Ethnomathematics Concepts in Yakurr Culture: Applicability of Ethnomathematics Concepts in Conjunction with Conventional Methods of Teaching Geometry

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Abstract
This study sought to explore ethnomathematics concepts that exist in the culture of the Yakurr people of Cross River State of Nigeria. It also aimed at determining the applicability of ethnomathematics concepts in conjunction with conventional methods in teaching geometry in junior secondary one (JS1). One research question and one null hypothesis were used to guide the study. The study employed survey and specifically, pretest, posttest, and non-equivalent control group (quasi-experimental) designs. The samples used for the study comprised 120 unschooled Lokaa speaking adults; and 304 junior secondary school one (JS1) students. Two instruments – Ethnomathematics Concepts Questionnaire (ECQ) and Geometry Achievement Test (GAT) were used for data collection. Two sets of lesson plans were prepared, one for the treatment group and the other for the control group. The treatment and control groups were taught JSS One geometry using ethnomathematics teaching approach and conventional methods, respectively. Research question was answered using qualitative data, while the null hypothesis was tested using Analysis of Covariance (ANCOVA), at .05 significant level. The results established that ethnomathematics concepts exist in the culture of Yakurr people and cultural artifacts have geometric concepts embedded in them as contained in the Junior Secondary School Mathematics Curriculum. The results also showed that ethnomathematics teaching approach is significantly better than the conventional methods in improving students' learning and achievement in geometry. Based on these findings, it was recommended that ethnomathematics concepts should be incorporated into the Junior Secondary School Mathematics Curriculum, and ethnomathematics teaching approach should be adopted in teaching geometry in the Nigerian education system, amongst others.

Keywords: Ethnomathematics, conventional, method, geometry, artifacts, teaching, applicability.

Introduction

Mathematics as a human activity is very relevant to everyday activities of man and manifests in all cultures the world over. This is as it provides a powerful, concise and unambiguous means of communication among people of either the same culture or different cultures. This is the reason Enukoha (1995) indicated that, every society no matter the level of its development, develops some type of mathematics that helps its people to tackle their daily societal problems. This further explains why adults and even school age children without formal education possess some basic knowledge of mathematics and mathematical competences.

In Nigeria, and indeed, Africa in general, mathematics which simply concerns calculation, measurement and shape is unwritten. Thus, it is culturally determined and transmitted orally from generation to generation (Zaslavsky, 1973). This mathematics which is culturally determined is reflected (Bishop, 1988) in the following significant activities that are universal in practice: counting, measuring, locating, designing and playing (example, games). The mathematical activities that exist in Nigeria and Africa are similar to those in other countries as mathematical ideas are universal and are embedded in the cultures of the peoples (Zaslavsky, 1973).

It is this mathematics, practised among identifiable cultural groups that D'Ambrosio (1999) called Ethnomathematics. Other mathematics educators have perceived and defined Ethnomathematics differently, though, without deviating from the meaning of the concept. For example, "A discipline interested in the study of mathematics and mathematics education in the cultural milieu of the learner" (Enukoha, 1995:39); it is the mathematical knowledge that is indigenous to a particular culture (Orey, 2003).
The existence of Ethnomathematics or cultural mathematics in every society has been established by the following studies in Nigeria. Oladimeji (1977) – among the Yorubas; Enukoha (1979) – among the Igbos, Enukoha (1981) – among the Efiks and Ibibios; Adaaku (1982) – among the Tivs, Akin and Fapenle (1985) – among the Awori people of Ogun State; Musa (1986) – among the Hausas; and Okpobiri (2005) – among the Ikwerre people of Rivers State.

These mathematical practices/activities of different cultural groups manifest themselves in arts and artifacts like clay bed, clay pots, fish traps, baskets, decorations, mats, native houses (round and rectangular), native caps, gongs, local drums, calabash plates, amongst others. Geometric concepts such as straight line, angle, parallel and perpendicular lines, lines of symmetry, square, rectangle, circle, cuboid, cube, cone, and cylinder are embedded in these artifacts. There are local terms within the tribes of Nigeria for these geometric concepts, but they are used in the topological rather than in the Euclidean sense. For example, the Igbo tribe of Nigeria have gburugburu for circle (Enukoha, 1979), the Efiks and Ibibios have terms like ekara for circle, ekari-ekari for round and itung for angles (Enukoha, 1981), the Tivs have ahwa for circle (Adaaku, 1982).

Bockarie (1993) indicated that mathematics teachers in Africa must explore and know the mathematics embedded in the learner's culture. In support, Gilmer (2005) argued that a mathematics curriculum aligned to the culture of the learner would respond to the classroom instructional needs of learners who ordinarily could have thought mathematics is too difficult to learn.

Geometry has for many centuries been regarded as one of the best ways of training the mind in logical thinking and imagination. Spatial ability, which is the learner's ability to judge the positions, sizes, and shapes of objects in space, can be developed through the knowledge of geometry. Kurina (2010) indicated that every child is in contact with quantitative impulses from the beginnings of life. The child lives and moves in space with important geometrical qualities like the basic properties of metrics (symmetry of metrics). Also, the space of the child's world is divided into some parts (the cot, the little room, the house, compound and the garden) and it is feasible to move from one of these parts to another. This means that before formal schooling, the child had acquired relevant geometrical experiences which if recognised and explored by the teacher could enhance instructions in geometry.

