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Effect of Ethno-Mathematics Teaching Materials on Students' Achievement in Mathematics in Enugu State

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Abstract
The study was conducted to ascertain the effect of ethno-mathematics teaching materials on students' achievement in mathematics. The sample for the study was 156 Senior Secondary Schools two (SSS 2) students, which were randomly selected from 16 Senior Secondary Schools in Igbo-Etiti Local Government Area of Enugu State through multi-stage sampling technique. The instrument used for the study was ethno-mathematics achievement test (ETHNOMAT). The data obtained with the instrument were analyzed using mean and Analysis of covariance (ANCOVA). Mean was used to answer the research questions posed, while ANCOVA statistic was employed in testing the null hypothesis at 0.05 significant level. Findings of the study showed that the ethno-mathematic achievement test was effective in enhancing students' achievement in mensuration with particular reference to volumes of cylinder and hemisphere. It was recommended among others that ethno-mathematics teaching materials should be incorporated in the Senior Secondary School mathematics curriculum as technique to be used by teachers in teaching the concepts of volumes of cylinders and hemispheres. More so, workshops/Seminars should be organized by professional bodies such as Science Teachers Association of Nigeria (STAN), Mathematical Association of Nigeria (MAN), among other bodies, to popularize and sensitize mathematics teachers on the use of ethno-mathematics teaching materials as approach in teaching students the concepts of volumes of cylinders and hemispheres.
Keywords: Ethno-Mathematics, Native Calabash Cups, Native Calabash Plates, Volume of Cylinder, and Volume of Hemisphere

1. Introduction

Mathematics is a science of magnitude and number as well as the science that sustains the daily practices of man. It is the only core science subject that acts as pivot on which national development and wealth of any nation is created. Competency in mathematics learning is vital and sustainable to every individual's meaningful and productive life. Mathematics learning is very important in enhancement and sustainability of human existence because mathematics is all about finding solutions to human problems and physical challenges. All these are indications that mathematics is useful in domestic and business deals, scientific discoveries, technological breakthrough, problem-solving and decision making in different situations in life (Usman and Nwoye, 2010; Unodiaku, 2011; and National Council of Teachers of Mathematics, (NCTM) 2013). It may be due to these vital usefulness of mathematics that Nigeria government made the study of mathematics compulsory at all the levels of 6-3-3 system of education in Nigeria by National Policy on Education (2004) provision.

The problem of learning mathematics in Nigeria primary and post primary school levels has continued to be topical and attracts the attention of researchers in the field. The incessant low level of performance in mathematics among Nigeria pupils and students is a clear manifestation of this perceived problem (West African Examination Council (WAEC) Chief Examiners' reports 2001 – 2006; National Examination Council (NECO) Chief Examiner's report, 2010; Eniayeju and Azuka, 2010; Usman and Nwoye, 2010; Adewale, 2011; and Unodiaku, 2012). These consistent reports on students' low achievement in mathematics are indications that teaching and learning of mathematics across Secondary Schools in Nigeria are faulted. It suggests that mathematics teachers teaching the students appear to have exhausted all their known teaching strategies. It appears that teachers are inclined to the traditional rote learning of mathematics and teaching materials that are alien to the students' cultural background.

Resent trend in teaching and learning of mathematics worldwide demands conceptual change approach as against the traditional didactic method, which promotes rote learning of mathematics. Educational reforms in mathematics teaching at both pre-secondary and secondary school levels in Nigeria follows from philosophers in science like Robert Sternberg (2013) who advocated for replacement of traditional cumulative view of scientific knowledge with an experiential change view. Consequent upon this philosophical viewpoint, Robert Sternberg (2013) insisted that in order to develop intelligent behaviour as a significant outcome of education, intelligent behaviour be interpreted along a continum of experience and that intelligent behaviour is defined by the sociocultural context in which it takes place. Such interpretation of intelligent behaviour along a continum of learning experience, defined by the sociocultural context in which it takes place and which, leads students

towards meaningful learning of mathematics is integration of ethno-mathematics teaching materials into the classroom. It is seen as a tool for generation, transmission and diffusion of knowledge with emphasis on socio-cultural environment of the learner. Fostering a culturally inclusive learning environment encourages all individuals – regardless of age, gender, ethnicity, religious affiliation, socio-economic status, sexual orientation or political beliefs – to develop personal contacts and effective intercultural skills to work harder and achieve better results (Gihegood Practice Resource Booklet, 2013).

