Ghana Journal of Education: Issues and Practices (GJE)
Vol. 7, December 2021, pp. 82 – 113

An Ethnomathematical Exploration of the Game of Ogiurrise – A Traditional Edo Game in Nigeria Schools

Festus Osadebamwen Idehen

Department of Curriculum and Instructional Technology, University of Benin

Email address: festus.idehen@uniben.edu

Abstract

Games are part of human culture, and indigenous games have been an expression of local people, culture, and social realities over a period of time. Games cannot only be viewed from the aesthetic perspective of play, enjoyment and recreation but also from that of promoting learning. Games can promote the learning of Mathematics in an interesting and entertaining way as well as provide room for interaction and lend informality to learning school Mathematics. Apart from showing the historical and cultural perspectives of indigenous games, analyses of games will reveal the related mathematical ideas/concepts, school Mathematics curriculum connections and educational implications. This paper is an ethnomathematics exploration of the game of Ogiurrise, an indigenous traditional game played by the Edos of the Mid-Western part of Nigeria. A brief description of the Rules of the Ogiurrise board game, the mathematical strategies that can be applied in playing the game and some related mathematical concepts are analysed and presented. The general classroom connections between the Ogiurrise board game and the conventional school Mathematics curriculum are discussed.

Key words: Ethnomathematics; Ogiurrise game; Mathematical Strategies; Mathematical Concepts.

Introduction

There are some mathematics in every activity of the student which have immediate root in the way of life of the people in the community in which he/she lives. This type of mathematics that can be inferred, for instance, from the traditional games and practices of the indigenous people is the focus of an ethnomathematics study. Ethnomathematics offers the possibility of the relationship that exists between the individual student and his social mathematics environment. Inherent in this view, according to D'Ambrosio (1988), is that individual conceptions of mathematical ideas or concepts develop out of the social interactions with his practices such as "counting, weighing, sorting, measuring and comparing" p.5. Furthermore, D'Ambrosio (2004), defined ethnomathematics as the mathematics of the identifiable cultural group, developed from quantitative ideas or even better mathematical practices of a different form. It reveals all mathematical practices of the day-to-day life of say preliterate cultures to the present and future generations to see how cultural and social factors shaped the different forms of doing mathematics or different practices of a mathematical nature or different mathematical cultural and traditional environment. This would support the art of explaining school mathematics in different contexts to the students so as to embrace mathematics as part of the culture and traditions of the people. This makes mathematics to be culture dependent and not value free as such. Bishop (1988, 1994) researched on the mathematical activities of indigenous people in Australia. He argued that, activities such as counting, measuring, locating, designing, playing and explaining are all present in some form in all cultures and these activities give rise to mathematics. That is, every culture does mathematics, although the mathematics is expressed in ways unique to that culture.

Generally, games are part of human culture, and indigenous games have been linked to the traditions of a cultural group. To Mosimege and Ismael (2004), indigenous games have been an "expression of a local people, culture and social realities over a period of time". Mosimege (2000) as cited in Mosimege and Ismael (2004), regards indigenous game as a culturally specific game and defined it as:

> *An activity in which one or more people may be involved, following a set of rules and the players engaged in this activity to arrive at certain outcomes. The outcomes may be the completion of a particular configuration, or the winning of a game. The importance of the game with it social and cultural implications would qualify this game to be a cultural game. Specific terminologies and languages used with different cultural groups further categorize this cultural game into a culturally specific game (p.31)*

According to Johnson and Rising (1972), games promote learning of mathematics in an interesting and entertaining way as well as providing room for interaction and lend informality to learning school mathematics. The traditional game can be an ideal device to involve the parent/guardian or community elders in out-of-class mathematics learning activities. The game can be sent home with the student to gain an informal setting where student and parents can work together at learning mathematics. According to Rogoff (2003) as cited in Cowan (2006), it aligns with the community - centred approach of learning, where children learn in an apprenticeship-type model by helping within the home or local community: learning from more knowledgeable others (peers, teachers, parents, elders) by enquiry, and at a pace and time that suit them. Therefore, ethnomathematics approach would promote open classroom teaching and learning of school mathematics through the use of indigenous games. These types of games are effective in lending variety and competition to classroom activities.

Ogiurrise is believed to be one of the oldest Traditional Sports that do serve for play, enjoyment and recreational purposes among different tribes in Africa. In Nigeria, there have been several attempts to go back to the tradition and try to understand the various cultural games. For example, as part of the process to revive the indigenous games in Nigeria, through the National Association of Traditional Sports (NATS), the Ogiurrise (Ayo) became a demonstration sport in Benue 1996, a scoring sport event at Imo 1998 producing two gold medals. At Bauchi 2000, it produced 3 gold medals (Afrotradosports, 2018). Often, schools organize Ayo competitions for pupils and students. Ayo and other traditional sports featured in the 2017 National Youth Games to help popularize and create awareness for the games (The Nation, 2017). Today, Ogiurrise (Ayo) is a fine and beautifully designed game that is part of the Nigerian culture (Taytronik, 2018). However, within the context of ethnomathematics research, the Ogiurrise and other indigenous games have not been identified and explored so as to know the mathematical and educational potentials of these games.

Review of Related Literature

One of the current challenges in mathematics education is how to link school mathematics to students' every day activities in order to improve the quality of students' educational experiences. Hence, Aboaye (2015) researched on understanding the mathematical practices of Kente weavers in Ghana. Drawing ideas from scholarship in ethnomathematics this study used ethnographic approaches to qualitative data collection to unravel the mathematical practices of the Kente Weavers. A diverse and purposeful sample of 15 Kente weavers and 5 mathematics teachers from Bonwire, Ashanti Region and Agotime, Volta Region were selected to represent a range of weavers as these helped to expose weaving patterns. The various stages and weaving patterns were observed to identify mathematical choices and reasoning they conveyed. It was followed by both informal and semi-structured interviews of the 15 Kente Weavers in the Kente industry. Series of meetings were organized for the 5 mathematics teachers in Bonwire to the potential classroom of the mathematical practices of the Kente weavers. The study placed emphasis on three of the Bishop's (1988) list for identifying mathematical practices in cultures- counting, measuring and designing as the data provided relatively little insight on the other three items on the list- locating, explaining and playing. Evidence of mathematical practices of the weavers indicated that irrespective of the mathematical experience of the weavers, they all employed a certain level of informal mathematics in counting, measuring and designing in the discharge of their duties as weavers. The study, however, noted that the level of mathematics employed in weaving a particular pattern depends on the complexity of the pattern.

