Cultural practice, Learning and Mathematical Thinking Identity: An Activity Theory Dimensions

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ABSTRACT

This study examines cultural practice, Learning and Mathematical Thinking Identity based on Activity Theory Dimensions with particular reference to Hausa and Yoruba secondary school students in Kano and Oyo states. A descriptive survey designed and causal-comparatives methods were employed. The populations comprise all the secondary schools in Kano and Oyo states. 10 secondary schools were randomly selected five from each state out of the 517 senior secondary schools in Kano and 805 senior secondary schools in Oyo states. In addition, the sample of 370 teachers and students were purposively selected from the target population of 246746 teachers and 579744 students. The instruments used to collect data were Teachers Evaluation of Mathematical Thinking Ability Questionnaire (TEMTAQ) and Students Mathematical Thinking Ability Questionnaire (SMTAQ). Three (3) Research questions and Two (2) research hypotheses were generated and formulated to guide the investigation. Data collected were analyzed using descriptive statistics and comparison of means. The findings show that the level of Mathematical thinking ability among the research subjects is good. There is also significant location's difference in mathematical thinking ability among the research subjects. Based on the research findings some recommendation were made to governments, parent, teachers, students, general public and NGOs in order to create awareness and promote Mathematical Thinking Ability in particular. It is recommended that: [a] Knowledge and mathematical thinking is not one sided phenomena it is for all and from each other, across- culture as well therefore students should put more effort and work hard in order to perform better. [b] All the parties concerned in this study should play a role in creating awareness on the need and importance of mathematical thinking likewise the relevance of historical and cultural events, activities and objects in mathematics.

INTRODUCTION

There has been remarkable interest in the roles of cultural practices in mathematics education, in particular, attempts to relate mathematical thinking identity to learning mathematics in the cultural historical activity theory dimensions. Research into teaching and learning has tended to consider its socially situated nature. It is pertinent to note that socially-culturally constructed learning plays significant roles in regulating learners and reproducing the workforce, this may play a good role in mathematics at the level of the classroom or the interactions between teachers and students. This paper wish to explore and shade light in understanding the difficulties that students usually experiences in learning, particularly mathematics. It was discovered by Radford &Michael (2011) that students solve problems with help of their speech, eyes and hands. Meaning that, efforts put forward in giving meaning or during learning mathematics objects is one way of dealing with problem referred to as Objectification. According to him objectification emphasises the historical and cultural dimension of knowledge and knowing. For instance the history of Algebra and Algebraic thinking, the influence of families interaction on the way each member thinks about himself in relation to others and his environment as well as the impact of Hausa and Yoruba games, riddles and visual discriminations in the development of mathematics. Accordingly the cultural and historical dimension referred to as activity theory attempt to describe not only the theoretical tools of the problem in context based on what students are doing in a particular classroom activity, but also to be able to understand this activity against the background of a cultural and historical setting as well (Michael, 2002). In a mathematics classroom activity, the tales about Gizo, Fowl and Hyena as well as the tales of Lion, Jackal and Hyena involve some aspect of mathematics and mathematical problem solving. This idea of relating mathematics teaching and learning with tales, stories, and cultural practices facilitate and consolidate students' mathematical thinking identity. It is possible for some people to describe Mathematics as difficult, abstract, systematic, joyful, aesthetics and rigorous, but still some people point to many objects and activities as Mathematical and calls some individuals as mathematicians or they are doing excellently in mathematics.

Similarly most students come to school with so many experiences from their community, ready and willing to learn. How can school foster and strengthen this out-of-school (socio-cultural) predisposition and ensure thatstudents learnt and leave school with the motivation, new knowledge, skills and capacity necessary for successful adaptation to changing circumstances. At home or in the community setting children or young adults learned from various sources such as mother, father, sisters, brothers, elders and many others. In school, teachers facilitate most of students' learning. In essence learning is effective, if students can handle it themselves, because by the time they leave school, most of their own learning have to be taken care by themselves. To do this, they need to understand their strength and weakness, be able to establishedlearning and life goals, to persevere, to systematically monitor their learning ability. Students with favourite and ability in a subject like mathematics are likely to be more motivated to mentor their own learning and develop the requisite skills to become effective learnersof that subject. Therefore, cultural practices, learning ability and self-concept, in particular mathematical thinking identity are relevant when considering the development of effective teaching and learning strategies for mathematics. In contrast, lack of significant relationship between them can act as a barrier to effective learning of mathematics. Students who feel disappointed about their ability to cope in mathematics learning situations may avoid the subject and thus lose important career and life opportunities as well as de-figure their relevance in the community. If a student feels alienated and disengaged from the learning of mathematics in school, his potentialities to master fundamental mathematics skills and concepts and develop effective mathematical thinking skills for adaptation to the changing socio-cultural circumstance is likely to be hindered. Because students' self-reported belief about themselves (such as their own competence, belonging, alignment, imagination, attitude and learning style in mathematics) and performance in Mathematics are shaped by their learning strategies and it seemed to be valid across-countries (Wenger, 1998). Thereby, cultural practices encourage and sustain certain kinds of cognitive processes, which then perpetuate the cultural practices (Nisbett and Norenyazan, 2002). Drawing on this direction is knowledge schema of Piaget to build the idea of cultural-mathematics schemas, patterns of mathematics schemas that make up the mathematics system of a cultural group usually referred to as Ethnomathematics. The easiest way to understand these cultural-mathematics schemas may be on the schemas of shared mathematics' knowledge structure involve in buying and selling in a cultural group like Hausa setting.

