

## **Hausa Riddles and Games Pertinent To the Development of Mathematical Thinking: A Reconstruction Focus**

**Dr. Garba Shuaibu**

*Department Of Science And Techology Education, Bayero University, Kano-Nigeria*

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**Abstract:** *The paper examines Hausa riddles and games pertinent for the development of Mathematical thinking as a reconstruction focus. The paper reviewed literature relevant to the topic and the writer interviewed students, lecturers and other members of the society in kano to gather some examples of Hausa riddles and games. The findings revealed that there are so many numbers of Hausa riddles and games very relevant to the development of mathematical thinking which mathematics teachers and students could use to improve mathematics teaching and learning at the same time can be used for recreational activities and psychological tension release. The paper conclude and recommends that: (1) Mathematics teachers should find out more examples of Hausa riddles and games and blend them during their teaching in order to help their students understand mathematics better. (2) Students being mathematics learners closer to community have armful opportunity to know many examples of the riddles and games the challenge and motivation to them is to put more efforts to see how they can relate them to school mathematics learning. (3) It is equally important to mathematics teachers to examine and develop solution methods of any riddle or game.*

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### **I. Introduction**

Many mathematical ideas and activities in Africa and Hausa cultures in particular are not explicitly mathematical. They are often inter-wined with art, craft, riddles, games, puzzle, jokes, graphic system, Folklores and other traditions. The mathematics is often hidden (Gardes, 1985). Some traditions are nowadays becoming interested in uncovering this hidden knowledge as a means of tentative reconstruction of knowledge as it existed in the past. For instance, in analyzing any tradition work or activity like baskets, chair, houses, clothes, fish traps, GidanDara, Yardalle hole, carafke, dalrarkulle, kurciya and so on, it will easily occur in one's mind that why do these activities or materials possess the form or shape they have? The form or pattern usually represents many mathematical practical advantages and offer optimal solution of a production or task problem. In some work or activities knowledge of about the properties and relations of circles, angles, square, symmetry as well as calculation, imagination, visual discrimination, figuring, higher order thinking and so on were involved in the activities or works techniques. Unfortunate Eshiwani (1979) observed that the contents, goals and method of mathematics education are not sufficiently adopted to the cultures and need of African people, Hausa inclusive. To this backdrop, there is a need to multiculturalize the mathematics curriculum in order to improve its quality, to argue the cultural confidence of all learners and arrest any racial and cultural bias and stigma.

### **II. Mathematics and Mathematical Thinking**

Mathematics as a subject is a science to do with computation, measurement and problem solving to which everyone require its use in one way or another. People have to count money, measures of grains, "Mangala" of sand or manures and other things as well as determine prices, time, areas, volume, number of rides, costs and number of "Awrad" made. However, the challenge is that mathematics achievement has been incessantly below expected standards relative to other subjects (NECO, 2010) reports. This has been accelerated by the fact that ordinary people fail to see the everyday application of school mathematics rather, they perceive it as something abstract and cold (Bansilal, James and Naidoo, 2010).

There exist a need for strategies and efforts to be made to help uplift the standard or image of mathematics through reconstructing and mapping school mathematics with everyday life so as to help mathematics concept-formation, develop mathematical thinking and drive away the fear of the subjects among students. Need for the development of mathematical thinking is the necessary and sufficient condition.

Mathematical thinking is one of the major aims of school mathematics and not merely to transmit mathematical knowledge to them. If developing mathematical thinking is one of the aims of mathematics education. It is pertinent to have an understanding of the nature and processes that are involved in mathematical thought.

The core of this end is an understanding on what learners are doing when they are doing mathematics. This involved ideas from educators, psychologists, philosophies, social culturists and historians of mathematics as well as mathematicians themselves on the nature of their work. Stanbird and Burgiel (2007) describe inductive, deductive and algorithm as the nature and process of mathematical thinking. Other scholars sees the

nature and process of mathematical thinking as converge and divergent thinking, open-minded, instinctive mind, in born inclination, logical thinking, analytic thinking, geometric mind and so on.

