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Cultural Mathematics in the Traditional Practices of the Orokam Community: An Analysis of the Educational Potential of the I'tche Game

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Abstract: *Indigenous studies from Nigeria have often highlighted the connection between ordinary children plays and vital science skills and affective behaviours. Apart from random plays and games of children, mathematical connections pervade many cultural activities of local Nigerians. These mathematically relevant cultural activities are seen in festivals, dances, bedtime stories, farm practices, art works, local architectures, and games. This study focused on the I'tche game, a mancala-class board game enjoyed across Africa. The*

contextual and educational relevance of the I'tche game among the Orokam people of Idoma Land in

Key Words: *Mathematics education; Ethnomathematics; Orokam people; Idoma Land; I'tche; Cultural practices; Local mathematical games*

1. INTRODUCTION:

Mathematics as a subject area is an aid for representing the physical word. It is the science of measurement, relationships, and patterns. Mathematics is the body of knowledge centred on such concepts such as quantity, structure, space and change, and also the academic discipline that studies them (Osafehinti, 2015). Mathematics can be described as an organized active thinking, which involves the search for patterns and relationships that may be expressed in symbols. It is an expression of the human mind that reflects the active will, the contemplative reason, and the desire for aesthetic perfection. Mathematics is essential for the full comprehension of technological and scientific advances, economic policies and business decision, and other complexity of social and psychological issues.

Mathematics educators see mathematics not simply as a body of knowledge or an academic discipline but also as a field of practice. According to Kilpatrick (2008), this is because they are concerned with how mathematics is learned, understood and used; as well as what it is, they take a comprehensive view. Mathematics education looks beyond applications to ways in which people think about mathematics, how they use it in their daily lives, and how learners can be brought to connect the mathematics they see in school with the mathematics in the world around them. Attempts by mathematics and mathematics educators to make mathematics real to learners resulted in the birth of ethnomathematics as a sub-field of mathematics. Rosa and Orey (2011) credited the term "ethnomathematics" to the work of D'Ambrosio from the mid-1980s to the present century. Ethonmathematics, according to Rosa and Orey, presents mathematical concepts of the school curriculum in a way in which these concepts are related to the students' cultural and daily experiences, thereby enhancing their abilities of elaborate meaningful connections and deepening their understanding of mathematics. The modus operandi of this perspective of mathematics entails the mathematics teachers seeking out culturally relevant mathematical activities that can enhance the effective communication of mathematical ideas.

Through the work of ethnomathematicians and those interested in multicultural mathematics, teachers all over the world have seen how games played in several cultures can help children hone mathematical skills, thinking strategies, and problem solving abilities and develop an awareness of participation in a global community (Power & Temple, 2001). Available information from psychologists indicates that play is not just

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a filling in of an empty period, or just a relaxation or leisure activity, but it is an important learning experience (Lowe, 1988). Playing games can be seen as a means of working off aggression, learning basic skills of survival and learning acceptable social behaviour. The sheer pleasure of playing a particular game enables children to learn the mathematics ideals embedded in it as a by-product of playing. Moreover, by actively observing and carefully listening to children as they play, teachers can learn about how children think and the mathematical knowledge that they are constructing (Powell & Temple, 2001).

As far back as the early 1980s, Nigerian educationists have been experimenting with integrating traditional games and play activities into primary education programmes. Lowe (1988) summarized an epic attempt by Dr. Eunice A.C. Okeke in 1984 which identified several connections between ordinary children plays and vital science skill and processes as well as affective behaviour. Apart from random plays and games of children, mathematical connections pervade many cultural activities of Nigerians. These cultural activities range from festivals, dances, bedtime stories, farm practices, artworks, architectural designs, to board games.

Board games are almost universal, and are estimated to be among the world's oldest games. A peculiar variation of board game predominant among the Orokam people of Idoma Land, Nigeria, is called the *I'tche* game. The *I'tche* game is actually a form of mancala, traditional to most African cultures (Tembo, 2012). *I'tche* is often the first game played by many Idoma children while growing up.

The premise of this exposition is the fact that *I'tche* holds a wide educational significance to the teaching and learning of mathematics, particularly at the basic educational level. The discourse focused on the Orokam people, a unique ethnic group found in Ogbadibo Local Government Area of Benue State, Nigeria. The interdependence of mathematics and culture is presented, followed by a brief introduction to the Orokam people of Idoma Land. Some mathematics – based cultural practices of the people are then discussed in detail. The fulcrum of this presentation is the discourse on the *I'tche* game along with its educational relevance. The tenets promoted in these discussions may aid instructional designs that will improvise local games to build up children in co-operation, competition, respect for others, self-control, sharing, teamwork and planning.