For instance if a Hausa man wanted to buy groundnut the mathematics schemas consist of knowing the number of 'Mud' or 'Sacks'to buy, the price of each 'Mud', the market to go to purchase, the kind of transport to use for going there, the cost of transport, the distance and time to get there as well as the total cost for the buying the needed amount of ground nut.

Furthermore, it is possible and pertinent to encourage students to think in a mathematical ways because as according to Piaget (1972, P. 70).

"Mathematical entities move from one level to another an operation on such entities becomes in its turn an object of the theory and this process is repeated until we reach structures that are alternatively structuring or being structured by stronger structures".

That is to say actions on objects like counting, addition, factorization, problems solving lead to a different kind of development. For instance the process of counting is developed using number words and symbols which become conceptualized as number concepts. Construction of this number concept in the cognitive structure results from the concept image in the mental map during mathematical thinking. The perceived objects (such as concept) are seen as visuo-spatial then they are analyzed and their properties are sorted out as they are communicated leading to collection, to classification based on the objects (or concepts) properties and to the development of systematic verbal formation of the objects (that is concept formation).

However, the existence of this systematic body of formal mathematical knowledge is not the ends in mathematics but a foundation upon which a wide range of mathematical activities or schemas produced a mathematical thinking. To this extent the writer is of the opinion that cultural practices, learning strategies via activity theory may have a significant impact on mathematical thinking identity.Specifically this paper intends to examine the role or relationship between cultural practices, learning strategies and mathematical thinking identity from the activity theory dimensions.

Review of Related Literature

In this age of accountability, space exploration, information technology among others, teachers need more and more varied data about their students' understanding of mathematics (Wendy and Nicole, 2004). In the first place students only memorize procedures that enabled them to produce correct answers without thinking about why the processes work and what the answer means. Indeed teaching for thinking has always been central to the very concept of a liberal arts, humanities, social and management sciences above all science and technology disciplines. The emphasis on thinking reflected in current approaches to education can be traced back to the philosopher John Dewey who wrote on the centrality of reflective thinking in the educational process. He is of the view that educators should view the nurturing of the scientific attitude of mind at the core of their endeavours when teaching child.

There is a growing body of study which pinpoint cross-cultural difference not only in the ways teachers teaches but also in the nature and sources of instructional material utilise in their classroom. For example Kaiser et al. (2006) have provided summaries of the distinguishing characteristics of English, French, German and Japanese mathematics teaching, particularly in respect of proof and the structural properties of mathematics.Huegener et al (2009) examined differences in the ways teachers presented the theorem of Pythagoras in Germany and Switzerland, while Santagata (2005) highlighted substantial differences in the ways teachers handle students' mathematical errors in Italy and the US. In addition Campbell and Kyriakides (2000) and Haggarty and Pepin (2002)demonstratedhow school texts reflect differences in systemic expectations and traditions.

Similarly, there are several local and international studies (Kamal, 2001, Berlin, 1998, Oloko, 1976, Jorma, 2005) which examined classroom discourse have characterized mathematics teaching as teacher-centred with procedural approach being the main teaching strategy. In this regard there is lack of development of mathematical thinking practices among mathematics teachers and students. However when students and teachers mathematical activity takes place in an inherently social or cultural context, where they work as individuals, as members of small groups and as participants in whole-class activities (Schoenfeld, 1992) tend to encourage and supports students development of mathematical arguments and representation. As pointed earlier, cultural practices encourage and sustain certain kinds of cognitive processes, which then perpetuate the cultural practices (Nisbett and Norenyazan, 2002). Since the schemas of the shared culturally oriented mathematics knowledge structure influence the line of thinking of the learner that enable him to understand classroom mathematics better. For instance ability of the teacher and students to use varied local objects, shapes, figures and events to teach and learn Geometry, Algebra, Statistics and Measurement may facilitate proper understanding of mathematics and develop sound mathematical thinking ability.

More importantly school learning must recognize learners' strategies which are learned and practiced-separately during teaching and learning of mathematics. This means students must have the strategies of doing and applying mathematics that include among others: - Systematic, analytic, deductive, inductive, open-mindedness, logic and so on. At the same time they should know where, when and how to apply them, justify and verify their solutions. Accordingly the idea of cultural and historical dimension referred to as activity theory attempt to describe not only the theoretical tools of the problem in context based on what students are doing in a particular classroom activity, but also to be able to understand this activity against the background of a cultural and historical setting as well (Radford &Michael, 2011).

From the cognitive perspectives Putnam and Borko (1997) emphasized that teacher's knowledge and belief are the key components that determine how a teacher teaches. Also according to Schon (1987) teachers gain new knowledge of their students, curriculum and pedagogical practices by engaging in actual teaching practice. Ball (2001) provides three perspectives of teacher's learning: -

1. Learning through acquiring new knowledge
2. Learning through collegial interaction
3. Learning in and four practices (that is classroom context).

