VillageMath Educational Review

Network for Grassroots Science and Mathematics Education (The VillageMath Network)

Department of Mathematics Education
Federal University of Agriculture, Makurdi, NIGERIA

Volume 2, Issue 1 June, 2021 CODEN: VERIAU

The Mathematical Aspects of the *Krita*, *Charabke* and *Gofu* Local Children Plays of the Irigwe People in Miango Village of Bassa Local Government Area of Plateau State, Nigeria

Moses UMORU and Joshua Abah ABAH

Department of Mathematics Education
Joseph Sarwuan Tarka University, Makurdi, Nigeria

DOI: 10.5281/zenodo.4904664
Article History: Received 23rd March, 2021; Revised 4th June, 2021; Published 6th June, 2021.

How to Cite this Article:
Umoru, M. & Abah, J. A. (2021). The Mathematical Aspects of the *Krita*, *Charabke* and *Gofu* Local Children Plays of the Irigwe People in Miango Village of Bassa Local Government Area of Plateau State, Nigeria. *VillageMath Educational Review (VER), 2(1)*, 32-53. https://ngsme.villagemath.net/journals/ver/v2i1/umoru-abah

Abstract

This study is aimed at determining the rules and mathematical aspects of the *Krita*, *Charabke* and *Gofu* local children plays of the Irigwe people of Miango village in Bassa LGA of Plateau state, Nigeria. Four research questions guided the study and the instruments used for data collection are Semi-Structured In-depth Interview Rubric. Three indigenous local children games were explored, and interpretive phenomenological design was adopted in exploring the lived experiences of the Irigwe people with the *Krita*, *Charabke* and *Gofu* games. The results of the study revealed that certain mathematical concepts such as Basic Geometry, Arithmetic, Mensuration, Numerical cognition, and Logic and reasoning permeates the *Krita*, *Charabke* and *Gofu* local children plays. These indigenous local children plays, when carefully engrafted into the Mathematics curriculum can enhance in-depth understanding of classroom Mathematics and better performance, especially at the Elementary and Basic Education levels. Furthermore, these indigenous children plays proved

to promote socio-cultural unity and foster peaceful coexistence between the Irigwe people and neighboring villages.

Keywords: Ethnomathematics, Irigwe People, *Krita*, *Charabke*, *Gofu*, Basic Education

Introduction

The concept, art and application of Mathematics have been in existence for donkey years. It is very relevant in all fields of human endeavor such as trading, farming, cooking, tailoring, medicine, and engineering and is found among all the cultures of the people all over the world. Adie (2013) defines Mathematics as a modern science with an unconscious originality, practicality and applicability in the daily activities of humanity. However, these requirements can be satisfied only on the extent to which the subject is made to relate to the culture of the people, it is a basic tool in the economic development of science, technology, commerce and industry and hence in the overall development of a nation. Its role in the development of a nation cannot be overemphasized.

Interestingly, every society no matter the level of its advancement develops a certain kind of Mathematics that helps its people to solve daily societal problems. Even where formal education does not exist, some basic knowledge of Mathematics has been used to tackle people's problems that are diverse in nature (Abiem, 2006).

Out of school, adults need a broad range of basic Mathematical understanding to make decisions in their jobs, household, and communities. Measures of establishing and sustaining a strong foundation are direly needed. This is so because we need to provide our young students with the right kind of interesting intervention and experience in their early years, otherwise this might deprive them of every vital cognitive growth opportunities.

Mathematics is the queen of the sciences and no nation could hope to achieve any measure of scientific and technological advancement without proper foundation in school Mathematics (Obodo, 2004). It is transmitted orally from generation to generation. It may be therefore, correct to conclude that Mathematics and indeed Mathematics education does exist in the cultural heritage of the child in all cultures of the world. And also, that there exist abundant similarities in Mathematical activities between the various cultural groups in Nigeria and elsewhere. This is because Mathematical ideas are universal and are embedded in the culture of the people.

Over the years, the persistent students' low level of academic performance in Mathematics at various public examinations in Nigeria continues to attract the attention of major stakeholders in education and well-meaning Nigerians. Available data from the WAEC Chief Examiner's Report (2004-2014) indicated that academic performance of students in Mathematics in Nigerian educational system is still in a sorry state of affairs with respect to students' grading in Mathematics. The role of Mathematics in our daily living and national development cannot be overemphasized. However, many secondary school students hardly meet the Mathematics knowledge and skills for useful living and national development (Azuka, 2002). Since Mathematics could be regarded as the fulcrum upon which any nation could rely on for its educational and national advancement, it therefore becomes imperative to steer up all programs, techniques, skills, means and methods necessary for promoting the teaching and learning of Mathematics. Despite government efforts to improve the state of affairs, not much fruitful results have been obtained.

According to Education for all Global Monitoring, out of 650 million primary school aged children, nearly 250 million lack basic Mathematical knowledge in Sub-Sahara Africa (UNESCO, 2015). It is possible therefore, that these children's poor basic Mathematical knowledge may have

tremendous impact on the other subjects and many aspects of pupils' academic development (Colliver, 2017). They (children) neither understand the basic computations, logic, fundamental principles nor the underlying processes that give rise to Mathematical facts and knowledge acquired from home that may be relevant to topics taught in the school (Omenka, 2010). This poor performance could also be attributed to the abstract method used in introducing Mathematics topics in schools. Often teachers use methods that do not make Mathematics real in life. Some students reason that Mathematics is highly structured and is so abstract and required special intellectual attitude (Dauda, Jambo & Umar, 2016). These and many more other factors has been enumerated as being responsible for poor academic performance in Mathematics particularly the claim that the Mathematics curriculum is not culturally based, it does not mean much to the students because it seems to be unreal (Omenka, 2010).

Resourceful and good Mathematics teachers must be very much interested and concerned not only with what students learn but also how and why they learn them. Teachers need to identify activities which their students like or dislike (Kurumeh & Onah, 2013). Enu, Agyman & Nkum (2015) listed the causes of poor academic performance to include inadequate teaching and learning materials, method of instruction, teachers and students' self-motivation.

For Mathematics to look real in life, Ethnomathematics as a teaching method or an instructional approach could motivate the students and enhance good academic performance in Mathematics. Ethnomathematics seeks to bridge the gap between local knowledge and school knowledge. It adopts a multicultural approach in education to open schools to the cultural diversity that characterizes our current society (Pais & Mesquita, 2013). A significant part of Ethnomathematics research has educational aims, seeking to bring to the schools or other formal educational environments the knowledge and the mathematical practices and plays or concepts of various cultural groups of people (Borba, 1990; Gerdes, 1995; Barton, 1996; Powell & Frankenstein, 1997; Knijnik, 2004). The realization that every culture generates its own ways of explaining, understanding and coping with reality gave rise to Ethnomathematics as a view in Mathematics education (Abah, 2019). These culture-based mathematical knowledge bounds around the Irigwe people of Miango village in Bassa Local Government Area of Plateau state in Nigeria.

The Irigwe peoples' culture and heritage envelop interesting local children plays which could provide rich ethnomathematical backgrounds for Mathematics class. The Irigwe people are ancient hospitable and friendly Rigwe-speaking people living in Miango village, Bassa L.G.A of Plateau state, Nigeria. Their children are conversant with several local children plays, but for the purpose of this study, the focus will be to discover the rules and mathematical aspects of the following Irigwe children plays namely *Gofu* (local golf), *Charabke* (stone play) and *Krita* (local thread).

The *Gofu* play is a typical game of the *Irigwe* children. Basic and necessary tools or kits needed to play this local game are *Gofu* ball, curved stick, a rectangular field, and the players. The making of *Gofu* requires three items namely bathroom slippers, empty peak milk tin, and *Krita*. The empty peak milk tin is heated to a certain degree capable of penetrating through the slippers, producing about two or three circular pieces of slips. The number of round-shape slips to be produced is dependent on the size of the slippers. These round-shaped objects are placed one on another, and sewed using the *Krita* rope. The players could range from two (2) to many, dividing themselves into two teams of equal number of players.

The field of play for *Gofu* is rectangular in shape, similar to that of a lawn tennis court. A straight line is drawn cutting through the center of the field, dividing it into two equal halves. It could be seen from a mathematical point of view that there are some aspect of Mathematics

embedded in the making of *Gofu*, identifying and shaping the curved playing stick, the rectangular field could indicate a certain aspect of Mathematics that deals with shapes (i. e Geometry).