Unodiaku (2013) conducted a study to ascertain the effect of Ethnomathematics teaching materials on students' achievement in mathematics. The study used native cylindrical Calabash cups to teach the concept of volume of cylinder and native Calabash plate for the volume of hemisphere. These Calabash cups and plates are found in the cultural practices and social activities of Igbo-Ekiti cultural group of South East zone of Nigeria, which are more prominent in their occupations and crafts particularly in their mode of measurements and counting system. The sample for the study was 156 senior secondary school two (SS2) students which were randomly selected from 16 Senior Secondary Schools in Igbo-Ekiti Local Government Area of Enugu state through multi-stage sampling technique. The instrument used for the study was Ethnomathematics Achievement Test, and the data were analyzed using mean and analysis of covariance(ANCOVA). Findings from the study showed that the Ethnomathematics Achievement test was effective in enhancing students' achievement in mensuration with particular reference to volumes of cylinder and hemisphere. Students who were taught using Ethnomathematics teaching materials achieved better results than their counterpart students taught with conventional method. It was recommended among others that Ethnomathematics teaching materials should be incorporated in the Senior Secondary School mathematics curriculum as technique to be used by teachers in teaching the concepts of volumes of cylinder and hemisphere. The finding of this study may be owing to the notion that the interaction of culture and mathematical ideas can be mutually reinforcing, as the application of local culture situations to the mathematics classroom represents a way of helping students see relevance of mathematics in their culture.

Davis (2016) investigated cultural influences on Ghanaian primary school pupils' conceptions in measurement and division of fractions. The study investigated how pupils' notions of measuring and sharing in out-of-school setting reflect their conceptions and practices in school. Two focus group interviews were carried out with 16 primary school pupils, eight each from grade 4 and grade 6 in two average achieving schools (one each from rural and urban schools) in Ghana. Qualitative analysis of pupils' activities on measuring and division of mixed/decimal fractions showed evidence of cultural influences on the participants' conceptions and practices in the measurement of capacity and division of a mixed/decimal fractions by whole number in the real-life situations. Findings from the study appear to confirm the local aspect of mathematical knowledge and recommend the need to help pupils to draw on and integrate every day and school mathematics teaching and learning situation.

Davis and Chaiklin (2015) reported on a study that drew on aspects of radical-local approach to teaching and learning, to teach the idea of measurement to primary four school children from an average achieving rural school in Cape Coast metropolis of Ghana. Four teaching sessions with each drawing on the social and cultural practices of the children to help them form an idea of what measurement is and which physical properties could be measured from given objects.

Qualitative analysis of the teaching sessions revealed that the teaching approach enabled children to change their notion of measurements as involving measuring tables, chairs and human beings and so on. The study supports the idea that a radical-local approach can be used to teach measurement meaningfully to pupils and has the potential to be used for mathematics teaching more generally.

Davis, Seah and Bishop (2009) observe that Mathematics is a subject that appears to be studied in school curriculum all over the world. However, while in some societies mathematical practices reflects the mathematics that is studied in schools, in other societies some of the mathematical practices in the society differ from those in schools. They did a study on students' transition between contexts of mathematical practices in Ghana. The paper reports on some of students' transition experiences in mathematics in Ghana, where some of the mathematical practices in the society differ from school. It also discussed the effect of some of these transition experiences on students' mathematical conceptions in factions, and their implications for mathematics pedagogy in multicultural societies such as Australia. The finding from their study showed that majority of the students were able to identify half in the out- of-school activity, perhaps due that fact it is the only unit that has local name. However, the results further revealed that students experienced fractions differently in in-school and out of school activities. The implications of these findings are that students who experience one set of mathematics is in everyday setting and another set of mathematics is in the school setting are likely to relate practical mathematics activities in school with their everyday mathematical experiences. They are also likely to experience concepts which differ between school and everyday context differently in classroom. Therefore, students bring their personal everyday mathematics knowledge to learning situations in school. It can be deduced from the findings and implications of this study that Ethnomathematics research can reveal cultural differences, which should not be ignored rather they could be utilized to help students who transit between contexts of mathematical practices in out-of-school and in-school settings.

Esuong and Ibok (2022) believed that pupils felt and saw mathematics as an abstract topic that was hard to master as a result of the westernized teaching methods used to teach it in schools and its attendant impacts on student comprehension. Esuong and Ibok therefore did a study to explore the various cultural practices of the Efik people of South South Nigeria that can assist the teaching and learning of mathematics. They listed and described the Ethnomathematics concepts that exist in Efik culture to include the following sub-topics: Numeration/Counting System, Basic Arithmetic Operations, Telling time/Days of the Week, Mathematical games, Rhymes and Geometric Concepts. The study described three mathematical games: The Nkpakana Game, The Nkonkor Game and The Nyeri Game. The Nkpakana Game is played by at least three children using plane bamboo sticks thrown gently on the floor. This game helps children to understand counting at very early stage. Its representations on the floor show the tally system of the frequency distribution table. The game also teaches probability and estimation as it has to do with chance and luck. The Nkonkor game is played among children of the same age bracket and up to about 3 persons. A long rectangular shape is drawn and divided into seven different rectangles each. The game teaches concepts of counting, rectangle and area of rectangles. The Nyeri game is played with seven seeds, one seed is used as a king for throw and caught. At each round of throwing, a certain number of seeds is picked from the remaining 6 on the floor. The Nyeri game can be used to teach counting and factors of 6. Thus, Ethnomathematics concepts and materials are richly embedded in Efik culture. The paper tried to reduce the Eurocentric mathematics beliefs of students and make them discover how best mathematics is learned from their cultural heritage. The paper recommended that teachers of mathematics should use examples of materials from the local environment to teach mathematics in order to improve students' understanding of the subject. Culturally based teaching of mathematics has shown to be a veritable option in classroom mathematics instruction.

Michael and Iyekekpolor (2013) had worked on the interplay of games and ethnomathematics by exposing some five indigenous games played in Taraba state, Nigeria, that could immensely be beneficial to Mathematics education in the primary and secondary levels. The games are the Ring (Rubber) game, Fehlo game, Buzz game, Brereng (Bamboo) game, and Ado game. These games could help the learner to think critically and logically on making moves to arrive at certain outcomes. These games have been translated into different local languages in Taraba State, Nigeria, but not nationally played. They concluded that the use of games in mathematics education has enjoined a considerable amount of empirical support as being helpful and useful in reducing students' phobia and increasing their enthusiasm for the study of mathematics.

Besides other studies reviewed in this paper, the Michael and Iyekekpolor, and Esuong and Ibok studies in Nigeria have brought eight games to the foreknowledge of other researchers but fell short of outlining the specific class where each of these games can be played and taught pupils or students. In particular, Michael and Iyekekpolor did not list the indigenous games related mathematical ideas or concepts. To fill these gaps and within the context of ethnomathematics, this paper seeks to examine and explore the mathematical and educational potentials of a national and culturally specific game, like the Ogiurrise. The traditional Edo Ogiurrise game is a culturally specific game that can be adapted for use in a mathematics class at any grade level.

