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## Exploration of Mathematical Probability from Hausa Cultural Practices: Implications for teaching and learning of Mathematics

By

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### ABSTRACT

*This paper is primarily concern with exploring and discussing Mathematical Probability in Hausa cultural Practices with particular implications to Mathematics teaching and learning. The paper reviewed literature relevant to the topic and the writer interviewed students, lecturers and other members of the society in Kano to gather some examples of Hausa Cultural games. The findings revealed that there are so many numbers of Hausa cultural games very relevant to the development of mathematical Probability which mathematics teachers and students could use to improve mathematics teaching and learning at the same time can be used for recreational activities and psychological tension release. It is recommended that mathematics and Hausa teachers should be prepared to face some very important area of concern such that there is different appropriate mathematics for different societies; hence teachers and students should strive hard to identify them for the sake of promoting what can be called mathematics for survival in both certain and uncertain life situation.*

**Keywords:** Mathematics, Probability, Hausa Culture, Cultural Practice, Mathematics teaching and learning.

### INTRODUCTION

Mathematics is successfully applied not only to natural sciences but also to economics and technical science as an indispensable tool. The need to acquire knowledge in mathematics in the world over has become very obvious. But much of the content of current mathematics programs does little to help students learning the information and skills necessary to function successfully in this digital world. This is evidence in the failure rate of mathematics at all level of our education cadre and mathematics courses in our institution of higher learning. The rate is so high that Nigeria was found to occupy the second to the last position when compared with the eleven other English speaking West African Countries in Mathematics School Certificate Examination (Abakpa and Agbo Egwu, 2008). Many Mathematics education researchers in Nigeria agreed with the observations that the method of teaching mathematics in Nigeria is completely unrelated with the background and local environments of the learners, making Mathematics learning more abstract to an average Nigeria students. The Nigeria mathematics curriculum depend purely on foreign nature, has no focus on Nigeria culture and purely derived from euro-centric culture. (Uloko and Imoko, 2007). One of the consequences of depending on this euro-centric curriculum and teaching

methods is the seemingly lack of basic mathematical principles which results to rote-learning and low performance in students. Researchers (Kurumeh, 2004; D'Ambrosio 2001) stressed that active participation of learners, practical oriented, project-oriented and applicable should be incorporated into any method that can ensure effective learning of Mathematics. Nevertheless it is unknown, hated, misunderstood and feared by students and adults. One source of this problem might be in the nature of mathematics itself and the other is inherent in the methodology of teaching mathematics. To this length if mathematics is well understood by students and adults there shall be sound development of science and technology, sound economy and better well-being to all citizens of that community or culture.

It was discovered by Radford & Roth (2011) that students solve problems with help of their speech, eyes and hands. Meaning that, efforts put forward in giving meaning or during learning mathematics objects is one way of dealing with problem and understanding it. For instance the influence of families' interaction on the way each member thinks about himself in relation to others and his environment help him to take right decision. Similarly the impact of Hausa puzzles, games, riddles and visual discriminations facilitate the development of mathematical reasoning and problem solving. Accordingly the cultural and historical dimension referred to as activity theory attempt to describe not only the theoretical tools of the problem in context based on what students are doing in a particular classroom activity, but also to be able to understand this activity against the background of a cultural and historical setting as well (Radford and Roth, 2011). In a mathematics classroom activity, the tales about Gizo, Fowl and Hyena as well as the tales of Lion, Jackal and Hyena involve some aspect of mathematics and mathematical problem solving. This idea of relating mathematics teaching and learning with tales, stories, and cultural practices facilitate and consolidate students' mathematical ability. It was opined that cultural practices encourage and sustain certain kinds of cognitive processes, which then promote the cultural practices (Nisbett and Norenyazan, 2002). Drawing on this direction is the idea of cultural-mathematics, patterns of mathematics that make up the mathematics system of a cultural group usually referred to as Ethno-mathematics. The easiest way to understand these cultural-mathematics system may be on the shared mathematics' knowledge structure involve in *Sallah Eids*, *hawan daushe*, and market gathering in a cultural group like Hausa setting. For instance a Hausa man during *sallah* activities purchased many things, visit relatives and so on, the mathematics system therein consist of knowing the types of clothes to buy, the price of each set, the market to go to purchase, the kind of transport to use for going there, the cost of transport, the distance and time to get there as well as the likely or probable total cost for buying the needed amount depending on the family size. .