Similarly, playing *Charabke* requires a lot of logical calculations. This play consist of certain number of stones and players, each player aims towards scoring the highest point in the game. The stones for the *Charabke* local children play are packed together in one hand and spread or thrown on the floor in a scattered manner with the intention of having adequate space between one stone and the other. This space is necessary for easy pickup of the stones during the play. As the stones are scattered on the floor, the first player is at liberty to pick any of the stones, then throws or toss it upwards and quickly pick one stone on the ground, and at the same moment catches the falling stone. The pickups are done in succession, starting from ones, twos, threes and so forth. This process is repeated for stage two where the player is expected to pick two stones at once while ensuring he catches the tossed keystone. Worthy of note is the increase in the number of stones to be picked at each stage of the game. This indeed, could mean addition of stones as the player progresses, hence there is an aspect of Arithmetic in the *Charabke* play. The basic principles of this game are to ensure that the keystone thrown up or tossed must not be allowed to fall on the ground, and the player should ensure that the appropriate number of stone is picked at each stage of the play.

Furthermore, an interesting art of the *Irigwe* people is the *Krita* making. The *Krita* is a locally made thread for fishing and farming purposes, sewing of shoes and bags, amongst others. The making of *Krita* involves planning. This planning is the acquisition of the necessary items for *Krita* making. The items include ropes of *bohu,* one can make the *Krita.* Bohu, which means Sack Bag in English language, is designed with fitted pull-strings. The Irigwe people use the sack bag for handling and packaging raw materials like grains, tubers, etc. The sack string is separated, dismantled and the strings or ropes are paired in twos' of equal length for *Krita* making. After pairing, they are tied together at one end, and then it is slided on a lap (leg) while holding it firmly upon the lap with the palm (inside of the hand). By sliding the ropes with the palm on the lap in a forward direction, the *Krita* is being formed. The twisting of the ropes during the sliding process makes the ropes to be tightly woven together. This procedure is repeated by the *Krita* maker until a satisfactory result is obtained. From observations, there is the Measurement concepts of Mathematics in the *Krita* making, especially in ensuring equal length of the two ropes of *bohu* that's used for *Krita* making.

In addition, the *Krita, Charabke, and Gofu* children plays of the *Irigwe* people are sometimes regarded as the most renowned and friendly games and art of the people because it accommodates both males and females. Perhaps, there could be some Mathematical lessons hinged on these aforementioned local plays. This present study intends to explore the Mathematical richness of these indigenous plays along with their rules and impact on the Irigwe people.

Statement of the Problem

There has been public outcry against students' poor performance in Mathematics in public examinations despite government expenditures and institutional strategies to improve status quo. This is a pointer to the fact that there may still be ineffective teaching and learning, and lack of interest in Mathematics in Nigerian schools. Teaching and learning of Mathematics is aimed at developing students' interest and achieving maximum result at all level of education. The discovery of mathematics related concepts in daily children's play should enable students add value to cultural heritage, society and the nation. Mathematics teachers who intend to link the routines and calculations in the subject to the reality of everyday life must be ready to borrow a leaf from the immediate culture of their learners.

The rich cultural heritage of the *Irigwe* people of Plateau state, Nigeria, can provide an immense resourceful background for Mathematics. Particularly, at the Basic Education level. Interesting children games and plays can become the springboard for exploring mathematical concepts. Indigenous children plays such as *Gofu, Charabke and Krita* may contain valuable aspects that can enrich the learning experience in the Mathematics classroom. Considering that the cultural values of these artifacts are largely left unharnessed, this study seek to explore their ethnomathematical dimensions.

Literature Review

Theory of Embodied Mathematics (Lakoff & Nunez, 2000)

In the theory of Embodied Mathematics, Lakoff and Nunez (2000) claimed that mathematics arises from an innate authentic ability and unconscious cognitive mechanisms such as image schemas, aspectual schema, conceptual metaphors and blend. This theory claims that all mathematics that we possibly can assess is human mathematics, structured and restricted by our mental capacities. Therefore, mathematics is entirely a mental product and human mathematics cannot be part of some transcendent mathematics. They further maintained that mathematical objects are embodied objects, that is, ideas that are ultimately grounded in human experiences and out together through normal human conceptual mechanisms, such as image schemas, conceptual blends and metaphors.

It is essential therefore, to accept mathematics just as it is (Lakoff & Nunez, 2000). It is believed that thinking of an object, activity or concept could trigger the stimulation of the experience collected with the object, activity or concept (Barsalov, 2008; Glenberg & Gallese, 2012). The emphasis here is levied upon the notion that certain indigenous cultural practices especially children plays have the ability to aid possible easy recall in the child when needed. This could boost the performance of the pupil when integrated into the classroom for mathematics instruction alongside the traditional and conventional teaching process or approach. Thus, excerpts from history, when augmented into the mathematics instruction, from a cognitive foundation of building present and future relationships xin the development of key mathematical concepts (Abah, 2017).

Interestingly, these schemas, blends and images could be richly found in the *Gofu* and *Charabke* local children plays of the Irigwe people. These local indigenous plays could constitute a massive growth in the cognitive domain of the child, which could aid and improve the performance of the student in the mathematics classroom. Specifically, during the process of playing the *Gofu* game, objects like the round shaped *Gofu* ball, curved stick, and rectangular field could develop schemas in the child, which can be of tremendous advantage to the child. These images develops schemas in the child, hence makes easy recall.

Theory of Realistic Mathematics Education (Freudenthal, 1973; Gravemeijer, 1994)

Realistic Mathematics Education (RME) has its roots in Hans Freudenthal's interpretation of mathematics as a human activity (Freudenthal, 1973; Gravemeijer, 1994). He proposed mathematics should be an actual activity which predominantly consists of mathematizing subject matter taken from reality. The verb mathematizing or the noun thereof mathematization implies activities in which one engages for the purpose of generality, certainty, exactness and brevity. Through the process of progressive mathematisation, learners are given the opportunity to reinvent mathematical insights, knowledge and procedures. In doing so, learners got through stages referred to in Realistic Mathematics Education as horizontal and then vertical mathematisation (*see Figure 1*);

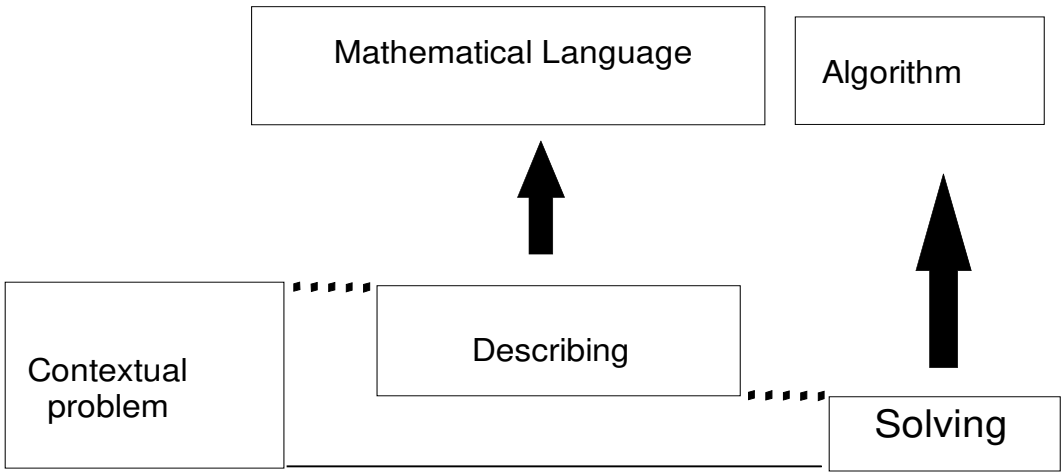

Figure 1. Representation of Horizontal and Vertical Mathematisation.

Horizontal mathematisation is when learners use their informal strategies e.g., local plays and concepts to solve a contextual problem. Vertical mathematisation occurs when the learners' informal strategies lead them to solve the problem using mathematical language (Treffers, 1987). The traditional formal approach to teaching mathematics that has dominated our classroom for a number of years has not afforded learners many opportunities to make use of horizontal mathematisation, where the collaboration of local knowledge and school knowledge could boost the performance of the child. Mathematics lessons are often presented in such a way that the learners are introduced to the mathematical language relevant to a particular section of work and then shown a few examples of using the correct algorithm to solve problems pertaining to the work before being given an exercise to complete (Venter, Barnes, Howie & Jansen Van Vuren, 2004). According to the Realistic Mathematics Education theory, this type of approach places leaners immediately in the more formal vertical mathematisation. The danger in this is that when learners have gone through a process of horizontal mathematisation, a strong possibility exist that if they forget the algorithms they were taught, they do not have an alternative strategy in place to assist them in solving the problem. It maybe imperative to assert that horizontal mathematisation which involves the indigenous local plays and concepts is significant in the instruction of mathematics in the classroom.