NCTM (2013) defined Ethno-mathematics as the study of the relationship between mathematics and culture or the mathematics which is practiced among identifiable cultural groups. Or the investigation of the traditions, practices and mathematical concepts of subordinated social groups (Knijnik, 1998). Ethno-mathematics is the study of mathematics which takes into consideration the culture in which mathematics is embedded. Mathematical concepts and ideas found in the cultural practices and social activities of Igbo-Etiti cultural group are more prominent in their occupations and crafts, particularly in their social activities, mode of measurements and counting system. It is the mathematics concepts and ideas embedded in the teaching materials found in the social activities, crafts and mode of measurement of this cultural group that this study intends to investigate its effect on mathematics achievement of Senior Secondary School two (SSS2) students.

The use of ethno-mathematics materials as strategies for teaching mathematics are accompanied with a lot of uses in the teaching and learning processes educators need to be aware of. Its instructional materials have been developed and used by Flores (1997) as strategies for Hispanic students. And this can be used both to increase the social awareness of students and offer alternative methods of approaching conventional mathematics operations (Gerdes, 2001); and the best of alternative approaches should come or be given through practical activities using concrete materials (NCTM, 2013), such as ethno-mathematics materials. It is a way of bringing together culture and mathematics in the classroom. Ideally, it is a way of bringing the cultural context of mathematics to students by teaching culturally based mathematics that students can relate to.

This study is using ethno-mathematics materials that are culturally based as tools to help the teaching as instructional materials (or similar materials) to demonstrate its efficacy in understanding the concept of volumes of hemisphere and cylinder aspects of mensuration. Mensuration was focused because literature search indicated that it was one of the areas in mathematics that students find difficult to learn. For instance, among the areas in mathematics that students find difficult include mensuration (Ozigboh, 1994; Okoli, 2001; Unodiaku, 2012; and Adigwe, 2013).

To achieve success in national development and wealth creation demands a greater achievement in science and technology and to achieve success in science and technology demands proper enhanced learning of mathematics by Nigerian children. Enhancement of mathematics learning experiences demands that mathematics be taught through practical activities using concrete materials (Douglas, 2013; NCTM, 2013; and Annenberg Foundation, 2013), such as ethno-mathematics (Ozofor, 2001; Unodiaku, 2011; and NCTM, 2013). It is in this regard that this study is carried out with ultimate intention to find out the effect of ethno-mathematics teaching materials on students' achievement in mathematics which will in turn guarantee wealth creation of the individual citizens and national development: to find out whether the ethno-mathematics teaching materials have effect or not, two ethno-mathematics teaching materials commonly found and used in all the towns and almost all the homes in Igbo-Etiti Local Government Area were purposely selected to teach the concepts of volumes of cylinder and hemisphere.

Literature search revealed insufficient research reports on the use of concrete teaching materials such as ethno-mathematics teaching materials in teaching mathematics concepts (Ozofor, 2001; Unodiaku, 2012; NCTM, 2013). Moreso, literature search revealed insufficient reports concerning influence of sex on student's achievement in mathematics. For instance, (Obioma, 1991; Olosunde and Olaleye, 2010; Madu and Hogan, 2010; and Unodiaku, 2010), all reported that boys performed significantly higher than girls at all class levels in mathematics. These reports of superiority of boys over girls in mathematics was contradicted by Hilton and Bergland (1974) and Ozofor (2001) who all reported apparent superority of females over thie males counterpart in mathematics test. Yet Onibokun (1979) and Usman and Nwoye (2010) reported that there was no significant difference between the male and female subjects' mathematical abilities. It appears that gender differences in mathematics are inconlcusive and need further equiry in this study to clearify this notion. This study, therefore, seeks to fill the gap of information on the influence of gender on mathematics achievement of the students. It is against this background that this study intends to determine the effect of ethno-mathematics teaching materials in teaching the concepts of volumes of cylinder and hemispehere using native cylindrical calabash cups as illustrated below with examples 1 & 2 respectively.

