ETHNOMATHEMATICS
A case of Wasakwakwalwa (Hausa culture puzzles) in Northern Nigeria

Mohammed Waziri Yusuf[#1], Ibrahim Saidu [#2], *Aisha Halliru* [#3]
[#1]Faculty of Science, Department of Mathematics University Putra,Malaysia,
mymuhammadwaziri@gmail.com
[#2] Faculty of Computer Science and Information Technology, University Putra,Malaysia.
Harmach1974@yahoo.com
[#3] Department of Mathematical sciences, Bayero University Kano,(B.U.K) Nigeria

***Abstract*— Before the coming of Western education/colonialists, Hausa people in northern Nigeria used mathematics in sorting, ordering, measuring, timing and weighing in their day to day activities. Featuring prominently in this culture are the traditional games/puzzles played by children or adults with the aim of deriving lessons, and for cognitive development. One of such games is wasakwakwalwa, a term derived from the Hausa word "wasa" meaning shaping and "kwakwalwa meaning brain. Therefore, wasakwakwalwa (Hausa puzzles) is a brain shaping game. The main concern of this paper is on the aspect of wasakwakwalwa that involves calculations and to highlight therein the existence of algebra, set theory, trigonometric, coordinate geometry, arithmetic progression and geometry progression. The paper also shows how to translate verbal Hausa statement to mathematical expression and solve them. Furthermore the paper will correct the erroneous believe that there was no mathematics in Hausa land/northern Nigeria before the coming of the colonialists and address those who believe mathematics only starts and ends in the classroom, thereby divorcing the rich cultural elements from the use of mathematics.**

***Index Term*— Wasakwakwalwa, Hausa, northern Nigeria,**

I. INTRODUCTION

Hausa is the largest and dominate language in northern Nigeria. The culture of Hausa people has over shadow almost all the other cultures in the region, up to the level of including it into National curriculum as a compulsory subject in primary and secondary education. Hausa culture is like any other cultures, it consists of variety of activities/games played by children or adult, with the aim of deriving lesson from them. Hausa Puzzles as Wasakwakwalwa is derived from the word Wasa in Hausa language meaning shaping and "kwakwalwa" meaning Brain. Wasakwakwalwa (Hausa puzzles) is a Brain shaping game.

In Hausa culture elder's shapes younger individuals brains by storytelling and question and answers, the elders use to organize them, just like competition, with the hope of getting the best out of the participants. The game Hausa puzzles 'Wasakwakwalwa', in northern Nigeria, is beyond the level of younger individuals now. It reached the stage of inclusion in to almost all the broadcasting station (Television or Radio) programs, now the contestants /participants are not only the younger ones, but also the elders.

The traditional believes of Hausa people in northern Nigeria about mathematics are:

i. There is no mathematics in Hausa culture.
ii. Mathematics starts and ends only in classroom.
iii. Mathematics has no relevance to Hausa people.

The three above believes are what motivate us to write this paper, so that we can wash away the assumption made by our people.

There are quite a few researches which attempt to survey some of those games on General Hausa experience. Not knowing that, concentrating on this game (Waskwakwalwa) can improve the teaching and learning mathematics,.

In this paper we made a survey on some Hausa puzzles 'Wasakwakwalwa' that involves mathematics, and translate those verbal Hausa statements to mathematical expression and solve them.

The paper shows the position of algebra, set theory, trigonometric, coordinate Geometry, Arithmetic Progression and Geometric Progression, e.t.c as tools of analysis for Hausa puzzles 'Wasakwakwalwa'.

The paper also proves the existence of mathematical knowledge in Hausa land before the coming of western education.

Moreover the paper shapes itself from the fact that Wasakwakwalwa is a Hausa game that requires intellectual, rational and analytical thinking, which is purely mathematics.

However we should not forget that, Hausa people use mathematics in sorting, ordering, measuring and weighing in their daily activities.