The Edo Indigenous Traditional Ogiurrise Game

The Edos are indigenous in Edo State in the Mid-Western part of Nigeria. Benin City is the traditional headquarters of the Edos who are also referred to as the Binis. *Ogiurrise* is a traditional recreational Edo game played on a carved-wooden board or dug into flat hard surface on the ground. The board is handy and portable with twelve holes as the field of play having six holes on each side of the board. Alternatively, round holes can be dug into a flat hard surface on the ground – clean enough for participants and spectators to sit on. The objects of play are forty-eight (48) seeds with four (4) seeds distributed into each of the twelve (12) holes. Traditionally, the most commonly used type of seeds among the Edos are the cowries (Ikpigho), cherry fruit seeds (Ikpotien), or para-rubber plant seeds (Ikparaba).

The Ogiurrise is a traditional game that is very common among the Nigeria tribes. Among the Yorubas in Western Nigeria, the Ayo plant seeds are used – hence, they named the game Ayo (Agbalajobi, Cooper & Sonuga, 1976). The Ogiurrise board game is popular and also known in other parts of Africa, however, with different versions. According to Mosimege & Ismael (2004), it is a mancala type game called moruba in the Limpopo province of South Africa played on the 4x36 board – that is a board of 4 rows of 36 holes each. It is called

Tchadji, played at Uhade Mocambique, a small island in the Northern Mozambican province of Nampula. Tchadji is usually played on wooden boards which have four rows of eight holes each (4×8 rows) carved into them. “AWELE-The Rules” (n.d.) http://s.helan.free.fr/awele/rules/ describes this type of Ogiurrise game with the version being traditionally played by adults and used for competitions all over West Africa and the Caribbean and known by different names. Some of these names are: “Ayoayo (Yoruba-Nigeria), Awale (Ivory Coast), Our (Cape Verde), Warri (Antigua, Barbados), Adji-Boto (Ewes-Ghana & Surinam), Awele (Ga's-Ghana & Ivory Coast)”. The Ogiurrise is on 2×6 board.

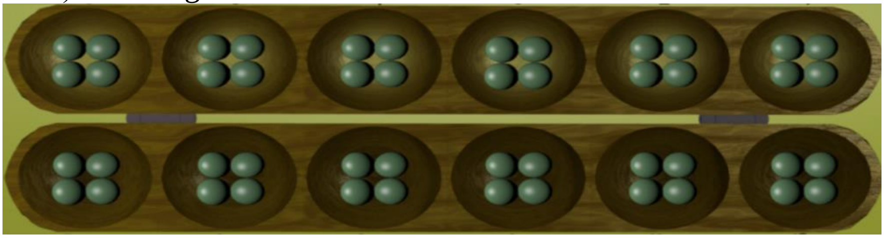


Figure 1*: A Simple Ogiurrise Board (Adapted from Taytronik, 2018)*

Theoretical Perspectives

This study is anchored on the constructivist theory that clearly identifies individual and social factors in the use of games to guide the conceptions of mathematical concepts held by each student. The constructivist theory includes aspects of Piagetian and Vygotskian learning theories, which states that knowledge is personally constructed but socially mediated. According to Trajkovick, Malinovski, Vasileva-Stojanovska and Vasileva (2018), in line with the concept of discovery learning, Piaget (1962) has developed a constructivist learning theory that places the learner at the centre of the educational process by promoting knowledge acquirement through active direct experience. That is, the acquired knowledge from playing traditional games, like the Ogiurrise, by each student guides his/her understanding of school mathematics concepts. Thus, learning is not viewed as transfer of knowledge from the teacher to the learner, but the student actively constructing or even creating his/her mathematical knowledge on the basis of the knowledge already acquired from playing traditional games. Though Vygotsky (1978) has shared Piaget's assumptions for the way children learn, he emphasized the importance of social interaction through the right use of games, simulations and problem solving in the classroom. Vygotsky, as cited in Cakir (2008), argued for the cultural basis of cognition - that is, there is a relationship between the individual and the society, because the individual's mind develops out of social interactions. Hence, in the constructivist Perspectives, school mathematics knowledge could actively be constructed by students through the interaction with the physical and social environments around playing traditional games.

Constructivist theory as proposed by Piaget and Vygotsky aligns with the ethnomathematics approach, that school mathematics should be taught using the already existing mathematical activities in the students' environment and in their own lives as an identifiable group. Teaching and learning school mathematics involves negotiation and reinterpretation of the mathematical knowledge which the learner draws from his cultural background and personal experiences in playing the Ogiurrise game. In this study, the Ogiurrise is explored as a Game Based Learning (GBL) from the culture of Edo people for Nigeria students to enhance learning activities using a game as an interesting medium that captures and retains student attention and interest in learning school mathematics. Therefore, connecting school mathematics teaching and learning to the rules and mathematical strategies that evolve from playing the Ogiurrise game, the GBL scenarios will engage learners in interactive and problem-solving situations that encourage critical thinking, communication, collaboration and adaptability for functional mathematical knowledge acquisition.

Methodology

The Ogiurrise game is popular and played by Edo people in Nigeria. In order to be able to explore the mathematical and educational potential of the indigenous Ogiurrise game, the study was based on the personal experience of the researcher having observed over the years the Ogiurrise game played in the social traditional setting as participant and non-participant. In playing the Ogiurrise game, the researcher analyzed the educational prospects as well as the mathematical concepts and topics which learning objectives can be achieved via learning based on the game. Since the Ogiurrise game involves a number of mental operations, the moves and strategies of playing the game were identified and analyzed. Thereafter, the rules of the game were outlined.

The Ogiurrise board has two rows and six columns. Therefore, a 2 × 6 matrix was assigned to the 12 holes in the fields of play. The rows were labelled 1and 2, and the columns as a, b, c, d, e, f (see figures 2, 3 and 4). To explain a player's moves and strategies, the game was played starting from each of hole a1, b1, c1, d1, e1 and f1. For each case, the number of seeds in each hole was recorded (see figure 4) in the two fields of play. Thereafter, possible number of seeds that can be won by Player A and Player B when Player A starts first were presented in Tables 1, 2, 3, 4, 5 and 6. From discussing the outcomes as presented in each table, conclusions were drawn based on the advantage/disadvantage of each strategy and moves to either Player A or Player B. Inferences were drawn on the Ogiurrise game-related mathematical ideas/concepts, and some preschool, primary school, and secondary School curriculum connections were outlined.

Rules of the Ogiurrise Game

The Ogiurrise game, among the Edos, is played by two players of same sex or different sexes. It is a recreational game played mostly in the evenings by elders, otherwise at any time of the day. Traditionally, it is a non-competitive game: winners are declared without prizes attached to it. The audience that could serve as spectators are members of the family, friends or acquaintances. They serve as referees, moderators or judges whenever dispute between players arises.