Since no study has investigated into the basic ethnomathematical concepts of the unschooled adults of the Yakurr people of Cross River State of Nigeria, the first part of this research project provided the relevant data that formed the basis for the main purpose of the study.

In spite of the existence of Ethnomathematics in different cultural groups in Nigeria, schools still seem to use Mathematics that is anchored on Western tradition or Western theorist thought (Bush, 2003). This situation is disturbing as classroom mathematics does not appear to be sufficiently aligned to the cultural milieu of the learner. This is in spite of the stipulation in the National Policy on Education (FRN, 2013), that as a means of preserving the people's culture, the language of the immediate community of the child should be emphasised.

This could be the reason (D'Ambrosio, 1990) argued that widespread apparent failure in school mathematics is actually a cultural problem being consciously played out through the filtering mechanism of Western Mathematics Education. This is the reason much of the contents of the current junior secondary school mathematics curriculum in Nigeria seem to be supported by a tradition foreign to the learner in Nigeria.

If we therefore think about ethnomathematics as our own mathematics practices, then the pedagogical approach which reorients teaching and learning towards ethnomathematics is advocated (Achor, Imoko and Uloko, 2009; Laridon, Mosimege and Mogari, 2005; and Odili and Okpobiri, 2011). The quality of teaching and learning mathematics in secondary schools in Nigeria has continued to be a source of concern to researchers in mathematics education. The continued low achievement in mathematics among Nigerian students is a clear manifestation of the perceived problem. Geometry remains one of the most poorly taught, widely disliked and poorly understood branches of mathematics, in mathematics education.

The methods of teaching Geometry (Kurumeh, 2004; Telima, 2011 and Undiaku, 2013) have been implicated as one of the undisputed factors responsible for this problem. Experts in education argue that mathematics phobia is borne out of the age-long Eurocentric bias of the mathematics curriculum and teaching methods which leaves the learner thinking in abstractions that are alien to his environment or real world. Therefore, a teaching approach that focuses on a cultural perspective as against the traditional/conventional didactic method of teaching that promotes rote learning of geometry is considered in this study as capable to address this gap in geometry teaching and learning.

Again, the state of teaching and learning geometry in schools does not appear to improve as conventional methods have failed to use the geometrical experiences of the learner acquired at home in teaching geometry. Zaslavsky (1973) indicated that mathematics is a cultural product. It means that mathematics educators might be transmitting the values of particular cultures while teaching students from different cultural backgrounds in the same classrooms. This has caused students outside the mainstream culture to see mathematics as foreign to them and hence their difficulty in learning the subject in school. Thus, the problem of the study.

Even though mathematics educators with interest in ethnomathematics research have argued in favour of the benefits of using a cultural perspective in geometry instructions, not much empirical evidence has been provided to favour the adoption of the approach. As a result, researchers in mathematics pedagogy are still faced with the task of providing statistical evidence for the adoption of ethnomathematics teaching approach in our junior secondary schools. This research project is a response to this challenge and is designed to explore (1) basic ethnomathematics concepts in Yakurr culture; and (2) examine empirically the effects of an Ethnomathematics teaching approach on junior secondary school students' achievement in geometry.

Research Method

One research question and one hypothesis formulated and tested at probability of = 0.05 level of significance guided the study. Survey research and quasi-experimental designs were adopted for the study. Two instruments were developed by the investigators for collecting data from research subjects.

The study was carried out in Yakurr Local Government Area of Cross River State of Nigeria. Two different populations were used for the study. The first population comprised all the Lokaa speaking adults of the area of study. The exact population figure could not be obtained because there were no records available to the investigators. The second population consisted of 1,260 Junior Secondary One (JS1) students in sixteen public secondary schools in the 2014/2015 academic session.

The samples for the study comprised 120 unschooled Lokaa speaking adults and 304 JS1 students from 12 secondary schools in 15 intact classes. Using hat-and-draw method, 8 villages were randomly selected from the list of 18 serially numbered villages that make up the area of study. Purposive sampling procedure was adopted to pick 15 unschooled adults from each of the 8 villages giving 120 subjects used for the study. The second sample of 304 JS1 students consisting of 155 students for the experimental (treatment) group and 149 students for the control group in 18 intact classes of 12 schools was used. Simple random sampling procedure was employed to randomly select 12 schools from 16 public secondary schools.

Through the random assignment of the experimental (treatment) and control groups with 7 intact classes; and 6 control groups with 8 intact classes were obtained using balloting. The experimental and control groups were exposed to ethnomathematics teaching approach and conventional teaching method, respectively.

The Ethnomathematics Concept Questionnaire (ECQ) contained 18 oral interview items on the existing ethnomathematics ideas/concepts and covered various aspects of school mathematics with emphasis on school geometry in Yakurr culture. The questionnaire was administered on the 120 unschooled Lokaa speaking adults through oral interview in "pidgin" English. "Pidgin" English is accepted in Nigeria, and spoken fluently by the uneducated/ unschooled adults in the area of study. Geometry Achievement Test (GAT) contained 20 multiple choice items with 4 options each which measured subjects' achievement in school geometry. The 20 items in GAT adequately covered all the basic ethnomathematics ideas/concepts identified in Yakurr culture. A test blue-print based on the school scheme of work for JS1 class was developed to guide the construction of test items. 20 test items which were constructed, validated, with reliability established were administered on the 304 JS1 students.