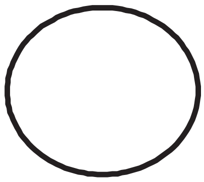
All these three forms of learning may be classified under Tall (2008) set-before and met-before abilities. A set-before is a mental ability that we are all born with (innate learning) which take a little time to mature as our brains make connotation in early life and usually operate in society and culture. Hence mathematical thinking grows in three distinct ways related to the three set-before. These are as follows: -

1. Recognition and language allows people to name points, lines and figure. For example triangle, cylinder and sphere. It also helps us to classify.
2. Repetition and language assist us to name actions, such as counting, measuring and the results of those actions such as number, weight and volume.
3. Language in particular becomes more powerful and as we build up sophisticated relationships it can be used to define mathematical concepts and prove mathematical arguments.

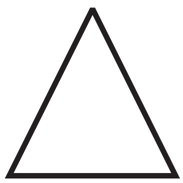
A met-before is a personal mental structure in our brain as a result of experiences met-before. Many different met-before are possible depending on experience available in our society and culture at the time. For example 2+2 = 4, or after 2 comes 3, addition makes bigger number, take away makes smaller number and so on, exists in all society and culture.

Practical measurement, counting, geometry and number representation have developed over the time and varied according to the needs of the society. Every culture begins from its human perception of the world and its' action upon that world survive and prosper, giving distinct mental world of mathematical thinking. For instance every culture had its own perception, practical recognition and action that give its unique mathematical concepts. Such as

a. Rectangle



b. a circle



c. a triangle

d. a number form 1,2,3,4,5 etc.

Similarly repetition leads to symbolism through action such as counting figures, body parts, tallying and using number representation. This symbolization turn to thinkable concepts such as number that function both as processes to do and concepts to think about referred to as precepts. For example 3+4, $x^2 + 3x + 2 = 0$, $\int \sin x \, dx$ etc

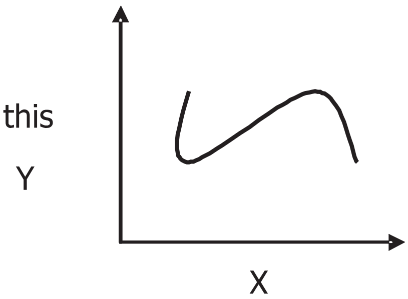
Furthermore language leads eventually to axiomatic formalism based on formal definition and proof which reverses or justifies the sequence of construction of meaning from definition based on known concepts to formal concepts based on set-theoretical definition, like the sets of real numbers, rational numbers or imaginary numbers.

Cognitively the brain compresses ideas into thinkable concepts that enable its' to manipulate them in a simple and precise way. The brain uses information it already has to build new concept. It blends together old ideas that fit in useful ways. Aspect that fit give pleasure, aspect that clash gives challenge, fatigue and anxiety. This buttresses the relevance of competence, motivation, satisfaction and interest of students toward mathematics and indeed the significance of mathematics models in human recreational activities. Such as games, riddles, puzzles, tales, folklores, stories and jokes in so many cultural groups.

More ever, a mathematics learner has to possess a succession of conflicting met- before that are differently blends in form of:

a. A triangle 

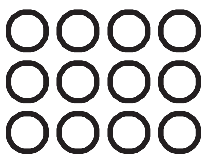
b. Embodies like a graphical equation such as this



a. Symbolic representation like 6 + 7, 2L = 36S where
   L = a number of the lecturers that supervise students project, S = number of students
b. Formal concepts like complex or Natural numbers, and so on.

In this vein a mathematical thinking which is based on these set-before and build on sound understanding of met-before lead to meaningful learning of mathematics. Since without making sense of new ideas there may be no development of new knowledge the only option for the learner is procedural learning, confusion, anxiety, fatigue and ultimately withdrawal from learning.

These imply that the theory and practice of mathematics education should consider the innate tendency and the environmental content of the leaner. Because traditionally the learners' social and cultural environment count, estimate, keep records, exchange money, memorize numbers, figures and diagrams from everyday life as well as many previous experiences that may enhanced mathematics learning process. For example poor memory among students may affects memorizing the multiplication table, law of logarithm, or law of indices by them. Because of failure to consider, co-opt or assimilate those historical and cultural objects or things that would enhance teaching and learning of mathematics. Poor memory equally affects students' time interval to answer a questions and they make a lot of errors. Usually long term learning requires compression of procedures into flexible symbols or Mnemonics as processes to do and concepts to think about. More importantly is the learners understanding rather than procedural learning especially in a situation where there is greater flexibility of ideas. For example a transition that involve algebra dealing with early Arithmetic can be embodied like 4 x 3 representing this figures



In this instance students may find difficulty or conflict between the previous knowledge (met-before) and new knowledge they require to solve that problem, if they have limited understanding of the whole ideas. This means proper learning or understanding of mathematics is enhance when there is congruence or peace between what student already know (met-before) and what he is expected to learn (New-knowledge). It is even more so when the learner have more confident and fluent language to think, discuss and express mathematics that can be regarded as **mathematical thinking**