Therefore, learners should learn mathematics from real contexts and their own mathematical activity rather than from the traditional view of presenting mathematics. Considerably, the *Krita*, *Charabke* and *Gofu* local children plays of the Irigwe people contain some interesting mathematics related activities capable of imparting the children certain mathematical knowledge and experiences. Such mathematical activities embedded in the *Charabke* and *Gofu* local children plays include counting, identifying the appropriate size of stone suitable for the play, positioning of the stones on the floor for easy pickups, the incremental stages in the game.

The APOS Theory (Dubinsky & MacDonald, 2001)

The role played by indigenous children plays in mathematics institution delivery can best be described in the APOS theory. APOS theory proposes that an individual has to have appropriate mental structures to make sense of a given mathematical concept. The mental structures refer to

the likely actions, processes, objects and schema require to learn the concept (Maharaj, 2010). The APOS theory (Dubinsky & McDonald 2001) begins with actions and moves through processes to encapsulated objects.

APOS theory assumed that mathematical knowledge which is possessed by someone is the result of interaction outcome with other people and the result of his/her mental constructions in comprehending mathematical ideas. The collection of action, processes, object and schema which is connected integrally and structurally in the individuals' thinking is called the schema (Syaiful, Kamid & Maissal, 2014). According to Dubinsky and McDonald (2001), the theory makes testable predictions that if a particular collection of actions, events, processes, objects and schemas are constructed in a certain manner by a student, then this individual will likely be successful using certain mathematical concepts and in certain problem situations.

A handful of indigenous local plays and activities amongst the Irigwe people contain situations that can set up problems which could trigger reasoning in the child in and out of the classroom. For instance, the *Krita* making requires two ropes of bohu (sack ropes) which should be of equal length. The various desirable lengths of the *Krita* could be incorporated into several topics covered in the Mathematics curriculum such as Measurement. Constant and frequent use and encounter or interaction with these plays and tools could gradually build schemas in the memory of the child. Playing these local children games with objects are actions and processes which requires schematic plans. In connecting these features to the mathematics classroom teaching for better understanding, the teacher needs to creatively develop interesting means of involving essential aspects of these local plays into the teaching content. For instance, it will be interesting that the bohu (sack ropes) of equal length is mentioned in the classroom during a mathematics lesson on Measurement. This will help to enhance swift grasping and better understanding in students.

Ethnomathematics

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 is a program that looks into the generation, transmission, institutionalization, and diffusion of knowledge with emphasis on the sociocultural environment. By drawing on the cultural experiences and practices of individuals and of communities, ethnomathematics allows for an easier flow of scientific ideas with children, reducing the effects of cultural blocks (D'Ambrosio, 1977).

Many if not all mathematics classrooms are micro sites of multiculturalism. Hence the notions of ethnomathematics are in play whether it is acknowledged or not. However, the fact that there are often multiple cultures and languages represented mean that the learning and teaching process could be promoted culturally. Cultural, linguistic, political, and social issues often seen as distant to and have little impact on the teaching and learning of mathematics. If mathematics education is to become an equitable practice, these issues need to be seriously addressed in most of our classrooms. That is, there is a continuing need for research that takes seriously an understanding of the complexity of the teaching and learning of mathematics in multicultural situations, and the possible benefits this may have for a more equitable society. Cultures can be understood as knowledge, beliefs and conceptions, in this case about particular mathematical situations. However, they can also be understood as a pattern of meanings, historically constructed and socially transited, that are embodied in symbols and languages, through which human beings communicate, perpetuate and develop their knowledge and their understanding of life. The idea seeks to use research regarding mathematical thinking developed outside school to improve the understanding of mathematics and mathematics teaching and learning in school. This seems to be the most common approach to ethnomathematics within mathematics education research (Adam,

Alangui & Barton, 2003): the use of students' ethnomathematical knowledge to construct a bridge for the learning of school mathematics.

The Irigwe People of Nigeria

"Miango" is an English derivation of Nyango, the name of the first Irigwe person to reputedly build the first permanent residence in present-day Miango, Plateau State, Nigeria. The Irigwes live mostly in Kwall, Miango, and nearby villages and harmlet sixteen to eighteen miles west of Jos. Some ancestors of Rigwe, who came from further north, had migrated to the Jos-Plateau by the 17th century, first settling in and around Kwall. In the early 19th century, Usman Dan Fodio and his followers established the Sokoto caliphate. Some protorigwe moved to Kwall in the early 1800s and later, about 1830, some came to Miango to escape Uthman Dan Fodio's successors who were seeking to expand the caliphate. By the onset of the European colonial era, most of the people living in Miango were Irigwe (Koggie, Iveh & Geysbeek, 2015). In the early 20th century, the Irigwe, though mainly farmers were also astute traders, hunters, and cavalrymen. They along with their neighbors were conquered by the British led West African Frontier Force in the period from 1905 to 1909.

The Irigwe people are natives of Miango village, Bassa Local Government Area of Plateau start, Nigeria. They are very hospitable and friendly, naturally farmers and hunters. They occasionally celebrate festivals for their farm produce, which according to their traditions indicates a hunting season. As they became efficient in hunting and farming, they gathered from the farm and overnight hunting. During the Zrechi festival in Easter season, Irigwe hunters embark on a three (3) day's journey of hunting, and return on the third day with lots of bush meats. There are a lot of tourist attractions in the Miango village like water falls, high hills, the Miango Rest Homes (MRH), amongst others. Irigwe people speak Rigwe language which belongs to larger Benue or Niger-Congo family. Though the region is sometimes plagued by religious crisis, the Irigwe people are peaceful, hospitable and highly industrious. Many of them are farmers and are responsible for supplying enormous amounts of eggs, fresh red hot pepper (miango pepper), maize tomatoes (tomato Jos), big sized Irish and sweet potatoes, carrots, water melon, cabbages, cucumber, wheat and bean to the rest of Nigeria (Koggie, Iveh & Geysbeek, 2015).

Children of yesteryears had increased free time to play with their peers compared to children of nowadays. The time that children spend in various activities can measure productive engagement and can also be indicative of their potential contributions to the society as a whole. Most children prefer to spend their leisure time playing with their peers. Generally, children enjoy playing especially leisure activities. The Irigwe children, in most cases play in groups and pairs. They engage in diverse interesting children plays during their leisure time. However, there is wide variation around the world in the amount of leisure time and activities available to children.

The *Krita*

The *Krita* is a locally hand-made thread used for fishing, hunting, decoration, making of mat and hats, sewing of shoes and bags. The indigenous craft is made from the ropes of bohu (sack bag). A complete made *Krita* is of huge economic benefit to the Irigwe people of Miango village in Plateau state, Nigeria (please see Figure 4). An interesting part of the *Krita* making is the angular manner of placing or positioning the ropes on the lap or leg, forming a v-like shape. When the tied end of the two jointed ropes is placed on the lap or leg for *Krita* making, the remaining parts of the rope is spread or separated from each other in an angle-like manner. This is done to avoid mistake and aid easy twisting of the ropes by the palm or inside of the hand. This local art takes cognizance of two mathematically related precautions; the length of the ropes must be equal, and that there must be a triangle-like spacing between the two tied ropes. Interestingly, ensuring equal length of these two ropes involves some mathematics. Consequently, the angle-like separation between these two ropes could indicate a triangle shape in the cognitive domain of the child. This concept has the tendency to enable and improve the understanding of some certain aspects of

geometry and mensuration in children when consciously and properly integrated into the mathematics curriculum, especially at the basic education level.