2. MATHEMATICS AND CULTURE:

Many people believe that mathematics is a collection of fixed truths and unchangeable laws (Kiselmen, n.d.). In the past mathematics was an abstract subject clamped with long formulae and mechanical processes. The days have passed and the focus is now on the meaning of what children learn and their application in day-to-day life. Newer experiments in mathematics have been emerging in order to make mathematics more meaningful to the children, their parents and teachers (UNESCO, 2008). Such approaches have carved out the field of Ethnomathematics, one of the innovative ideas of mathematics education that identifies meaning in everyday activities of ordinary people and looks for the implication for lifelong learning.

Mathematics as a discipline is a tool of the society, crafted to aid human existence. The teaching of the subject is, therefore, expected to inculcate in learners certain modes of thinking that are quite important in the successful building of society and nation. The analytical approaches of mathematics enhance one's ability to take hold of a situation, to analyse the situation and to perceive correctly the state of affairs (Thomaskutty & George, 2007). Consequently, to attain the societal expectation of mathematics, the subject must be embedded in the culture of the people it serves.

The heritage of every society shows that culture consists of an ensemble of religion, philosophy and arts. Political organization, moral or ethical views, judgments, the principles of democracy, of citizenship, languages, music, sportsmanship and games, are all components of culture as is mathematics, science, and to an increasing extent in today's world, technology (Sidjanski, 2010). Culture reflects how people live, behave, dress eat, drink, rear children, and maintain society relationship. Thomaskutty and Grorge (2007) observed that culture is greatly determined by the scientific and technological advancement of the society, which in turn depends upon the progress and development of mathematics. Thus, the history of mathematics portrays the culture and civilization of the society and mathematics helps in preservation and transmission of cultural tradition.

Modern thinking of the ethnomathematics programme acknowledged that there are different ways of doing mathematics by considering the appropriation of the academic mathematical knowledge developed by different sectors of the society as well as by considering different modes in which different cultures negotiate

their mathematical practices (Rosa & Orey, 2011). In this regard, Kiselman (n.d.) revealed that mathematics plays a role both as cultural element and as subculture. As part of culture, mathematics consist of all the mathematic knowledge, views and skills that a certain people own collectively, with the purpose of keeping these alive and perhaps expanding them as a goal for general education. On the other hand, mathematics as subculture is the culture that is specific for people who have had training in mathematics as a science.

In the views of ethnomathematics, mathematics education should be an introduction to the cultural element as well as to the subculture, in varying degrees from the early years to postgraduate studies (Kiselman, n.d). The obvious implication is that at the basic education level, mathematical communication should reflect children's view of reality, a reality that arises out of the cultural practices of the people. The curriculum of mathematics at this level should be a knitted sequence of instructional experience that is rooted in the history and culture of the people. A significant objective of the new 9-year Basic Education Curriculum of Mathematics is geared towards providing learners the opportunity to develop the essential element of problem solving, communication, reasoning and connection within the study of mathematics (Aynor & Abah, 2014). The mathematics teacher as a the key stakeholder in the curriculum implementation process is expected to guide the learner through activities that brings life to the broad themes of number and numeration, basic operations, measurement, practical and descriptive geometry, everyday statistics, and elements of computer operations.

In bringing out realities out of abstract mathematical concepts, the teachers may call to mind several cultural artefacts which can easily be blended into classroom instruction. The abacus is often used by elementary mathematics teachers in this respect. Other culturally relevant mathematical artefacts include ancient mathematical texts like the *Nine Chapters on the Mathematical Arts*, the Chinese counting board, and other indigenous games (Abah, 2016b).

Local games bearing mathematics significance such as the *I'tche* game are also reading available. Since the Internet, numerous communication processes, and advanced technologies such as smartphones are currently imbibed as innovations into the framework of culture (Sidjanski, 2010), the mathematics teacher can readily extract relevant mathematical relationships to enrich his everyday mathematics instruction.

3. THE OROKAM PEOPLE OF IDOMA LAND, NIGERIA:

Orokam is one of the three districts in Ogbadibo Local Government Area of Benue State, North Central Region, Nigeria. Orokam is a key ethnic group in Idoma Land with a unique variation of the Idoma mother tongue. Orokam shares boundaries with the Enugu State in the South, Kogi State in the West, Otukpa district in the North, and Owukpa district in the East. Orokam is made up of five (5) clans: Ai-Inam, Ai-Oko, Ai-Ona, Ai-Agbo-Oriko, and AiAkor (Amuta, 2013). Each has a number of kindreds and many villages and hamlets. The district headquarters of Orokam is Igwu which hosts the popular Nkwo-Orokam market.

