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ETHNOMATHEMATICS
(A Mathematical Game in Hausa Culture)

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Abstract
Before the coming of Western education, 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 played by children or adults with the aim of deriving lessons. These games are meant to shape individual brain. The primary concern of this paper is on the games that involves calculations and to highlight therein the existence of algebra, set theory, coordinate geometry, arithmetic progression and geometry progression in Hausa culture. Furthermore the paper will correct the erroneous believe that there was no mathematics in Hausa land/northern Nigeria before the coming of the Western education and address those who believe mathematics only starts and ends in the classroom, thereby divorcing the rich cultural elements from the use of mathematics.

Keywords: Hausa culture; Mathematical game; Western education.

1. 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 culture, it consists of variety of games played by children or adult, with the aim of deriving lesson from them. In Hausa culture elders shapes younger individuals brains by storytelling and question and answer, they organize competition with the hope of getting the best out of the participants. The mathematical games in northern Nigeria have become hot games played by all categories of people.
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.

However there are quite a few researches which attempt to survey some of those games on General Hausa culture. Not knowing that, concentrating on these games can

improve the teaching and learning mathematics. In this paper we made a survey on some Hausa games 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 games. 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 Hausa games require intellectual, rational and analytical thinking, which is purely mathematics. Furthermore, Hausa people use mathematics in sorting, ordering, measuring and weighing in their daily activities.

According to [Habibu (2004)] Hausa game shapes individuals (children and adults) intellectual reasoning capabilities. Hausa game is a conceptualize way of developing cognitive development of individuals [Yahaya (1997)]. [Habibu (2004)] Identifies features and the types of leisure these games encourage in the Hausa community. [Habibu (2004)] 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.[Heather (2003)] Also [Kanh (2003)] confirms that Learning mathematics requires you to develop ways of thinking mathematically. [Jonh (1998)] Asserts, there is a perception that mathematics is an effective tool for analyzing, examining and verifying truth. Human life remains incomplete without mathematics [James (1982)]. According to [Musa (2007)] 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 [Glorin (1980)]. Mathematics is a universal subject in whom every culture has its concept of numbers and the idea that 1 + 1 = 2, no matter how technologically advanced the culture. 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 [John (1998)] Plato proclaims that mathematics is a reliable tool for pursuing truth.

Ethnomathematics refers to the study of mathematical practices of specific cultural groups in the course of dealing with their environmental problems and activities [Glorin (1980)] and [Ascher (1991)]. 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 modeling patterns arising in the environment. The suffix "ticks" means art to technique. According to [John (1998)] ethnomathematics is the study of mathematical techniques used by identifiable cultural groups in understanding, explaining, and managing problems and activities arising in their own domain. Ethnomathematics also 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 [Louis (1986)]. 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 [James (1982)].
The paper is arranged as follows: Procedure of the Game in section 2, analytical solution to the problems in section 3 and Conclusion in section 4.

2. Procedure of the Game

The game is of two forms namely:

(i) Say your opinion.
(ii) Get the actual answer.

The primary concern is on the games that involve mathematical formulation and solution. Because of the scanty literature on the topic, some games were sourced from [waziri et al (2010)] and broadcasting stations [Rabiu (2006), Tandarki (2007) , Musa (2007) and Auwalu (2003)] .

3. The Games

Game 1: You are asked to bring out two oranges from a garden. The garden has ten 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.

Let x_8 be the number of orange at 8^{th} gate.

Let x_9 be the number of orange at 9^{th} gate.

Let x_{10} be the number of orange at 10^{th} gate

Therefore we have this sequence $x_1, x_2, x_3 \ldots\ldots x_{10}$

The 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 with 4, 2^{nd} gate with 8, 3^{rd} gate with 16, and so on up to 10^{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 $n = 10$

We need to look for the 10^{th} term. Using the below formula.

$$T_{10} = ar^{n-1} \quad (1)$$

Therefore the number of oranges needed at the 10^{th} gate is 2048

Analysis

4 8 16 32 64 128 256 512 1024 2048

1^{st} 2^{nd} 3^{rd} 4^{th} 5^{th} 6^{th} 7^{th} 8^{th} 9^{th} 10^{th}

Game 2: 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

$$x + y + z = 18 \quad \text{(i)}$$

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

Therefore we have

$$8x + 6y + 6z = 118 \quad \text{(ii)}$$

And

$$0x + 4y + 2z = 40 \quad \text{(iii)}$$

When we solve the three equations simultaneously we obtained the solution as $x = 5 \;\; y = 7 \;\; \text{and} \;\; z = 6$

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.