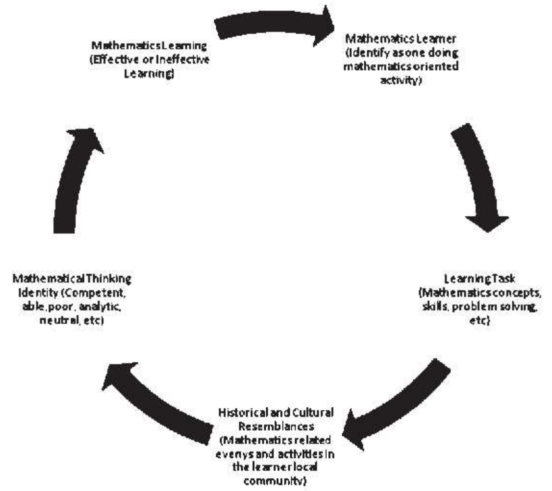
identity. This was similar to Sam, L, Mon, C. and Meng, C. (2008) observation that both teachers and pupils in their study showed much more confidence and fluency in using Mandarin Language, to think and communicate mathematically. As according to Wenger (1998) in mathematics Identity is very essential to students' belief about themselves as learners and as potentials mathematicians. It is also important to issue of race, gender, class room component and geographical location.

From social constructivist perspectives learning is conceived as a fundamentally social activity (Vinner, 2006). According to him learning is getting acquainted with the language, rules and practices that govern the activities in a certain community be it a social or academic community. Through this engagement in practices of this community people or learners uses languages and rules to discover meaning, understanding and skills. In this way students learning in classroom is characterized by an actualization of their identity, shared belief and affective structure acquired or learned through the interaction with the teachers, the books, the peers, members of the society and parents they engage with.

For instance students' appraisal or judgment influenced not only personal but also unique contextual and socio-cultural features of mathematics and its learning. In other word the effects of student past personal mathematics experiences (e.g competence, interest or lack of interest in mathematics) and those of the fundamental socio-cultural and contextual features of mathematics learning (such as objects, figures, shapes, social learning set up, etc) determine their future affective responses to mathematics. This view is relevant in understanding the **self-concept (identity**) and persistence of belief systems shared culturally that are productive or counter-productive to effective mathematics education. Piaget contended that learning is subordinated to development and categorized into four hierarchical stages of cognitive development and the passage through these stages depends on the four main factors of maturation, experience, social-cultural transmission and equilibration.

All of these factors have relevant implication to both theory and practice of mathematics and to this discussion in particular. **Maturation**, for example has to do with the development of mental function that helps the learner to acquire the mathematical objects and to act accordingly. This is also important to the concept of student readiness in learning mathematics. Similarly, **equilibration** was described as a self-balancing of two intrinsic polar: namely-assimilation and accommodation. The first polar or behaviours enables the learner to put new knowledge into his existing cognitive structure. Accommodation, the second polar comprises the learner's reorganization and expansion of such a cognitive structure.

Furthermore, equilibration may tend to be an adequate description of a way of constructing individual knowledge in mathematics. Since it involve the internal organization and build-up of mental schema. The mathematics schemas model contending by the writer is such that where the Mathematics learner (as his identity) is actively engage in doing mathematics facilitated by proper understanding of the task through some number of historical and cultural resemblances. In other words the writer intend to build a model that will account for the way in which students learn mathematics in a much culturally and historically forms of knowing and being (existence). For instance in Fishing hatchery or blacksmithing events understanding develop by fisherman or blacksmith at a time about the kinds of fish catch or hoe to make, makes estimate or measurement, looks at the size of the fish or hoe. In all the two cultural activities have some historical connotations they all use particular forms of mathematical representation and relationship in terms of class population for the different graphical and figure distributions of the fish or hoes. For some people this is different from classroom mathematics activity where the learners have a lesson on system of equation such as '$2x + 1=0$', '$X^2+ 2x - 1=0$', etc. Herein the students are made to think in algebraic activity rather than in the fish catching or hoe making activity. More importantly is to **understand the object of activity theory** that will help the learners to easily identify the cultural and historical forms and methods of representing mathematical objects and knowledge in an attempt to produce right solution.Fundamentally in the fishing events or blacksmith activities they are concentrated with either catching healthy fish or producing good hoe. In the classroom mathematics activity it should be a process where each student refracts different or similar cultural or historical constituted form of thinking and doing mathematics to satisfy the teacher. The diagram below illustrates the model:



The model the writer has developed is based on the fact that classroom teaching is a complex activity. The classroom mathematics learning is dynamic and on-going (circle). It is an evolving network consisting of the school setting, the learner, the mathematics learning tasks, the mathematical thinking potentiality, the wider education system, the learner's local community containing historical and cultural resemblances of mathematically related events and activities as well as the mathematics learning itself (either effective or ineffective). The understanding of a close relationship between social processes and conceptual development also forms the basis of Lave and Wenger's (1991) cited by Glenda & Margaret (2009) well-known social practice theory, in which the idea of a community of practice and the connectedness of knowing are emphasised. In that perspective, individual and collective knowledge emerge and evolve within the dynamics of the spaces people share and within which they participate. As in this paper the focus is on the understanding that teachers who facilitate positive student learningofmathematics do so through their self-concept (actualisation and identification) on the needs of all students to have quality mathematics education derived from the forms of historical and cultural activity dimensions. In order to fosters their understanding of mathematics and an appreciation of their historical-cultural mathematical heritage and application of mathematics in everyday life.It is pertinent to consider the contribution of social interaction as reflected through language and cultural environment. In this line, there are: - (1) Piaget (1964) who claims that social transmission is fundamental but insufficient factor in developing knowledge. (2) Vygostsky (1986) who claims that cognitive development results from social interaction and education by means of language. He emphasizes that knowledge is socially constructed. (3) Similarly Harvard (1997) observes that social activity and cultural practice are sources of thinking. Similarly Kagan [1974] cited byShuaibu (2005) pointed out that urban-rural environment effects students' progress in school. However Bichi[1982] cited inShuaibu (2005) study revealed a contrary finding indicate that urban environment had more significant influence on pupils' school performance than rural environment. In line with Kagan[1974] as cited in Shuaibu (2005) is the work of Guberman [1994] that showed urban and rural differences in Latino and American children performance in Mathematical thinking ability. Basically, it may be connected to the multi-variety of socio-cultural resources existing in the rural areas relevant to mathematics teaching and learning. For instance the language fluency and richness of the rural learners out weight that of the urban learners, socio-cultural objects, events, activities and developments are numerous in the rural areas than urban centres putting all together will facilitate the development of mathematical thinking in particular and mathematics education in general.