According to [4] Hausa puzzles 'Wasakwakwalwa' is a game that shapes individuals (children and adults) intellectual reasoning capabilities. Wasakwakwalwa is a conceptualize way of developing cognitive development of individuals [12]. [4] Identifies features and the types of leisure these games (Wasakwakwalwa) encourage in the Hausa community.

[4] Asserts that, it is a well known fact in Hausa culture, individuals are often for lacking "tsari" or "Lissafi". These two concepts are mathematics.

Learning mathematics is not just about acquiring and mastering computational and problem solving techniques, or solely about understanding definitions, arguments and proofs. In addition to all of these things, it also involves you reconstructing the thinking of work of other mathematicians.[13] Also [14] confirms that Learning mathematics requires you to develop ways of thinking mathematically. [1] Asserts, there is a perception that mathematics is an effective tool for analysing, examining and verifying truth.

Human life remains incomplete without mathematics [11].

According to [7] mathematics is the construction of knowledge with regard to the qualitative and quantitative relationships of space and time. Mathematics is human

activity that deals with patterns, problem solving, logical thinking, and so on, with the aim of understanding the world [10].

Mathematics is a universal subject in which every culture has its concept of numbers and the idea that 1 + 1 = 2, no matter how technologically advanced the culture is.

The universality notion of mathematics is further reinforced by the fact that it was invented all over the world, in a multitude of places' and different times, with little or no contact amongst its creator. According to [1] Plato proclaims that mathematics is a reliable tool for pursuing truth.

According to [9] mathematics, like music can exist without its usefulness.

However, the paper focuses on culture and mathematics, in particular Wasakwakwalwa which is Ethnomathematics.

Ethnomathematics is the study of the mathematical practices of specific cultural groups in the course of dealing with their environmental problems and activities [10] and [15].

The Prefix "ethno" refers to identifiable cultural groups, such as notional tribal societies, professional classes etc. and includes their language and daily practices. "mathema" here means to explain, understand and manage reality specifically by counting, measuring, classifying, ordering and modelling patterns arising in the environment.

The suffix "ticks" means art to technique. According to [1] ethnomathematics is the study of mathematical techniques used by identifiable cultural groups in understanding, explaining, and managing problems and activities arising in their own environment.

Ethnomathematics refers to any form of cultural knowledge, or social activity characteristics of a social and/or cultural group that can be recognized by other groups [2].

For example, the manner professional basket ball players estimate angles and distances differs greatly from the corresponding manner used by truck drivers. Both professional basketball players and truck drivers are re-identifiable cultural groups that use mathematics in their daily work. They have their own language and specific way of obtaining the estimate and ethno mathematicians study their techniques.

Culture refers to a set of norms, beliefs, and values that are common to a group of people who belong to the same ethnicity [11].

The paper is divided into four sections: one Introduction, two Procedure of the Game, three analytical solution to the problems and four Conclusion.

The main work of this paper is written in two languages, we have Hausa Language (Northern Nigeria) and its translation in to English language (Western Language).

II. Procedure of the Game

The game "Wasakwakwalwa" is of two forms namely:

(i) Say your opinion.

(ii) Get the actual answer.

Our main area of interest is on those that involve mathematical operations, particularly (ii).

As in Hausa culture, before you ask any Hausa puzzles 'Wasakwakwalwa' problem, you must have the answer to such problem.The questioner will state the problem and keep his answer in his mind and allow people around (participants) to find their own answers. Everyone has a chance to say his own answer once. If the given answer is correct the questioner will say yes. Else they will say "MUN BAKA GARI" meaning 'you are the king' then the questioner will give out his answer.

Because of the scanty literature on the topic, some data were sourced from Radio and Television stations, in northern part of Nigeria. [5, 6, 7, 8] and centre for the study of Nigerian languages Bayero University Kano Nigeria.

The main concern of the paper is to solve some problems of Wasakwakwalwa by using mathematical formula, fact, knowledge, and idea etc to agree with the Hausa cultural answer.