The people of Orokam are pre-dominantly farmers, considering the fertile loamy soil of the district. Apart from arable farming, the Orokam people are known for taking good care of wild oil palm plantations, banana plantations, cashew plantations and mango plantations. Orokam is also among the few places where economic trees such as *Ogbono* (Irvingia gabonensis) and *Udara-cherry* (Chrysophyllum albidum) are found. Agricultural produce from the plantation are traded pre-historically in markets such as the Nkwo-Orokam and Afo-Adupi which hold every five (5) days, and recently, more modern store-styled daily markets located across all major towns of the districts. The people of Orokam are fast adopting modern technologies of palm oil processing and are leading the pack as a hub for palm produce distribution in Nigeria.

Settlements in Orokam are mainly off-shoots of traditional extended family households. The adults in each household participate in gainful economic activities to cater for their young ones, particularly in seeing their children through sound education. This practice contributes to the high literacy levels Orokam has come to be known for as evidenced from several recruitment statistics in Benue State and even across Nigeria. In recent times, other

employment opportunities outside faming and trading are popping up in the district given the rapid rate of urbanization.

Orokam is known for its rich traditions and enforcement cultural values. Despite the threat modernization, the people of Orokam are known for their honesty, generosity, and hardwork. Their lifestyle

is guided by the fear of *alekwu* (deified ancestors) who specify general code of conduct for every situation in pursuit of morality. The code of conduct are passed down the linage, as oral traditions communicated via poetry, bedtime stories , regular *eje-alekwu* ancestral festivals (Ogidi & Tondo, 2015), and extended family meetings. Adherence to good moral ethics is believed to bring abundant blessings such as rain and increased yield of farm and cash crops, while it is believed that wickedness incurs *alekwu's* wrath, ill-health, and gross loss of means of livelihood. This belief system is paving the way for the rapid spread of Christianity among the people.

4. MATHEMATICS-BASED CULTURAL PRACTICES OF THE OROKAM PEOPLE:

The traditional practices of the Orokam people permeate every sphere of their existence. The unique culture of the people holds a huge mathematical significance that is still largely untapped. From the traditional counting of objects to pre-historic measurement scales, farming and food processing to traditional games and plays, the searching mathematics educator can observe outstanding features which can serve as concrete support resources for classroom mathematics instruction delivery.

Essentially, counting skill is required for stock-taking and general classification of objects such as fruits,

tubers, trees, cultivated pieces of land, and farm animals. The counting system of the people is in base ten, yielding high tendency for manoeuvrability in a conventional classroom. Also, household objects are often crafted in diverse shapes similar to plane and solid shapes taught in school. For instance, a local seat called *eji* is carved out of the trunk of a sizeable tree by forming two circular bases, one being the flat surface connected by crisscrossing support to the second being the foothold. Also, traditional huts are roofed using grasses spread over a conic frame of bamboo sticks.

Orokam men are seasoned palm wine tappers who often recur to different quantitative measures in order to

market the product. Pre-historic measure using *och'a* (gourd) is still in use today. The *och'a* is a dried container made from the pods of the calabash tree (Crescentia aijete) and comes in different sizes approximating present-day two litres, four liters and even ten litres containers. Grains are measured in *ochubu* (basin) while fruits are measured in *ikpodo* (basket). The variations in the quantities carried by these traditional units of measurement can be built into several topics covered in the current mathematics curriculum. For instance, the number of items a unit measure can carry can be used in teaching and demonstrating fractions, thereby transforming the abstraction for fraction into factual and observable realities

Cultural practices in agriculture and food processing techniques among traditional Orokam families contain a lot of illustrations for the elementary mathematics teacher. Heaps (*ebe*) for planting yam seedlings are often cultivated and moulded as cones. It is believed that the bigger the cone (in height and circular base) the bigger the tubers of yam to be harvested per heap. The *okpaka* (climbing support) used in climbing very tall palm trees is formed from highly tensile palm fronds material tied in a sphere and knotted at the two points the axis of symmetry cuts the sphere. To climb the palm tree the farmer will unite one of the knots of the *okpaka*, wrap it round the rough trunk of the palm tree, and knot it back tightly with him in the sphere (almost embracing the tree). By leaning on the *okpaka*, placing both feet on the tree and lifting the second hemisphere up the tree with both hands, the gradual trip up the tree becomes an easy practice, albeit it a brave one. Other common tools of palm oil processing are the *okr'a* (a spherical hollow in the ground built by an array of hardened palm kernels) and the *oji* (cylindrical mortal carved out of the trunk of hard trees). Both *okr'a* and *oji* are used in crushing cooked palm fruits.