Statement of the Problem

There has been so much concern and complains from all nooks and corners of the Nigeria's society that the standard of education has fallen (Barkie, 2002). Students' performance in Senior Secondary School Examination administered by both WAEC and NECO continues to deteriorate from year to year in both Science and Social Sciences. For instance Rabi'u (2005) asserted that, according to WAEC chief Examiner's report (2003) students' performance varied from one subject to another and the marks ranged from high, average, low, to very low. The performance was generally poor in English language and below expectation in Chemistry, Mathematics and physics. He further argued that the candidates' weaknesses are precipitated by among others: -

a. Poor expression because of lack of proficiency and fluency in English language which prevent them from understanding the question and unable to express their answer accurately.
b. Inadequate preparation resulted from examination oriented reading culture transforming into superficial and scanty answers for the examination questions.

Furthermore Idris (2004) opined that the poor performance of secondary schools students in Mathematics examination can be rightly attributed to many causes, some of which include the following: -

1. Teachers factors like poor method of teaching and incompetent.
2. Students attitudes towards mathematics
3. Lack of materials and teaching aids
4. Poor learning environment
5. Parental background and involvement in their children education.
6. Others include poor motivation, difficult or abstract curriculum content, peer group influence etc.

All these situations do not favour Nigeria's society and culture as well as a move toward developing democratic society where opinion (relativism) and respect for individual to make rightful decision is a key issue in national development. Again little or no consideration is given to child's social and learning environment of mathematics which tends to develop the thought processes of the learners which also influences their performance in the subject. Consequently there exist a need to understand the possible relationship between students' cultural and learning environment and their mathematical thinking ability. This study was an attempt to fill this gap. This is in line with Adedeji (2009) contention that people in Nigeria are narrow-minded, the younger generation are not thinking and they are being carried away with the passion that they see and would perish refusing to give quality to man's life and education. Because according to him education is about having the ability to transverse every sphere of human existence. Indeed travelling the whole spectrum of the universe open up mind, help man' to see things, ponder or 'Tadabbur' on those things (Tadabbur" this is referred to as reasoning or thinking).

Based on the above backdrop, this study is designed to investigate the mathematical thinking ability among Hausa and Yoruba secondary schools students in Kano and Oyo States. That is to say the study intend to find out the level at which the two cultures, Hausa and Yoruba, in Nigeria differ in favouring or disfavouring mathematical thinking ability among their children. This is with a view to unravelling the obstacles and menace affecting the effective development of mathematical thinking ability on one hand and influencing the teaching, learning and good students' performance in mathematics on the other, in the Nigerian school systems.

Objectives of the Study

The objectives of this study are as follows: -

1. To determine the level of mathematical thinking among Hausa and Yoruba SS students.
2. To find out the extent to which Hausa and Yoruba cultures promote mathematical thinking in their children.
3. To determine the rural and urban difference in mathematical thinking between Hausa and Yoruba SS students.

Reseach Questions

This study intends to find out answer to the following questions:

1. What is the level of mathematical thinking among Hausa and Yoruba students in secondary school?
2. To what extent do Hausa and Yoruba cultures promote mathematical thinking in their children or otherwise?
3. Is there a rural and urban difference in mathematical thinking between Hausa and Yoruba SS Students in Kano and Oyo states?

Hypotheses:

The study seeks to test the following hypothesis:

H1: There is no significant difference between Hausa and Yoruba secondary schools students in terms of mathematical thinking ability.

H2: There is no significant urban and rural difference in mathematical thinking ability between Hausa and Yoruba secondary schools students in Kano and Oyo states.

METHODOLOGY

Research Design

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

The present research uses the research subjects in their cultural or semi-cultural setting. That is to say the study uses teachers who are Hausa and Yoruba teaching mathematics to the students of the two cultures. The reason for using descriptive method in this study again is because questionnaires were used to examine the influence of socio-cultural factors from the learners' environment on their mathematical thinking ability. Similarly causal-comparative method was suggested in view of the cause-effect relationships that may exist between the socio-cultural background and mathematical thinking among the Hausa and Yoruba Secondary Schools Students.

Population and Sample

In this study, the population includes students in secondary schools and their mathematics teachers in Kano and Oyo states. As indicated by the Federal Ministry of Education Abuja (2005) reported by National Bureau of statistics the population are as follow bellow.