The following are the general rules of the game:

i. The Ogiurrise board is placed between two players who sit opposite to each other.

ii. The fields of play are of two territories (sides). The 6 holes on the side of each player form his/her territory.

iii. Four (4) seeds are arranged into each of the twelve (12) holes.

iv. Rules and regulations are determined and said to the players and the audience (if any). “The touch and play rule” apply while a player takes turn to play, whatever hole(s) he/she touches, he/she must start from there (whether to his/her advantage or disadvantage). The audience is warned never to suggest strategy or moves to any player so as not to influence the outcome of the game.

v. On mutual agreement, one player starts the game from any hole of choice from his/her territory. And moving anticlockwise, he/she sows the seeds dropping a seed in each consecutive hole and stops until he/she comes to an empty hole.

vi. As the game is played, the empty holes are refilled to get to 4 seeds in a hole for the hole to be captured.

vii. A player captures the 4 seeds in a refilled hole in any territory if he/she terminates his/her play in that hole.

viii. Otherwise, the 4 seeds in any refilled hole not captured belongs to the owner of the territory.

ix. Therefore, each player plans strategy to make moves and sow seeds into the empty holes in his/her territory to make up to 4 so that he wins the seeds in the hole or sow seeds to terminate his play in a hole that adds up to 4 seeds in his territory or that of his opponent.

x. Each player plays to win all the seeds in a refilled hole or thwarts his/her opponent's moves to win the seeds in holes in either territory of the field of play.

xi. Each player takes turn to play and collects won seeds until the last group of four seeds are won. Then, each player is asked to count the number of won seeds in his/her reservoir.

xii. The game can end as follows:

  i. In a win for the player who won more seeds.

  ii. In a draw, without counting the seed gained by each player, when the game is stalemated as no one player can out-manoeurvre the opponent to win the game.

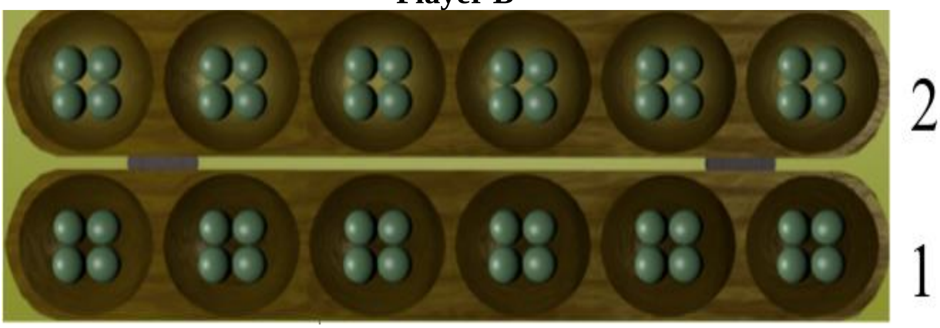
  iii. In a Technical Knock-Out (TKO) if all the seeds are in the territory of a player who takes turn to play and his opponent has no seed to play anymore. That is, the 6 holes in the opponent's territory are now empty of seeds. This opponent loses the game.

xiii. The game then enters another round of play, with each player spreading the seeds won into the holes. The player with more seeds can then capture holes from the opponent field of play. If a player wins 32 seeds for instance, he/she has 8 holes for his/her territory or field of play – capturing 2 holes from the opponent.

Mathematical Strategies

A sort of a matrix can be applied on the Oguirrise board to explain players’ strategies and moves.

Player B

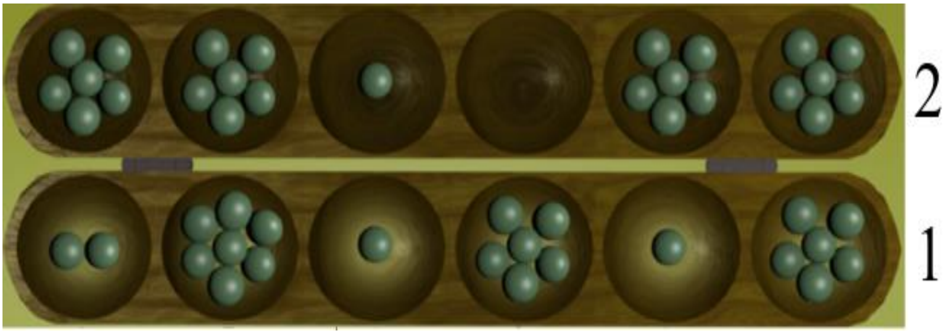


a b C d e f

Player A

Figure 2: *The Ogiurrise Board with Players A and B ready to start a game*

Starting the game of Ogiurrise with a hole of 4 seeds (Figure 2), player A has 6 starting moves (from a1, b1, c1, d1, e1, or f1); and player B has 6 starting moves also (from a2, b2, c2, d2, e2 or f2). For instance, player A starting from hole a1, he/she sows the seeds and spreads them to cover the 6 holes in his/her territory and 5 holes of the opponent’s territory (except hole d2) after making 26 moves which terminates in hole c1 (now an empty hole). This is illustrated in Figure 3.



A b C d e f

Figure 3*: The Spread of the Seeds after play by Player A starting from hole "****a1****"*

The 26 moves involve the following steps:

i. Removing the 4 seeds in hole a1, player A sows and spreads the 4 seeds dropping 1 seed each into holes b1, c1, d1 and e1.

ii. The seeds now in e1 adds up to 5, player A moves further sowing the seeds into 5 holes to terminate in c2 in the territory of the opponent.

iii. Hole c2 now holds 5 seeds and player A moves still further to c1 which now holds 6 seeds.

iv. Again, player A moves from c1 through to d2 now holding 6 seeds.

v. Player A then moves from d2 through to c1 (an empty hole) and drops his/her last seed. Player A stops playing and the opponent takes over play.

The opponent (player B) strategies to start from any hole (a2, b2, c2, e2 or f2) to make moves that will help him/her to capture 4 seeds preferably from the side of player A. Player B sows the seeds round until play terminates in an empty hole or in a hole with 3 seeds and dropping the last seed, to make it 4. The player wins these 4 seeds for keep in his/her reservoir.

The game of Ogiurrise to some extent is deterministic. After the starting of the game by player A, an experienced player B only needs to count seven (7) holes from whatever hole player A started to win 4 seeds in a hole in the territory of player B (the opponent). For instance, as player A starts from a1, player B takes his/her turn by starting from e2 to make 17 moves to end play in a1 and capture the 4 seeds in the opponent territory and thereby increasing the probability of the player B winning the game. This is illustrated in Figure 4.

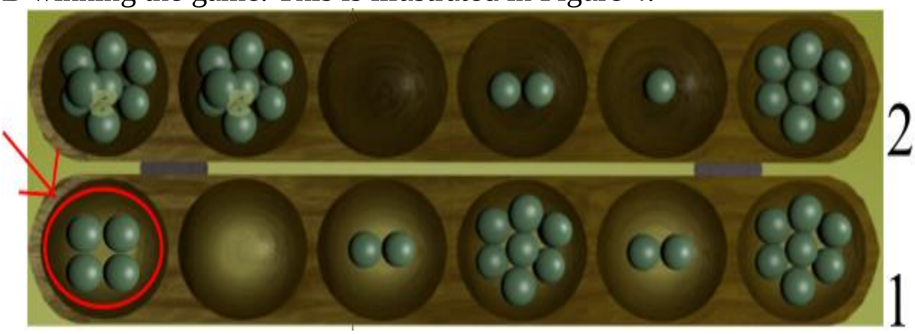


***Figure 4**: Player B Capture the 4 Seeds in hole a1.*

As it now comes to the turn of Player A (the second time), he/she plays working out strategies and moves to either dislodge the seeds in the holes in the territory of the opponent, so that each never adds up to 4 (where he cannot capture them), or play to capture the 4 seeds from any hole and also win those in his/her territory.