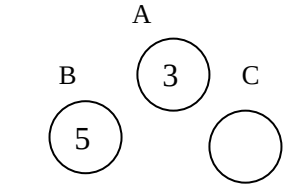
Game 3: A man has a bag container containing 8 measure of maize. A buyer come to buy half of this maize (4 measures) and he has 2 empty bag containers with the capacities 5 measure and 3 measure respectively. Without weighing, how can you put 4 measure of maize into container of 5 capacity measure?

Solution.

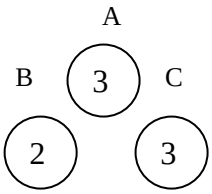
Let the container of capacity 8 measure be A and let the container of capacity 5 measure be B, let the container of capacity 3 measure be C.

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

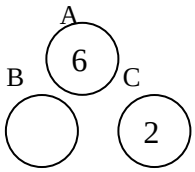
STEP 1: Put 5 measures into container B, and then we have 3 measures in container A and 5 measures in container B while C is empty



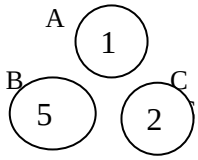
STEP 2: Put 3 measures in container C from container B now we have 3 measures in container A, 2 measures in container B and 3 measures in container C



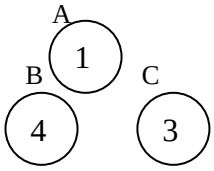
STEP 3: Return 3 measures from container C to container A and 2 measure from container B to container C now we have 6 measure in A , 2 measure in container C and container B is empty.



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.



Game 4: There are 8 ducks in front of 8 other ducks.
There are 8 ducks behind 8 other ducks.
There are 8 ducks beside 8 other ducks.

How many ducks are there altogether?

Solution
Consider the diagram below:

Duck 1	Duck 2	Duck 3	Duck 4
Duck 5	Duck 6	Duck 7	Duck8
Duck 9	Duck 10	Duck 11	Duck 12
Duck13	Duck14	Duck 15	Duck16

- In front of Duck 1, 2, 5,6,9,10,13 and Duck 14 there are Duck 3,4,7,8,11,12,15 and Duck 16. Therefore in front of 8 Ducks there are 8 Ducks.
- Behind Duck 3,4,7,8,11,12,15 and Duck 16 there are Duck 1, 2, 5,6,9,10,13 and Duck 14. Therefore behind 8 Ducks there are 8 Ducks.
- Beside Duck 1, 2, 3, 4,5,6,7 and Duck 8 there are Duck 9,10,11,12,13,14,15 and Duck 16. Therefore in front of 8 Ducks there are 8 Ducks.
- The total Ducks altogether are **sixteen (16).**

Game 5: 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 said if you double the sum of the onions and tomatoes the number is 26, but if you double the product of onions and tomatoes will be 80. What is the actual number of onions and tomatoes that the father got?

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 solved simultaneously, i.e.

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

(iii) is a quadratic equation which can be solved by numerous methods.
Using formula method

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

With a=1, b= -13 and c=40, we obtain the solution as $y=8$ 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

Analysis

- double the sum of tomatoes and onions is 26, i.e 2(8+5)=26
- Double the product of onions and tomatoes is 80, i.e 2(8*5)=80

We observe that any of the tomatoes and onions can take the value of 8 or 5 respectively; this is because of commutative properties of addition and multiplication of real numbers.

4. 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 education because mathematical game in Hausa culture existed before the advent of Western education. Elders in Hausa society used to give Hausa game to the younger ones with hope of shaping their intellectual thinking. The existence of RAS KONA UWAR LISSAFI (idiot savants who are the fastest answer-givers to Hausa game) phenomenon in Hausa culture underscores the practice of Hausa game.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.

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