A clear understanding of mathematical thinking may be source out from brain activity that has two identifying features such as a huge store of experiences and simultaneous activity at one hand and a small focus of attention. But in order to minimize the cognitive stress two activities take place the compression of knowledge appropriate for the small focus of attention. The second is the construction of linkages to other mental warehouse to make it easy and quick for use.

Fortunately, mathematics is compressible subject because one can work step by step through some process or idea from several approaches. But once you understand it and have the mental capacity to see or fantasize it as a whole there is often a lot of mental compression in this regard. One can file it away recall it quickly and completely when he require it and use it as just a step into some other mental process. The insight that goes with these compressions is one of the real joys of mathematics refers to as the joy of thinking by Starbird and Burger (2007).

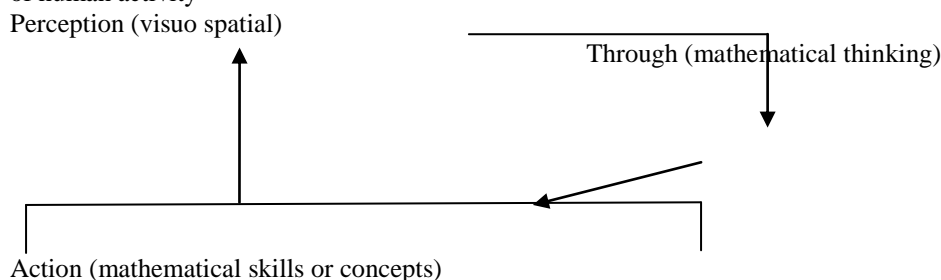
This is because mathematics seem to endow one with something like a new sense that arise from, puzzle, jokes, games, riddles, folklores, artworks, buildings, geometric objects, customs and superstitions, observation of everyday life and habits of curiosity and fantasy (imagination). The development of this new or uncommon sense among students should be the work of education as according to Ridgway (2000). This means mathematics educators should recognize that thinking in mathematics lead not only to insight and understanding about our everyday lives and everyday world but also pinpoint to us toward far beyond our own.

To this end Schwenfield (1992) sees mathematical thinking as the development of mathematical point of view by valuing the process of mathematization and abstraction and having the predilection to apply them and the development of competence with the tools of the trade and using those tools in the service of the goal of understanding structure.

This means that mathematical thinking is applying mathematical concepts, process and techniques either explicitly or implicitly in the solution of problem(s). In other word mathematical thinking has to do with learning to recognize, understand the mathematical language, concept, procedures and tools effectively and accurately, efficiently communicate, represent quality mathematical relationship that may arise in everyday situations, events, development and experiences.

For instances, Abdu wants to cover 5 meters by 7 meters office floor with ceramic tiles. The cost of using 20cm square tiles is N1000. What will be the cost for filling the floor? What tools or strategies could you use to help complete this exercise?

Problem or exercise of this kind stimulate mathematical thinking among students rather than rote learning and what Daines (1986) regarded as recall of facts. Therefore, mathematical thinking as a process of performing mathematics is a very complex and useful process. It start with inspiration, motivation or perception of something say an object in our everyday life in a visual (imaginative or fantasy) spatial form. When this object is analysed through the guidance of previewing students experience or strong imagination as a result of transfer of knowledge or build on idea the process develop into a systematic verbal formation of the object or concept. The diagram below represents the mathematical thinking episode in accordance with three component of human activity



The diagram above is telling us that mathematical activities entails perceiving or inspiring or motivation on (visuo-spatial) objects, thinking (conception) about these objects and performing action (process) on them. This means that any mental effort or action on an object or statement in order to get answer or solution to a problem is mathematical thinking. Since in so doing one has to look at the object or statement with intent of perceiving it then think on it before embarking on any effort or action.