Tables 1, 2, 3, 4, 5 and 6 present the possible wins of players A and B when player A starts from a1, b1, c1, d1, e1, or f1. Player B's probable moves are from a2, b2, c2, d2, e2, or f2.

Table 1: Possible Number of Seeds that can be won by Player A and Player B with Player A starting from a1.

Player B Moves From	Position of Holes from a1	Player A wins	Player B wins	Advantage A/B
f2	6th	8	4	A
e2	7th	0	4	B
d2	8th	Nil	Nil	None
c2	9th	0	4	B
b2	10th	4	0	A
a2	11th	0	4	B

From Table 1, when Player A starts from a1, Player B has the advantage by moving from e2, c2 or a2 to win 4 seeds in each case. If Player B moves from f2, Player A has the advantage of winning 8 seeds with Player B winning 4 seeds. Therefore, Player B should not move from f2 or b2 so as not to give the advantage to Player A. Note that Player B cannot start from d2 because the hole has no seed.

Table 2: Possible Number of Seeds that can be won by Player A and Player B with Player A starting from b1.

Player B Moves From	Position of holes from b1	Player A wins	Player B wins	Advantage A/B
f2	5th	4	8	B
e2	6th	8	4	A
d2	7th	0	4	B
c2	8th	Nil	Nil	None
b2	9th	0	4	B
a2	10th	4	0	A

From Table 2, when Player A starts from b1, Player B has the advantage by moving from f2, d2 or b2 by winning 4 seeds over and above Player A in each case. If Player B moves from e2 or a2, Player A has the advantage of winning 4 seeds over and above Player B in either case. Player B cannot move from c2 because the hole has no seed.

Table 3: Possible Number of Seeds that can be won by Player A and Player B with Player A starting from c1.

Player B Moves From	Position of holes from c1	Player A wins	Player B wins	Advantage A/B
f2	4th	4	8	B
e2	5th	4	8	B
d2	6th	4	8	B
c2	7th	0	4	B
b2	8th	Nil	Nil	None
a2	9th	0	4	B

From Table 3, Player B has the advantage of countering Player A by starting from f2, e2 or d2 to win 8 seeds in each case while Player A wins 4 each. Player B playing from c2 or a2 gives him/her the advantage of winning 4 seeds each with Player A winning zero seed. Therefore, Player A can choose not to start from c1 in order not to give the advantage always to Player B, the opponent.

Table 4: Possible Number of Seeds that can be won by Player A and Player B with Player A starting from d1.

Player B Moves From	Position of holes from d1	Player A wins	Player B wins	Advantage A/B
f2	3rd	4	4	A/B
e2	4th	4	4	A/B
d2	5th	8	4	A
c2	6th	8	4	A
b21	7th	0	4	B
a2	8th	Nil	Nil	None

From Table 4, when Player A starts from d1, Player B has the advantage by starting from b2 to win 4 seeds and Player A winning no seed. Player B moving from f2 or e2, each Player wins 4 seeds. However, it is to the disadvantage of Player B to move from either d2 or c2 as Player A will in each case win 8 seeds, 4 seeds more than Player B.

Table 5: Possible Number of Seeds that can be won by Player A and Player B with Player A starting from e1.

Player B Moves From	Position of holes from e1	Player A wins	Player B wins	Advantage A/B
f2	2nd	8	4	A
e2	3rd	4	4	A/B
d2	4th	4	8	B
c2	5th	8	4	A
b2	6th	4	8	B
a2	7th	0	4	B

From Table 5, when Player A starts from e1, Player B has the advantage by moving from d2, b2 or a2 to win 4 seeds more than Player A in each of these cases. Both Players have equal advantage when Player B moves from e2, but Player A has the advantage when Player B moves from f2 or c2.

Table 6: Possible Number of Seeds that can be won by Player A and Player B with Player A starting from f1.

Player B Moves From	Position of holes from f1	Player A wins	Player B wins	Advantage A/B
f2	1st	Nil	Nil	None
e2	2nd	8	4	A
d2	3rd	4	4	A/B
c2	4th	4	8	B
b2	5th	8	4	A
a2	6th	4	8	B

From Table 6, when Player A starts from f1, Player B has the advantage by moving from c2 or a2; they have equal advantage by Player B moving from d2. However, Player B losses the advantage to Player A by moving from e2 or b2. Note that, if Player B starts from f2, he/she will terminate his/her play in b1, a hole with no seed earlier but now with 1 seed.

Going through the Table, Player A has more advantage in starting from f1 (Table 6), for whatever hole Player B takes or moves from, A wins at least 4 seeds. In this case, for Player B to have the advantage over A, B has to start his/her moves from either c2 or a2 to win 8 seeds each while A wins 4. It is all to the disadvantage of the first player (Player A, in this case), to start from c1, as the opponent (Player B) will always win 4 seeds more than the first player in each case (See Table 3). It is more to the disadvantage of a player to start the game first, for the experienced second player would strategise to make moves from the hole he/she has absolute advantage over the first player (the opponent). However, every player has the opportunity to counter the moves of his/her opponent as the game continues. From the analysis of the Tables, knowledge of the basic mathematics principle of counting helps a player to assess the cardinal or ordinal position of a hole to make moves or counter the moves of his/her opponent. Therefore, knowledge of the basic mathematics operations would help a player to win more seeds and win the game.

Ogiurrise Game and Related Mathematical Ideas/Concepts

The analysis of the Ogiurrise game reveals a number of mathematical concepts. The following mathematical concepts are found in the analysis of Ogiurrise game:

i. **Counting:** The twelve holes with 4 seeds each have 48 seeds altogether. This illustrates counting from 1 to 12, and from 1 to 48.

ii. **Number Base 4:** Each of the 12 holes has 4 seeds. This is groupings in 4 and counting in number base 4.

iii. **Addition:** Summing in 12 groups of 4, i.e., $4+4+4+4+4+4+4+4+4+4+4+4 = 48$. Also, counting the seeds won by each player at the end of a game teaches the concept of addition.

iv. **Multiplication:** Multiplying 12 groups by 4: i.e., $12\times4 = 48$.

v. **Subtraction and concept of zero (0):** A player starting from a hole means subtracting 4 from 4 thereby making the hole empty of seeds (i.e., $4-4=0$). This illustrates the principle of subtraction and the concept of zero (0).

vi. **Addition of integers:** Sowing 1 seed by a player into a hole with x seeds means addition of one (1) seed to each hole. That is, $(x+1)$ seeds always in a hole to be refilled, where x is a variable of integral values with $x = 0,1,2,3$. When the seeds in a hole add up to 4 they are captured by a player.

vii. **Equality:** 4 seeds in each hole teaches the concept of equality using groups of 4.

