in schools particularly in our junior secondary school education, while teaching statistics since it has proved to be a viable option in promoting meaningful learning and affected students' retention rate positively. Again, the ministry of education and professional bodies such as Mathematical Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) should be involved in promoting this method through conferences, seminars and workshops so as to expose to teachers an ethno method in teaching mathematics.

INTRODUCTION

Mathematics without any doubt remains the most serviceable subject to all disciplines and fields of human work and it has become an indispensable tool in the study of humanities, sciences and technology and has entered into the many areas of human activities. Every individual needs some measure of mathematics for his or her day to day activities. Usefulness of mathematics in human activities cannot be underestimated because it is the precursor of scientific discoveries and inventions, of which any nation that overlooks the study of mathematics and does not take interest in it would remain underdeveloped.

Stressing the usefulness of mathematics, Pollak (1986) believed that the "most fundamental reason why we place so much emphasis on mathematics is that mathematics is integral to everything about life. He added that every occupation which our students may choose to pursue, and much of their every day lives are full of opportunities that need the application of mathematics. Adegboye and Adegboye (2003) observed its usefulness in other fields of study as well as in humanities such as arts, social sciences, religious mysticism, commerce, war and pastoral life. It is also applied in the description of various phenomena both in physical and economic situations. This observation points to the fact that mathematics is not only universally useful and utilitarian in nature; it is also regarded as the key to the solution of human problems (Iyekekpolor, 2007).

The Federal Government of Nigeria has for long been aware of the pivotal position of mathematics to individual fulfillments and national developmental goals with particular reference to scientific and technological emancipation and breakthrough. This understanding has consequently led educational policy makers to position mathematics as a compulsory and one of the core subjects in primary and secondary levels of education (FRN, 2004). It is also a requirement for pupils to proceed from upper basic to senior secondary level as well as for almost all courses in the tertiary level. Despite the high position offered to mathematics in Nigerian education system it is highly disheartening that approaches and strategies for teaching and learning of this subject at both primary and secondary levels are not probably being put to use effectively that could promote learners' activity and provide learners' guided practice enabling them to retain concepts taught and solve problems. Generally students fear and hate and/or dislike mathematics because they see it as abstract. This has resulted to their lack of interest and low retention rate which leads to poor performance in mathematics examinations, both internally and externally (Obodo, 2004).

Reporting to the National Council on Education (NCE) on students' performance in the May/June senior secondary school certificate Examinations (SSCE), the West African Examinations Council (WAEC, 2006), expressed worries over the low achievement due to poor retention rate and interest in mathematics by Nigerian candidates. Kurumeh (2007) maintained that the inappropriate, inadequate, elitist and euro-centric teaching techniques and methods used by mathematics teachers is instrumental to learners inability to understand and retain the basic mathematical principles, computations or logical facts involved. And the underlying process that gave rise to the mathematical facts resulted to learning by rote memorization, which led to poor retention, low performance and lack/loss of interest in mathematics. According to Child cited by Iji (2010), man is endowed with limited capacity for memorization. Thus the ability to memorize difficult subjects by rote learning calls for exercising the minds and the muscles of the mind and brain. However, mathematics is not a subject that can be learnt by rote memorization but for one to remember and recall information demand passing through one's experience. This goes to mean that the task before a teacher is how to help learners improve on their ability to assimilate information towards effective recalling/retrieving when the need arises. Resourcefulness in mathematics teaching demands that the mathematics teacher should focus attention on methods of teaching that stimulates learner's zeal, interest and higher retention rate, taking into cognizance of individual differences of learners.

This then suggest that mathematics educators should be able to develop new teaching techniques/methods to take care of the individual abilities of learners in the class room. Mari (2002) maintained that teaching strategies is a variable that can easily be manipulated by teachers to increase students' retention rate and performance as well as reduce or eliminate sex-related differences in science and mathematics performance.