Although, mathematical thinking is a very abstract term more abstract than mathematics. It is refers in this discussion as the ability to perceive a mathematical activity, to think about it, abstract such experiencing or ideas and appropriately perform certain action or effort on it. The development of this action may lead to another mathematical activity. This contends that mathematical thinking is an on-going or a cyclic process.

### **Reconstruction in Mathematics Classroom**

At a certain stage in teaching mathematics the teacher reasonably ask students to write "four hundred and twenty seven" as a number, some children would write 40027 or 4027 or 400207 and many other answers offered by the children; whereas most children would correctly write it as 427, but the incorrect responses, however would require remediation through conceptual teaching of the topic. That is to say the learners must be taught through mental activity (Putman & Borko, 1997). More so, learners understand more about learning of mathematics, if they knew more about the function of the brain as a process of information as mentioned earlier. That is, brain receives information, interprets it, stores it, transforms it, associates it with other information to create (reconstruct) new information and allows information to be recalled. This indicates how logical thinking became acquired or learned. The ability to think logically in mathematic is a transferrable or reconstructable skill and can be put into practice outside school mathematics.

This assumption has been championed by Schulman (1970) transfer of learning and by extending the psychologists and learning theorists' views on what they called broad transfer of ideas and strategies within a discipline and outside. For instance, mastering the idea of balance and a physical property using weight scales, can be transferred, reconstructed and applied to the solution of linear equation, studies of balance in economics and in day-to-day life.

Furthermore learning mathematics is not just about acquiring, mastering computational and problem solving techniques or solely about understanding definitions, arguments and proofs. It is also about reconstructing the thinking or work of other mathematicians (Heather, 2003) and what existed in the past hidden. Kahn (2001) agrees that learning mathematics requires the learner to develop ways of thinking mathematically. John (1998) has a perception that mathematics is an effective tool for analysing, examining and verifying truth. Generally, James (1982) opined that human life remain incomplete without mathematics.

This demonstrate that every culture has its own mathematics and quite adequate for its own needs. What is pertinent is the processing and technique used in the development of this mathematics. Every culture use its own techniques to develop their mathematics and procedures, referred to as in the modern concept as ethno mathematics. In order to understand mathematics and have effective mathematical thinking ability, it is mandatory to reconstruct our teaching of mathematics in line with cultural equivalence of the learners.

The goals of this reconstruction approach are to help students to develop intellectual, aesthetic or practical interest, setting up an environment which would lead to deeper understanding of mathematics and mathematical thinking in particular. For reconstructing approach of experiences yield results must take the form of actual living and doing. Consequently, schools must transform into a place where students go, not once to acquire knowledge, but to carry on a way of life. Hence the school is to be regarded as an ideal community where the students practice and apply their traditional cultures as they may arise in school activities. However, this involved important and intellectual drill, skill developments, events, jokes, riddles, puzzles, games and so on it is in this response to the conduction of school mathematics today and the writer adopted the ideas of Bode (1933), Counts (1932) and Cremin (1977) who proposed that school should create a new social order through a structuring of education. This is using community cultures, knowledge, experiences and values to construct the alternative form of those aspects for schools curriculum purposes and uses.

For instances, community photo collections and their context represent a very rich set of information about our world and practical mathematics problems such as experience which is extremely usually compelling giving as the ability to walk around in a photo realistic 3-D version of the scenes. There are also the tendencies of reconstructing useful geometric and semantic structure from the clouds of photos like the vision algorithm and visualization strength. The reconstruction of photo would help the camera men to answer many questions such as; where was a given photo taken? What parts of the scene was it looking at? Do the two or more photos overlap?