viii. **Division:** Sharing the field of play with 12 holes into 2 territories with 6 holes between the two players means dividing 12 by 2 (i.e., $12 \div 2 = 6$). Sharing the 48 into the 12 holes means dividing 48 by 12 to give 4 seeds in each hole (i.e., $48 \div 12 = 4$).

ix. **The concepts of greater than and lesser than:** The player with the more seeds wins the game, and that with the less seeds losses the game. This illustrates the concepts of greater than (>) and lesser than (<).

x. **Geometrical shapes and patterns:** The field of play in the board in each half has 6 hemispherical holes that are symmetrical. This illustrates geometrical shapes and patterns.

xi. **Cognition:** A player's ability to analyze and read a game by making the right moves and counter moves shows the level of his/her mathematical cognition. A player has knowledge of the specific facts of a game; comprehends a game by translating and interpreting his moves and counter-moves of his opponents; applies mathematical concepts and rules to establish relationship in his plan and judgment of the outcomes of the game.

xii. **Probability:** Playing Ogiurrise can be a game of chance and probability of the following events can be calculated:

- Prob (a win or a loss) = $\frac{1`}{2}$.
- Prob (starting from a hole) = $\frac{1`}{12}$
- Prob (picking a seed) = $\frac{1`}{48}$
- Prob (winning all seeds in a hole) = $\frac{1`}{12}$

Ogiurrise Game and School Mathematics Curriculum Connections

Ogiurrise is an excellent way to introduce pre-school and primary school pupils, and secondary school students to ethnomathematics in order to study the relationship between mathematics and culture.

Playing the Game

a. Divide the kids/pupils/students into two teams of 2 players for the activity. They can choose their partners based on the objectives of the lesson.

b. Teach teams how to play following the instructions below (Beyond the Chalkboard, n.d.):

i State the objective of the game- To capture as many seeds as possible and win the game.

ii How to sow seeds.

iii How to capture seeds.

iv How to end a game.

c. After each team has played once or twice, gather the children to talk about what they have discovered. Is it a hard or an easy game? Did anyone discover any strategies for playing well? Ask him/her to demonstrate such strategies.

d. Build on what they talked about by making it better. After playing a few times, teams can switch partners if they would like to play with someone else.

e. In higher classes, tables 1,2,3,4,5, and 6 can serve as Table of Problem-solving Matrix that is used to illustrate the possible number of seeds that can be won by Player A (Team A) and Player B (Team B).

f. The analysis of the Ogiurrise game will then reveal a number of mathematical concepts and relationships in the moves and strategies in playing the game.

Pre-school Curriculum Connections

Use a play based method to assign kids to individual roles in the game of Ogiurrise. By this method, children's interest in mathematics is aroused and learn mathematics concepts and principles while they play. A pre-school mathematics curriculum content is counting. The concept of addition, for example, can be taught and learnt by doing the following activities:

a. Counting the number of holes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12 holes.

b. Counting the number of holes in each half territory: 1, 2, 3, 4, 5, 6 holes.

c. Counting the number of seeds for each hole: 1, 2, 3, 4 seeds.

d. Counting the total number of seeds for playing the game: 1, 2, 3, . . . 46, 47, 48.

e. Counting the number of groupings in 4s: 1, 2, 3, . . . 10, 11, 12 groups.

f. Counting the number of seeds sowed into each hole.

g. Counting the number of seeds captured each time.

h. Counting the total number of seeds captured at the end of the game.

Primary School Curriculum Connections

Building on the pre-school content and experience, according to Learn Math with Games (n. d.), below are some curriculum connections that fits the games in Grade 1 (Primary 1) and Grade 3 (Primary 3).

Grade 1: Numbers

a. Count the number sequence 0 to 100 by:
   - i 1s forward (counting on) between any two given numbers, say 0 to 48.
   - ii 1s backward (counting down) from 20 to 0.
   - iii 2s forward from 0 to 20.
   - iv 4s forward from 0 to 48.
   - v 5s and 10s forward from 0 to 100.

b. Demonstrate an understanding of counting by:
   - i. Indicating that the last number said identifies "how many".
   - ii. Showing that any set has only one count.
   - iii. Using counting on (counting down) count seeds.
   - iv. Using equal parts or equal groups to count sets of seeds.

Grade 3: Numbers

Demonstrate an understanding of division (limited to division related to multiplication facts) by:

- i Representing and explaining division using equal sharing and equal groupings.
- ii Creating and solving problems in context that involve equal sharing and equal groupings, say in 4s.
- iii Modeling equal sharing and equal groupings, say in 4s, using concrete and visual representation, and recording the process symbolically.
- iv Relating division to repeated subtraction. For example, 48÷4 means subtracting 4 repeatedly until you get to 0 to give 12 as answer. Relate it to dividing 48 seeds by 4 to get 12 (i.e., 4 seeds each distributed into 12 holes sum up to 48).
- v Relating division to multiplication (i. e., $48 \div 4 = 12$ means $12 \times 4 = 48$).

Secondary School Curriculum Connections

At this level, students may have become masters of the game with tested strategies and relating them to learn basic concepts and solve some mathematical problem. For example, Ogiurrise game can support the teaching and learning of Numbers and Numeration process in the Junior Secondary School (say, JSS 1), according to Learn Math with Games, through Communication, Visualizing, Reasoning, Problem Solving, and, Mental Mathematics and Estimation.

a. **Communication:** Ogiurrise game offers students opportunity to learn or discuss mathematical ideas:

i Students may begin by speaking using their own vocabulary and the teacher or their peers can guide them towards the formal language and symbols of mathematics which represent ideas (e.g., placing more/less seeds is addition/ subtraction).

ii Students may need to communicate about concrete mathematical ideas happening within the game board, and also about the mathematical mental representations of potential moves.

b. **Visualizing:** Ogiurrise helps students to visualize their potential moves which requires them to know how many seeds would be in various holes if they distributed the seeds in a hole of the of their choice.

i. Students develop their visualization because it provides an excellent concrete example of counting, addition and subtraction. This will help students to develop their spatial sense and reasoning.

ii. The game of Ogiurrise has a strong connection with remainders - as students divide their seeds across the game board, they can calculate remainder to predict the placement of their last seed. When students can perceive these concrete ideas and transfer them into mental representation, they develop a deeper and more flexible understanding of the concepts of addition, subtraction and remainder.

c. **Reasoning:** During this game, students will gain experience analysing an unknown mathematical problem. That is, as students discover effective playing strategies, they will develop confidence as they can logically explain their reasoning and thereby defend their conclusions.

d. **Problem Solving:** Playing Ogiurrise game poses problems for students to solve as they observe, listen, experiment and discuss multiple methods/strategies to gain seeds and win the game.