III. The Problems

Sample 1. (Hausa language version)

Akwai tsuntsaye akan bishiya wasu kuma a kasan bishiya .Idan daya daga cikin nakan bishiya ya sauko kasa, na sama zasu zama daidai da na kasan.Idan daya daga na kasan ya hau sama,na sama za su linka na kasa sau biyu.Tsuntsaye nawa ne ainihi a sama da kasa?[5]

Translation to English

There were some birds at the top of a tree and some on the ground. If one at the top comes down, those at the top will be equal to those at the bottom. But if one of those at the bottom met those at the top, those at the top will doubled those at the bottom. What is the actual number of birds at top and bottom of the tree?

Solution

Let x be the number of birds on top of a three

Let y be the number of birds at bottom of the tree.

$$y+1=x-1 \qquad (i)$$

$$x+1=2(y-1) \qquad (ii)$$

By rearrangement of (i) and (ii)

$$y-x=-2 \qquad (iii)$$

$$x-2y=-3 \qquad (iv)$$

Solving the two equations simultaneously by elimination method

We have y =5 and x =7

Hence there are seven birds at the top of the tree and five birds at the bottom of the tree.

Analysis

$$7+1=2(5-1) \qquad 8=8$$

Also

$$7-1=5+1 \qquad 6=6$$

Sample 2. (Hausa language version)

Mafarauci ne ya sami tsuntsaye a kan bishiya,sai yace,dari ku tashi ,sai suka ce ba mu kai dariba sai ka hadamu sau biyu, katara da rabin mu sannan ka sake tarawa da rubu"in mu ka kuma tara da kai kanka tukun za mu kai dari.Nawa ne tsuntsayen da mafarauchin ya samu a kan bishiya?[7]

Translation to English

A hunter met some birds on a tree, and then he asks them one hundred (100) fly up? They answered him, we are not up to hundred till you double us ,add half of us, add quarter of us then add yourself , then we reach hundred. How many birds are there on the tree?

Solution

Let x to be the number of birds at the tree. Then we have

$$2x+\frac{1}{2}x+\frac{1}{4}x+1=100$$

Solving the above equation with respect to x, we have

X =36

Hence, the number of birds at the tree is 36.

Analysis

$$=2(36)+\frac{1}{2}(36)+\frac{1}{4}(36)+1=100$$

Sample 3. (Hausa language version)

A gidan kallo ne (Dambe),ana son mutane dari su shiga,kuma a sami naira dari biyu,kudin yara sule daya,kudin mata naira biyu,kudin maza naira goma.In mace daya ce tashiga.yara da manya nawa ne za su shiga dan a sami naira dari biyu,daga mutum darin da ake so su shiga? [6]

Translation

The capacity of a traditional boxing theatre is 100 people. The amount needed to gather is ₦ 200, but the gate fee for children is 10k, gate fee for ladies ₦ 2 and gate fee for gentlemen is ₦ 10. If only a lady enters, how many children and gentlemen are to enter so that the amount needed will be achieved?

Solution

Let x_1 be the number of children (yara)

Let x_2 be the number of Female(Mata)

Let x_3 be the number of Male (Maza)

$$x_1+x_2+x_3=100 \qquad (i)$$

$$0.1x_1+2x_2+10x_3=200 \qquad (ii)$$

Since we have one female

$$\therefore x_2=1 \qquad \text{(iii)}$$

We obtained $x_1=80$, $x_2=1$, $x_3=19$ by solving the tree equations simultaneously.

Analysis

Since we need 100 people to be in, therefore

80+1+19=100

And also it yields two hundred naira, that is

$$=0.1\times80+2\times1+19\times10$$
$$=8+2+190$$
$$=200$$

Sample 4. (Hausa language version)

An umurce ka ka kawo lemu guda biyu daga cikin lambu. A lambun akwai kofa bakwai,ko wace kofa akwai maigadi. Za ku raba lemun da ke wajen ka daidai da mai gadin ko wace kofa.Nawa ne lemun da yakamata ka ibo ?[8]

Translation

You are asked to bring out two oranges from a garden. The garden has seven gates with gateman each. Whatever number of oranges you have it should be divided equally with each of the gateman. How many oranges are you to carry?