In life there is no certainty about what will happen in the future but decisions still have to be taken. Therefore, decision processes must be able to deal with the problems of uncertainty about types and quality of the clothes, the fairest price, the relevant and fair price market, the distance and time to get there as well as the family size. Uncertainty creates risk and this risk must be analyzed. Both qualitative and quantitative techniques for modelling uncertainty exist. In many situations large amounts of numerical data is available which requires statistical techniques and logical reasoning for analysis. Quantitative modelling of uncertainty uses a branch of mathematics called **Probability**.

To this extent the writer is of the opinion that Hausa cultural practices may have a significant contribution on students' mathematical ability. Specifically, this paper explored and X-ray Mathematical probability in Hausa cultural practices with implications to teaching and learning of mathematics.

## REVIEW OF RELATED LITERATURE

### *Hausa Culture*

There are more than 250 ethnic groups in the 21st century Nigeria. The largest and most politically dominant ones are the Hausa, Igbo and Yoruba. Other minor ethnic groups are the Fulani, Kanuri, Ibibio, Ijaw, Babur, Tiv, Idoma, Karekare and many others. Geographically, the Niger and Benue Rivers come together and form a 'Y' shape that splits Nigeria into three separate entities. Fortunately this 'Y' shape marks the boundaries of the three major ethnic groups with the Hausa in the North, the Yoruba in the south-west and the Igbo in the south-east.

In this paper the Hausa ethnic group's culture is going to be addressed as a way of helping students to understand and like mathematics as well as uplifting the image of Hausa cultural studies. The largest per cent of the Hausa population are found in Northern Nigeria and South-Eastern Niger. A significant number is also found in Sudan, Cameroon, Ghana, Mali, Chad, Central Africa, Co d'voir and Gambia. Hausa people spoke Hausa language and their main occupations are agriculture, trading, blacksmithing, basketry, wood carving, weaving, dyeing, tanning, metal work, Gardawankura, maciji and biri, Islamic teaching and learning. It is really clear from these traits to note that Hausa people must have some aspects of mathematics congruent to pursue of their works effectively.

The Nigeria National curriculum included Hausa among the compulsory subjects in Primary and Secondary school [Waziri, 2010]. This may be connected to the organized nature of the tribe, in terms of traditional administration [Sarki, Dagachi and MaiUnguwa], Scholarship and Commercial excellence of the language. In view of this development Hausa culture is rich with mathematical stuffs such as puzzles, riddles, games, crafts, events, folklores, customs, objects and other traditional festivals. Remarkably Hausa culture aims at developing logical thinking skills, cognitive functioning, verbal fluency, entertainment and recreational activities as well as developing '**mutum mailissafi or reasonable person**'.

### *Mathematical Probability*

Throughout the early years of life, children notice and explore mathematical dimensions of their world. They compare quantities, find patterns, navigate in space, and grapple with real problems such as sorting and classifying objects, building a house or sharing sugar cane or groundnuts fairly with a playmate. Mathematics helps children make sense of their world outside of school and helps them construct a solid foundation for success in school. In primary and secondary school, students need mathematical understanding and skills not only in mathematics topics but also in sciences and other subjects. Basically students need mathematical proficiency to succeed in course that provides a gateway to technological literacy and higher education. Once out of school, all adults need a broad range of basic mathematical understanding to make informed decisions in their jobs, households, communities, and civic lives. Besides ensuring a sound

mathematical foundation for all members of our society, the nation also needs to prepare increasing numbers of young people for work that requires a higher proficiency level and ability to make informed decision. National Council of Mathematics Teachers (NCTM, 2000) advocated that effective mathematics teaching requires understanding of what students know and need to learn and then challenging and supporting them to learn it well. Again students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.

Therefore, teachers need to find out what students already understand and help them begin to understand these things mathematically through effective mathematics teaching since it is critical for successful learning. Such as sand drawings from Africa, music from Brazil, games such as Patience the way it is played in Madagascar, the arithmetic system of the Incas or the Egyptians, the weaving of baskets or carpets, the Mayan calendar, the production of dyes out of natural substances, drinking tea and keeping tea warm in China, water collection in the Kalahari desert, the construction of Indian arrows, terrace cultivation in China, the baking of clay bricks in Africa and the construction of African houses (Bazin & Tamez 2002).