Paden and Dereshiwsky (2007) and Omenka (2010) as well attributed the low performance and retention rate in mathematics of students particularly among sexes to instructional modality adopted by teachers. They, in their research, recommended blended instructional techniques towards enhancing better retention and achievement. In view of the above situation there is need to develop or adopt teaching methods which are capable of improving the reasoning and logical ability of the learners to enable them retains concepts. Against this background the effect of ethnomathematics approach to teaching of statistics in JSS III is examined, being an approach that is built on the students' background, his previous knowledge, the role his environment plays in terms of content and methods blended with euro-centric statistics in a practical way (Kurumeh & Opara, 2008)

Statistics is an integral part of mathematics. Kolawole and Oluwatayo[2005] defined statistics as a branch of mathematics which deals with the collection, presentation, analysis and interpretation of information

based on the number of things. It deals with quantitative analysis of numerical data so as to enable one make accurate, reasonable, reliable and acceptable decision on a policy. Stressing the importance of statistics for educational effectiveness, Kolawole and Oluwatayo maintained that statistics enables the education manager to determine the cost analysis of funding, pupil-teacher ratio, number of school age, pupils enrolment ratio, geographical inequality, sex-ratio, number of dropouts and predict the outcome of educational programmes. This means that the knowledge of the above concepts will help to achieve effective educational system as the institutional research data is collected, analyzed and result utilized. Using statistics, the effectiveness of instruction is always determined by measuring students' retention rate and achievement against objectives undertaken. The evaluation result helps to provide intelligent guidance in teaching and learning.

Despite its importance in all levels of education in particular and life in general, Kurumeh (2008) and WAEC examiners (2006) report revealed that students have difficulties in statistics. And such difficulties among others were traced to their inability to retain statistical processes such as: counting, summarizing and organizing data in columns and rows; change or interpret tallies into actual numbers/figures, present data in tallies, summarizing data into mean,
mode, median, differentiate histogram from bar chart, interpret information on pie chart, etc. With the use of ethno approach to the teaching of statistics (ethno statistics), statistical processes could be made lively and meaningfully capable of improving retention This is because statistical processes are concerned with collecting, organizing, analyzing and interpreting of data which are all found in every one's culture and environment (home or school).

Retention is measured in collaboration with achievement. This means that closely related to achievement is retention. Hornby (2000) defines retention as the ability to remember experiences and things learnt. Similarly, kundu and Tutoo (2002) posited that retention is the preservation of mind. These imply that the amount of knowledge learnt and kept, skill maintained or problem-solving behaviors manifested consistently reflects what is retained. Thus retention of statistical knowledge is the ability of a learner to keep and remember as well as recall or reproduce the acquired knowledge or some part of the knowledge after some period of time must have elapsed. Therefore, to improve students' achievement level in statistics in particular and mathematics in general, implies to improve the level at which they retain the concepts of statistics learnt. Hence the researchers see the need to find out if ethno mathematics approach to the teaching of statistics could improve the retention of students in junior secondary statistics.

The term ethnomathematics was introduced by the Brazilian educator and mathematician Ubiratan D' Ambrosio in 1977. According to him, ethno simply 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, skill or technique. He thus defined ethnomathematics as mathematics which is practiced among identifiable cultural groups such as national, tribal,, societies, labor groups, children of certain age brackets, professional classes and religious tradition (D' Ambrosio, 1985). Identifiable cultural groups according to Carss (1986), include groups of people (ethnic groups) who share common and distinctive characteristics such as ideologies, behavior, hopes, fears, language and culture. The ethnomathematics approach to teaching of mathematics according to D'Ambrosio (2001) is an approach or technique of teaching and learning mathematics which builds on the students' previous knowledge, background, the role his environment plays in terms of content, methods and his past and present experience of his immediate environment. He further added that this teaching technique. The focus of ethnomathematics is to determine how familiar situations and tactile and visual approaches, integrated with systematic Eurocentric activities can be used to help learner's different cognitive skills to improve their level of mathematical functioning as well as performances in a wider range of mathematical objectives (Kurumeh, 2007). Hence the focus of ethnomathematics approach to the teaching of statistics is to use already existing statistical activities in the learners' culture, environment, background, reasoning and experiences, integrated with Eurocentric statistics to help him/her develop skills to improve their level of statistical functioning in a wide range of statistics objective. The approach involves:

- Situating learning and problem solving in real life context where the environment is very rich in information with physical materials that serve as a source of manipulative and interactive processes
- Students are made to link the past to the present so as to build the future.
- The teacher then explores the cultural statistics experiences of the learners based on the initial experiences to teach the present school (academic) statistics and relate to their environmental usefulness (Kurumeh & Opara, 2008)

This approach will serve as a means of sharpening the logical and creative motivator for learning statistics across the educational level of learning. It helps students retain statistical concepts and is capable of improving learners' performance in statistics. Hence this study will investigate the effects of Ethno mathematics/statistics approach on the retention of junior secondary school III in statistics

STATEMENT OF THE PROBLEM

Most secondary school students in Nigeria view mathematics as problematic and abstract probably because students have great difficulty in understanding, assimilating and retaining the mathematics especially statistics taught to them in the classroom. Report from the WAEC examiners (2006) revealed some of the problems encountered by learners in statistics as their inability to retain statistical processes such as; counting, summarizing data, interpreting tallies into actual figure, wrong presentation of data, among others which are associated with ways it is being taught in the classroom.

Kurumeh (2007) maintained that the mathematics (statistics inclusive) taught in schools is foreign, euro-centric in origin and built on western cultural background, making students to learn by rote memorization in which the attendant result is consistent mass failure of students. Hence students no longer have interest towards the study of the subject. Ashafi and Areelu (2010) assert that in mathematics, boys achieved significantly higher than girls as a result of retentive rate. In the view of Aiyedun, (2000), there is no significant difference in the performance of boys and girls in mathematics and that they both retain equally well. This conflicting results call for continuous investigation especially with teaching strategies to bring equity in gender retention in mathematics. Therefore the problem of this study is to find out the effects the ethnomathematics approach could have on Statistics' retention of junior secondary three (JSSIII) students. Again, would the ethnomathematics approach have any significant impact due to gender on students' retention in the statistics?

Research Questions

The following research questions were raised to guide the study.

1 What is the difference in the mean retention scores of students in the experimental and control group in statistics?
2 What is the difference in the mean retention scores of male and female students taught statistics using ethno mathematics approach?

Research Hypotheses

The study is guided by the following null hypotheses to be tested at $P < 0, 05$

1 There is no significant difference in the mean retention scores of students taught statistics using Ethnomathematics approach and those taught using conventional method.
2 There is no significant difference in the mean retention scores of male and female students taught statistics using Ethnomathematics approach.

MATERIALS AND METHODS

The design of this study was quasi-experimental. Specifically, it was a non-equivalent but culturally homogeneous group, pre-test, post and delayed test design. This design was adopted because it was not possible to have complete randomization of the subject as this will disrupt school organization. Hence intact classes were randomly assigned to experimental and control groups.

The target population of this study was all the JSS3 students in 44secondary schools within Obi and Oju Education Areas of Zone C of Benue state, Nigeria. The sample of the study was made of 248 JSS3 students. Multi-stage sampling technique was used in the study. First, the schools were stratified based on the local government areas; Oju and Obi local government areas with each local government considered as a stratum. This is because the study covers the entire two local government areas inhabited by the Igede people. Two coeducational schools in each local government area were drawn using a simple random sampling and assigned to both control and experimental groups, making a total of four coeducational schools for the study. This was to ensure that the academic programmes of the schools were not disrupted.

One intact class from each of the four sampled schools was selected using simple random sampling. They were assigned randomly to experimental and control groups. The experimental and control groups, each comprised two intact classes totaling four intact classes. The experimental group was taught statistics using ethnomathematics while the control group was taught by conventional method. The experimental group comprised of 124 subjects while the control group comprised of 124 subjects, making of a total of 248 subjects.