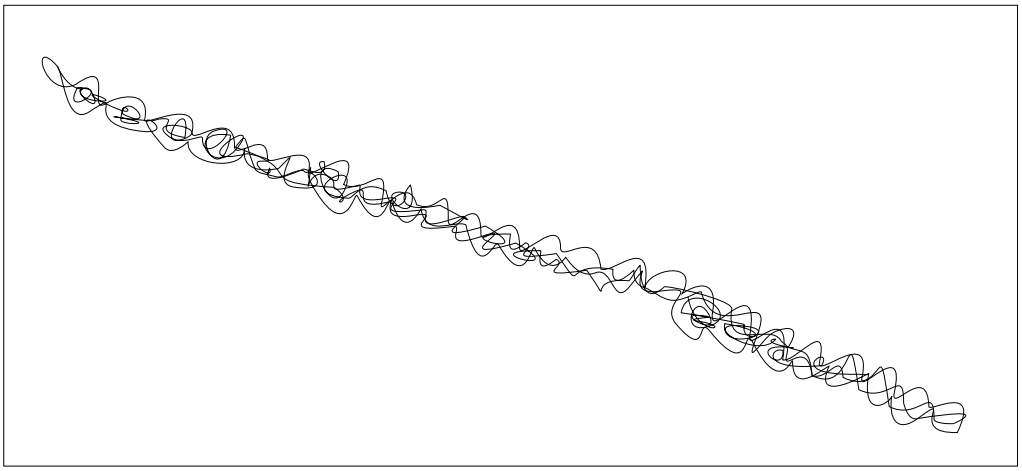

Figure 2: The Krita

The *Charabke* Local Children Play

The word "*Charabke*" emanated after the pattern of playing the game. Due to the prompt and quick grabbing of the stone when thrown up or tossed, the Irigwe people named the game *Charabke* meaning the "quickly grabbed". Counting is an integral part of the *Charabke* local Children play. One interesting advantage of this game is the fact that it can be played by both boys and girls. As shown in Figure 2, the *Charabke* children game is played with stones, these stones could be five (5) or seven (7) in number depending on the choice of the players. Players can be two to as many as possible, they take turns in playing the game one after the other. From the beginning to the end of the *Charabke* play, counting is done. The required number of stones for the play is unanimously agreed and counted by all participating players, the picking of stones during the game involves counting and numbering, from stage one, two, three, etc.

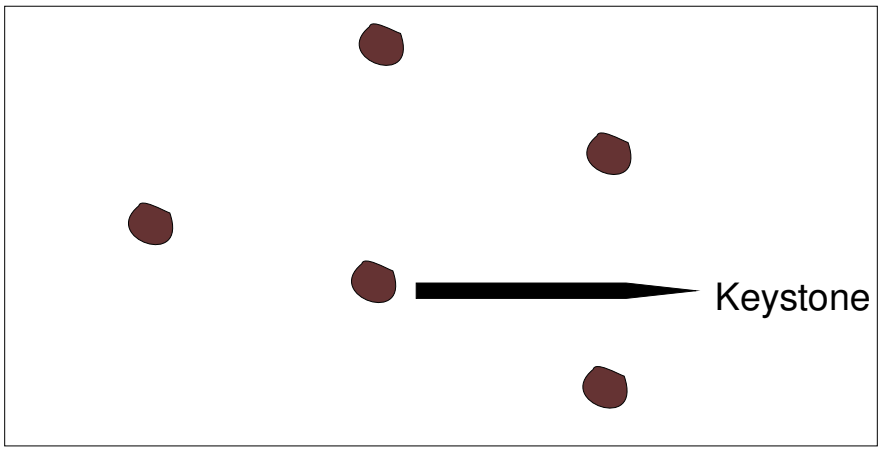

Figure 3: Five stones for Charabke Children play

At each stage, the appropriate number of stones should be picked, if a player picks two stones in stage three, such a player fail, and the next player plays (please see figure 3). Noticeably, the increase in the number of stones to be picked as the player progresses from one stage to another could depict a basic aspect of mathematics termed Arithmetic. Counting, addition of items, objects, numbers are mathematical related phenomenon not only found or restricted to the four walls of the classrooms, but could also be encountered in the homes and play grounds of the Irigwe children. This indigenous local children play may possibly enhance better and effective performance of students in the mathematics classrooms.

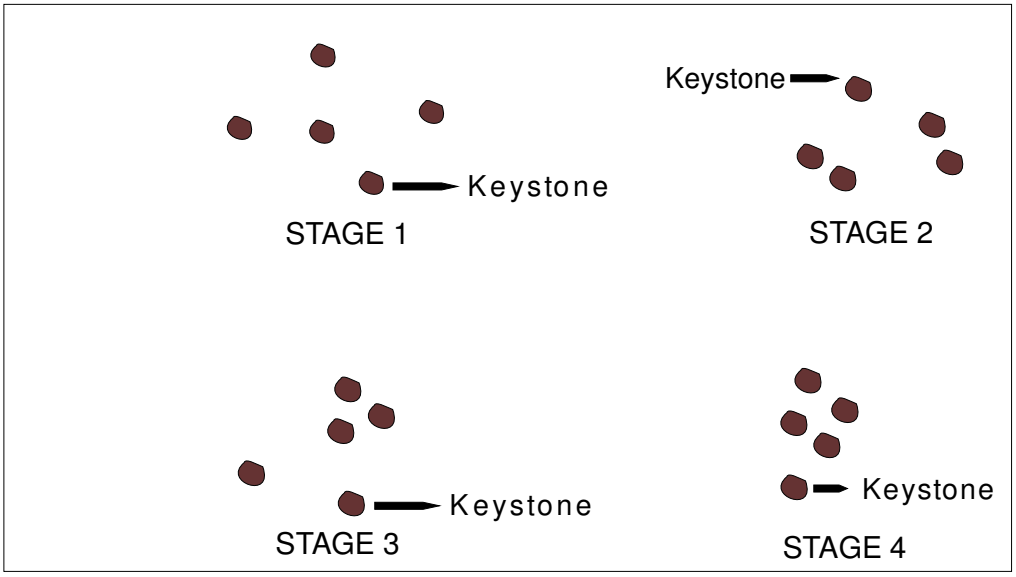

Figure 4: Stages of the Charabke Children play

The *Gofu* Local Children Play

The *Gofu* local children play is a locally played game where children uses curved stick, a *Gofu* ball, a field. According to the Irigwe people, it is believed that the inspiration behind this particular

children play was derived from the way and manner the whites play golf and polo games. The Irigwe people saw it and made theirs locally. The process of playing *Gofu* requires close observations, especially when the *Gofu* ball is running on the ground during the play.

The technicalities involved in the making of *Gofu* have some steps that could be mathematically related. From the making of round-shaped slips with the heated tin-can, to the sewing of the slips using *Krita* and misila (thread and needle), which makes the *Gofu* object. These steps and processes could enrich the child with experiences related to shapes, patterns and logic. In the field of play, worthy of note is the rectangle-like shape of the field. *Gofu* local children game is played on this rectangle-like field. As shown in Figure 5, the field is divided into two equal halves by a straight line that cuts through the center of the field. It may be reasonable to state that these real life situations and items could possess some snippet of geometry, which could be incorporated into the mathematics curriculum for instruction and better understanding.

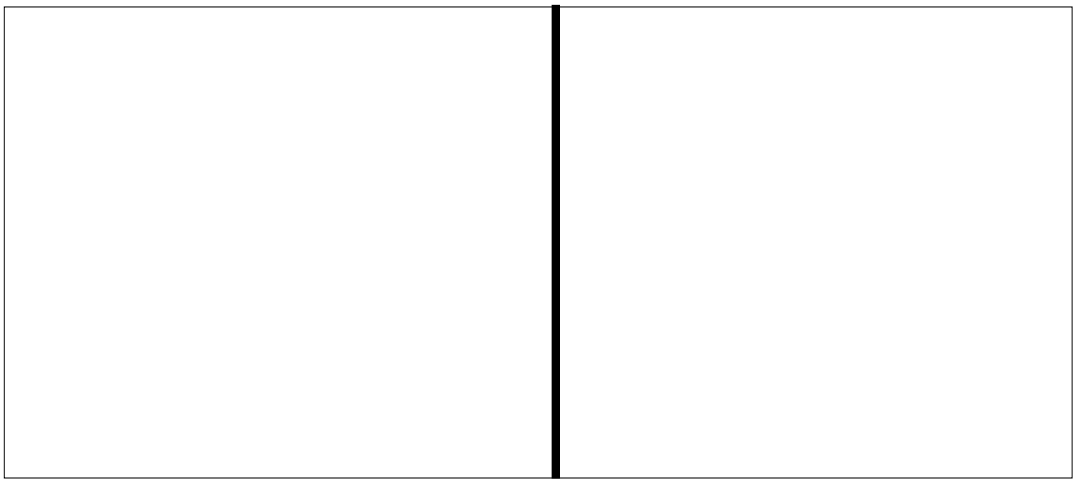

Figure 5: A rectangular gofu field

The stick for playing *Gofu* could be gotten from any type of tree, the stick should be about 30cm long, depending on the height of the player nonetheless. When shaping the stick into form, it is paramount to ensure that one end of the stick is curvy so as to enhance or afford hitting the rolling *Gofu* during the play. The shaping of the playing stick involves the use of a cutlass to trim or cut away its branches and leafs, so that it will be smooth to hold. Below is a pictorial view of the *Gofu* stick.