The sets of instruments were validated by two experts in Tests and Measurement and three experts in Mathematics Education. ECQ and GAT were trial-tested. The suggestions of the experts and the results of trial testing were used to produce the final versions of ECQ and GAT. Furthermore, item analysis was done on the items in GAT. The calculated difficulty and discriminating indices of each item were found to be 0.53 to 0.88 and 0.12 to 0.89, respectively. Test items with difficulty and discriminating indices equal to and above 0.20 were accepted or revised (Aiken, 1988).

The reliability of the instrument (ECQ) was established as the two sets of instruments were found to be stable after administering ECQ twice at a time lapse of two weeks after trial testing. Kuder-Richardson 20, Test-retest and Pearson Product Moment Correlation Coefficient(r) techniques were used to determine the reliability of GAT.The analysis yielded internal consistency reliability coefficient of 0.69 (Kuder-Richardson 20); test of stability (Test-retest); and reliability index of 0.72(r). Copies of the two instruments were administered to research subjects in their various locations with the help of 8 and 15 research assistants respectively.

Two sets of lesson plans for teaching the units of geometry concepts outlined for the study were prepared by the investigators. They were prepared based on the test blue-print. The two sets of lesson plans were 12 and used for classroom instructional delivery for one month. Three experienced Mathematics teachers who have been teaching Junior Secondary Mathematics for at least five years were used to establish the suitability and conformity of the prepared lesson plans with the prescribed lesson plan format in current use in the school system in the State. The lesson plan for the treatment group used ethnomathematics teaching approach while the other lesson plan for the control group used the conventional method only in teaching geometry. The procedure was the same in both cases, except that the control group was not exposed to cultural mathematical artifacts. Fifteen (15) classroom teachers from 15 intact JS1 classes were used as research assistants. They were trained by the investigators and they taught the lessons for one month while the investigators monitored and supervised their teaching. Before the start of teaching, GAT was administered as pre-test to both the treatment and control groups. Post-test GAT was administered to the research subjects in the two groups by the research assistants at the end of one month of twelve periods of teaching during school lessons as appeared on the time-table in each school used for the study. The following extraneous variables were controlled:

Subject variable, teacher variable, pre-test and post-test wiseness and Hawthorne effect, which could introduce bias into the research.

Data collected were analysed using qualitative data to answer the research question; while Analysis of Covariance (ANCOVA) statistic was used to test the null hypothesis at probability = 0.05 level of significance at relevant degree of freedom.

Results

Research Questions

What are the ethnomathematics concepts that exist in Yakurr culture?
It was revealed that the Mathematics of the people of Yakurr can be described under the following topics: (i) Numeration/Counting System; (ii) basic arithmetic operations; (iii) fractions; (iv) zero; (v) telling time; (vi) geometric concepts; (vii) Mathematical games and probability; and (viii) rhymes.

Numeration/Counting System

Counting is done at four different base levels, namely, (1) sub-base 5, (2) sub-base 10, (3) sub-base 15 and (4) main base 20. The special number words for these base numbers are: 5=yataan, 10=joo, 15=jiib, 20=leyau. Other number words worthy to mention because intermediary numbers are formed from them include: 40=aapoo, 60=aatele, 80=aanaa, 100=aataan, 200=aajoo, 400=ledu, 800=aduapoo. Counting using the number words goes thus: 1=wana, 2=yapoo, 3=yatele, 4=yaana, 5=yataan, 6=yataanawana, 7=yataanyapoo, 8=yataanyatele, 9=yataanyaana, 10=joo, 11=jooawana, 12=jooyapoo, … 15=jiib, 16=jiibawana, 17=jiibyapoo, … 20=leyau, 21=leyauopaliwana, 22=leyauopaliyapoo, … 40=aapoo, 41=aapooopaliawana, … 800=aduapoo, 1000=addu-apoo-opoliaajoo (Iyam, 2011). It can be seen from this counting system that the number words are said to multisyllabic and literally constructed since symbols/numerals are not invented for numbers. The existence of the special number words mentioned above has made possible the formation of number words for numerals up to 1000 and beyond. However, situations are very rare in the daily transactions where the people of Yakurr are required to count beyond 1000.

Basic Arithmetic Operations

The terms in Yakurr for +, –, x, ÷, are fooneneke, delikeka, non-oso and ton-mbenben, respectively. It is clear that the method of addition in this culture brings out the idea of place value and the writing of whole numbers in expanded form. For instance,

$$11 = \underset{\text{Tens}}{10} + \underset{\text{Units}}{1}; \qquad 113 = \underset{\text{Twenties}}{(20)\,5} + \underset{\text{Tens}}{10} + \underset{\text{Units}}{3}$$

These arithmetic operations could be carried out mentally, using fingers and toes; and objects to aid simple computations.

Fractions and Zero

The idea of fraction exists in Yakurr culture. Number word for a fraction does exist, but they do not exist for most fractions as in Hindu/Arabic. For example, proper fractions like $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{2}{3}$, to mention a few, cannot be distinguished from one another in Yakurr. Fraction is called yipah while yopah is used to refer to many fractions. However, the fraction $\frac{1}{2}$is commonly called yipah and can easily be determined or estimated, whereas all other fractions are each estimated as it relates yipah$\left(\frac{1}{2}\right)$.