### **Riddles and Games**

A riddle is a statement, question or phrase that has a double meaning. A riddle can also be described as a puzzle to be solved. When someone uses a riddle, it can be a thought provoking challenge to figure it out on your own, or it can be funny comment that makes you laugh. Riddle can be a question with a quick answer. They can be just a sentence that makes you have a sudden realization. Usually, riddles can be great brain busters or conversation starts to get you think. In a simple riddle, the answer can be right before hand and even in the riddle itself. Riddle can be hard or difficult to comprehend, it answer depends on how much you open your mind to the possibilities. Some examples of riddles are:

1. Three eyes have I, all in a row, when the red one opens, all freeze. The answer is traffic light.
2. What falls, but does not break, and what break but does not fall? Night falls and day breaks.
3. A silly man who drags his intestines (answer: a needle and thread).

In essence the riddles involve the interplay and comparison of two unlike things in which a problem is set and the solution is obtained. Riddle then served two intrinsic roles, the figurative mode and lateral mode that is

reality and fantasy which in turn metaphor can be found. The images in metaphor by their nature evoke emotion, the dynamics of metaphor trap those emotion in the images and meaning is caught up in the activity. These generate some useful mathematical components such as problem solving skills, comparison and intellectual activity, poetic activity, visual memory, metaphorical transformation and many others.

Furthermore, games are as an activity engaged in for diversion or amusement. It is also seen as a procedure or strategy for gaining an end. It can also be regarded as a physical or mental competition conducted according to values with the participant in direct opposition to each other. In this vain any activity undertaken or regarded as a contest involving rivalry, strategy or struggle or calculated strategy is seen as game. This agrees this Kette and Eric (2007) who opined that a game is a system in which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome. In addition, David (1988) sees game as a form of recreation constituted by a set of rules that specify an object to be attained and the permissible means of attaining it.

Games are many some of them are; football game, racket, swimming competition, charades, jigsaw, puzzle, jumping rope, tic-tac-toe, gala-gala, malannabakinkogi and so on.

Moreover, a research study conducted on the positive benefit of video game by Allaire and Mclenglin (2012) found that the habitual video game group performed significantly better on test of visual attention, spatial ability and visual short term memory skills compared to the non-video gaming under graduate group. Although the negative effects of the video gaming on is higher than the positive benefit. But the point to be drawn from the above is this, game not video game served a lot of purposes among them are the development of visual attention span, spatial ability, visual short term memory skills, reasoning skills, logical thinking, chance and probability factor, problem solving skill, competition ability, develop social identifiers and organization, complex verbal negotiation, disputes and conflict resolution and so on.

In general, riddles and games were used to demonstrate wisdom, logical thinking, ice-braking, to motivate listeners and readers as well as allowed the writers or speakers to successfully get their message across in a more internship way. More importantly riddles and games can served **as means of continuous reconstruction of experiences.**

**Hausa Riddles and games as Mathematical Thinking Ability Reconstruction Focus**

There are more than 250 ethnic groups in the present day Nigeria. The largest and most dominants ones are the Hausa, Yoruba and Igbo. Other minor ethnic groups are the Fulani, Kanuri, Ijaw, Ibibio, Baburr, Tiv, Idoma, KareKare, and so on. Geographically, the Niger and Benue Rivers come together and form a "Y" shape that splits Nigeria into three separate sections fortunately this "Y" shapes marks the boundaries of the three major ethnic groups with the Hausa in the North, the Yoruba in the South-West and the Igbo in the South-East.

In this discussion Hausa riddles and games are going to be examined traditionally and as a venous way of learning mathematics and developing mathematical thinking ability. Although largest percent of the Hausa population are found in Northern Nigeria and South-Eastern Nigeria, a significant number is found in Sudan, Cameroon, Ghana, Cot deivoir, Gabon, Central Africa and Chad. Hausa people spoke Hausa Language. Their main occupations are agriculture, trading, blacksmithing, weaving, wood work, dyeing, tanning, metal works, Islamic teaching and learning. It is pertinent to note from the above traits that Hausa people must have some traditional mathematical thinking ability to carry out those activities very well.