Solution

Let x_1 be the number of orange at 1^{st} gate.

Let x_2 be the number of orange at 2^{nd} gate.

Let x_3 be the number of orange at 3^{th} gate.

Let x_4 be the number of orange at 4^{th} gate.

Let x_5 be the number of orange at 5^{th} gate.

Let x_6 be the number of orange at 6^{th} gate.

Let x_7 be the number of orange at 7^{th} gate.

Therefore we have this sequence

$x_1, x_2, x_3 \ldots\ldots x_7$

Our goal is to find the total number of oranges to carry at the initial point.

Since at 1^{st} gate we are expected to come in with 4, 2^{nd} gate with 8, 3^{rd} gate with 16,and so on up to 7^{th} gate.

Hence we can generate the following sequence

4,8,16,…….

The above sequence is a Geometric sequence.

Where

$a=4$, $r=2$,and $n=7$

We need to look for the 7^{th} term. Using the below equation.

$$T_7=ar^{n-1}$$

Therefore the number of oranges needed at the 7^{th} gate is 256

Analysis

4 8 16 32 64 128 256

1^{st} 2^{nd} 3^{rd} 4^{th} 5^{th} 6^{th} 7^{th}

Sample 5. (Hausa language version)

Musa yanada Kwandala daya, Audu nada takardar kudi ta naira dubu daya. Musa yace kudinsa daidai yake dana Audu.Ta ina suka zamo daya?[6]

Translation

Musa has coin money and Audu has a one thousand naira note. Musa says his money is the same as Audu`s own. How will it be possible?

Solution

Let the Musa's money be Z_1 (coin)

Since Z_1 is a coin it has 360° (Angle at a point)

Let Z_2 be a paper money (#1000 notes)

Z_2 has four equal angles of 90° each

Hence $4\times90^\circ=360^\circ$

Therefore Z_1 *and* Z_2 are the same in terms of Angle.

Sample 6. (Hausa language version)

Mutun ne ya mutu ,ya bar shanu 18,000. A cikin magada akwai maza dari, da Mata dari biyu, da yara dari hudu. Mace zata samu rabin na namiji,yaro zai sami (Rubu'i) namiji. Na wane kowannansu zai samu?[8]

Translation

A Man died and left eighteen thousand cows. His heirs are one hundred men, two hundred female and four hundred children .He instructed his brother that female should get half of male's share and children should be given quarter of male's share. How many will each of them get?

Solution

Let x_1 be thse number of male (maza)

Let x_2 be the number of Female (mata)

Let x_3 be the number of Children (yara)

$$x_2 = \frac{1}{2}x_1$$

$$x_3 = \frac{1}{4}x_1$$

$$\therefore \quad 100x_1 + 200x_2 + 400x_3 = 18000 \text{ (i)}$$

after substituting x_2 and x_3 in (i) we have

$$x_1 = 60$$

$$x_2 = 30$$

$$x_3 = 15$$

$\therefore$ We should give male sixty cows, give female thirty cows and give children fifteen cows

Analysis

$$100x_1 + 200x_2 + 400x_3 = 100(60) + 200(30) + 400(15)$$
$$= 6000 + 6000 + 6000$$
$$= 18,000$$

Sample 7. (Hausa Language Version)

Mutum uku ne, kowa yana da yaya biyu. Suka je walima, sai aka basu kujera guda bakwai dan su zauna. Kuma ana so kowa ya zauna akan kujera daya.Yaya za ayi kenan?

Translation

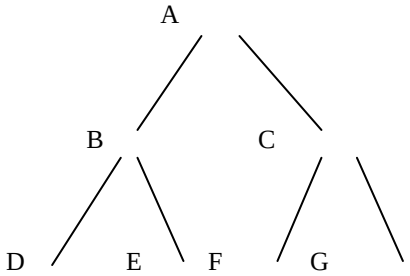
In one House there are three (3) Households each of them has two children. They went for one gathering and seven (7) chairs were given to them to seat, with the hope that each of them should be seated at the same time. How possible?

Solution

One of the Household is a father to two households.