The instrument used for the study was Statistics Retention Test (SRT) constructed by the researchers. The SRT was administered on students as pre, post and delayed test after successive reshuffling to collect data so as to measure students' retention. The instrument was subjected to both face and content validity. The validation was done by three experts in mathematics education and two experts in measurement and evaluation. The SRT so validated consisted of a 20 multiple- choice items comprehensively developed based on the test blue print. The reliability coefficient of SRT using Kuder Richardson formula 20 (K-R 20) was 0.80 which shows a high level of internal consistency of the instrument and hence it was considered reliable enough to be used for data collection in this study (Emaikwu, 2008).

Before the commencement of the actual treatment, the researchers organized a two day orientation programme for the regular mathematics teachers who served as research assistants in this study. The programme covered the following areas: The

purpose of the research, the use of the lesson plans, the statistics concepts to be taught, the use of SRT as well as general conduct of the study and procedures for administering the instrument. This was to ensure homogeneity of instructional situations across all groups. They were trained on the necessary steps on the use of ethnomathematics approach and the Conventional approach for the treatment and Control groups respectively. Thus, Ethnomathematics as used in this study involves taking students out of class to practically undertake some traditional (cultural) way of collecting information (data) using counting sticks, stones, etc from school playground and home environment. The teachers administered SRT as pretest before the commencement of the lesson to the students in each class.

During lesson, the teacher taught the experimental group statistics topics using ethnomathematics approach in line with lesson procedure prepared by the researchers. The control group was taught the same statistics topics using the normal lesson plans, all under the supervision of the researchers. The actual teaching lasted for four weeks of ten periods to cover the units of statistics specified in the test blue print. At the end of this period, the SRT was administered by the mathematics teachers on the subjects as post-test. The pre-test scores constituted the covariate of the post-test scores. The researchers allowed a gap of another period of four weeks in order to find out if the knowledge gained is retained. The instrument SRT was then reshuffled and administered as delayed (or retention) test by the same mathematics teachers to measure the subjects on retention in each of the group. The SRT was collected and used for analysis.

RESULTS

Research Question 1

What is the difference in the mean retention scores of students in the experimental and control group in statistics?

This research question is answered using mean and standard deviation scores. These scores are calculated from the pre-test and retention test administered on students in experimental and control groups. The results are presented in Table 1.

Table 1: Mean and Standard Deviation of Pre-test and Retention Test for Experimental and Control Groups.

Teaching Method		Pre-test	Post test	Retention	Mean difference
Ethnomathematics	Mean	22.7016	51.7742	60.9274	38.2258
	N	124	124	124	
	SD	8.39568	9.69439	10.34697	
Conventional method	Mean	20.4839	39.9597	39.6694	19.1855
	N	124	124	124	
	SD	7.84555	10.31915	10.57588	

In Table 1, the mean retention score for the experimental pre-test is 22.7016 as against 20.4839 of the control group. This shows that the background level of their knowledge of statistics were almost the same before treatment. Further more, the mean retention scores of retention test for the experimental group (those students taught with ethnomathematics) is 60.9274 with standard deviation of 10.34697 and that of control group (those students taught with lecture method) is 39.6694 with standard deviation of 10.57588. This seems to reveal that the students taught with ethnomathematics appeared to have scored higher retention than their counterpart in control group. Also the difference in the mean retention scores of experimental group and that of the control group is 21.258 and in favor of the experimental group.

Research Question 2

What is the difference in the mean retention scores of male and female students taught statistics using ethnomathematics approach?

The results of the calculation of mean and standard deviation of pretest and retention test to answer the research question four is presented in Table 2.

Table 2: Mean and Standard Deviation of Pretest and Retention Test for Male and Female Students in Experimental Group.

Sex		Pretest	Post test	Retention Test	Mean difference
Male	Mean	23.6567	50/8955	60.5224	36.8657
	N	67	67	67	
	SD	8.81554	10/8070	10.55772	
Female	Mean	21.5789	52.8070	61.4035	39.8246
	N	57	57	57	
	SD	7.80098	8.71255	10.16622	

In Table 2, the mean scores in pretest of male is 23.6567 with SD of 8.81554 and the mean retention scores for same male subjects in the retention test 60.524 with standard deviation of 10.55772, while the mean pretest of female is 21.5789 and the mean retention scores for the same female subjects in retention test is 61.4035. This suggests that both the subjects (male and female) improved positively in their retention rate of the knowledge gained in statistics after treatment. However, the mean retention scores of 60.5224 for the male and 61.4035 for the females in retention test shows a difference of 0.8811. This tends towards indicating that the retention rate of both male and female subjects taught statistics using ethnomathematics teaching approach is relatively the same but goes to suggest that the approach is relatively effective in enhancing retention in statistics.