Table 3: Teachers and students population in secondary schools

State	No of schools	Teachers		Total	Students		Total Students
		Male	Female		Male	Female	
Kano	517	61479	20729	82208	158639	66793	225432
Oyo	805	91481	73059	164538	188817	165495	354312

SOURCE: National Bureau Of Statistics, Abuja (2005) FMOE.

Sample Size

As indicated in the table 3 (above), Kano state has five hundred and seventeen (517) senior secondary schools ,two hundred and twenty five thousand four hundred and thirty–two (225432) secondary schools students and Eighty –two thousandtwo hundred and eight (82208) teachers. Oyo state has eight hundred and five (805) senior secondary schools and three hundred and fifty four thousand three hundred and twelve (354312) secondary schools students as well as one hundred and sixty four thousand five hundred and thirty eight (164538) teachers. In view of the large number of these populations, the researcher selected representative sample of the population using **Purposivesampling technique**. In this regard, a sample population of three hundred and seventy (370) was used for this research study. The population and sample population include only teachers of mathematics in secondary schools and their students in Kano and Oyo states.

The summary of the sample size used in this study is presented below.
Table 4: Sample subjects

State	Name of school	No. of teachers	No. of students	Total
	Rumfa college	7	30	37
	GGC[WTC] Kano	7	30	37
Kano	GSS Panshekara	7	30	37
	GSS Bichi	7	30	37
	GGSS Kabo	7	30	37
	Govt. College Ibadan	7	30	37
	GSS Atisbo	7	30	37
Oyo	AMSS Ibadan	7	30	37
	CSS Parapo	7	30	37
	St. Lukes GS Ibadan	7	30	37
Total		70	300	370

Sampling Techniques

There are two main types of sampling techniques namely- Probabilistic and Non-probabilistic sampling. [1] The probabilistic sampling is a type of sampling in which every number has an equal chance and independent chance of being selected in the sample being selected. The inclusion of each member is made by chance. There are many types of probabilistic sampling among them are:[a] Random sampling [b] Stratified sampling [c] Cluster sampling and [d] Systematic sampling. [2] The Non-probabilistic sampling technique does not need any randomness assumption. That is to say element in the population does not have that equal and independent chance of being selected. The types of sampling technique under this non-probabilistic sampling are: [a] Accidental sampling [b] Quota sampling [c] Convenience sampling and [d] Purposive sampling

This study employs the use of **purposive sampling procedure**. This technique is usually referred to as **Judgmental sampling** [Sambo, 2005]. Under this technique sampling elements which are judged to be typical or representative are selected from the population. The assumption underline this type of sampling is that, judgment in the selection of the element of the population will counter balance one another. Purposive sampling is often used as a basis for evoking or eliciting opinions of a sample subjects. The use of this technique is cost effective, convenience and usually useful in attitude and opinion survey. For these reasons this study employs purposive sampling technique in selecting this study sample subjects. In addition this technique was used in order to give each and every individual member of the sample population **equality of representation.** That was the purpose of selecting equal representative sample from both Kano [185] and Oyo [185] states to make up 370 sample population. A total of ten (10) secondary schools were selected, five (5) from each state, two (2) from rural areas and the remaining three (3) schools from urban areas. Then thirty [30] students were selected randomly from each school. The other research subjects, in this regard are mathematics teachers, were selected using stratified sampling from the sample schools. The stratum here was subject being concerned with teaching mathematics in the secondary schools selected.

Measuring Instruments

1. **Student Mathematical Thinking Ability Questionnaire (SMTAQ)**: This instrument was modified from Olubadewo and Stella, (2005,) Sanchez and Ice, (2004,) Jenni (2001) and Jorma (2005) and developed in order to examine students' mathematical thinking ability and views of mathematics. The instrument was based on some closed-ended, open-ended and good questioning techniques as well as likert's scaled statement.
2. **Teachers Evaluation of Mathematics Learning Questionnaire (TEMLQ).**

This instrument was developed from the modified instrument of Jorma (2005) to assist the researcher obtained teachers perspective on mathematics learning in Secondary Schools especially among Hausa and Yoruba children. It also includes teachers' evaluation of Secondary Schools mathematics curriculum and the nature of the students' mathematical thinking ability.

Methods of Data Analysis

The data of this study were analysed using simple percentage, frequency table,mean, standard deviation, Cross-tabulation and t-test,

The data analyses

The data presented and analyzed were in research questions, hypotheses and table forms as follows: However the reader should note that 273 students' questionnaire and 54 teachers questionnaire where only retrieved out of the 300 students questionnaire and 70 teachers questionnaire distributed to the respondents.

Research Question one

What is the level of Mathematical Thinking Ability among Hausa and Yoruba secondary school students in Kano and Oyo states?

Research Hypothesis 1

There is a significant urban and rural difference in Mathematical Thinking Ability among the Hausa and the Yoruba SSS in Kano and Oyo states.

This question and hypothesis were addressed through the students' responses on SMTAQ that were summarized and analyzed using Cross-tabulation and Simple percentage among the Mathematical Thinking Ability scores in table 5 below.

Table 5: Cross-tabulation on Level of Mathematical Thinking Ability [MTA] among the Hausa and the Yoruba SSS in Kano and Oyo states [N=273].