9-2=7

Then the people are logically seven (7),



A is a father to B and C , B gives birth to D and E, then C gives birth to F and G

ANALYSIS

One of the household is a father of the two households, and then the number is seven not nine. Hence there is no problem on the seating arrangement.

Sample 8. (Hausa Language Version)

Mutum ne yake da albasa da tumaturi wan da bai san kansu ba. Sai yatambayi dansa nawa mukeda albasa da tumaturi yanzu. Yaro yace masa, Baba in aka hada albasar da tumaturin za su zama guda goma sha uku. Amma idan aka lunka yawan albasar sau yawan na tumaturi zasu zama guda arba 'in. Nawa ne adadin albasar da tumaturin?

Translation

A father has a certain numbers of onions and tomatoes, but he doesn't know the actual number of them. Then he asked his son to tell him the number of onions and tomatoes at hand, the boy says if you add the onions and tomatoes their number is 13, but if you multiply the number of onions and tomatoes together they will be 40. What is the actual number of onions and tomatoes that the father has?

SOLUTION

- Let x to be the number of onions
- Let y to be the number of tomatoes
- x+y=13 ----------(i)
- xy=40 ----------(ii)

Equation (i) and (ii) can be solve simultaneously, i.e.

y^2-13y+40=0 ---------- (iii)

(iii) is a quadratic equation which can be solve by numerous methods.

By formula method

$$y = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

With a=1, b= -13 and c=40, we get $y = 8$ or $y = 5$.

Then $x = 5$ or x =8

Therefore the numbers of onions are either 8 or 5, also the number of tomatoes are either 8 or 5

ANALYSSIS

- When we add the number of tomatoes and onions is 13, i.e 8+5=13
- And multiplying the number of onions and tomatoes together we have 40, i.e 8*5=40
- Observe that any of the tomatoes and onions can take the value of 8 and 5 respectively; this is because of commutative properties of addition and multiplication of real numbers.

Sample 9. (Hausa Language Version)

A gida ne akwai mutane (maza) da dawakai, akwai kawuna guda asirin da biyu da kafafuwa guda saba'in da biyu. Dukan mutanen su nada dawakai bibbiyu, sai dai daya daga cikin su bai dashi. Nawa ne mutanen da dawakan a gidan?

Translation

In a house there are men and horses. In all, there are 22 heads and 72 feet. Each of all the men except one has two horses. How many men and horses are there in the house?

Solution

- Let x be the number of horse.
- Let y be the number of men.
- There is only a head for each man and horse respectively, x+y=22
- A man has two feet and a horse has four feet 4x+2y=72

There fore

$x+y=22$ (i)

$4x+2y=72$ (ii)

Solving the two equations simultaneously we get x =14 and y =8

Therefore there are 14 horses and 8 men.

Analysis

- There are 22 heads altogether. But there are 14 horses and 8 men, therefore we have 8+14=22
- There are 77 feet altogether, but a man has 2 feet and a horse has 4 feet, we have 4(14)+2(8)=56+16=72
- Each of all the men except one has two horses. 8-1=7 therefore

  $\frac{14}{7}=2$ Horses i.e. each of the seven men has 2 horses.

Sample 10. (Hausa Language Version)

Akwai agwagi guda biyu agaban agwagi biyu.
Akwai agwagi guda biyu bayan agwagi biyu
Akwai agwagi guda biyu gefen agwagi biyu
Nawane jimillan agwagin?

Translation

There are 2 ducks in front of 2 other ducks.
There are 2 ducks behind 2 other ducks.
There are 2 ducks beside 2 other ducks.
How many ducks together?