The abundance of games available to both children and adults for leisure also constitute mathematical snippets that can be used in conventional schools. The most predominant of these games are *oda* and the *I'tche*. The *oda* involves throwing and catching (grabbing) similar object such as *udara-cherry* seeds. The higher the number of seeds in a catch the better for the player who will have to pay his opponent based on pre-arranged rules and strategies. Odd and even number of seeds catches requires different repayment procedures. The *oda* is purely counting game and can aid the teaching of numeration at the basic education level.

The second game, *I'tche*, is more strategic and requires higher-order reasoning.

5. THE *I'TCHE* GAME:

The *I'tche* game of the Orokam people is the ancient mancala game, so common among the people that the term "*I'tche*s" in the Idoma language means "game". It is obviously the first game every Orokam child learnt to play since it can easily be replicated on the hard ground by digging little holes and filing them with the required number of stores.

The *I'tche* game has many name across Nigeria and much of Africa . The Yoruba people of southwest Nigeria calls it *ayo* while the Igbo people in southwest calls it *Okwe*. The Tiv people of Benue, Nigeria, calls it *ateratar dar*. OpenLearn Works (2016) provide series of name for the game such as *Moruba* (the pedi of South Africa), *kpo* (vai people of Sierra Leone and Liberia), *ajua* (luo in Kenya), *omweso* (Ganda of Uganda), *bao* (Swahili in East Africa), *gambatta* (Ethiopia), and *warri* (Ashante in Ghana). Basically, the variant of the mancala game played across Nigeria is a board game comprising of a two rows of six holes (2 by 6) containing four seeds (or stones) each. The board is usually carved on a rectangular wooden surface, but several artistic designs of the board exists, often depicting the status of the owner or group of players (O'Connell, n.d).

Figure 1: A typical *I'tche* (mancala) Board Game (*Source:* McGill School of Computer Science, 2007*)*

"*ogo*" while the seeds (*i'kpo)* are often gotten locally from tress that The Orokam people calls the holes produce sizeable hardened seeds. The *i'kpo* could be cowries, pebbles or real plant seeds obtained from the African nut tree (Ricinodendron heudelotii) and *I'tche* tress (Caesalpina crisa). The two store houses (*ole*) at the edge of the board are meant for players to keep their captured seeds. The *I'tche*s game is played by two players facing each other with the *I'tche*s board in-between them. The side with six holes in front of each player belongs to him.

The rules and strategies for *I'tche* are often stated openly for players and observers by the owner (or coordinator as the case may be) and varies from round to round as deemed fit by the owner (*ad-I'tche*), players and observers. The most popular of the pattern of seeding and capturing is the *re'epa* and *re'eta* (literally "eat two" and "eat three"). In this style of play, a player is required to move seeds from any hole, in his front sowing round (in anticlockwise direction) into the opponents side and capturing any hole his last seed ends in if such ending hole now contain two or three seeds. To clarify, a hypothetical game (see Figure 2) between two boys, Oche and Ondugbe, is explained next in the framework provided by Powell and Temple (2001).

Oche scoops up all the seeds from any one of the six holes on his side. Beginning with the next hole, he distributes or sows one seed in each successive hole counter-clockwise around the board until all those seeds have been sown. During the games, both Oche and Ondugbe may count the seeds in any hole visually but not deliberately, and observers are not allowed to suggest moves to any of the players. If in the course of play, Ondugbe has no seeds in his hole, Oche must, if possible, make a move that seeds the opponent for the sake of continuing the game. Refusing to do so may cause Oche to forfeit the game.

A harvest or capture occurs when, for example, Oche's last seed drops into one of Ondugbe's holes that contained one seed (making the hole's content two: *re'epa*) or two seeds (making the holes content three: *re'eta*). Oche harvests the contents of the hole and places the seeds in his store house (to his right). Oche can also harvest the content of the holes that contain two or three seeds and come immediately before the harvested hole, with no intervening holes that contain fewer than two or more than three seeds.