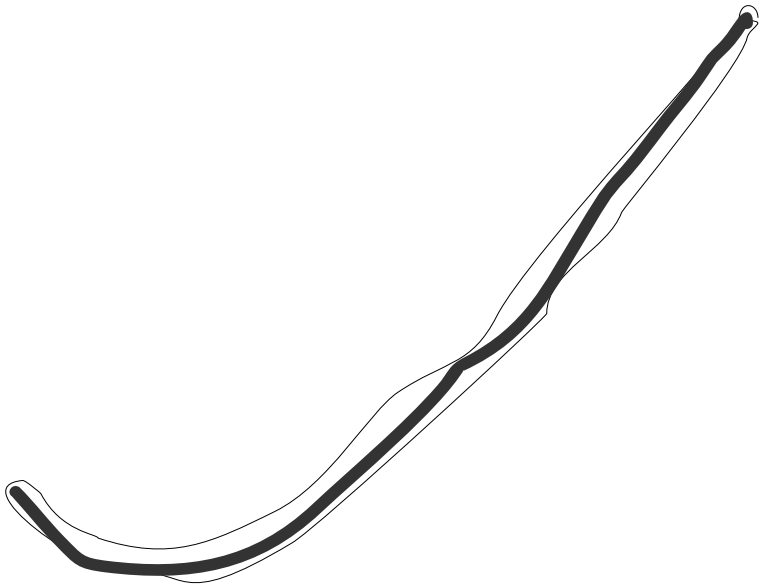

Figure 6: The Gofu Stick

Empirical Studies

Fouz and Amit (2019) embarked on a study to mainly offer an ethnomathematical analysis of Bedouin embroidery samples taken from traditional dresses made by Bedouin women from Negev area in south of Isreal. In the work "Ethnomathematics and geometrical shapes in Bedouin Women's traditional dress", Fouz and Amit (2019) described how ethnomathematical elements are incorporated in the teaching of mathematics for Bedouin students in the Negev, and how this contributes to their learning of mathematics. This study developed teaching units based on integrated ethnomathematical elements within the Bedouin society into the mathematics curriculum and evaluated its influence on the students. The study comprised five stages; the first stage identified ethnomathematical elements in the life of Bedouins in the Negev through interviews with community elders; the second stage analysed these elements according to formal mathematical categories. In the third stage, the researchers created teaching units incorporating the ethnomathematical elements identified in the initial stages into the standard mathematics curriculum and the fourth stage saw the application of the combined teaching units in two Bedouin high schools. Finally, in the fifth stage, tests were administered and data compiled in order to evaluate and compare the students' performance in solving mathematical problems as well as the influence of the new teaching units of the new teaching units on the self-confidence and attitudes of the students, compared to a control group. The results were then compared. The findings clearly demonstrated an increase in the motivation, self-confidence and enthusiasm of the research group students compared to the control group. The way the research group students perceived their schools, families and the study of mathematics transformed. However, Fouz and Amit (2019) focused on the local lives of Bedouin Israelis. This present work intends to explore the richness of some local plays of the Irigwe people of Plateau State, Nigeria. The focus of the current study

will be on the rules and mathematical aspects of indigenous children plays such as *Charabke, Krita and Gofu children plays*.

Similarly, in ethnomathematical studies on indigenous games, Mosimege and Ismael (2000) observed that indigenous games are an integral component of the broader scope of indigenous knowledge. Such games in general are usually viewed from the narrow perspective of play, enjoyment and recreation. Mosimege and Ismeal (2000) believed that even though these views are very important; there is more to games than just the three aesthetic aspects. In their study, analyses of games revealed complexities about games that are not usually considered. South African indigenous games like Malepa, Morabaraba and Tchadji revealed a number of mathematical concepts. They discovered that using these culturally specific games in classrooms showed that learners bring to class various levels of knowledge of the games. The concluding results of this investigation indicated that, for example Tchadji players do count, think and act logically to numerical patterns while paying the Tchadji game. Therefore, it could be concluded that there is mathematical thinking in these indigenous games. Evidently, this assertion is being extended by the present study by identifying the rules and mathematical aspects of the *Charabke*, *Krita* and *Gofu* children play of the Irigwe people of Plateau state, Nigeria.

Matang and Owens (2003) carried out a study to explore the possibility of utilizing and building on the rich cultural knowledge of counting and arithmetic strategies embedded in Papua New Guinea's 800-plustraditional counting systems. This was based on the commonly accepted educational assumption that learning of mathematics is more effective and familiar mathematical practices found in the learners' own socio-cultural environment. Based on the basic number structures and operative patterns of the respective counting systems from selected language groups, they described briefly how the rich diversity amongst these language groups could be used as the basis to teach Basic English Arithmetic Strategies in both elementary and lower primary schools in Papua New Guinea. They selected a diverse number of counting systems in Papua New Guinea, but also because they possess many important features of the majority of these counting systems by linking them meaningfully to the teaching and learning of English Arithmetic Strategies in schools as it provides meaningful and relevant learning experiences for school children at the same time bridging the gap between school mathematics and the existing indigenous knowledg systems in each cultures. Similar considerations are being explored in the current work. Specifically, the present study seek to explore the mathematical aspects of the *Krita*, *Charabke* and *Gofu* children plays of the Irigwe people in Miango village of Plateau state, Nigeria.

Furthermore, Abah (2018) in his study of the mathematics in the cultural practices of the Orokam people of Nigeria: insights into the Educational Relevance of the I'tche game unveiled a captivating contextual and educational relevance of the I'tche game among the Orokam people of Idoma land in Nigeria. The I'tche game of the Orokam people of Nigeria is the ancient mancala game, so common among the people that the term "I'tches" in the Idoma language means "game". Basically, the variant of the mancala game played across Nigeria is a board game comprising of two rows of six holes (2 by 6) containing foir seeds (or stones) each. In the I'tche game, one move pair is the combination of a players' move and his opponents' response. Children ultimately develop the ability to think three or more move pair deep, which means to envision what the game state might be after three more responses. With each improvement in move pair depth, children develop their problem solving skills over time. With experience, children begins to formulate intermediate goals, learn to consider more options and the set of possible responses, and search for the patterns in the configuration of seeds on the I'tche boards to recognize a threat or an opportunity to harvest. The I'tche game is an abstract strategy game involving little amount of chance. It enhances observational skills, critical thinking, planning ahead, spatial perception and number sense. Although, it is normally played by two persons, the elementary mathematics teacher can redesign the pattern of play to accommodate any other convenient group size. In the process,

members of the group will be able to collaborate, discuss tactics and strategy for short-term and long-term advantages. Similarly, the present study seeks to identify the mathematical aspects of the *Krita*, *Gofu* and *Charabke* local children plays of the Irigwe people of Nigeria. These local games is capable of accommodating a large number of students if critically engrafted into the mathematics classroom.

In addition, Fiorentino and Favilli (2002) embarked on a study to introduce an electronic version of an indigenous tool called Yupana, the Inka abacus. One of their major aims is to show that it is possible to make attractive and usable ancient mathematical artifacts, which still clearly prove their didactic utility. The electronic Yupana, in their view, represents an attempt to link tradition and modernity, indigenous and scientific knowledge, poor and rich cultures. It presented an educational environment, where pupils and students can find a friendly tool throughout which they can achieve the notion of natural number, compute basic mathematical operations, familiarize with positional notation and base change and develop personal computational skills and algorithms.

Research Questions

The following research questions guided this study:

1. What are the rules and mathematical aspects of the *Gofu* children play?
2. What are the rules of *Charabke* children play and its mathematical aspects?
3. What are the steps involved in the making of *Krita*?
4. What is the Irigwe peoples' experience with the *Krita*, *Gofu* and *Charabke* children plays?