Solution

Consider the diagram below:

Duck 1 Duck 2

Duck3 Duck4

- In front of Duck 1 and Duck 3 there are Duck 2 and Duck 4. Therefore in front of 2 Ducks there are 2 ducks.
- Behind Duck 2 and Duck 4 there are Duck 1 and Duck 3. Therefore behind 2 Ducks there are 2 Ducks.
- Beside Duck 1 and Duck 3 there are Duck 2 and Duck 4. Therefore beside 2 Ducks there are 2 Ducks
- The total Ducks altogether are **four (4).**

Sample 11. (Hausa Language Version)

" Ubane yace da dansa gizo-gizo yana da kafafuwa guda takwas sannan kyankyaso daya yana da kafuwa guda shida fikafikai guda hudu. Sannan fara tana da kafafuwa guda shida da fikafikai guda biyu sai aka zuba wadannan kwari guda goma sha takwas acikin keji batare da ka ganiba amma jimlar yawan kafafuwan su guda 118, yawan fikafikinsu guda 40. Nawane yawan gizi-gizo acikin keji, yawan kyankyaso da yawan fara acikin kejin?

Translation: *A father tells his son that, a spider has 8 legs, a cockroach has 6 legs and 4 wings and a grasshopper has 6 legs and 2 wings. 18 of these three kinds of insects are in a cage while the total number of legs and wings of these three kinds of insects are 118 and 40 respectively. What is the number of each kind in the cage?*

Solution

The goal is to find the number of spider, cockroach and grasshopper in the cage.

- Let x be the number of spider
- Let y be the number of cockroach
- Let Z be the number of grasshopper

Observe that the total number of insects in the cage is 18, therefore we have

$x+y+z=18$ ……..(i)

And also observe that the total number of legs and wings are also given.

Therefore we have

$8x+6y+6z=118$ ……..(ii)

And

$0x+4y+2z=40$ ……..(iii)

When we solve the three equations simultaneously we have

$x=5 \;\; y=7 \;\; and \;\; z=6$

Therefore the number of spider in the cage is 5 ,The number of cockroach in the cage is 7 and the number of grasshopper in the cage is 6.

Analysis

- 5 + 7 + 6 = 18 , We have18 insects
- 8 (5) +6(7) + 6(6) = 118 We have 118 legs
- 4(7) + 2(6) = 40 We have 40 wings

Sample 12. (Hausa Language Version)

Ma'auni ne yake da buhu mai daukar kwano takwas na masara (8), sai mai saye yazo yana neman kwano hudu na masara, amma mai awo bashi da abin awo sai buhu guda biyu, daya yana cin kwano biyar daya kuma yana cin kwano uku. Tayaya zakaraba wannan kwano takwas na masara batare da kayi amfani da ma'auniba sai wadannan buhunhuna guda biyu, sannan kwano hudun yazama acikin buhu maicin kwano biyar.

Translation:

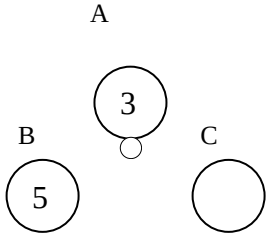
A man has a bag container containing 8 measure of maize. A buyer come to buy half of this maize (4 measures) and he has 2 empty bag containers with the capacities 5 measure and 3 measure respectively.
How can you, without weighting put 4 measure of maize into container of capacity 5 measures.

Solution.

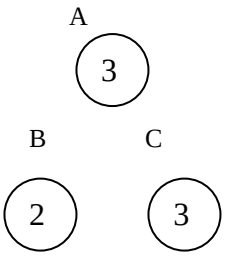
Let the container of capacity 8 measure be A and let the container of capacity 5 measure be B, let the container of capacity 3 measure be C.

And none of this container will contain more than its capacity.

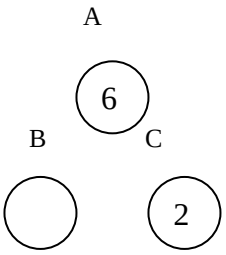
STEP 1: Put 5 measures into container B, and then we have 3 measures in container A and 5 measures in container B while C is empty



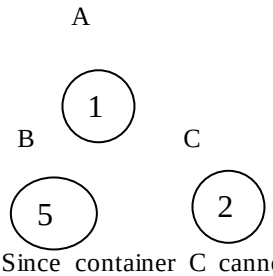
STEP 2: Put 3 measures in container C from container B now we have 3 measures in container A, 2 measures in container B and 3 measures in container C



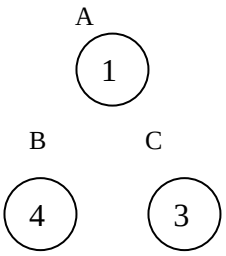
STEP 3: Return 3 measures from container C to container A and 2 measure from container B to container C now we have 6 measure in A , 2 measure in container C and container B is empty.