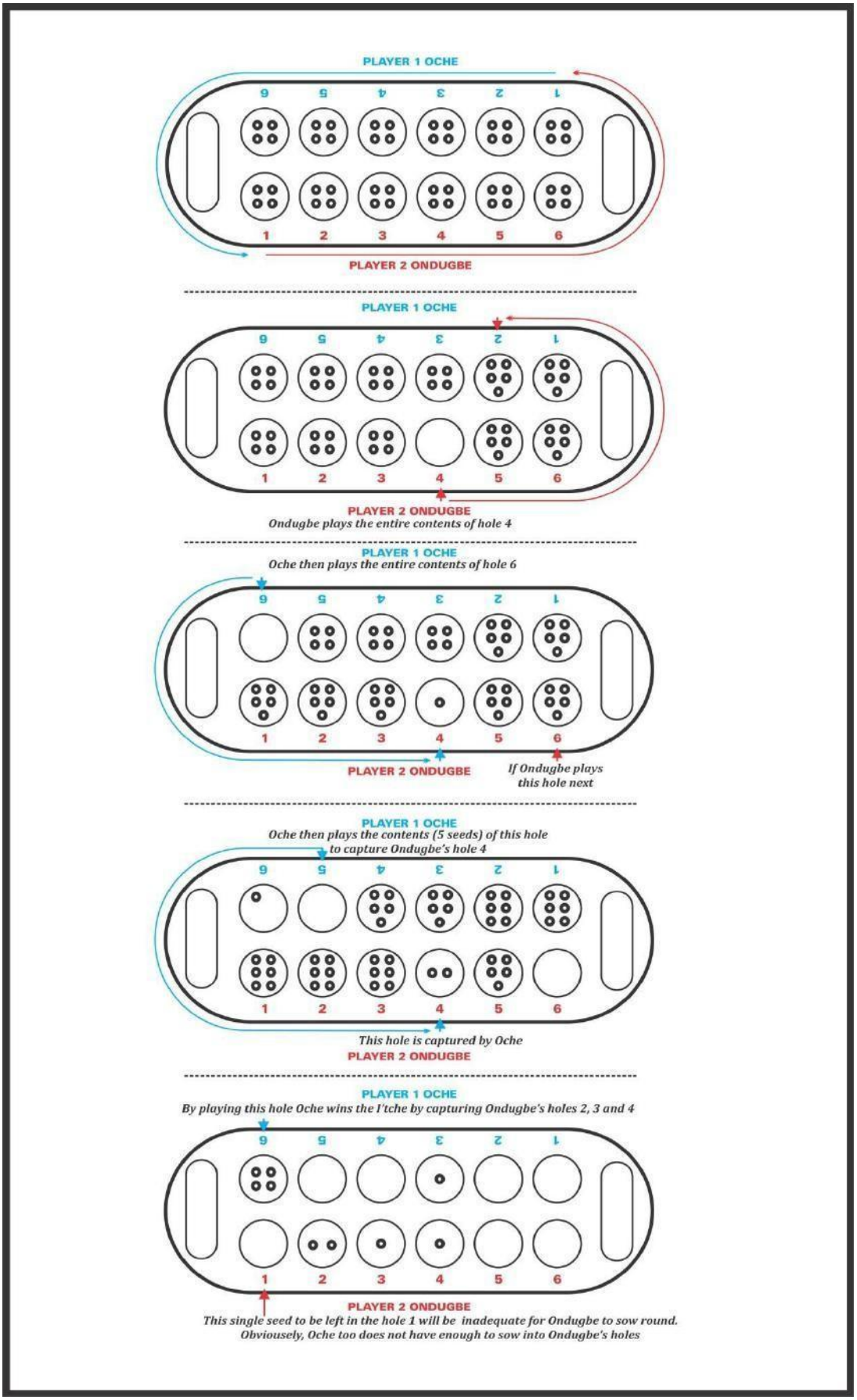

Figure 2: A Hypothetical *I'tche* Game between Oche and Ondugbe

The game ends when Ondugbe, for example, has no seeds left on his side of the *I'tche* board and it is not feasible for Oche to sow one or more seeds into Ondugbe's holes. The objective of the *I'tche* game is to

capture the largest number of seeds (at least 25). As Lowe (1988) observed, the game ends when there are only two, three or four seeds remaining on the board and these tend to circulate endlessly without the possibility of any capture. At this point a decision is reached in consultation with the *ad'I'tche* (an appointed referee) and observers for each player to add to his captured seeds those seeds which remain in his side of the board. The player who has captured the most seeds wins (*y'ale*) the game.