Methodology

Research Design

This study adopted a phenomenological design method. Since it aims at developing a rich, complete, accurate and clear description and understanding of a particular human experience or experiential moment. Findings are allowed to emerge rather than being imposed by the researcher. Specifically, this research seeks to rally round interpretive phenomenology in the course of the research. In this study, the concern is to understand lived experiences of the people and how they make sense of these experiences with the *Charabke*, *Krita* and *Gofu* local children games. Interpretive phenomenology aims to capture and explore the meanings that participants assign to their experiences (Reid *et al.*, 2005)

Area of the Study

The research was carried out in Miango village, Bassa Local Government Area of Plateau state, Nigeria. Miango village is located between latitude 9° 51' and 0" North, longitude 8° 41' and 0" East (Maplandia). Miango is a village under Bassa Local Government Area of Plateau State. It is made up of enclosed, extended family compounds that are clustered closely together to form a belt of almost continuous settlement running on the Jos-Plateau, Nigeria.

Population of the Study

The population of the study consists of the entire Irigwe people living in Miango village. Miango is made up of eight sub-divisions namely Ancha, Kweshe, Jebu, Tegbe, Te'egb'e, Huke', Nzjaruvo, Zogu. Miango village and the surrounding communities have a population of over 20,000 people, more than 50% of which are women and children.

Sample and Sampling Technique

The study used a sample of 15 Irigwe people, both young and old who willingly volunteered to participate in the study. These participants were considered based on their

knowledge and experience in the subject matter under investigation. To do this adequately, the researcher shared the volunteers into three groups. The first group is for the *Gofu* local children play which consist of six children and one elderly person. The second group is for the *Charabke* local children play and was made up of four children and one elderly person, while the third group is for the *Krita* making which consisted of two children and an elderly person.

Instrument for Data Collection

Two instruments were used for data collection. A semi-structured and in-depth interviews rubric, and video recorder were the two instruments for data collection. The semi-structured interview includes a number of planned questions, but the researcher exercised more freedom in modifying the wording and order of the questions in the course of the interview. In-depth interviews made the session to be less formal and least structured in the set of questions, this made the participants to be freer and relieved in the whole process of the interview. The interview enabled the researcher collect complex information with a higher proportion of opinion based information. The questions were more focused on the lived experiences of the Irigwe people with the *Krita*, *Charabke* and *Gofu* local children plays. A video coverage of the interview sessions was captured all through the process as well as pictures. The video coverage also highlights the indigenous plays in action, capturing the entire process of the games as currently played by the children.

Method of Data Collection

The video recorder was used for the coverage of the interview and game sessions. Furthermore, notes were taken, observations made and noted. A close watch on the participant's gestures was also taken into consideration at each moment of the process. Participants' experiences and feedback added insight to the research questions posed in this study. By observing, listening and analyzing the experiences of these participants, valuable information was obtained about the study. Most interview questions were asked exactly as they were written. However, the researcher often followed up the semi-structured questions with open ended questions such as "why?", and "can you please tell me more?" This was the researcher's way to get at deeper meaning and richer understanding of the participants' experiences. Prior to the main interviews, each participant received a copy of the interview rubric, so the researcher felt comfortable hitting the major points outlined therein and asking each participant "Do you have any questions before we begin?"

Method of Data Analysis

The research adopted a Narrative analysis method for analyzing the data. This analytic frame was used to interpret the shared experiences of the people of Irigwe land and their everyday lives in relation to the *Krita*, *Charabke* and *Gofu* local children plays.

Results

The presentation of results is carried out according to the research questions. To protect the identity of the participants, they are coded P1, P2, P3, and so on. Those shown in pictures and videos gave their verbal consent for their images to be displayed in this study.

Research Question One

What are the rules and mathematical aspects of the *Gofu* local children play?

Three themes emerged from the research data of this study. These include easy learning of mathematical concepts, improved recall of learned experiences, and spurring critical thinking in the children. It is very interesting seeing and observing the Irigwe children play the *Gofu* game. How they coordinate themselves during the play, working together as a team is remarkable to behold. Having asked to tell us rules of the *Gofu* local children play, P1 said:

> "Although, no formal written rules were handed over to us by those who played *Gofu* before us, we learnt the rules while playing the game along with some of them."

He went further to outline five rules as thus:

a. A point is scored when the *Gofu* ball drop dead in the opponents' court or side.
b. On no account should any player step beyond the center line to the opponents' half. If this happens, the player loses his play stick or *Gofu* stick.
c. There is no referee or umpire in the *Gofu* local children play, players coordinate them game based on predefined rules.
d. Should the *Gofu* ball drop dead on the center line, the ball is erectly placed on the line and a count to three is done for the fastest player to hit the *Gofu* ball between representatives of each team.
e. The game ends when both teams are tired or deem it fit.

Certain features of the *Gofu* children play have the ability and capacity to enhance easy learning of concepts, improved recall of learned experiences, spur critical thinking in these children. Physical features within the field of play and objects such as the round-shaped *Gofu* ball, curved *Gofu* stick, the straight line which divides the rectangular field into two equal halves, and even the rectangular field; all are evident indications of mathematically related concepts hidden in these indigenous children plays, which when carefully harnessed into the mathematics curriculum of instruction could enhance better performance. In dealing with mathematical shapes of objects, basic geometry and mensuration consist of similar shapes as the *Gofu* ball, the rectangular field, and more. These shapes are schemas in the cognitive domain of these children which when triggered by certain activity or instructions could enhance better performance in mathematics classes. It is interesting and unique.

Research Question Two

What are the rules and the mathematical aspects of the *Charabke* local children play?

The *Charabke* children play is an interesting game both to watch and play. Children derive is much excitement playing this particular game. In an interview with P3, the following rules emerged;

a. The keystone thrown-up during the game must not be allowed to fall to the ground.

   During the game, the player picks one of the stones out of the five stones on the floor to become the keystone. Players don't just pick any stone and make it the keystone, the trick is to select the most suitable stone that is easy to grab when thrown up. The keystone, as shown in Figure 1 should not be allowed to fall to the ground during the play. If a player fails to grab the keystone along with the picked stone in his hands, such a player failed the stage and would have to wait for another turn to repeat the same stage.

b. The number of stone to be picked is determined by the stage of play.

   Basically, there are four stages in the *Charabke* local children play. *(see Figure 3)*

   Stage 1: a player is expected to pick one stone from the ground per throw i.e whenever the player throw the keystone, the player is expected to pick only one stone from the ground, until all the stones are picked;

   Stage 2: a player is allowed to pick only two stones per throw;

Stage 3: a player is to pick three stones per throw, and pick the remainder with another throw;

Stage 4: this is the final stage, a player is expected to pack all four stones with a single throw of the keystone.

c. If a player completes all the stages without allowing the grabbed stone to fall to the ground, such a player becomes the winner.

At every stage of the play, the children or players try as much as possible to arrange the stones in such a way that it will be easy to pick. For instance, in stage two of the *Charabke* local children play as shown in Figure 6, the keystone would be the single stone without a partner, while the remaining stones are well arranged according to the stage.

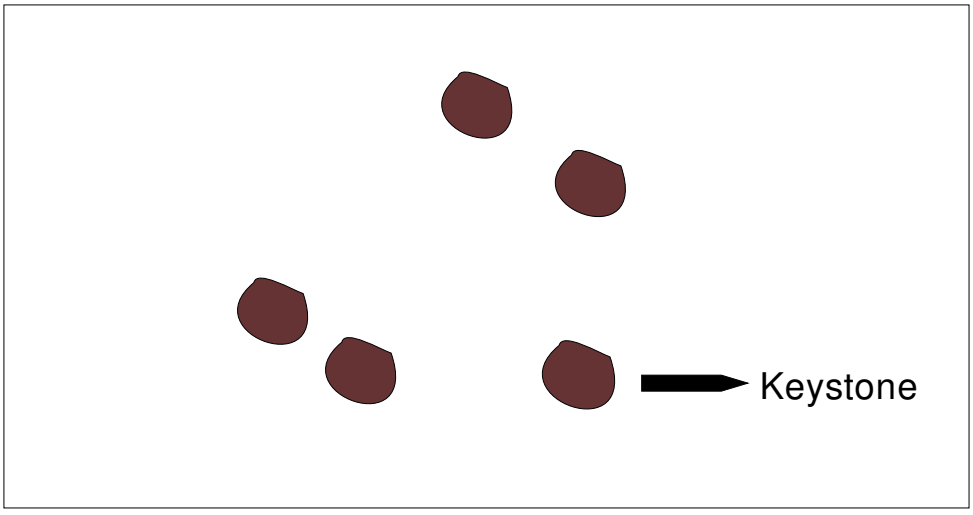

Figure 7: Stage 2 of the Charabke Children Play

This arrangement is done by the player to avoid picking more than the appropriate number of stones for that particular stage. This act of critical thinking is also found within the corridors of mathematics.