2. Example I: Using Native Cylindrical Calabash Cups to Teach Concept of Volume of Cylinder.

2.1 Procedure: Consider the steps below as illustration

Step I: Introduction of the ethno-mathematics materials shown below as measuring devices commonly produced

locally and used at homes by the students. The three ethno-mathematics teaching materials were selected from different sizes and heights of native cups made from a certain type of calabash. They were purposely selected because they posses the shape of cylinder. Moreso, cylinders of various heights and widths were selected. There were measured with ruler and their ratio of heights is 4cm:6cm:10cm and width is 2cm:2cm:4cm respectively (see diagrams below).

NB: The width is the diameter of the circular mouth of the cylinder.

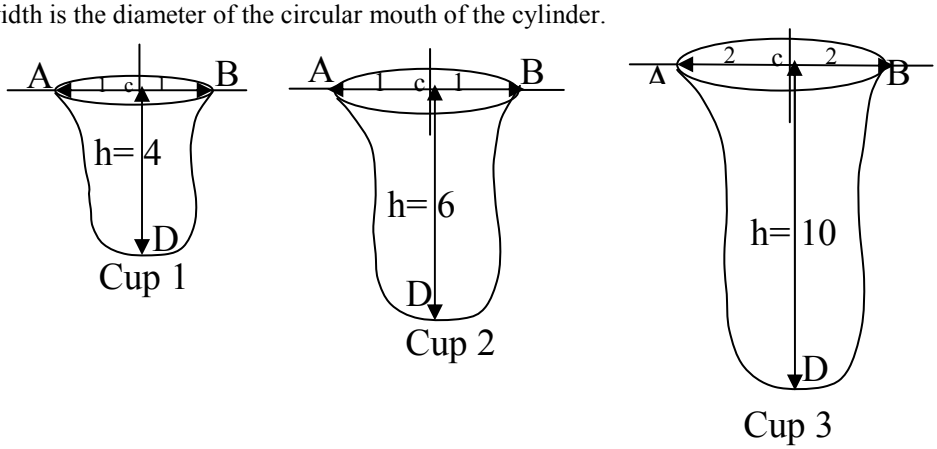


Fig. 1:

Step 2: To find the volumes of figure 1, the teacher lead the students by inserting a ruler inside the cup measuring from its bottom to the point C where it intersects the diameter AB of the circular mouth of the cup. This measurement gives the height (4cm) of the cup. Also, the diameter AB will be measured to obtain 2cm which follows that its radius is 1cm (i.e. diameter ÷2 = radius).

Similarly, in cup 2, its height (DC) was measured with ruler inserted inside the cup. This was recorded as 6cm and width (AB) yielded 2cm. Therefore, it has radius 1cm. Finally, in cup 3, its measurement of height and diameter gave 10cm and 4cm respectively. Therefore, it has radius 2cm.

Step 3: Calculation of the volumes of the cylinders (cups 1, 2 and 3) above.

The teacher lead the students on substitution of the values obtained from measurement of the heights and radii of the cups in the formula for volume of cylinder given as Vol. $= \frac{1}{3}\overline{\wedge}r^2h, where\ \pi = \frac{22}{7}$. The dimensions (radii and heights) of the cups measured were substituted in the formula as follows. This gives the volumes of the cups 1, 2 and 3.