STEP 4: Put 5 measures to container B from container A then we have 1 measure in container A, 5 Measure in container B and 2 measure in container C



STEP 5: Since container C cannot contain more than 3 measures and it contain 2 measures, remain 1 measure, therefore from container B we fill up container C, so that container C contain 3 measures and B contain 4 measures.



IV. CONCLUSION

This paper provides evidence that mathematics as a universal language was not necessarily introduced into Hausa culture (the dominant culture of northern Nigeria) as a result of Western system of education because Wasakwakwalwa existed before the coming of the colonialists. Elders in Hausa society used to give wasakwakwalwa puzzles to the younger ones with hope of shaping their intellectual thinking and also help in their cognitive developments. The existence of RAS KONA UWAR LISSAFI (idiot savants who are the fastest answer-givers to wasakwakwalwa puzzles) phenomenon in Hausa culture underscores the practice of wasakwakwalwa.

Given the foregoing, and the highlighted applications of mathematics in Hausa culture, it is hoped that experts from different fields such as education, mathematics, psychology, and game design will put heads together to explore and expand the empirical studies in the use of mathematics in Hausa culture with the possibilities of extending the work to other areas. This might even encourage our younger ones who dread mathematics to have more interest in the subject.

REFERENCES

[1] John Murry (1998): "Ethnomathematics concept, Definition and Research erspectives "ISGEm Newsletter vol. II No. 1 Dec 1998.
[2] Louis Franco (1986): "Candy Selling and math learning" ISGEm Newsletter vol. 4 No. 2
[3] Bill Collins (1999)" The mathematics of Nature Longman Group U.K limited.
[4] Habibu Babura (2005): "Ethnomathematics: The case of mallam Na Bakin Kogi" Bayero University, Kano. Nigeria,
[5] Rabiu Musa 92006): Wasakwakwalwa" Radio Kano Am Kano, Nigeria, Unpublished Book.
[6] Tandarki et, al (2007): Wasakwakwalwa" Freedom FM Radio ,Kano, Nigeria,
[7] Musa H. I (2007): "Wasakwakwalwa" Radio FM Kano, unpublished
[8] Auwalu G. R.(2003): "Wasakwakwalwa" CTV Kano Nigeria.
[9] David M. (2000): "A view of Ethnomathematics" Vol. 8 N0. 2 ISGEm Newsletter.
[10] Glorin G. (1980): "Connecting mathematics practices in and out of Schools" Vol. 3, No. 2 journal of Ethnomathematics Canada.
[11] James R. (1982): "How students can own mathematics" Vol. 5, No. 1 journal of Ethnomathematics.
[12] Yahaya I. Y. (1977) "*Labarun Gargajiya 1*", Ibadan: Oxford University Press.
[13] Heather.C .(2003) "*Success with Mathematics*" Routledge taylor and Francis Group, New York.
[14] Kahn. P. (2001) Studying Mathematics and its Applications, Basingstoke,palgrave.
[15] Ascher, Marcia.(1991 *Ethnomathematics: A Multicultural View of Mathematical Ideas*. Pacific Grove: Brooks/Cole.
[16] Abubakar Nura (2006): Wasakwakwalwa" Radio Kaduna Am Kano, Nigeria,
[17] Rabiu Musa (2003): Wasakwakwalwa" Radio sokoto Am , Nigeria
[18] Rabiu Ado (1998): Wasakwakwalwa" Radio Kano Am Kano, Nigeria, Unpublished Book.
[19] Alluri R. (2003): "How students can simplify mathematics" Vol. 9, No. 7 journal of Ethnomathematics.