e. **Mental Mathematics and Estimation:** Ogiurrise game offers students′ excellent opportunity to practise modular arithmetic. By mentally performing division of number of seeds they are sowing into the holes, students use the remainder to determine exactly where their last seed will land at the end of the turn relative to the starting hole. For example, if a student has 15 seeds in a hole, the remainder would be 2, and would mean the last seed lands 2 holes beyond their starting hole. In addition, at the secondary school level, Ogiurrise can be connected to the principle of developing mathematical formulae and rules and the concept of probability.

f. **Algebraic Rules:** In addition of integers, for example, $x + 1$ seeds are always in a hole to be refilled and captured, where x is a variable of integral values with x = 0, 1, 2, 3. Developing strategies and rules for problem solving to know possible number of seeds that can be won by a player with the opponent starting from a particular hole as presented in Tables 1, 2, 3, 4, 5 and 6. For example, from Table 1, player A starting from hole a1, player B (the opponent) starts playing from e2, c2, or a1 to win 4 seeds for player A not to win any seed. Tables of problem-solving matrix are prepared for players or teams to read and study and therefore take the most advantageous position (s) or moves to capture more seeds than the opponent and win the game.

g. **Probability:** Playing Ogiurrise game, though deterministic, could also be a game of chance and some statistical calculations are done to forecast and predict results of matches. The probability of following events can be calculated:

i Prob (a player or team starting the game) = $\frac{1`}{2}$

ii Prob (a player or team winning the game) = $\frac{1`}{2}$

iii Prob (a player or team starting from a hole) = $\frac{1`}{12}$

iv Prob (a player or team ending play in a hole) = $\frac{1`}{12}$

v Prob (a player or team capturing all seeds in a hole) = $\frac{1`}{12}$

vi Prob (picking a seed) = $\frac{1`}{48}$

vii Prob (winning the game) = Prob (losing the game) =$\frac{1`}{2}$

viii Prob (winning the game) + Prob (losing the game) = 1.

Discussion

The analysis of the Ogiurrise game has identified a number of mathematical concepts such as counting, addition, multiplication, subtraction, division, equality, probability, geometrical shapes and patterns, and the concepts of zero (0) and greater than/lesser than. Some of these align with the definition of D'Ambrosio (1988) of Ethnomathematics as the mathematics of the identifiable cultural group, derived from quantitative and qualitative practices such as counting, weighing, sorting, measuring and comparing. Identifiable cultural groups include group of people who share common and distinctive characteristics (e.g., code of conduct, behaviours, hopes, fears, language and culture) which are invented or evolved from activities as the needs arise. Such activities as counting, addition, multiplication, subtraction, division, etc, peculiar to playing Ogiurrise game can be translated into formal mathematics representations in the mathematics classroom. Ethnomathematics approach expects that when teaching mathematics to such groups, their characteristics in living, their way of doing things, reasoning etc should be reflected and taken into consideration. This will make what is taught to be meaningful and useful to them as well as being understood by them. The analysis of the Ogiurrise game also align with Bishop's (1988) idea of six mathematical activities of indigenous people. He argued that, activities such as counting, measuring, locating, designing, playing and explaining are all present in some form in all cultures and these activities are necessary and sufficient for the development of mathematical knowledge. Every culture does some mathematics, although the mathematics is expressed in ways unique to that culture, as in playing the Ogiurrise game among the Edo people of Nigeria.

Another point to discuss is the players' mathematical cognition which describes the ability of each player to analyze and read a game by making the right moves and counter moves. This is explained in a 2×6 matrix of two rows and six columns assigned to the 12 holes in the field of play of the Ogiurrise board. These are displayed in figures 2, 3 and 4, and in tables 1, 2, 3, 4, 5 and 6. They present the possible moves and wins of player A and B, and in addition outlining the advantages/disadvantages to either of the players. From the analysis of the figures and tables, knowledge of the concept of counting would help a player to assess the cardinal or ordinal position of a hole to make moves or counter the moves of the opponent. Therefore, knowledge of the basic mathematics operations (addition, subtraction, multiplication and division) would help a player to win more seeds and win the game. The tables can be compiled into a ready reckoner that can serve as reference material a player can study to prepare, strategize and play the Ogiurrise board game. The tables also can serve as a Table of Problem-Solving matrix for students that illustrate the possible number of seeds that can be won by Player A (Team A) and Player B (Team B). Using mathematical cognition, a player would have knowledge of the specific facts of the game, comprehends by translating the moves and counter moves of the opponent, applies mathematical concepts and rules to establish relationships in his plans/strategies and judgement of the outcomes of the game.

The analysis of the Ogiurrise game and school mathematics curriculum connections revealed a number of mathematical concepts and relationships in the moves and strategies in playing the games. Preschool curriculum contents are revealed in counting and addition of number of holes and seeds in the field of play. Primary school curriculum connections were demonstrated in counting of the number sequence 0 to 100, and in the understanding of the relationship between the basic operations of addition and multiplication, subtraction and division, and division to multiplication. These findings may align with that of Davis (2016) that pupils' activities on measuring and division of fractions showed evidence of cultural influences on their conceptions and practices in the measurement of capacity and division of fractions by a whole number in real life situations.

This study also revealed that the Ogiurrise game can support the teaching and learning of number and numeration process in the Junior Secondary School through communication, visualizing, reasoning, problem solving, mental mathematics, estimation and probability as students listen, observe, experiment, discuss mathematical ideas and multiple methods/strategies in making potential moves to gain seeds and win the game. These findings are supported by Esuong and Ibok (2022) paper that explored the various cultural practices of Efik people that can assist the teaching and learning of number and numeration, counting, basic arithmetic operations, probability and mathematical games. Some of these findings can infer support from the work of Aboaye (2015) on understanding the mathematical practices of Kente weavers in Ghana, that evidence of mathematical practices of weavers indicated that they all employed a certain level of informal mathematics in counting, measuring and designing in the discharge of their duties as weavers.

The findings of this study have confirmed that mathematics that was once regarded as culture and value free is no longer such: views about the nature of mathematical facts and practices being absolute have changed in recent times (Davis, Bishop & Seah, 2009; Unodiaku, 2013; Aboaye, 2015; Esuong & Ibok, 2022). The local aspect of mathematical knowledge used in playing the Ogiurrise game can help learners to draw on and integrate every day and school mathematics knowledge in teaching and learning situations. The Ogiurrise game is a veritable option to introduce preschool, primary school pupils and secondary school students to Ethnomathematics in order to study the relationship between mathematics and culture using out-of-school and in-school activities.