$$Vol.of\ cup\ 1 = \frac{1}{3}\times\frac{22}{7}\times\frac{1^2}{1}\times\frac{4}{1} = \frac{1}{3}\times\frac{22}{7}\times\frac{1^2}{1}\times\frac{4}{1} = \frac{88}{21} or\ 4\frac{4}{21}cm^2 \cong 4cm^3$$

$$\text{Vol.of cup } 2 = \frac{1}{3}\times\frac{22}{7}\times\frac{1^2\times6}{1} = \frac{132}{21} = 6\frac{6}{21}cm^2 \cong 6cm^3$$

$$\text{Vol.of cup } 3 = \frac{1}{3}\times\frac{22}{7}\times\frac{1^2\times10}{1} = \frac{1}{3}\times\frac{22}{7}\times\frac{4}{1}\times\frac{10}{1} = \frac{880}{21} = 41\frac{19}{21} \cong 42cm^3$$

2.2 Example 2: Using Native Calabash Plates to Teach Students Concept of Hemisphere.

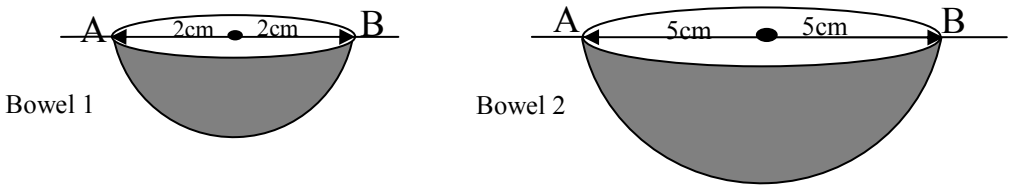
Calabash plate was made by cutting calabash into two-halves: throwing away the top part and using the bottom part as hemisphere.

2.3 Procedure: Consider the steps below as illustration.

Step 1: Introduction of the ethno-mathematics materials used locally as plates, measuring devices at the students homes and market places, and bowels in use for feeding domestic animals and birds at homes.

Step 2: The concept of volume of hemisphere was illustrated using these calabash bowels which are of different sizes and volumes. To find the volume, two calabash bowels of different sizes and volumes were arbitrarily selected. They are drawn below in fig. 2.

Fig 2



Step 3: The teacher lead the students by using ruler to measure the diameters of bowels 1 and 2 which gave 4cm and 10cm respectively. Therefore, the radii for bowels 1 and 2 are 2cm and 5cm respectively (i.e. obtained by dividing the diameters by 2).

Step 4: Calculation of the hemispherical bowels (1 and 2above).

The volumes are calculated by substituting the values of the radii obtained from the practical measurements of the diameters of the bowels drawn above.

Volume of hemisphere is given as $\frac{2}{3}\overline{\Lambda}r^3$, where $\overline{\Lambda} = \frac{22}{7}$

$$\therefore \text{Vol. of bowel } 1 = \frac{2}{3} \times \frac{22}{7} \times \frac{2^3}{1} = \frac{2}{3} \times \frac{22}{7} \times \frac{2 \times 2 \times 2}{1} = 16.76 \cong 17\text{cm}^3$$

Again, Vol. of bowel $2 = \frac{2}{3} \times \frac{22}{7} \times \frac{5^3}{1} = \frac{2}{3} \times \frac{22}{7} \times \frac{5\times5\times5}{1} = \frac{5500}{21} = 261.9 \cong 262\text{cm}^3$.

The volumes of the bowels (1 and 2) in fig. 2 were approximated to 17cm^3 and 262cm^3 respectively. The teacher hinted the students that approximately 17 cubic centimeter of liquid (say palm oil, water, palm wine etc) fills the bowel 1 to the approximate value of 262 cubic centimeter calculated as volume of the second bowel implies that 262 cubic centimeter of liquid, powdered or seeds is the quantity that can fill the bowel 2 to the brim. The concept of volumes of cylinders and hemispherical objects are topics in senior secondary school mathematics curriculum which are posing difficulty to many mathematics teachers to conceptualize and teach due to lack of teaching materials that students are familiar with, that can resist harsh-handling by the students and that can be obtained within the cultural environment of the students.

Therefore, the use of ethno-mathematics teaching materials in Igbo-Etiti Secondary School classrooms will help us realize the prospects of the national educational aims and objectives which demands that our children should be exposed to education system that is content – relevant and has problem – solving potential (Unodiaku, 2011). Hence, this study was designed to investigate the effect of ethno-mathematics teaching materials as strategy on students' achievement in volumes of cylinder and hemisphere learning.