The number word for zero(0) is kekongha. The concept of zero is vague among the people, and thus, not in common use. However, if a problem like 10 cups of garri minus 10 cups of garri was asked, a Yakurr person would correctly respond kekongha, meaning nothing is left. Similarly, other arithmetic operations are used involving objects, not pure numbers; they have various ways of keeping records of events; units of measurement which are not standardized are used to measure lengths and distances.

Geometric Terms

There is a dearth of geometric terms in Lokaa language. Lokaa is the language spoken by the Yakurr people. Where such terms exist, they are used descriptively; or technically put, they are used in the topological sense (example, enclosure, proximity, separation) as the Euclidean notions are lacking in the Yakurr culture. Some of these geometric terms are shown below:

English	**Lokaa**
Rectangle	keku
Square	yopah-yonahboyobonghoma
Triangle	yopah-yoteleboyobonghoma
Circle	lensonghoo
Cone	yopah-yopoh boyo-yakekekanha

Again, some geometric forms derived from the Lokaa cultural artifacts (example, thatched houses, long wooden gong, native drum, native box, traditional chief cap, leg bead, clay pot, calabash plates) included: rectangles, cylinders, circles, symmetries, patterns and parallelism. The artistry displayed in these artifacts is a rare attribute. These culturalartifacts could have been formed by observing the natural environments, thereby consciously or unconsciously producing these geometric forms found in the Junior School geometry.

Hypothesis

There is no significant difference in the mean achievement scores of students taught geometry using the ethnomathematics teaching approach and those taught geometry using the conventional method.

The hypothesis was tested using Analysis of Covariance (ANCOVA) at probability = 0.05 level of significance. Summary of results is presented in Table 1.

Table 1: Analysis of Covariance for Students Geometry Achievement Scores by Methods of Teaching

Source of variation	Sum of squares	Df	Mean square	F	Fcv
Corrected Model	32662.591	4	8165.648	150.967	
Intercept	25042.254	1	25042.254	462.981	
P	19021.770	1	19021.770	351.675	
Method	10083.287	1	10083.287	186.420	
3.88					
Residual	16172.642	299	54.089		
Total	948633.000	304			
Corrected Total	48835.234	303			

From the hypothesis, the Analysis of Covariance (ANCOVA) table (Table 1) showed that the calculated F-value of 186.420 is higher than the critical value of 3.88 at probability = 0.05 level of significance. Hence, we rejected the null hypothesis and retained the alternative hypothesis. The investigators concluded that there was a significant difference in the mean achievement scores of students taught geometry using the ethnomathematics teaching approach and those taught geometry using the conventional methods.

Discussion

The findings of this research revealed that there exist basic ethnomathematics concepts in Yakurr culture. There counting system uses bases 5, 10, 15 and 20 and they can count up to 1000 and beyond. Basic arithmetic operations, concept of zero, fractions, records keeping of events, cultural artifacts with geometric patterns and shapes and geometric terms are embedded in the culture. However, as noted, the local geometric terms are used in the topological, rather than in the Euclidean sense. This finding agreed with those of Zaslavsky (1973), Oladimeji (1977), Enukoha(1979 and 1981), Adaaku (1982), Akin and Fapenle (1985), Musa (1986) and Okpobiri (2005) which established the existence of ethnomathematics concepts in various cultural groups in Nigeria. As they indicated, their existence provide the basis for Mathematics teachers in Nigeria and elsewhere to adopt teaching techniques from a cultural perspective for mathematics instructions in schools.

The study also showed a significant ($p<0.05$) difference between the mean achievement scores of students taught geometry using ethnomathematics teaching approach and those taught geometry using the conventional methods. This higher achievement could be attributed to the active involvement (Blanco, 2009) of students in the cultural, student-centred and activity-based ethnomathematics approach. Similar findings had been established by Kurumeh (2004), Achor, Imoko and Uloko (2009) and Odili and Okpobiri (2011). They concluded that this kind of learning environment is practical and makes feasible the applicability of geometry in real life situation. This learning situation also is in agreement with the constructivist approach that supports learning in cultural and social contexts which is anchored on learners' perceptions of experiences.

Conclusion

It was established in this study that ethnomathematics concepts and materials are richly embedded in Yakurr culture. These ethnomathematics materials such as identified cultural mathematical artifacts have geometry concepts like rectangles, squares, cuboids, cubes, triangles, circles, cylinders, cones, amongst others. This forms the basis for their relevance in fostering positive learning in students, and by extension, effective teaching of mathematics in classrooms.

It is for this reason we strongly recommend their use in geometry instructions to enhance students learning, effective teaching, and hence improve achievement in geometry examinations. Thus, culturally-based teaching approach in Mathematics has been shown to be a veritable option for adoption in classroom mathematics instructions.

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Footnote:

Lokaa people with a population of 196,450 are located in the Central Senatorial District of Cross River State of Nigeria. At present, they constitute one Local Government Area in Cross River State. The geographical area is referred to as "Yakurr", while the language as "Lokaa".

APPENDICES

Appendix 1: Table of Specification on Geometry for Junior Secondary 1

Content Total Items	**Knowledge (30%)**	**Comprehension (50%)**	**Application (20%)**	**Total Items**
Properties of solid shapes-cubes, cuboids, cone, prisms, cylinder and spheres (35%)	2	4	1	7
Properties of planes, shapes, rectangles, squares, triangles and circles (30%)	2	3	1	6
Angles (15%)	1	1	1	3
Parallel and perpendicular lines (20%)	1	2	1	4
Total (Items)	**6**	**10**	**4**	**20**

Appendix 2: Lesson Notes For Treatment Group:
Using Ethnomathematics Teacing Approach In Geometry

Topic: Properties of 3 – dimensional Shapes
Class: JSS 1
Time: 40 minutes

Instructional Objectives

At the end of the lesson, students should be able to:

(i) Construct selected cultural artifacts in their locality.
(ii) Draw cultural artifacts, constructed.
(iii) Match cultural artifacts to related solid shapes.