Research Question Three
What are the steps involved in the making of *Krita*?

Before the emergence of civilization in the Irigwe kingdom, the *Krita* was and still is one of the Irigwe peoples' prominent cultural artifact. The economic essence of the *Krita* is highly remarkable. According to P2, when asked of the uses of the *Krita*, he said;

> "The *Krita* is a very strong thread which we use for several purposes. It can be used for hunting, fishing, to tie bags of corn, tie broom, sewing of shoes and bags, and several other uses."

When asked of the steps for making the *Krita*, P2 reached for the rope of Bohu (sack rope) used for making the *Krita*, and began to state the steps while demonstrating it on his leg. Below are the steps;

Step 1: get two bohu (sack) ropes;

Step 2: ensure the ropes are of equal length;

Step3: tie one end of the two bohu together and place it on your leg;

Step 4: ensure the ropes are widely open and separated in an angle-like manner to avoid entanglement;

Step 5: hold firmly the tied end on the leg with one hand and apply pressure on the two ropes while twisting it on the leg with your palm or inside of your hand to form the *Krita*;

Step 6: repeat step 5 continuously until you finish making the *Krita*.

The Irigwe children are fond of making the *Krita* due to it widely uses amongst the people. The application of the *Krita* is found in almost all spheres of their daily activities. Children specifically use the *Krita* to sew the *Gofu* ball for the *Gofu* local children play. This cultural heritage has been passed from one generation to another.

Research Question Four
What is the Irigwe peoples' experience with the *Krita*, *gofu* and *Charabke* local children plays?

The shared experiences of the Irigwe people with the *Krita*, *Charabke* and *Gofu* local children plays are richly educative, enlighten and interesting. Their lived experiences built certain relationships amongst the Irigwe people. At some point in the interview, P2 has this to say;

> "I was 17years old when I first tried to make the *Krita*, and it was my grandfather that taught me then. I later perfected the *Krita* making with the help of my elder brothers".

According to P2, the *Krita* making requires a lot of concentration and attention. Any slight mistake could frustrate your efforts and could lead to damage of the *Krita*. Amidst the numerous uses of the *Krita*, using it as curtains in huts is quite interesting and unique. P2 went further to say this;

> "In using the *Krita* for hunting, it is attached to traps. If it is a rat trap, the *Krita* is used to make what we call Tarko i.e rat trap".

During the Zrechi festival, men and youths alike embark on a three days hunting spree. They go with hunting tools and equipments made with indigenous local tools. On the third day, they all return from the hunt with bush meats. This festival is usually observed during the early raining season to indicate the beginning of the planting season. On market days, the *Krita* is sold at the market place to both Irigwe natives and those from neighboring villages. The *Krita* is of enormous economic importance to the Irigwe people.

Similarly, the *Charabke* local children play can be traced as far back as 1966 when P3 first played the game with friends. P3 has this to say;

> "The first time I played the *Charabke* was in 1966. The name *Charabke* was given to the game because of the quick catch or grab done during the play".

When the keystone is thrown-up, all efforts must be made to ensure the stone does not fall to the ground after picking the required stones from the ground.

P3 went ahead to say that there were rather unsuitable moments she could recall during the game. P3 said:

> "There was a certain moment I could remember that one of our friend got angry because the game was not favoring her. At that time we were kids, we get angry easily, but we however did not fight".

The *Charabke* local children play is a very important game played amongst the Irigwe children till date. It has very positive implications I the lives of the Irigwe people. It has the ability to unite children of diverse backgrounds, fostering social unity, love and togetherness.

Furthermore, the *Gofu* local children play present similar pattern of play as the internationally recognized golf sport. P1 has this to say:

> "Irigwe people saw how captivating and interesting the golf sport was and decided to create theirs locally, using indigenous local resources".

P1 went on to state that the *Gofu* play has no specific season or stipulated time of play. Whenever one group of children start playing the game, the next group will also develop interest and start playing as well. When the Irigwe people saw how the *Gofu* children play remarkably unites their children, they encouraged the play to thrive in their society.

Notably, during this study in Miango village, children began to play the *Gofu* game, even though it was not been played before the study. This is in agreement with P1's claim earlier.

Discussion of Major Findings

The outcomes of this study have indicated how rich the culture of the Irigwe people is, and the presence of mathematical related concepts in some of their local indigenous children plays, specifically the *Gofu*, *Krita* and *Charabke* children plays. These mathematical concepts can be carefully blended into the mathematics curriculum of instruction at the Basic Education level. These indigenous historic and cultural games present a more interesting approach to the teaching and learning of mathematics for children. Howbeit, Abah (2016) hinted that there is the indication that very little element of history are being embedded in classroom instruction considering how General History as a subject has fared in the development of curriculum in Nigeria. Present day teaching methodology in mathematics hinges on mathematical proficiency. Consequently, the task of the mathematics instructor is to improvise series of experiences that will closely build the strands of mathematical proficiency in the learners. This may involve the careful combination of instructional activities with mathematical objects and cultural artifacts that are relevant to the comprehension of abstract concepts (Abah, 2018).

Interestingly, the *Gofu*, *Krita* and *Charabke* local children plays makes available enriching concepts capable of enhancing better understanding of mathematics, especially at the Basic Education level. The *Gofu* children play has been one of the most admired local children games in the lives of the Irigwe people. This study is in close alliance with the work of Abah (2018) in Traditional I'tche Board game of the Orokam people which asserts that it serves an enriching purpose as a cultural artifact if carefully engrafted into the pedagogy of mathematics. In the *Gofu* children play, players know exactly when to hit the *Gofu* ball, where and how far to hit it. These are well articulated, planned and calculated steps that the players make prior to the arrival of the *Gofu* ball during the play. All these attributes are critical skills useful in the understanding of mathematical concepts like arithmetic, numerical cognition, logic and reasoning at the Basic Education level.

In the mathematics classroom, the teacher can innovatively feature strands of the *Krita*, *Gofu* and *Charabke* children plays into the mathematics lessons. For instance, the ropes of the *bohu*

with equal length can be referred to during lessons on Measurement. Also, the rectangular *Gofu* field may be used during mathematics lessons on geometrical shapes, while the straight line that divides the field into two equal halves could represent a diameter.

The socio-cultural and economic development of the Irigwe people can be traced to some significant contributions from the much admired *Gofu*, *Krita* and *Charabke* local children plays. Exploring the shared experiences of the Irigwe people with these indigenous children plays has brought to the limelight certain valuable cultural ethics that could engage children by enabling deeper understanding of certain mathematical concepts in and out of the classroom. Fouz and Amit (2018) asserts that the use of stories from within the students' culture and previous knowledge contributes greatly to the students' learning process, help them better understand the study materials, raise their motivation and ultimately, improve their performance in mathematics. Evidently, this assertion is similar with this current study. Beyond the mathematics classroom, the significance of the *Gofu*, *Krita* and *Charabke* local children plays can be seen across all spheres of the Irigwe peoples' society. These indigenous children plays if properly harnessed into the mathematics curriculum of instruction at the Basic Education level will not only enhance better performance in Mathematics but foster social unity amongst the studnets. This significant aspect of the *Gofu*, *Krita* and *Charabke* children plays can be extended into the larger society.

Conclusion

This study has explored the rule and mathematical aspects of the *Gofu*, *Krita* and *Charabke* local children plays of the Irigwe people of Plateau state, Nigeria. The study also unraveled the Irigwe peoples' experiences with the *Gofu*, *Krita* and *Charabke* local children plays. It can be concluded in this study that there are mathematical aspects in the *Krita*, *Gofu* and *Charabke* children plays of the Irigwe people. The rules for these local games were also identified. The use of ethnomathematical methods in teaching could enhance better understanding of mathematics concepts.

Recommendations

Based on the outcomes of this study, it is recommended that:

i. A concerted effort by relevant stakeholders with the Basic Education sector to device means of harnessing rich indigenous children games such as the *Gofu*, *Krita* and *Charabke* local children plays into the mathematics curriculum of instruction at the Basic Education level;
ii. Mathematics curriculum planners should plan their scheme of work systematically by involving largely ethnomathematics. The specific usage of indigenous children plays in this study hold broad implication for classroom practices in Mathematics education.
iii. The government is encouraged by this study to see the need to train mathematics teachers on the use and relevance of ethnomathematics Basic Education. The activities of this study can humanities basic mathematics by presenting the relationship between mathematics and indigenous cultural plays within the society.