The following constraints apply throughout the *I'tche* game:

Constraint 1: The player move alternately; a toss of the coin could be used to decide who makes the first more.
Constraint 2: A player is denied capture if the capture, including the mandatory bonus capture, word completely empty his opponents home. The more is allowed but the capture is not.
Constraint 3: A more-hole must remain empty at the end of a more. This if the more-hole contained several seeds that the more resulted in a second cycle of seed sowing, then the more –hole must be passed over
(Lowe, 1988)
Constraint 4: It is not allowed to more the single seeds. A player cannot begin from a hole containing one seed. Single seeds can only be move, if the player has only single seeds left in his or her holes.(Awale, 2016).

The *I'tche* game has a built-in culture of both teams discussing and arguing strategy very openly before each crucial play. Tembo (2012) observed that laughter, friendly teasing, bunter, bluffing an opponent, baiting, and feigning victimhood to trick or lure opponents into over-confidence, are all part of the cultural game. Usually, after each game is over, the player will laugh, connect and reminisce about strategies.

6. EDUCATIONAL RELEVANCE OF THE *I'TCHE* GAME:

Present-day teaching methodology in mathematics hinges on mathematical proficiency. According to Kilpatrick and Findell (2011), the central strands of mathematical proficiency are conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and productive disposition. Consequently, the task of the mathematics teacher as a guide in the instructional process is to arrange experiences that will coherently build the strands of mathematical proficiency in the learner. This may entail the augmenting of instructional activities with mathematical objects and cultural artefacts that are relevant to the understanding of abstract concepts (Abah, 2016b). The *I'tche* game serves an enriching purpose as a cultural artefact if carefully engrafted into the pedagogy of mathematics, particularly at the basic education level.

In the *I'tche* game, one move pair is the combination of a player's 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 response. Given more time, they would have been able to use developed strategies consciously and at greater depth (Powell & Temple, 2001). With each improvement in move pair depth, children develop their problems-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 patterns in the configuration of seeds on the *I'tche* board, to recognize a threat or an opportunity to harvest. These critical skills and the *I'tche* process of arriving at them constitute very useful assets for pupils in elementary schools. They are naturally aided in intuitiveness and procedural fluency whenever the game is used to augment certain topics in mathematics.

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. Lowe (1988) recognized counting, clock-arithmetic and basic arithmetic operations as the core topics of mathematics the *I'tche* game stand to enhance. Tembo (2012) opined that the counting, piling up, and adding of stones strategically seems to mimic the use of exponentials. Also, considering the numerous possible moves that depend on many factors around *I'tche*, it can be asserted that the game has many elements of probabilities as well as conditional probability.

Although the *I'tche* game 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. Lowe (1988) suggested it could also be instructive to time the moves as this could indicate how fast the child is

counting and how much problem-solving skills pupils have acquired. To provide more opportunities for children to develop mathematical ideals, the teacher can ask pupils to reflectively write about their playing strategies. Such schemes of mathematics instruction motivate schools children to learn and add a reasonable measure of aesthetic value to the subject.

Traditional African values, such as sharing and saving face, are manifested in the rules of the game. The rules of play and harvest compel players to treat one another politely and with dignity (Powell & Temple, 2001). These values are at the core of Nigerian education system, and recently imperatives in the wake of the economic recession have been re-directed towards vital socio-cultural revival (Abah, 2016a). Integrating traditional games into mathematics methodologies dose not only enhance mathematical proficiency in children, but result in the psychosocial well- being of future generations.

Mathematics learnt this way helps an individual in his character formation in many ways. As Thomaskutty and George (2007) rightly highlighted, it develop in the individual a proper attitude, as there is no space for prejudiced feelings, biased outlook, discrimination and irrational thinking, and aids him in objective analysis, correct reasoning, valid conclusion and impartial judgment.

7. CONCLUSION:

It is factual that most schools at the basic education level in Nigeria may not be able to afford powerful computer games equipment to augment the teaching and learning of mathematics. Fortunately, turning to readily available games as instructional aids can concretize abstract mathematics concepts and procedures for learners. By introducing pupils to traditional games like the *I'tche*, the familiar and enjoyable experience may stimulate curiosity and interest in children to continue their mathematics learning and there by become useful members of the community. Concisely, this is the grand plan of the entire education process. This exposition has been able to unveil captivating opportunities for mathematics education professionals, particularly teachers of the subject at the basic education level, to design augmented pedagogies that incorporate local and culturally relevant games.

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