Instructional Materials

Wood, raffia, native rapes, clay, and selected cultural artifacts.
Step I: Entry Behaviour: Students have seen clay bed, wooden gong, local drum, and traditional container made of cane rope, among other cultural artifacts.
Mode: Group Work

Teacher's Activities

A local artifacts constructor who would teach students how to construct local artifacts would be introduced to the students by the teacher.

Student's Activities

Students welcome the local artifacts constructor or maker.
Step II: Content Development
Mode: Group Work

(a) Construction / making of cultural artifacts.
(b) Drawing of Cultural Artifacts.**Teacher's Activities**

Construction of cultural artifacts. Ask students to observe attentively the procedure for making of native box (Kiku), long gong (Lokumo), native drum (Ekoma), native cap (Koboljongho), (Liman), thatched house (Etoh). Chart 1

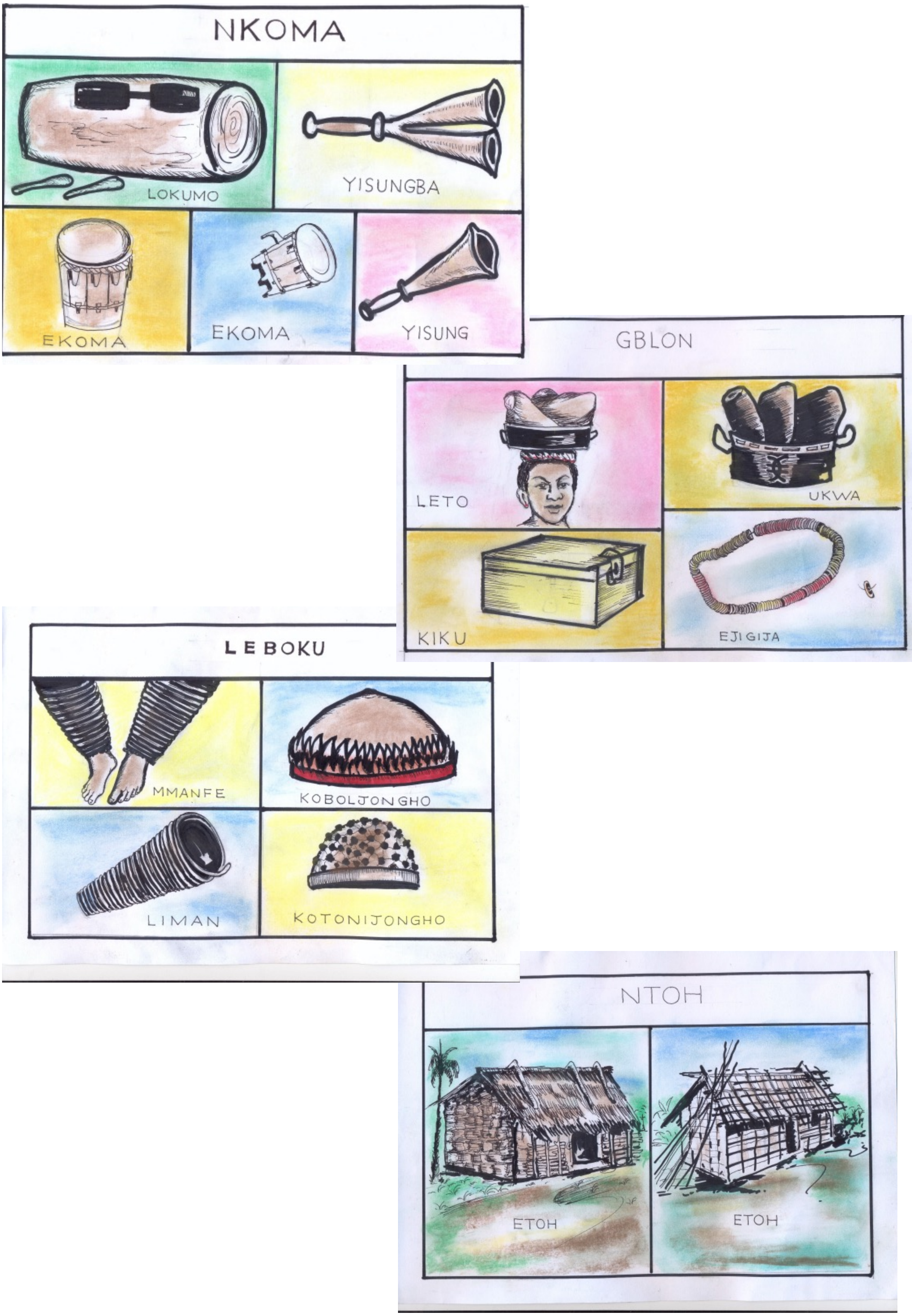


Chart 1: Cultural artifacts in Yakurr culture

Student's Activities

(i) Students observe the constructor/maker as he makes the cultural artifacts.

(ii) Students follow the procedure observed and construct the cultural artifacts.