School Mathematics Curriculum and Educational Implications

There could be a connection between conventional mathematics and the use of ethnomathematical ideas in the classroom by exploring how Ogiurrise game that is associated with cultural values and practices can have a role in the mathematics education of present and future generations of our children. The use of Ogiurrise game to support the teaching and learning of some basic concepts in school mathematics has the following curriculum and educational implications:

- The indigenous game enhances the teaching of mathematics from different social context and shows that school mathematics curricular contents are culturally based.
- The game can be used to teach basic concepts in mathematics such as, counting, number base, addition, multiplication, subtraction, and division of integers.
- The game can promote creativity in students thereby helping them to fulfill their potential and be raised to the highest of their capability.
- The Ogiurrise game can promote the learning of mathematics in an interesting and entertaining way. The game can enhance the right attitudes towards mathematics learning by creating fun and enjoyment for the students.
- The Ogiurrise provides for interaction among learners with the two players and other students serving as audience to watch them play; it enhances cooperative learning of mathematics.
- Also, the game turns informality to learning school mathematics. Assignments and project work can be given to students to involve the parents/guardians/elders in the community in out-of-class learning activities in school mathematics. It supports Open Classroom teaching and learning of school mathematics.
- The game provides a variety of teaching methods to the teacher. It can promote demonstration to students rather than giving them instructions to follow. It can also promote cooperative and

activity-based learning as students count, do calculations, make and predict moves, visualize situations and recognize different mathematical patterns and relations while playing the game.

- Ogiurrise, as indigenous game, provides local and cultural alternative resource materials that can enhance the teaching of mathematics in Nigeria Schools.

Conclusion and Recommendations

There is a great potential to use Ogiurrise as an indigenous game in the mathematics classroom. An example of a game that provides a challenge combined with concept formation and reinforcements can be found in the traditional Ogiurrise game. The learning activities can be analysed (mathematized) to reveal a variety of mathematical concepts that are useful in school mathematics.

The mathematics teacher is to appropriately use his mathematical knowledge and teaching strategies to translate the students' knowledge of Ogiurrise game into meaningful mathematical explorations within the context of the students/teacher's social environment. School mathematics curriculum should therefore include indigenous games (like Ogiurrise) as content and resource material to enhance the teaching and learning of mathematics.

References

Aboaye, S. (2015). Understanding the mathematical practices of Kente weavers in Ghana. A dissertation submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy in the Graduate Academic Unit of Education, University of New Brunswick.

Afrotradosports (2018). *Ayo facilities at national sports festival in Nigeria.* Retrieved on March 21, 2020 from: https://afrotradosports.com

Agbalajobi, F.B., Cooper, R.L. & Sonuga, J.O. (1976). Investigation into the use of the African board game, Ayo, in the study of human problem solving. In J. Cea (ed), *Optimization technique modeling and optimization in the service of man, part 1.* Retrieved on February 9, 2020 from: https://www.springer.com/gp/book/9783540076223

AWELE-The Rules (n.d.). Retrieved from: http://s.helan.free.fr/awele/rules/

Beyond The Chalkboard (n. d.). *One Africa, many countries.* Retrieved on March 23, 2021 from: https://www.beyondthechalkboard.org/activity/one-africa-many-countries-ayo/

Bishop, A. J. (1994). Cultural conflicts in mathematics education: Developing a research agenda. *For the Leadership of Mathematics,* 14 (2), 15 - 18.

Bishop, A.J. (1988) *Mathematical enculturation: A cultural perspective on mathematics education.* Dordrect : Kluwer Academic Publisher.

Cowan, P. (2006). *Teaching mathematics: a handbook for primary and secondary school teachers.* London: Routledge.

D' Ambrosio, U. (2004). Preface: Ethnomathematics and Mathematics Education. In F. Faville (ed), *proceedings of the 10th international congress of mathematics education,* Copenhagen, Pisa; Tipografia Edditroce Pisana. V-x. Retrieved on January 24, 2020 from: http://people.dm.unipi.it/favilli/Ethnomathematics_Proceedings_ICME10.pdf

D'Ambrosio, U. (1988). Ethnomathematics: A Research Program in the History of Ideas and in Cognition. *International Study Group on Ethnomathematics, Newsletter* 4(1), 2-6, Oct.

Davis, E. K. (2016). Cultural influences on Ghanaian primary school pupils' conceptions in measurement and division of mixed fractions. *African Journal of Educational Studies in Mathematics and Science, 11, 1-18.*

Davis, E. K. & Chaiklin, S. (2015). A radical- local approach to bringing cultural practices into mathematics teaching in Ghanaian primary schools, exemplified in the case of measurement. *African Journal of Educational Studies Studies in Mathematics and Science, 11, 1-14.*

Davis, E. K., Bishop, A. J. & Seah, W. T. (2009). Gaps between in-school and out-of-school mathematics in Ghana. *Mathematical Connections,* 8, 1-15.

Davis, E. K., Seah, W. T. & Bishop, A. J. (2009). Students' transition between contexts of mathematical practices in Ghana. In D. Martin, T. Fitzpatrick, R. Hunting, D. Itter, C. Lenard, T. Mills & L. Milne (Eds.), *Mathematics of Prime Importance,* Melbourne: Mathematics Association of Victoria, 62-71.

Esuong, U. U. & Ibok, E. O. (2022). Expository narrative of the ethnomathematics concepts in that in the Efik cultural heritage: implication for teaching and learning mathematics. In Adebola S. Ifamiyuwa, *Stem education and 21st century skills,* 62nd annual proceedings of the Science Teachers Association of Nigeria (STAN), 151-158.

Johnson, D. A. & Rising, G.R. (1972). *Guidelines for teaching mathematics*. Belmont: Wadsworth Publishing Company Inc. Retrieved on October 10, 2019 from: https://www.amazon.com/Guidelines-teaching-mathematics-Donovan-Johnson/do/0534001890

Learn Math With Games (n. d.). *Resources for educators and families.* Retrieved on March 27, 2021 from: http://www.learnmathwithgames.com

Michael, A. & Iyekekpolor, S. A. O. (2013). Exposition of selected indigenous mathematical games in Taraba State of Nigeria: implication on ethnomathematics for national development. In J. S. Sadiku (ed), *proceedings of September 2013 annual conference of Mathematical Association of Nigeria (MAN),* 479-488.

Mosimege, M. & Ismael, A. (2004). Ethnomathematical studies on indigenous games: examples from Southern Africa. In F. Faville (ed), *proceedings of the 10th international congress of mathematics education,* Copenhagen, Pisa; Tipografia Edditroce Pisana. 119-137. Retrieved on January 24, 2020 from: http://people.dm.unipi.it/favilli/Ethnomathematics_Proceedings_ICME10.pdf

Piaget, J. (1962). *Play, dreams and imitation in Childhood.* Norton: New York.

Taytronik (2018). *Ayo: The Most Popular Local Game in Nigeria.* Retrieved on October 9, 2020 from: www.taytronik.com.

The Nation (2017). *Traditional Sports to Feature in 2017 National Youth Games.* Retrieved on March 21, 2020 from: https://thenationonlineng.net/traditional-sports-to-feature-in-2017-national-youth-games/

Trajkovik, V., Malinovski T., Vsileva-Stojanovska, T. & Vasileva, M. (2018*). Traditional games in elementary school: relationships of student's personality traits, motivation and experience with* *learning outcomes.* PLoS ONE 13(8): e0202172. Doi: 10.1371/journal.pone.0202172

Unodiaku, S. S. (2013). Effect of ethnomathematics teaching materials on students' achievement in mathematics in Enugu state. *Journal of Education and Practice,* 4 (23), 70 - 77.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.