For teachers to be effective in their teaching it is paramount for them, among others, to deeply understand the learning process and their role in learning so that they can prepare and plan lessons in such a way that learning can be more conceptually inclined. Most importantly, approaches to mathematics teaching should incorporate the premises that all learning involves extending understanding to new situations, that young learners come to school with many ideas about mathematics, that knowledge relevant to a new setting is not always accessed spontaneously, and that learning can be enhanced by respecting and encouraging students to try out the ideas and strategies that they bring to school-based learning in classrooms. Rather than beginning mathematics instruction by focusing solely on computational algorithms, such as addition and subtraction, students are encouraged to invent their own strategies for solving problems and to discuss why those strategies work. Teachers may also explicitly prompt students to think about aspects of their everyday life that are potentially relevant for further learning. For example learners sort and classify sets of numbers and objects, play game and determine probability of event,

The idea of **probability** is familiar from games of chance such as card games. Probability values may also be determined from sample data. For instance a bag contains 5 mangoes, 3 guavas and 2 oranges. If an item is chosen at random from the bag, what is the probability that it is: (a) a mango; (b) a mango or an orange; (c) Not an orange?

Answers: (a) 0.5; (b) 0.7; (c) 0.8

### **Definition of Probability**

The idea of probability is something that quantifies likelihood and long-term behavior that requires time (Brousseau, Brousseau, and Warfield, 2002).

If an experiment is performed a large number of times (say,  $N$ ), and the number of times that a particular event  $A$  occurs is counted (say  $n$ ), it is then define: Probability of event  $A$  occurring, denoted by

$$P(A) = \frac{\text{number of outcomes } n}{\text{total number of outcomes } N}$$

In other words, the probability that the event A occurs in any one performance of the experiment, is defined to be the limiting value of the proportion of times that A would occur if the number of repetitions of the experiment tended to infinity. For example, consider the experiment of tossing a fair coin. The set of possible outcomes for this experiment is {H, T}, the letter H representing the simple event “Heads”, and T representing “Tails”. According to this definition one would assign equal probability of 0.5 to each of these outcomes, because, in a large number of tosses, heads and tails turn up an approximately equal number of times. It is good to know that an **experiment** is an act or process of observation that leads to a single outcome that cannot be predicted with certainty. A **sample point** is the most basic outcome of an experiment. The set of all possible outcomes to a random experiment (all the sample points) is called the **sample space**. Elements of the sample space are also called **simple events**. Simple events for the example of drawing a playing card from a well-shuffled pack would be “Ace of Clubs” or “Three of Hearts” etc. Events consisting of more than one simple event are called **compound events**. For example, a compound event for this experiment would be “Drawing a Heart”. Consider the three compound events “drawing an ace”, “drawing a heart”, and “drawing a face card” (i.e. one of King, Queen, and Jack).

$$P(\text{ace}) = \frac{4}{52}$$

$$P(\text{heart}) = \frac{13}{52}$$

$$P(\text{face card}) = \frac{12}{52}$$

### Basic rules of probability

If  $E_1, E_2, E_3, \dots, E_n$  are the set of possible simple events which could occur from an experiment, then

- All probabilities must be between 0 and 1. An event that will never occur has probability of 0, and an event that is certain to occur has probability 1.
- The sum of the probabilities of all possible simple events must equal 1.

### Statement of the Problem

In line with the empirical research by Pinxten & François (2007) on mathematical practices in classroom settings, one can prove many appropriate examples that pupils' mathematical practices may be used in class as a utilization of a mathematical concept. Starting from learners' mathematical knowledge and their everyday mathematical practices is a basic element of the new orientation towards realistic mathematics education and the development of innovative classroom practices (Prediger 2007). In this way, ethno mathematics became a way of teaching mathematics where cultural diversity of pupils' everyday mathematical practices are taken into account (François 2007). It occurred that people from many cultures figured out that the sum of the squares on the

legs of a right triangle equals the square on the hypotenuse, or that there was a regular method of determining the number of ways you could choose  $k$  objects out of a set of  $n$ . In none of these occurrences was there any notion of logical proof from explicit axioms. But logic is common to many culture in making decision in a randomize process sometimes involve the determination of the cause of an event or, more often, how, when, or whether to carry out some future action, called probability in mathematics. Learning probability, which explores and measures the likelihood of random events occurring, is a crucial experience for learners and their teachers. Why is the study of probability appropriate for the school curriculum? How do we convince teachers that probability is an important learning area for students? What contexts provide useful learning experiences in probability? The question is how can one move from a teacher centered learning process towards a learner-centered learning process where students' cultural mathematics practices can enter the classroom? This imply that students' daily mathematical practices have to be studied. Therefore this study intend to explore mathematical probability from Hausa cultural practice with particular reference to their implications for teaching and learning of mathematics.