Teacher's Activities

(i) Teacher guides the students to relate each cultural artifact constructed to the 3 – dimensional shapes they have seen in their environment.

Student's Activities

(i) Students observe attentively how each cultural artifact is made.

(ii) They follow the same procedure and make the same cultural artifacts.

(iii) Students detach the components that make up the objects constructed and put them together again.

Step III Discussions.
Mode: Group Work

Teacher's Activities

(i) Teacher gives the groups three minutes to discuss the procedures they have learnt in making the cultural artifacts.

(ii) Ask each group leader to present the procedures, while the local constructor helps, where necessary.

Student's Activities

(i) Students discuss the procedures for making these selected cultural artifacts.

(ii) Group leaders present the procedures.

Step IV Summary
Mode: Whole class

Teacher's Activities

(i) The local constructor goes over the procedure again.

Student's Activities

Students observe with apt attention as the constructor explains the procedure and then write down summary notes.

Step V: Evaluation
Mode: Individual Work

Teacher's Activities

Ask students the following questions:

1. Asks students to match the cultural artifacts constructed with the solid shapes in their locality.
2. Ask students to write the names (vernacular) of the cultural artifacts.
3. Students draw the artifacts with solid shapes.

Student’s Activities

Students provide answers to questions

Assignment

Each student to construct one cultural artifact with solid shape and bring to the next class.

Topic: Properties of 3- Dimensional Shapes

Class: JSS 1

Time: 40 minutes

Instructional Objectives

At the end of the lesson, students should be able to:

(1) Identify some common 3-dimensional shapes, namely, cuboids, cubes, cylinder, cone, and sphere.

(2) Identify the faces, surfaces, vertices/corners, and edges of solid shapes.

(3) Draw their shapes using cultural artifacts

Instructional Materials

Cultural artifacts as may be mentioned by students in class.

Step 1 Entry behaviour: knowledge of cultural artifacts like clay bed, local basket, long gong, native drum, etc.

Mode: Group work (Gender sensitive)

Teacher’s Activities

He divides the students into groups. Asks each group to appoint a leader.

Student’s Activities

Students cooperate with the teacher to form groups and appoint leaders.

Step 11 Content Development

Mode: Group work

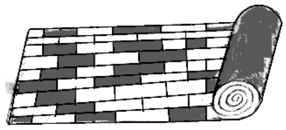
(a) Identification of Common 3-dimensional Shapes

Teacher’s Activities

(i) The teacher introduces the lesson by explaining the things seen around, like liquids, gases and solids. All these things occupy space and have shape. A thing which occupies space and which can keep it shape without help is called a solid. Gases and liquids occupy space but must be kept in a container if their shape is to remain the same. So they are not solids.

(ii) Asks students to give examples of solids from their environment.

(iii) through appropriate questioning, the teacher explores students’ knowledge of solid shapes using various cultural artifacts like clay bed/sleeping bed, long drum (Lokumo), native drum (Ekoma), leg bead (Liman), round house, gong (Yisung), top of a basic of garri, calabash plates (Kemekpla and Okiki) (Chart 2).



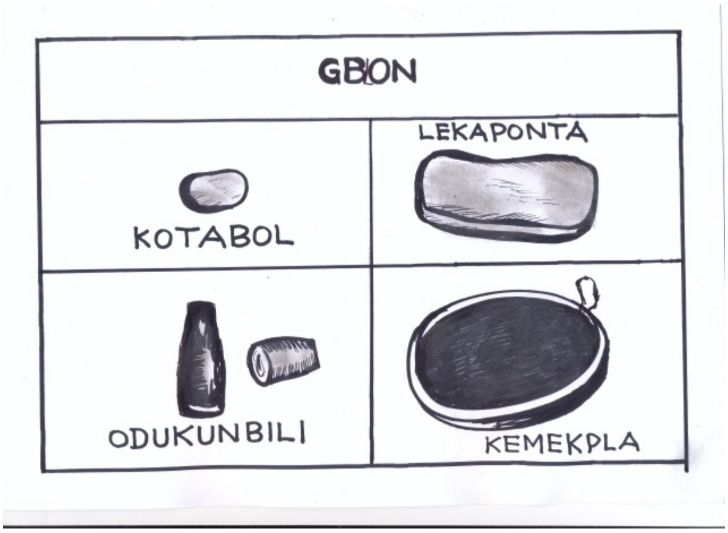


Chart 2: Cultural artifacts in Yakurr culture

(iv) Provides opportunity for students to discuss the names of these cultural materials (artifacts)

(v) Explains that these things that occupy space have their sizes, lengths and shapes (identify each cultural artifact with its related 3- dimensional shape)

(vi) Asks each group to show the outside, inside, width, length and height of solid shapes.

(vii) Explains that every solid shape has three dimensions, namely, length (1), width (w) and height (h).

Student's Activities

(i) Students listen attentively to teacher's explanations.
(ii) They give examples of solids from their environment
(iii) Students mention cultural artifacts that are identifiable with 3-dimensional shapes
(iv) They discuss the names of these cultural artifacts
(v) They observe the sizes, length and shape of solids.
(vi) Students identify the outside, inside, width, length, and height of solid shapes.

(b) Identification of Parts of the Outside of Solid Shapes

Teacher's Activities

(i) Explains that the outside of any solid shape is called the surface. Edges divide the whole surface into faces.
(ii) The teacher shows the students the surfaces, faces, vertices and edges on the various objects as indicated in charts 1 and 2.