Ethnicity	LMTA 0-39%	MMTA 40-49%	GMTA 50-69%	VGMTA 70% & Above	Total	Mean	SD	df	Chi-square Value	Chi-square Critical	P
Yoruba											
Count	2	9	67	54	132	65.61	12.86	3	5.477	7.815	0.05
% W. Eth.	1.5%	6.8%	50.8%	40.9%	100.0%						
%W.SMTA	66.7%	50.0%	55.4%	41.2%	48.4%						
% of Total	7%	3.3%	24.5%	19.8%	48.4%						
Hausa											
Count	1	9	54	77	141	67.89	11.26				N S
% W. Eth.	7%	6.4%	38.3%	54.6%	100.0%						
%WSMTA	33.3%	50.0%	44.6%	58.8%	51.6%						
% of Total	4%	3.3%	19.8%	28.22%	51.6%						

Key: W. Eth= Within Ethnicity, W. SMTA= Within STMA, LMTA= Low MTA, MMTA= Moderate MTA, GMTA= Good MTA and VGMTA= Very Good MTA

Explanations on the Mathematical Thinking Ability scale in the questionnaire.

1. 0- 39%: **Low Mathematical Thinking Ability:** This refers to little thinking or guessing, memorization of facts and rote learning during Mathematical tasks.
2. 40 – 49%: **Moderate Mathematical Thinking Ability:** This refers to average performers in mathematic task. Their thinking ability is also average.
3. 50 -69%: **Good Mathematical Thinking Ability:** This involve the above average or successful Mathematical achiever who widen his/her thinking to capture as many mathematics objects as possible in order to solve the problem at hand.
4. 70% and Above: **Very Good Mathematical Thinking Ability:** A Mathematical Thinker under this level deeply widen his/her thinking horizon to capture as many mathematical objects as possible in order to solve the problem at hand.

The result on table 5 above showed that 132 subjects comprising 48.35% of the respondents were Yoruba, while 141 subjects comprising 51.65% of the respondents were Hausa subjects. Majority of the Yoruba subjects [50.8%] had Good Mathematical Thinking Ability. Whereas most of their Hausa counter-part 54.6% were within Very Good Mathematical Thinking Ability level. However the mean scores of the Yoruba subject was 65.61%, while Hausa subject had 67.89% with respective standard deviation of 12.86 and 11.26. Likewise, the obtained chi-square value=5.477 which is less than the table value of chi-square=7.815 at p=0.05, showed lack of significant difference between the subjects. This indicated that both subjects had the same high level of Mathematical Thinking Ability within the category of 50 -69% which is Good Mathematical Thinking Ability Level.

Research question Two

What is the level of mathematics teachers' evaluation of their students Mathematical Thinking Ability among Hausa and Yoruba SSS in Kano and Oyo states?

Table 6 Hausa and Yoruba mathematics teachers' responses on their students' level of Mathematical Thinking Ability in Kano and Oyo states [N=54].

Ethnicity	N	%	Mean	Sd	Df	Tcal	Tcrit	P
Yoruba	22	38.88	40.74	9.78	52	2.48	1.96	0.05
Hausa	32	61.11	59.26	18.59				
Total	54	100	100					Sig.

From the table 6 above it can be seen that 22 subjects consisting 38.88% of the respondents are Yoruba subjects while 32 subjects consists of 61.11% of the respondents are Hausa subjects. However the means score of the Yoruba mathematics teachers is 40.74, SD=9.78 while Hausa teachers had the mean scores of 59.29, SD = 18.59. This revealed that Yoruba teachers evaluation of their students Mathematical Thinking Ability (40.74) is less than that of Hausa teachers (59.26). The mean score of 40.74 is indicating that the students had moderate mathematical thinking ability and 59.26 mean score is indicating that the students had Good Mathematical Thinking Ability.

Research hypothesis 2:

There is a significant urban and rural difference in Mathematical Thinking Ability among the Hausa and the Yoruba SSS in Kano and Oyo states.

Table 7: Urban and Rural differences in Mathematical Thinking Ability among the Hausa and the Yoruba SSS in Kano and Oyo states.[N=273]

Location	N	%	Mean	SD	DF	T value	T critical	P
Rural	106	38.83	70.21	11.02	271	3.92	1.96	0.05
Urban	167	61.17	64.61	11.72				
Total	273	100						

From the above table 7 one can deduce that a hundred and six [106] subjects comprising 38.83% of the respondents were from the rural areas, while a hundred and sixty seven [167] subjects comprising 61.17% were from the urban areas. The subjects respectively had mean scores of 70.21%, standard deviation of 11.02 and mean scores of 64.61%, standard deviation of 11.02. These percentages show that the subjects from the rural areas had Very Good Mathematical Thinking Ability. However, the subjects from the urban areas had Good Mathematical Thinking Ability level. The result of the t-test proved this research hypothesis 2 and accepted that there is a significant urban and rural difference in Mathematical Thinking Ability among the research subjects. This is evident because the computed t-test value = 3.92 is greater than that of the table value of t= 1.096, at P=0.05.

Summary of the Findings

(1) It was discovered from the study that both the Hausa and the Yoruba secondary schools students in Kano and Oyo states had the same Good Mathematical Thinking Ability level.