### ***Objectives of the Study***

1. To identify some Hausa Cultural Practices
2. To determine aspects of mathematical probability from Hausa cultural practices

### ***Research Questions***

1. What are the Hausa cultural practices?
2. Are there aspects of mathematical probability in Hausa cultural practice?

## **METHODOLOGY**

This study intend to use descriptive survey technique of research because according to Shua'ibu (2005) it is an attempt by a researcher to collect data from members of a population which determine the current status of that population with respect to one or more variables. It is also similar to what Kolo (2003) described descriptive research technique as a situation where the investigator collects data on two (or more) variables and through statistical analysis determine the type of relationships that exists between them.

The present research will use the research subjects in their cultural setting. That is to say the study collect data from Hausa teachers and students of mathematics in Secondary schools in Kano state. The reason for using descriptive survey method in this study again was because it help the researcher to explore the wide range of Hausa cultural practices, the aspects of mathematical probability therein as well as apply mathematics concepts to real life situations.

In this study, the population and sample included students in Kano state secondary schools students and their mathematics teachers. This study employed the use of purposive sampling procedure. This technique is usually referred to as Judgmental sampling [Sambo, 2005]. Under this technique sampling elements which are judge to be typical or representative sample were selected from the population. This study generate data through documentary analysis and oral interview.

## RESULTS

### *Mathematical Probability in Hausa Cultural Practices*

Milder[1979] in her work 'African counts' which is a stimulating work in the area of the History of mathematics along south of the Sahara and contributed to abroad perspective on the area of mathematics called socio-cultural mathematics or ethno-mathematics of Africa. This refers to application of mathematics in lives of African people and the impact that African institutions had on the development of mathematics. Milder [1979] described written, spoken and gesture, counting, number mysticism, concepts of time, number and money, weights and measures, record keeping, mathematical games, riddles, puzzles, magic squares, graphics and geometrics forms, events and festivals as evidences that indicate the mathematical heritage of Africans and Hausa culture in particular. Visual discrimination and visual memory were needed for survival on the wild environment of the Hausa land as represented in Dawakin kudu rocks arts of Kano state.

Possible relationship was established between visual memory [Berlin, 1998] and concentration as a sufficient condition for achievement in many games, riddles, transaction and puzzles in many cultures. For instance in Hausa culture there are many games, riddles and plays relevant to the development of logical reasoning, chance and likelihood of making right decision this referred to as Mathematical probability as illustrated in the table 1.

**Table 1:** Hausa Cultural Practice and Mathematical Probability Concepts

S/N	Hausa cultural Practice	Description	Mathematical Probability Concept (s)
1.	Yar'dalle/Chikwi	Hausa cultural play each participant find a number of stones or date seeds, a fix point (called gaza) for scoring the stones of the other participant, and kicking the stones toward gaza from a fixed line by each participant.	Play event, number of participants and stones, kicking or throwing the stone toward the fixed points, kicking from a fixed line, likelihood of scoring the stone of other player.
2.	Dakunku-Dakunku	Hausa cultural play where the participant will select one member, close his eyes, mention Dakunku-dakunku, replay 'a gidan suwa', the person with close eyes will mention the name of a sister or brother who mentioned Dakunku-dakunku, if he is correct then he get a point that person whose sister or brother name was mentioned will now close his eyes and do the play. But if he failed to mention the name of any sister or brother of the person	Play event, selecting a person from the participant, eyes close, mentioning a statement, replaying, competition and chance of winning or failing, acquitted by mentioning the correct name, punishment by back taking the other person who's sister or brother was failed to be mentioned.
3.	Biyilliya		
4.	Awara-Awara Zanchi		

S/N	Hausa cultural Practice	Description	Mathematical Probability Concept (s)
5.	Kwado	mentioned Dakunku-Dakunku then he will hide some way the close eyes person will go and take him on his back. Hausa cultural play consist of four half covers of groundnut or four bottle covers, the point is rate from 2, 4, 12 and 0. It has five possible outcome, 3 of them pass and 2 of them fail.	Play event, four half covers, a number of participants, five possible outcome, winning and failing.
6.	Charafke	These are: (a) if after shaking and releasing the four covers on the ground they all appear to be closed the play get 12points, if they all open he get 4points, if two close and two open he get 2point but if one open and three close he get fail (o) point and if three open and one close he also fail (o) point.	Play event, four possible outcome, many participants, success and fail.
7.	Yar' jeri	Hausa cultural play consist of so many players with four possible outcomes only is success the other three are failures. The outcomes are presented as thus 'Jaminlin', 'Goren', 'Goriya' and 'Kai' The 'Jamili', 'Goren', 'Goriya' are all failures only 'Kai' is success. The players is expected to mention the word one by one whoever the word 'kai' come to his turn is successful. Hausa cultural play that has long history of about four hundred years ago played by two persons, a shallow holes called 'gida', the holes are divided into two among the players, equal number of stones by the participants, each hole will carry a maximum of four stones, the outcomes depend on the number of	Play event, some number of shallow holes, two participants, maximum of four stones per hole, number of outcomes, increase possible outcomes.  Play game by girls, consists of many participants, select some number of stones, digging a small hole, putting equal number of stones by the players, holding and throwing a stone up, possible chance of catching before reaching the ground, the distance and time taken of throwing the stone, number of outcomes, success and failure.