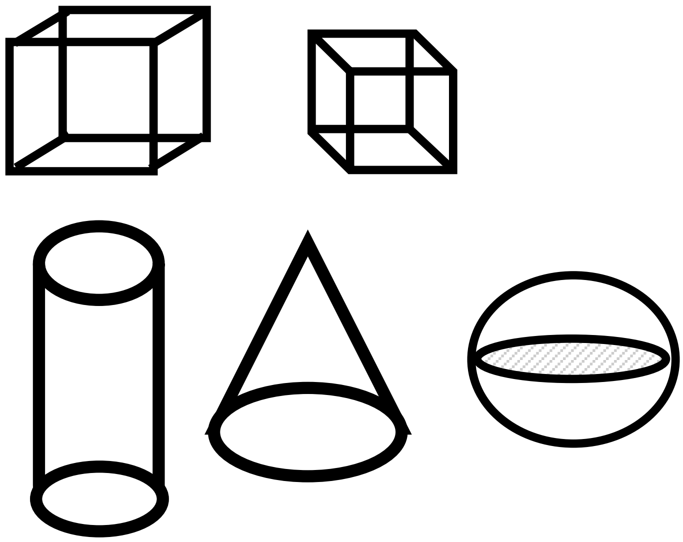


Chart 2: Diagrams of cuboids, cube, cylinder, cone, sphere

(iii) Asks students to discuss in their groups the various parts of solid shapes.

Student's Activities

(i) Students observe and identify the surfaces, faces, vertices and edges of solid shapes

Step III Discussions
Mode Whole class

Teacher's Activities

Teacher leads the class discussions by asking students to

(i) Differentiate between solids and gases/liquids

(ii) Give examples of three dimensional objects from their home.

(iii) Mention cultural artifacts that have shapes like cuboids, cube, cone, cylinder and sphere.

(iv) Identify the surfaces, faces, vertices, edges, height, width and length of solid shapes.

(v) Teacher corrects misconceptions that may arise as regard these shapes using cultural artifacts.

Student's Activities

Students participate actively by explaining the ideas learnt.

Step IV Summary

Mode: Whole class

Teacher's Activities

(i) Teacher summaries the lesson

(ii) Gives summary notes

(iii) Gases, liquids and solids that we see occupy space and have shape

(iv) Solids can keep their shapes without help; but gases and liquids cannot, except they are kept in a container.

(v) Solid shapes have sizes, lengths and shapes.

(vi) A solid shape is called 3 – dimensional because it has 3 dimensions – length (1), width (w) and height (h).

(vii) They have surfaces, faces, vertices and edges.

Student's Activities

Students write Summary notes in their exercise books

Step V: Evaluation (oral)

Mode: Whole class

Teacher's Activities

Mention:

1. The dimensions of a solid shape
2. Why is a solid different from gases/liquids?
3. The outside parts of a solid shape.

Pupil's Activities

Provide responses to questions asked by the teacher.

Assignment.

Draw the different cultural artifacts.

Topic: Properties of 3 – dimensional Shapes

Class: JSS 1

Time: 40 minutes

Instructional Objectives

At the end of the lesson, students should be able to:

(i) Draw some common cultural artifacts and other solid shapes

(ii) List the properties of 3- dimensional shape (solid shapes)

Instructional Materials

Cultural artifacts

Step I: Entry Behaviour: Students have seen and constructed clay bed, wooden gong, local drum, and traditional container made of cane rope.

Mode: Group Work

Teacher's Activities

Using some cultural artifacts, asks students to point out the surfaces, faces, vertices, edges, width, length and height.

Student's Activities

They supply answers to the teacher's questions

Step II: Content Development

Mode: Group Work

(c) Drawing of Cultural Artifacts and Other Solid Shapes

Teacher's Activities

Asks students to draw cultural artifacts in their exercise books.

Student's Activities

Students draw some cultural artifacts in their exercise books.

(d) Identification of properties of Solid Shapes.

Teacher's Activities

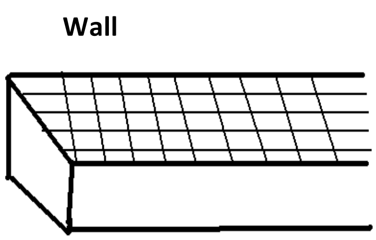
(i) Teacher notes down the relevant concepts students have acquired culturally in relation to these cultural objects (solid shapes)

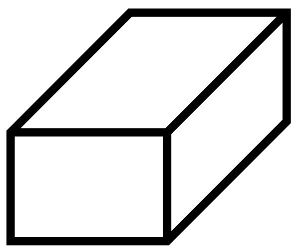
(ii) He connects to the students initial ideas of these cultural artifacts with the new concept to be introduced in the lesson

(iii) Teacher gradually introduces the properties of each solid shape based on the initial ideas students expressed as surfaces, faces, vertices and edges.

The Cuboids:

Through questioning, students discuss the shape of a native box (Kiku), the traditional container (Ukwa), made of cane rope, and thatched house (Etoh).