Research Null Hypothesis one (HO_1)

Ho_1 : There is no significance difference in the mean retention scores of students taught statistics using ethnomathematics approach and those taught using lecture method ($p<0.05$).

This research hypothesis was tested using two way analysis of covariance (ANCOVA). The result is presented in Table 3.

Table 3: Two ways ANCOVA Tests of Between - Subjects Effects for Experiment and Control Groups Student's Achievement and Retention

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig	Decision at P<.05
Corrected model	Posttest	10092.383**a**	2	5046.191	53.298	.000	s
	Retention Test	28853.856**b**	2	14426.928	135.477	.000	s
Intercept	Posttest	47513.564	1	47513.564	501.841	.000	s
	Retention Test	62955.255	1	62955.255	591.184	000	s
Pretest	Posttest	1438.250	1	1438.250	15.191	.000	s
	Retention Test	835.727	1	835.727	7.84	.000	s
Method	Posttest	7572.111	1	7572.111	79.977	.000	s
	Retention test	26215.478	1	26215.478	246.178	.000	s
Error	Posttest	23196.226	245	94.678			
	Retention test	26090.063	245	106.490			
Total	**posttest**	**555025.000**	**248**				
	Retention test	**682366.000**	**248**				
Corrected total	**posttest**	**33288.609**	**247**				
	Retention test	**54943.919**	**247**				

a. R Squared = .303(Adjusted R Squared = .297)
b. R Squared = .525 (Adjusted R Squared =.521)
Note: S = significant at p<.05; Ns = Not significant.

The result of Table 3 indicates a significant group main effect at 0.05 level of significance. This shows that there is significant difference in the mean retention scores between the students taught statistics with ethno mathematics approach and those taught with conventional method in favor of ethno mathematics

approach. Therefore the null hypothesis of no significant difference in the mean retention scores of experimental group and control group is rejected. This then means that ethno mathematics approach enhances students' retention in statistics.

Research Null Hypothesis Two (HO_2)

Ho_2: There is no significant difference in the mean retention scores of male and female students taught statistics using ethno mathematics approach.

The null hypothesis four was tested using two-way analysis of covariance (ANCOVA). The result is presented in Table 4

Table 4: Two ways ANCOVA Tests of Between- Subjects for Male and Female Students' Achievement and Retention in Experimental Group.

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig	Decision at P<0.05
Corrected model	posttest	1295.554**a**	2	647.777	7.636	.000	s
	Retention test	1057.653**b**	2	528.826	5.284	.006	s
Intercept	posttest	27723.156	1	27723.156	326.818	.000	s
	Retention test	41428.179	1	41428.179	413.916	.000	s
Pretest[1]	posttest	1183.023	1	1183.023	13.946	.000	s
	Retention test	1033.742	1	1033.742	10.328	.002	s
Sex[1]	posttest	218.621	1	218.621	2.577	.111	Ns
	Retention test	78.037	1	78.037	.780	.379	Ns
Error	posttest	10264.123	121	84.827			
	Retention test	12110.694	121	100.088			
Total	**posttest**	**343950.000**	**124**				
	Retention test	**473475.000**	**124**				
Corrected total	**Posttest**	**11559.677**	**123**				
	Retention test	**13168.347**	**123**				

a. R Squared = .112 (Adjusted R Squared = .097)
b. R Squared = .080 (Adjusted R Squared = .065)
Note: S = significant at p < .05 Ns = Not significant at p<.05.