The organized nature of the tribe, in terms of traditional administration (Sarki, maiUngwa) scholarship and commercial excellence they are included into the National Curriculum as a compulsory subject in primary and secondary school (Waziri, 2010). Therefore, Hausa riddles and games area among the traditional way of learning mathematics within the culture. As earlier mentioned, Hausa riddles and games are very important to the development of mathematization. The primary aims of them are to develop logical thinking skill, cognitive functioning, verbal fluency, entertainment and recreational activities as well as for the purpose of developing "mutunmailissafi or reasonable person".

There are many Hausa riddles and games relevant to mathematics educational in general and pertinent to the development of mathematical thinking ability in particular among them are:

Table 1: Hausa Riddles and Games Related to the Mathematical Concepts

S/N	Hausa Riddles and games	Mathematical concept
1.	Uku, Uku game gari (murhu)	Counting number bases, quantity, etc
2.	Dakin saurayi BabuKofa (Kwai)	Geometry, construction, etc
3.	Rawanin Sarkiyafaskarinadawa (hanya)	Linear, distance, weight, quantity, problem solving, etc.
4.	Kasuwa tacit a karetabarkarekala (harshe)	Limit, function, proportion, set, logic, etc.
5.	Hikayarmutum da kare da kaza and dawazasutsallakekogi a kankwalekwalemaiyadaukarabugudadayatak das hi mutimin. Yayazaitallake das u daya da daya.	Logic, arithmetic operation, problem solving, diagram, probability, etc.

6.	Wawanmutummai hudacikinsa (Allura da Zara)	Estimate, logical reasoning, observation, visual memory, geometry, function, etc.
7.	Wacce da bacemaitafiya da kafahudu da safe, kafabiyu da rana, kafauku da yamma (Mutum)	Logic, visual memory, sequence and series, chance and possibility, geometry structure, vision algorithm, quantity, day and night, variation, limit and function,, motion, momentum, etc.
8.	Ina da jela, ina da kai, bani da jikikuma nib a maciji bane, wane ni? (kwandalla)	Circle, space, shape, chance and probability, visual memory, problem solving, logical thinking, etc.
9.	Menenekefaduwa amma bayakaryewa da kuma wane abu ne yakekaryewa amma bayafaduwa? (dare da rana)	Variation, motion, discontinuous and continuous functions, construction, linearity, force, dynamic, stability, etc.
10.	Dan watakabiladaga Edo yagaiyaciwani Bahaushewajenbikinbinnegawa da ako, zoza'asakagawararamisais hi mutumin Edo yasadoya, shinkafa, nama da sauransu. Shaibashe Hausa yacesaboda me aka sasu. Saidan Edo yaceaimamaciyana cikindoguwartafiyasabodayanabukatarabin da zai ci. Saibahausem mam yasa naira dubu (N1000) cikinramin y ace idanabincin yak are saiyasayiwasu.	Series, limit, distance, logical reasoning, metaphor, proof, probability, assumption, estimate commercial arithmetic, etc.
11.	Nagarinakowamugusai me shi	Quality and quantity, logic, problem solving, etc.
12.	Aiki da hankaliya fi aiki da agogo	Logical reasoning, time, work done, problem solving, strategy, etc.
13.	Biyarbukata yafodogonburi, biyarbukata yaficinriba	Commercial arithmetic, usury, profit, problem solving, success, etc.
14.	Shanunadubumadaurinsudaya (tsintsiya)	counting, number base, quantity diagram, logical thinking, boundary, etc
15.	Angina anginata kigina. Na rufenarufetakirufe (inuwa)	Closure, transformation, set and logic, diagram, visual memory, etc.
16.	Makahoyasayi TV, kurmayasayi Radio, bebeyasayi Mobile phone. Wanenezaiyamfani da abin da sukasiyo?	Equality, value judgement, logical thinking, visualization, structure, function and limit, etc.
17.	Baba nadakagemuna wage (wata da hayaki)	Transformation, function, diagram, set and logic, etc.
18.	Kai mutumin nana yautaine	Resourceful, thoughtful, problem, solving, transformation, change, addition, abstraction, etc.
19.	Hassan yaba Hussaini naira dariyasayo rake yankadari. Dagacikiakiwaiyankadan naira biya, akwaidan naira goma, da naira ashirin da biyar. Idanyasayi rake yankadan naira ashirin da biyar gudagomashauku, rake gudanawanasauryan naira darinzataiyasiye?	Mathematical concepts, commercial arithmetic, buying and selling, problem solving, logical thinking, counting, arithmetic operation, simultaneous equation, analysis, etc.
20.	Carafke, dara, langa, macukulle, jataumaimagani, yarmero, way a tsallakaka, kullekurciya, malam nab akin kogi, tankomaikanbashi.	Recreation, counting, logic, logical thinking, chance, probability, visual memory, intellectual skill, diagram arithmetic operation, substitution, method, time conscious, problem solving, etc.
21.	Goma ta marmarigoma ta wuyagoma ta dokinSallah, zanbugakarkabiga, kayirawambanyi, muzaunamuna da zaunawa, mu kwantamua da kwantawa, asharuwantsuntsaye.	Time knowledge, counting, motion, recreation, geometry, proof, problem solving, arithmetic operation, etc.
22.	Talleyana son yatsunkomangorogudabiyudagacikinlambu. Ammalambunyana da kofagudagomakowacce kofatana da maigadi. Masugadinsukacewa Talle duk mangoron da yadebozasurabadaidai da kowannemaigadinkofa. Sabodahaka, mangoronawa Talle zaidebo.	Counting, logical thinking, problem solving, simultaneous equation, quantity chance, probability, sharing, double, etc.