S/N	Hausa cultural Practice	Description	Mathematical Probability Concept (s)
		<p>holes for example ranges from 8 to 10. If 8 holes are used the outcomes is 9 and if 10 holes are used the outcomes is 11.</p> <p>Hausa cultural play by girls they made a single hole in which every participant will put equal number of small stones and one in their hands. The single one in their hand will be threw up before it return they pick up those inside the hole and at the same time catch the single one before reaching the ground. If it reach the ground the player fail the game and the opponent take over the play. If it is catch the player return them in the hole until all the opponents share of stones become exhausted. It has four possible outcomes, one is success and the other three are failures.</p> <p>Hausa cultural play by two or more persons using stones or mongo seeds at least three of them, putting them in a hole, when all three stones were arranged in a line by a player he win the game. If nobody arrange three in a single the players will continue with the play.</p>	<p>Play event by two persons, using at least three stones, putting the stones in a hole, possibility of arranging them in line, success and failure.</p>

The table above revealed some examples of Hausa cultural practices that are relevant to out of school and school Mathematical probability. For instance Yar' jeri the last game involve both tricky aspect of game in arranging the three stones in one line. In so doing all the players will try to see they block the chance of each opponent to arrange his stones in line. In addition the ideal of logical reasoning, visual discrimination to identify the right point and ability to block the chance of opponent in arranging his stones in one line. The line can be illustrated as follow:

A stone	B stone	C stone
D stone	E stone	F stone
G stone	H stone	I stone

### ***Implications for teaching and learning of Mathematics***

Mathematics teaching and learning can be better and fun if it happens in a familiar context with the teachers' role being to facilitate and mediate learning. To this end, teachers have

1. To be aware that learners bring knowledge and experiences to class that should be recognized when teaching particularly some examples dealing with probability concepts;
2. To be familiar with a learner-centred activity-oriented teaching approach that focuses on the mastery of mathematics content and induces affinity for mathematics through relevant real-life activities that are familiar to learners
3. To be accustomed to this approach through an appropriate teacher development programme, seminar, conferences, etc. where they are familiar with the concept of ethno-mathematics and trained on how to use the ethno-mathematical approach.
4. To formulate strategies that enable learners to discover and develop knowledge of probability concepts; and
5. To create an atmosphere in class that promotes learning of probability through out of school examples.

### **CONCLUSION**

More importantly teachers and students will develop and acquire mathematical constructs through discovery and exploring wide range aspects of Hausa cultural heritage. This paper tried to use play events from every-day life of Hausa environment to develop important mathematical probability concepts: play events, selecting, possible outcomes, chance, abstract and visual reasoning, decision making, uncertainty, winning, success, failure, throwing, among others through the seven (7) play games presented. Similarly the number of games in Hausa cultural environment revealed and provided opportunities of understanding more about mathematical probability in Hausa society. The wealth of cultural practices and abundant opportunities in Hausa society and kano in particular motivate people to comment that '*kano timbingiwa and giwa bukkardaji*'. Signifying many things naturally from the size, shape, 6 months winning period of young elephant baby, elephant habit of not accepting nonsense across her own way, fairly patient a very important aspect of certainty in probability and resemblance with the 'hut'[which is circular, conical and triangular].

## RECOMMENDATIONS

Mathematics and Hausa teachers must be prepared to face some very important areas of concern:

1. Mathematics for citizenship and the part mathematics have to play in preparing students to take an active part in Hausa culture.
2. Mathematics and Hausa how they are related.
3. The likely effect of mathematics on Hausa culture in the future and the effect it has had on the society in the past.
4. The influence Hausa culture has exacted on mathematical development in the past.
5. That there is different appropriate mathematics for different societies, hence teachers and students should strive had to identify them for the sake of promoting what can be called mathematics for survival.

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