The result in Table 4 revealed that the observed difference between the mean retention scores of male and female in experimental group is not significant at 0.05 level of significance. This means that ethnomathematics approach is effective in enhancing male and female retention in statistics but has no differential effect. Hence, the hypothesis of no significant difference in the mean retention scores of male and female students taught statistics using ethnomathematics approach is not rejected.

DISCUSSION

The study revealed that students taught with ethno mathematics approach had a significant higher mean retention score (60.924) in statistics than their counterpart taught with conventional method with (39.6694) mean retention scores. This was further confirmed by the results in Table 3 which revealed that the difference in retention between students taught statistics using ethno mathematics approach and their counterparts using conventional method were significant leading to rejection of the hypothesis. This shows that ethno mathematics approach effected students' retention more positively and effective in enhancing and facilitating student's retention in statistics than the conventional method.

The reason for this high retention rate by the experimental group could be that ethnomathematics approach affords learners the opportunity to build on their initial knowledge, integrate and link their background of study and immediate environment with the euro-centric aspect of learning of statistics. It also facilitated learners' understanding and retaining of the statistical concepts and structures which helped them to recall the knowledge of statistics gained. This finding is in agreement with earlier results of the studies carried out using ethnomathematics approach by Kurumeh (2006) and Omenka (2010), which showed that ethno-method of teaching, enhances better achievement in learners which implies that retention is also enhanced since achievement is a function of retention.

The results of the study shows that both male and female subjects in the experimental group who were taught using ethno-technique benefited and retained statistics concepts more in the instruction than their conventional approach in the control group and the difference between the retention mean scores of male and female subjects in experimental group is statistically not significant. This result is in line with the observation of Paden and Dereskiwsky (2007) in their study that low retention rate in mathematics of students particularly

among sexes is as a result of instructional modality adopted by teachers. This non significant difference is in conflict with the findings of Paden and Dereskiwsky (2007) who in their study found that the females' rate of retention is higher than that of males using blended instruction. Thus this result of the findings could point to mean that ethnomathematics approach uses the familiar, cultural environment and background of the learner which must have accounted for the males and females to benefit equally thereby leading to equality in statistics' retention.

CONCLUSION

The findings of this study have created awareness that the use of ethnomathematics approach has proved to produce higher retention rate for JS3 students in statistics than their counterpart taught with conventional method.

Another striking and unique feature of ethnomathematics is its capability of removing gender inequality in the retention rate of the group where ever it had prevailed if properly used. This was proved in the findings that there was no significant difference in the retention rate of male and female students taught statistics using ethnomathematics approach, showing that both males and females in the ethnomathematics group retained statistics knowledge equally well and with improved retention. This affirmed that retention in statistics in this study depend on the approach of instruction. Thus, ethnomathematics approach is significantly a very useful instructional strategy for increased meaningful understanding of concepts, higher retention and more recall of concepts in statistics.

RECOMMENDATION

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

1. That Ethno teaching approach be adopted in schools particularly in our secondary school education, since it has proved to be a viable option in promoting meaningful learning and affected students' retention rate positively.
2. Ministry of education and professional bodies such as Mathematical Association of Nigeria (MAN) and Science Teachers Association of Nigeria (STAN) should be involved in promoting this method. This can be done by organizing conferences and workshops where the ethno method in mathematics and science teaching will be exposed to teachers for better application and to meet up with the challenges and demands of the new curriculum.
3. Planners of mathematics curriculum and all other subjects' curriculum should include ethno teaching techniques in different topics students are expected to learn in the curriculum as well as incorporating this method in the mathematics and other subject curriculum for pre-service teachers. This will make students/learners develop positive attitude towards the subject as it will link home-school and school-home. Also it would be an aspect of methodology course to be undertaken in tertiary institutions' mathematics and other subject curriculum.

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Cite this Article: Kurumeh MS, Onah FO and Mohammed AS (2012). Improving Students' Retention in Junior Secondary School Statistics using the Ethno-mathematics Teaching Approach in Obi and Oju Local Government Areas of Benue State, Nigeria**.** Greener Journal of Educational Research, 2(3): 054-062, http://doi.org/10.15580/GJER.2012.3.10051286**.**