3. Purpose of the Study

The main purpose of the study was to find out the effect of ethno-mathematics teaching materials on students' achievement in volumes of cylinder and hemisphere learning. Specifically, the study tried to determine;

- The effect of ethno-mathematics teaching material approach on the mean achievement score of students in volumes of cylinder and hemisphere learning.
- The effect of gender on ethno-mathematics teaching materials means achievement scores in volumes of cylinder and hemisphere.

4. Research Questions

The following research questions were posed to guide the study.

1. What is the difference between the mean achievement scores of students taught volumes of cylinders and hemispheres with ethno-mathematics teaching materials and those taught with conventional method?
2. To what extent does gender influence the mean achievement scores of students taught volumes of cylinders and hemispheres using ethno-mathematics teaching materials?.

5. Research Hypotheses

The following null hypotheses were formulated to guide the study.

$H0_1$: There is no significant difference between the mean achievement scores of students taught volumes of cylinders and hemispheres with ethno-mathematics teaching materials and those taught with conventional method.

$H0_2$: There is no significant difference between the mean achievement scores of male and female students taught volumes of cylinders and hemispheres with ethno-mathematics teaching materials.

6. Research Method

The design of the study was quasi-experimental research design. Specifically, the design is pretest-posttest non-equivalent control group design. The study was carried out in Igbo-Etiti Local Government Area of Enugu State. The population of the study consisted of 1292 SSS two students in the 16 Senior Secondary Schools in Igbo-Etiti Local Government Area of Enugu state.

The sample for the study was obtained through multi-stage sampling technique. First, simple random sampling technique was used in selecting 8 schools out of 16 Senior Secondary Schools in the Local Government Area. The choice of 8 Senior Secondary Schools was purposely chosen to enable the researcher handle the sample size effectively. This was followed by adopting simple random sampling technique in selecting one intact class each from the four schools. This brought the total number of sampled subjects to 306 students used for the study. Four out of the eight selected schools were randomly assigned into experimental group, made up of 156 students, while the remaining four schools were assigned to control group with 150 students.

The instrument used for data collection was called Ethno-mathematics Achievement Test (ETHNOMAT). The instrument was subjected to content validation whereby eight experts in mathematics and measurement and

evaluation of the Faculty of Education, University of Nigeria, Nsukka and the Faculty of Education, Godfrey Okoye University, Enugu, Enugu State, rated the instrument based on coverage of the cognitive domain and adequancy of the items to the concepts of volumes of cylinder and hemispher. The instrument was Pilot tested in a school different from the schools used in the main study but has similar characteristics as that of the main area of the study. Data collected from the pilot study was analysed using the computer software SPSS version 10.0, to apply the Cronbach alpha coefficient/method which yielded approximately 0.83. The ETHNOMAT was composed of 15 items used for the study. Mean and standard deviations were used in answering the research questions. Research hypotheses posed were tested using the analysis of covariance (ANCOVA) at $P \leq 0.05$ significant level. The pretest scores were used as covariance to the posttest scores.

7. Results

The results of the study were presented in accordance with the research questions and hypotheses.

Research Question 1: The research question one was answered using Table 1 below.

Table 1: Summary of Mean Achievement and Standard Deviation (S.D) Scores of Experimental and Control Groups as Measured by ETHNOMAT.

		Pretest		Posttest	
Group	**No of Students**	**Mean**	**S.D**	**Mean**	**S.D.**
Experimental	156	10.22	1.011	11.37	1.153
Control	150	11.74	1.013	12.79	1.278
Total	306	11.48	1.102	12.06	1.407

Table 1 reveals that students in experimental group had mean and S.D. of 10.22 and 1.011 in pretest and mean and S.D of 11.37 and 1.153 respectively in posttest. Students in control group had mean score of 11.74 and S.D. of 1.013 in pretest and mean and S.D. scores of 12.79 and 1.278 respectively in posttest.