References

Abah, J. A. (2017). Viewing Basic Math through the lens of history: Undergraduates' reflective learning in a history-augmented mathematics classroom. *Waikato Journal of Education, 22(4), 33-48*

Abah, J. A. (2016). Recency bias in the era of big data: The need to strengthen the status of history of Mathematics in Nigerian schools. *Advances in Multidisciplinary Research Journal*, 2(4), 241-248.

Abah, J. A. (2018). *The Traditional I'tche (Mancala) Board Game of the Orokam People*. Blog Article retrieved from https://villagemath.net/2019/06/03/the-traditional-itche-mancala-board-game-of-the-orokam-people/

Abiam, P.O. (2006). *Basic Ethnomathematics Concepts of unschooled boki and Ejagham speaking a duise of Cross River State of Nigeria: applicability to the Teaching of primary School Mathematics*. Unpublished M.Ed project University of Calabar.

Adam, S., Alangui, W., & Barton, B. (2003). A comment on: Rowlands and Carson "Where would formal, academic mathematics stand in a curriculum informed by Ethnomathematics? A critical review". *Educational Studies in Mathematics*, 52, 327–335.

Adei, E.B. (2013). *Effect of Concept Mapping Strategy on Post Basic Students' Achievement and Interest in Geometry in Obudu Educational Area of Cross River State*. (Unpublished M.Ed Thesis). Faculty of Education, Benue State University Makurdi.

Amit, M., & Qouder, F. A. (2017a). *Weaving Culture and Mathematics in the Classroom: The Case study of Bedouin Ethnomathematics and its Diverse Approaches for Mathematics Education (pp. 23-50)*. ICME -13 Monographs, Berlin: Springer. https://doi.org/10.1007/978-3-319-59220-62

Anyor, J.W & Iji, C.O. (2014). *Effect of Integrated Curriculum Delivery Strategy on Secondary Schools Students' Achievement and Retention of Algebra in Benue State*. Abacus, the Journal of the Mathematical Association of Nigeria 39(1).

Azuka, I.B. (2002). Mathematics in Technology Development focus on the next millennium-implication for secondary education; *Abacus, the Journal of the Mathematical Association of Nigeria, 25(1), 75-77*.

Barton, B. (1996). *Making sense of ethnomathematics: Ethnomathematics is making sense*. Educational Studies in Mathematics, 31, 201–233.

Borba, M. (1990). *Ethnomathematics and Education in Africa*. Stockholm: Institute of international, Education, University of Stockholm.

Colliver, Y. (2017). Fostering young children's interest in numeracy through demonstration of its value: the footsteps study', *Mathematics Education Research Journal,* doi: 10-11 77/0002764209331540.

D'Ambrosio, U. (1977). Science and technology in Latin America during discovery. *Impact of Science on Society, 27, 3 (1977) p. 267-274*

Daniel, D. A., & J. K. Bari (1983). *An outline of Irigwe Phonology and Grammar*. Unpublished ms. http://www.rogerblench.info/Language/Niger-Congo/BC/Plateau/Rigwe/Grammar/Rigwe%20Phonology.pdf

Dauda, B. Jambo, H.E. & Umar, M.A. (2016). Students' perception of factors influencing teaching and learning of mathematics in senior secondary schools in Maiduguri metropolis, Borno State, Nigeria. *Journal of education and practice, Vol.7 (20).*

Dubinsky, E. , & McDonald, M.A. (2001). APOS: A Constructivist Theory of learning in Undergraduate Mathematics Education Research. In D. Holton (Ed.), *The teaching and learning of mathematics at the University level: An ICMI Study (pp. 275-282).* New York, NY: Kluwer. Retrieved from https://link-springer.com/content/pdf/10.1007%2F0-306-47231-7-pdf

Ekwueme, C. O., & Meremikwu, A. (2010). Evaluation of the Millennium Development Goals Project (NDG) for primary school teachers in Nigeria: Teacher's perspective. *International Journal of Research in Education,* 2(6), 84-88.

Enu, J, Agyman, O.K, & Nkum D. (2015). Factors influencing students' mathematics performance in some selected Colleges of Education in Ghana. *International Journal of Education Learning and Development,* 3(3), 68-74.

Fiorentino, G. & Favilli, F. (2002). *The Electronic Yapana: A didactic resource from an ancient Mathematical tool. Department of Mathematics, University of Pisa-Italy*

Fouze, A. Q., & Amit, M. (2018). Development of Mathematical Thinking through Integration of Ethnomathematics Folklore game in Math Instruction. *Eurosia Journal of Mathematics, Science and Technology Education, 14(2), 617-630*.

Freudenthal, H. (1973). *Mathematics as an Educational Task, Dordrecht: Reidal*

Gerdes, P. (1995). *Ethnomathematics and education in Africa.* Stockholm: Institute of International Education, University of Stockholm.

Gravemeijer, K. P. E. (1994). *Developing Realistic Mathematics Education, Utrecht*: Freudental Institute

Gurol in Mehmet (2016). *Curriculum development: reviews of education research vol.47 (1)*

Knijnik, G. (2004). *Ethnomathematics and Education in the landless movements.* Santa Cruz do Sul; Edunisc.

Koggie, A., Iveh, Z., & Geysbeek, T. (2015). *"That was the Beginning of Great Things at Miango". Brra Kwe' Tingwe and the Origins of Christianity in Miango, Nigeria, 1913-1936. International Bulletin pf Mission Research. 39(4) (133-137). doi:10.1177/239693931503900305*

Kurumeh, M.S. & Onah, F.O. (2013). *Ethnomathematics: a cultural way of teaching Mathematics.* Makurdi: Azaben Press.

Lakoff, G. & Nunez, R. E. (2000). *Where Mathematics comes from (New York: Basic Books, ISBN 0465037704)*

\Maharaj, A. (2010). *An APOS Analysis of Students' Understanding of the Concept of a Limit of a function. Pythagoras, 71, 41-52.* https://doi.org/10.4102/pythagoras.vOi71.6

Matang, R. A., & Owens, K. (2003). *Building on the Rich Diversity of Ethnomathematics in Papua New Guinea. A paper presented at the SAAMI Conference, Sweden.*

Mosimege, M. D., & Ismael, A. (2000). *Explorations of the games of Malepa and Morabaraba in South African Secondary School Mathematics Education.* Unpublished PhD Thesis, University of the Western Cape.

Obodo, G.C. (2004). *Principles and practice of mathematics education in Nigeria.* Enugu: flextone press.

Omenka, J.E. (2010). *Effect of Ethnomathematics approach on Achievements and Attitude towards number and numeration among the Junior Secondary School Students. (Unpublished Ph.D. Thesis).* Benue State University, Makurdi.

Pais, A. & Mesquita, M. (2013). Ethnomathematics in non-formal educational settings. The urban boundaries project. *Revista latinoamericana de etnomatematica, 6(3), 134-144.*

Powell, A., & Frankenstein, M. (1997). *Ethnomathematics: Challenging Eurocentrism in mathematics education.* Albany: State University of New York Press.

Reid, K., Flowers, P., Larkin, M. (2005). *Exploring lived Experience: The Psychologist*, 18(1), pp. 18-23.

Remillard, & Heck (2014). *Transforming Preservice Mathematics Teacher Knowledge for and with the Enacted Curriculum: The Case of Digital Instructional Materials (p. 707).*

Syaiful, Kamid, & Marssal, J. (2014). *Student Comprehension about line and row from APOS Theory point of view. International Journal of Contemporary Applied Science, 1 (4), 21-32*

Taba, T. (1962). *Curriculum: Theory and Practice.* New York: Harcourt, Brace.

Tall, D. (1999). *Reflections on APOS Theory in elementary and advanced mathematical Thinking. In O. Zaslausky (Ed.), Proceeding of the 23rd Conference of PME (pp. 111-118).* Haifa, Isreal: PME

Treffers, A. (1987).*Three Dimensions – A model of Goal and Theory Description in Mathematics Instruction, Dordrecht: Kluwer Academic*

UNESCO (2015). *Education for all 2000-2015: Achievement and Challenges- EFA Global Monitoring Report 2015.* Paris, France. Available at http://en.unesco.org/gemreport/report/2015/education-all-2000-2015-achievements-and-challenges#sthashap6wdoxi.dpbs.

Venter, E., Barnes, H., Howie, S. J. & Jansen van Vuuren, S. (2004). *Mpumalanga Secondary Science Initiative – Learner progress Research Project. Pretoria: Center for Evaluation and Assessment.*