The table above presented some few Hausa riddles and games that provides good examples of traditional mathematics in Hausa culture. The writer deliberately decided to leave them in their Hausa context as a challenge and motivation for further research in the area. What is central is for the teachers to increase effort to sort out more Hausa riddles and games in order to help him in reconstructing mathematics teaching. Similarly, it is also pertinent for the teachers to explore mathematical methods which he can use to solve Hausa riddles and games. For instance, let us try to solve the Talle problem of number 22 above.

**Solution.**

It is observed that Talle need to know the number of mangoes he will pick from the garden and the number of gatemen he will equally share the mangoes with. In coming to gate one he must come with two mangoes, gate two with four, gate three with eight continuously like that.

Mathematically, this is a geometric progression such as; 2,4,8,16,32,64,128,...



The first term of the series is the number of mangoes at gate one where the common ratio is 2,  $a=2$  and the number of term  $T_n = 10$  which is the number of gates in the garden.

Hence the Tenth Term  $T_{10} = ar^{10-1}$

Where;  $a=2$ ,  $r=2$ ,  $T_{10}$  = number of mangoes at gate 10, which is the number of last term in the series.

This implies  $T_{10} = 2(2)^{10-1} = 2(2)^9 = 1024$ .

Talle is supposed to pick 1024 mangoes if he likes to come out with two mangoes at the first gate. This exercise requires some analysis, logic, sharing formulae and so on before a person can solve it.

### III. Conclusion and Recommendations

This discussion shade more light on the fact that mathematics is a universal language that existed in every culture, Hausa inclusive. Implying that school mathematics introduced in the advent of western education was just white man mathematics, but Hausa people give their children, other peoples and themselves some riddles and games in order to develop their cognitive function and mathematical-logical skills. The writer is of the opinion that expert in education, mathematics, psychology and recreation should join heads together to examine and develop empirical research on the types, uses and application of mathematics in Hausa culture. These will definitely encourage our students in the study of mathematics. Teachers should also try to explore more approaches in solving Hausa riddles and games.

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