Research Question 2: The research question two was answered using Table 2 below.

Table 2: Summary of Mean Achievement and S.D Scores of Male and Female Students as Measured by ETHNOMAT.

Sex	**Method**	**N**	**Mean**	**S.D**
Male	Experimental	67	11.75	1.049
	Control	77	12.91	1.289
	Total	144	12.37	1.316
Female	Experimental	89	11.08	1.150
	Control	73	12.66	1.261
	Total	162	11.79	1.434
Total	Experimental	156	11.37	1.153
	Control	150	12.79	1.278
	Total	306	12.06	1.407

Table 2 indicates that males in Experimental and control groups had mean scores of 11.75 and 12.91 with standard deviations of 1.049 and 1.289 respectively, while females in experimental and control groups had mean scores of 11.08 and 12.66 with standard deviations of 1.150 and 1.261 respectively. Moreso, both sexes in experimental and control groups had mean scores of 11.37 and 12.79 with standard deviations of 1.153 and 1.278 respectively.

8. Research Hypotheses

Hypothesis 1 and 2 were answered using Table 3 below.

Table 3: Analysis of Covariance (ANCOVA) Table of Male and Female Scores on Mathematics Achievement Test.

Source	**Type III sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Result**
Corrected model	190.203[a]	4	47.551	34.604	.000	S
Intercept	508.989	1	508.989	370.405	.000	S
Pretest	16.321	1	16.321	11.877	.001	S
Gender	31.195	1	31.195	22.702	.000	S
Method	147.322	1	147.322	107.210	.000	S
Gender * Method	3.331	1	3.331	2.424	.121	NS
Error	413.617	301	1.374			
Total	45125.000	306				
Corrected Total	**603.820**	**305**				

a. R square = .315 (Adjusted R squared = .306), S = Significant at the 0.05 level
NS = Not significant

Table 3 presents the statistics of the distribution of difference between the paired differences (paired scores), the 95% confidence interval of the difference, the value of F (107.210) is significant at .000. The F value is equally significant at 0.05. Therefore hypothesis 1 of no significant mean difference between experimental and control groups is not accepted. Hence there is a significant difference between the mean achievement scores of students taught volumes of cylinder and hemisphere with ethno-mathematics teaching materials and those taught with conventional teaching approach. Moreso, the value of F (31.195) is significant at 0.000. This F value is equally significant at 0.05 level. Therefore hypothesis 2 of no significant difference between the mean achievement scores of male and female students taught volumes of cylinder and hemisphere with ethno-mathematics teaching materials was rejected. Hence there is significant difference between the mean achievement scores of male and female students taught with conventional approach and those taught with ethno-mathematics teaching materials in favour of students taught with ethno-mathematics teaching materials.

9. Findings

Based on the analysis of data as presented in this study, the following major findings were made.

1. The mean achievements scores of male students taught using ethno-mathematics teaching materials was significantly higher than the mean achievement scores of females taught with conventional approach.
2. The mean achievements scores of students taught with ethno-mathematics teaching materials was significantly higher than the mean achievement scores students taught with conventional approach.

The mean achievement scores of males exposed to both ethno-mathematics teaching materials and conventional method was found to be significantly higher than the mean achievement-scores of females exposed to both methods. In other words males achieved significantly high than females in both experimental and control groups.

10. Discussions

Based on the findings of the study, it was clear that students who were taught using ethno-mathematics teaching materials achieved better result than their counterpart students taught with conventional method. Result of Table 3 showed significant difference between experimental method and conventional method. The difference between the two methods was attributed to the effect of ethno-mathematics teaching materials used. This may be owning to the notion that the interaction of native culture and mathematics ideas can be mutually reinforcing (Davison, 1988) or that the application of native culture situations to the mathematics classroom represents are way of helping native students see relevance of mathematics in their culture, and to use this connection as a means of teaching more mathematics (Aichele & Dawning, 1985). It is such method that students will find quite reinforcing and interesting to use and will hopefully increase their participation and wipe out their forbia in mathematics learning. The finding supported Magallenes (2003) who found significance of statistical differences between group A and group B, demonstrated that the use of ethno-mathematics software in combination with traditional teaching practices can increase student success in the area of coordinate planes and associated concepts. This finding also confirm NCTM (2013) view that ethno-mathematics aims to draw from the cultural experience and practices of the individual learners, the communities, and the society at large, in using them as vehicles to not only make mathematics learning more meaningful, but more importantly, to provide learners with the insights of mathematical knowledge as embedded in their social and cultural environment.