(2) The result of t-test analysis has showed that there is no significant ethnic (cultural) difference in Mathematical Thinking Ability between the Hausa and the Yoruba secondary schools students in Kano and Oyo states.

(3) The finding of this study shows that there is a significant urban and rural difference in Mathematical Thinking Ability between the study subjects. Whereas the urban subjects had Good Mathematical thinking ability, the rural subjects had Very Good Mathematical thinking ability.

Discussion of Results

This research is a cross–cultural study of Mathematical Thinking Ability among the Hausa and the Yoruba SSS in Kano and Oyo states. Specifically, the study investigated the level of Mathematical Thinking Ability among the population. Similarly, being a cross–cultural study, the research examined the ethnic differences in Mathematical Thinking Ability between the Hausa and the Yoruba subject. In addition, the study examined urban and rural differences in Mathematical Thinking Ability among the subjects. Other aspect investigated by the study is the level of mathematics teachers' evaluation of their students Mathematical Thinking Ability among the subjects in order to complements the students' responses.

Therefore the discussions of results are systematically treated as follows:

The first and second research questions are answered on the level of and differences in Mathematical Thinking ability among the Hausa and the Yoruba SSS subjects in Kano and Oyo states. The results showed that (Table 4) 132 subjects comprising 48.66% of the respondents had mean scores of 65.61% which is within the category of Good Mathematical Thinking Ability. While 141 subjects consisting of 51.65% of the respondents had mean scores of 67.89%fall also within the category of Good Mathematical Thinking Ability. This result together with the obtained t-test Value=1.60 which is less than the critical t- test Value=1.96, at P =0.05 shows and tested the first research hypothesis and proved that there is no significant difference in Mathematical Thinking Ability between the Hausa and the Yoruba SSS subjects. This result is in agreement with most of the studies conducted on Mathematical Thinking Ability. For example Jorma (2005) study shows that successful students have Good Mathematical Thinking Ability. Also Sexe (1987) study showed considerable Mathematical Thinking Ability among his research subjects. Again, Ginsburg et al (1981) study showed cultural similarities in Mathematical Thinking Ability between the African and the USA children.

The second research hypothesis was used to address the urban and rural differences in Mathematical Thinking Ability among the Hausa and the Yoruba subjects. The results indicated (Table 7) that 106 subjects consisting of 38.83% of the respondents are rural subjects with the mean scores of 70.21 representing Very Good Mathematical Thinking Ability. While 167 subjects comprising 61.17% of the respondents are urban subjects with the mean scores of 64.61% which fall within the category of Good Mathematical Thinking Ability. This result, plus the calculated t-test value = 3.92, at P =0.05 level of significant, tested and accepted that there is a significant rural and urban difference in the subjects Mathematical Thinking Ability. Fundamentally, the view that rural areas are bless with more socio-cultural resources relevant to mathematics teaching and learning than the urban areas can be the promo of that differences in mathematical thinking ability among the sample subjects. This view is in agreement with Kagan (1974) cited in Shuaibu (2005) that urban–rural environment affect students' progress in schools. However, Bichi (1982) cited in Shuaibu (2005) maintains that urbanization has influences on pupils' school performance because it makes them perform better than the rural schools pupils. This contradicts the present study where the rural subjects are found performing better than urban schools subjects. This study is also in line with the research and work of Guberman (1994) which discovered urban and rural environmental differences in Latino and American children-Mathematical Thinking Ability.

Conclusions

Based on the data presented and analysed as well as the discussions of results made thereupon, the following conclusions are hereby made:

1. That there is no significant difference in Mathematical Thinking Ability among Hausa and Yoruba SSS in Kano and Oyo states.
2. There is a significant rural and urban difference in Mathematical Thinking Ability among Hausa and Yoruba SSS in Kano and Oyo states.

Recommendations:

The following recommendations are hereby made by the researcher:

(1) In order to maintain and improve on the nature and level of Mathematical Thinking Ability among these research subjects, teachers, students and parent alike should allow cordial human relationship to exist among them in order to give room for more learning opportunities, assistance and encouragement.

(2) Lack of ethnic or cultural differences among the subjects indicate that most of the subjects have interest in the study of mathematics, particularly because of its position among required subjects for further studies in science and other related areas. Hence, all the parties concerned should play a role in creating awareness on the need and importance of studying mathematics likewise its simplicity.

(3) Mathematics teachers should strive hard to see that they encourage and assist their students for excellent Mathematical Thinking Ability. This should be through employing multiple and varied learner-centre approaches to teaching and learning, utilisation of multi-varied historical and culturally oriented instructional materials, assigning and marking homework, assignment and test, organizing quiz competitions and so on.

(4) Since there is no cultural differences in mathematics thinking ability' among the subjects parents and guardians should therefore feel comfortable to encourage their children to study mathematicsat any urban or rural school. What are most important are the teacher's interest, ability and commitment to the attainment of his/her students' excellent Mathematical Thinking Ability.

(5) All the stakeholders in secondary school mathematics education should notes the implication of urban and rural differences in mathematical thinking ability among the cultural group. In terms of the factors that made rural subjects perform better than urban subjects, the priority given to urban school and their teachers more than the rural schools and their teachers as well as the need for teachers posted to rural schools to heartedly accept and go to the school.

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