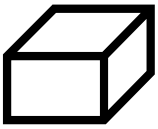




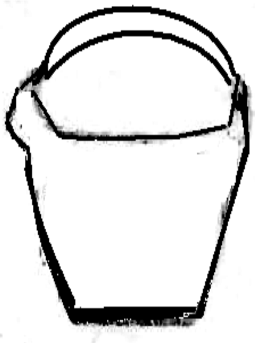
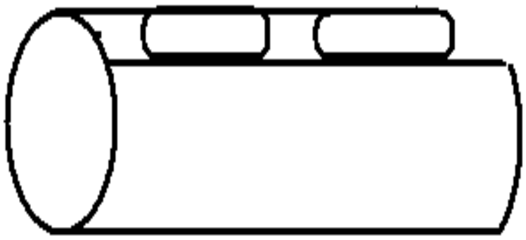
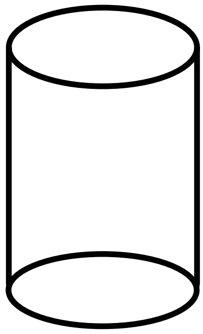
Each student participates in identifying and counting the number of the faces (6) edges (12) and vertices (8) and each flat face is rectangle. The chalk box or match box is used to illustrate the properties To explore their knowledge of a cuboid, each group is ask to write down six objects that have the shape of a cuboid in their home environment. Examples include, chalk box, maths set, match box, carton, etc. This brings out the cultural applications of cuboids.

The cube: teacher illustrates the shape of a cube employing a traditional musical drum (Ekoma). Students are asked to draw these cultural artifacts which have all sides equal. Together with the students, the properties of a cube are identified and counted thus: 6 equal faces, 12 edges, 8 vertices and each flat surface (face) is a square. The teacher then explores students' knowledge of common objects that have the shape of a cube in their home. Examples are maggi, sugar, die, etc.

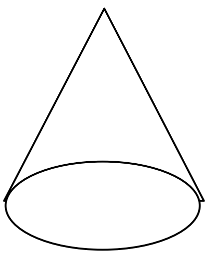
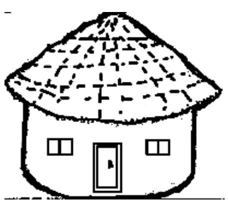
The cylinder:



The teacher uses appropriate questions to explore student's knowledge of objects (cultural artifacts) that have the shape of a cylinder. Students discuss the shape of native drum (Ekoma), long drum (Lokumo), made of wood and a leg bead (Liman). Students are asked to draw these cultural artifacts which are cylindrical in shape. Students participate to determine the properties of a cylinder (closed) 3 surfaces (two circular surfaces and one curved surface); 2 curved edges and no vertices. Students should discuss the uses of these cultural artifacts in their home setting. The teacher further asks group to list the local application of cylinder in their home environment. Examples include, the body of a round house, native drum, basket making with cane rope etc.

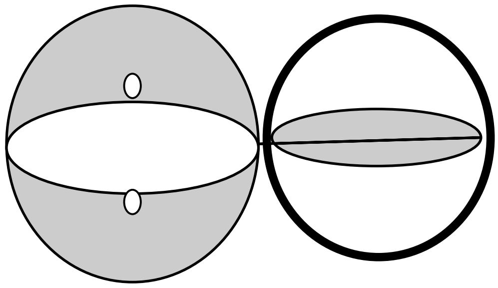




The Cone: The teacher explores the knowledge of students of traditional objects (cultural artifacts) with the shape of a cone. Students list out such objects like the gong (Yisung), top of a basic of garri, etc.

Students are asked to explain the cultural applications of this shape (conical) in making yam heap/mound, building the roof of a round house, top of the basin of garri. Teacher explains the properties of a cone: 2 faces (the circular and the curved surfaces), 1 edge and one vertex.

The Sphere: The teacher explores students' initial ideas of a shape that is spherical. They are asked to explain the shape of cultural artifacts like a pair of traditional eating plates (Kemekpla and Okiki) (calabash) made from gourd.



He determines the properties of a sphere: 1 face (round surface), no edge, and no vertex. Students are asked to explain the cultural applications of this shape (spherical) in making "Okiki" (traditional plates). Examples in the home are: an orange, ball, body of a water pot

Student's Activities
Students participate actively with the teacher to develop the content and to mention cultural artifacts related to each solid shape.

Step III Discussions.
Mode: Group Work
Teacher's Activities
(i) Gives the groups two minutes to discuss properties of solid shapes with regards to cultural artifacts.
(ii) Asks each group leader to present the ideas, listing the properties of each shape.
(iii) Teacher reconciles any misconceptions students may express and links same to the lesson

Student's Activities
(i) Students discuss the properties of solid shapes using cultural artifacts
(ii) Group leaders present the properties of solid shapes
(iii) Take note of any correction given by the teacher.
(iv) They mention the difference between a cuboid and a cube.
Step IV Summary
Mode: Whole class

Teacher's Activities
(i) The teacher summaries the lesson and writes summary notes on the chalk board for students to write in their exercise books.
(ii) Goes round the class to supervise students work.

Student's Activities
Students listen and then write down summary notes.
Step V: Evaluation
Mode: Individual Work

Teacher's Activities
Ask students the following questions:

1. List the properties of a cuboid, cone, cube, sphere, and cylinder.
2. Write down the names of solids shaped like (a) an orange (b) a brick (c) top of basic of garri (d) a die (e) a ball.
3. What is the difference between a cuboid and a cube?

Student's Activities
Students provide answers to questions
Assignment
Indicate the number of (a) faces (b) edges (c) vertices of a cuboid, cube, sphere, cylinder and cone.

Note: Other Lesson plans to cover angles, parallel and perpendicular lines and be presented using this format.