The findings in Tables 2 showed that males achieved significantly higher than females in the overall results with total mean difference of 0.58 in favour of the males. This result vindicates that gender is a significant factor on students' achievement in mathematics. This finding upheld the earlier findings (Osafehinti, 1998; Olosunde and Omolayo, 2010; and Unodiaku, 2012) who all reported that male learners consistently obtained significantly higher in mathematics achievement scores than their female counterpart especially from the age of 11 years upward.

However, this finding contradicted Hilton and Bergland (1974) and Agwagah's (1993) findings which indicated that female students made higher gains in the mean achievement score than the male students. Based on these reports, it suggests that the issue of gender as factor of mathematics achievement is inclusive. There is need for further enquiry to clarity this notion.

11. Recommendations

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

1. Emphasis on the use of Ethno-mathematics teaching materials should be made in the National Mathematics curriculum for Senior Secondary Schools, as technique to be used in teaching the concepts of volumes of cylindrical and hemispherical shapes.
2. Professional bodies such as Science Teachers Association of Nigeria (STAN), Mathematical Association of

Nigeria (MAN) among others, should organize workshops and seminars to popularize and sensitize mathematics teachers on the use of ethno-mathematics teaching materials as approach in teaching students the concepts of volumes of cylinders and hemispheres.

3. Teacher training institutions of learning should include the use of ethno-mathematics teaching materials as method in the mathematics method course content. This will guarantee that after the teacher training, they will be equipped on how to teach the concepts of volumes of cylinder and hemisphere effectively.

12. Conclusions

The results of this study have clearly indicated that the use of ethno-mathematics teaching materials does enhance the students' achievement in mathematics. Thus, the use of native cylindrical calabash cups and plates to teach the concepts of volume of cylinder and hemisphere respectively enhances students' performance in mathematics. The results of the study also suggest that mathematics teachers should recognize that in today's mathematics classes, students in the classes are composed of different sexes with varied ability levels and as such strategies to encourage and enhance maximum achievement by all in such classes be adopted. To this end ethno-mathematics teaching materials approach can be included as one of the major teaching approaches to volumes of hemispheres and cylinders instruction in Nigeria Secondary Schools Mathematics classrooms.

References

Adewale, J.G. (2011). Teacher Factors as Correlates of Students' Anxiety in Junior Secondary School Mathematics: A Study in School Effectiveness. *African Journal of Science, Technology and Mathematics Education* (AJSTME), 1 (1), 1-16.

Agwagah, U.N.V. (1993). Instruction in Mathematics Reading as a Factor in Students' Achievement and Interest in Woro Problem Solving. *Unpublished Ph.D Thesis*, University of Nigeria, Nsukka.

Aichele, D. and Downing, C. (1985). Increasing the Participation of Native Americans in Higher Mathematics Project Funded by the National Science Foundation.

Annenberg, F. (2013) Teaching math: Grades k-2: Representations. www.learner.org/../section-03-b.html.

Davidson, D.M. (1988). Mathematics for the Native Students in Hap Gilliand SL Jon Reyhner, *Teaching the Native American* (PP. 153-157). Dubuque 10: Kendall/Hunt.

Davidson, D.M. (2012). An Ethno-Mathematics Approach to Teaching Language Minority Students. National University.

Douglas, H. C. (2013). "Concrete" Manipulatives, Concrete Ideas. www.didax.com/articles/concrete-manipulatives.

Eniayeju, A.A. and Azuka, B.F. (2010). Impediments to Mathematics Teaching at the Universal Basic Education Level in Nigeria. *Journal of Mathematical Sciences Education*, 1 (1). TIMEX: Abuja.

Federal Republic of Nigeria (2004). National Policy on Education (Revised), Lagos: Federal Government Press P. 7-8.

Flores, T. (1997). Native Hispanic Mathematics. Austin, TX: University of Texas Press.

Gerdes, P. (2001). Survey of Current Work in Ethno-Mathematics, in Powell and Frankenstein (2002).

Gihegood Practice Resource Booklet, (2013). www.ethnomathematical. org /articulos/ambros.pdf

Harbor-Peters, V.F. (1990). "Aspects of Senior Secondary School. Further Mathematics Students Find Difficult. *Unpublished Paper,* University of Nigeria, Nsukka.

Hilton, J.C. and Bergland, G.W. (1974). Sex Differences in Mathematics – a Longitudinal Study. *The Journal of Education*, XVIII (2), 295 – 304.

Ekpo, I.M. (2000). Ibibio Cultural Practices and their Implications for Mathematics Instruction. *M.Ed. Thesis*, UNN.

Knijnik, G. (1998). "An Ethno-Mathematical Approach in Mathematical Education: A Matter of Political Power" in Powell and Frankenstein (1998).

Magallanes, A. (2003). Comparison of Student Test Scores in a Coordinate Plane Unit using Traditional Classroom Techniques Versus Traditional techniques Coupled with Ethno-Mathematics Software at Touch Middle School. National University.

National Examination Council (NECO) 2009). Chief Examiners' Report. Mina: Niger State.

NCTM, (2013). www.pat-thompson.net

Okoli, C.C.O. (20010). Effect of Discovery Method on Students' Achievement and Interest in Geometric Construction and Bearing. *Unpublished M.ED. Thesis*, UNN.

Olosunde, G.R. and Olaleye, O.O. (2010). Effect of Concept Mapping Strategy on Senior Secondary School Students' Performance in Mathematics. *Journal of Mathematics Science Education* 1(1) TIMEX: Abuja.

Osafehinti, J.O. (1998). Sex-Related Differences in Mathematics at the Secondary School Levels. *Journal of Mathematics Association of Nigeria*, 18(1), 80-88.

Ozigbo, I.G. (1994). Effect of Geoboard and Roleograph as Instructional Materials in Teaching Plane Geometry in Secondary Schools. *Unpublished M.ED. Thesis*, UNN.

Ozofor, N.M. (2001). Effect of Two Modes of Computer Aided Instruction on Students' Achievement and Interest in Statistics and Probability. *Unpublished Ph.D. Thesis*, University of Nigeria, Nsukka.

SPSS Inc. (2000). Statistical Package for the Social Sciences Personal Computer (SPSSPC), Version 10.0, Chicago, IL:SPSS Inc.

Robert, Sternberg (2013). www.instructionaldesign.org/theories

Unodiaku, S.S. (2011). Development and Validation of Simultaneous Linear Equations Assessment Instrument among Junior Secondary school Nigerian Students. International *Journal of Education, Science, Mathematics and Environmental Studies (IJESMES),* 3(1), 49-64).

Unodiaku, S.S. (2012). Development and Validation of Mathematics Readiness Test for Senior Secondary School Students. African *Journal of Science, Technology and Mathematics Education (AJSTME).* University of Nigeria, Nsukka, 2 (1), 57-71.

Unodiaku, S.S. (2012). Development and Validation of Mathematics Readiness Test for Senior Secondary School Students. African *Journal of Science Technology and Mathematics Education (AJSTME),* 2(1), 57-69.

Usman, K.O. and Nwoye, M.N. (2010). Effect of Graphical – Symbol Approach on the Pupils' Achievement in Ratio at Upper Primary School Level in Nsukka Central Local Government Area. *Journal of Mathematical Centre*, Abuja, Vol. 1 (1), 123 – 132.

West African Examination Council (WAEC) (2001 – 2006). Chief Examiners' Reports Yaba: Lagos State.