

## ***Ethnomathematics: The Role of Culture in the Teaching and Learning of Mathematics***

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### **Abstract**

*Mathematics is one of the most important as well as the least understood school subjects in Nigeria. This lack of understanding manifests in low performance during examinations and has severally been attributed to the abstract nature of the subject, pedagogical style as well as lack of qualified teachers, among others. The relatedness of the learners' cognitive patterns and background experiences to the study of mathematics as a subject is in most cases not considered as a cause of the low performance during mathematics instruction. Mathematics is greatly distorted when it is reduced to a series of techniques and is detached from the rich intellectual setting of a culture. The teaching and learning of mathematics should therefore be derived from the learners' background knowledge and experiences drawn from his culture. This forms the background to the study of ethnomathematics. This paper discusses the relatedness of the concept of mathematics, culture, and ethnomathematics. Various challenges facing the use of ethnomathematics in a multicultural classroom setting and especially in a developing nation like Nigeria is also discussed. Recommendations are made for students, teachers, and other stakeholders towards the improvement of mathematics teaching and learning.*

**Keywords:** Mathematics, culture, ethnomathematics

### **Introduction**

Mathematics is one of the most important as well as least well-understood school subjects in Nigeria. This has resulted in a regular low percentage of passes among students especially in external examinations. Various reasons have been advanced for this low performance to include ineffective pedagogical methods, overloaded curriculum, inadequate number of teachers, students' interest level, and lots more (Ogunkunle, 2007). A common but erroneous view regarding teaching of mathematics has been, and still is, the belief that mathematics can be taught

effectively and meaningfully without relating to the culture of the learners. Students have been presented a Euro-centric view of mathematics for several years. From this perspective, the ideas of mathematics are taught as if other cultures have contributed little or nothing to its development. A Euro-centric conception of mathematics depicts only a partial picture of the subject. It marginalizes the contributions of other cultures to the development of mathematics. Against this belief, it is known that Mathematics is embedded in other cultures. This paper reviews what Mathematics and Culture are, how they are related and the role culture plays in the teaching and learning of Mathematics.

### **The Concept of Mathematics**

Zeigler (2010) defined mathematics as the study of quantity, structure, space and change. According to this author, Mathematics seeks out patterns, formulates new conjectures and establishes truth by rigorous deductions from appropriately chosen axioms and definitions. D'Ambrosio (2005) defined mathematics as the science of numbers and forms, of the relations and measures, of the inference, and its features point to precision, rigour and exactness. Rosa and Orey (2008) see Mathematics as a language system that has its own history, symbols, syntax, grammar and comes with an enormous variety of representation. It relies on an intensive use of different variables, signs for numbers, diagrams, formula and algorithm. Mathematical practices include symbolic systems, spatial designs, practical construction techniques, calculation methods, measurement in time and space, specific ways of reasoning and inferring, and other cognitive and material activities which can be translated to formal mathematical representation. According to Burton (1999), Mathematics represents the foundation to humanity's scientific and cultural heritage. It is a construction of knowledge that deals with vital qualitative relationships of space and time as used by different people. From this, it is clear that mathematics is rooted in the culture of every place.

Generally speaking, Mathematics pervades everyday lives, sometimes obviously and sometimes in a more hidden or implicit level. In classrooms, mathematics has been considered a subject one studies in schools, to learn and practice procedures using numbers and symbols written as algorithms. Also mathematics is usually presented as a set of static unchangeable rules developed by ancient people with no connection to current problem solving situations. There is a dearth of research on the nexus between the learners' cultural background and their mathematics achievement patterns, especially in Nigeria. Gaps in achievement scores have been tied to these disconnect. Part of the problems in achievement is related to the gaps in opportunities for all students to learn mathematics in ways they see as relevant to their identities and communities.

To further deepen the need for the connection between the learners' personal identities and the study of Mathematics, the Nigeria junior secondary school mathematics curriculum spelt out the goals, content, instructional and evaluation strategies of mathematics education at this level. One of the instructional strategies is that the teaching of mathematics should be carried out by using local aids and examples in the immediate environment of the learner for the concretization of mathematics concepts. Gbamaja (2001) posited that a good curriculum must be based on a good theory which reflects the values of the society for which the curriculum is designed. Francois and Kerkhove (2010) posited that mathematics is greatly distorted when it is reduced to a series of techniques and is detached from the rich intellectual setting of a culture. The implication is that of learning mathematics from the first principles embedded in cultures before the application of more technical theories and explanations which could also be explained in the happenings within the culture of the learner. It is therefore pertinent, at this point to have a clearer understanding of what culture is and how mathematics study can be derived from cultures.

### **Culture and Mathematics**

Culture is defined variedly based on the different schools of thought. Culture could be seen as the ideas, custom and social behaviours of a particular people or society. Wikipedia (2017) defined culture as the characteristics and knowledge of a particular group of people encompassing language, religion, cuisines, social habits, trades and music. It also refers to it as the cumulative deposit of knowledge, experience, beliefs, values, attitudes, meanings, hierarchies, religions, notions of time, roles, spatial relations, concepts of the universe and material objects in the course of generations through the individual and group strivings.

Stenhouse (1967) observed that culture involves the shared understanding through which individuals interact (i.e. communicate) with each other. This definition emphasizes the role of communication in culture which has particular significance in education and mathematics. Anderson-Spence (2014) noted that culture also applies to macro, meso, and micro levels within educational spheres (i.e. society, school, and classroom). The action of teaching and learning exists in cultures that vary greatly from society to society, from school to school and even from classroom to classroom. Mathematics classroom is therefore occupied with multicultural learners. The culture of the classroom and the learners therefore determines the types of learning which take place and greatly affects the types of experiences in which students engage.

Teaching mathematics through cultural relevance and personal experiences therefore helps students to know more about reality, culture, environmental issues and

themselves by providing them with mathematics contents and approaches that enable them to master academic mathematics successfully. It is worth emphasizing that each culture develops ways, styles, and techniques for doing things as well as responding to the search for explanations and the quest for understanding and learning; or essentially how and why they do things. In the human species, early attempts to explain and understand led to the search for origins, which led to myths. These attempts were organized as systems of knowledge and religions. The attempts to explain and understand rely on observation, comparison, classification, evaluation, qualification and measurement, courting, representation and inference, which are steps in the generation of knowledge. These steps are basically mathematical. The guidelines of the National Council of Teachers of Mathematics (NCTM, 1991) as cited in Rosa and Orey (2011) highlighted the importance of building connections between mathematics and students' personal lives and cultures. In accordance to this approach, Rosa and Orey (2008) affirmed that when practical or culturally-based problems are examined in a proper social context, the practical mathematics of social groups is not trivial because they reflect themes that are profoundly linked to the daily lives of students. This understanding gave rise to the study of Ethomathematics.

### **Ethomathematics in Perspective**

Ethomathematics uses the etymology of three Greek roots, ethno, mathema and tics. It is a programme that incorporates mathematical ideas and procedure practiced by members of distinct cultural groups, which are identified not only as indigenous societies but as groups of workers, professional classes, and groups of children of a certain age group as well (D'Ambrosio, 1985). This programme is concerned with the motives by which members of specific cultures (ethno) developed, over history, the measuring, calculating, inferring, comparing and classifying techniques and ideas (tics) that allow them to model natural and social environments and contexts in order to explain and understand these phenomena (mathema) (Rosa & Orey, 2016).

According to D'Ambrosio (1990), the search for solutions for specific problems that helps the development of mathematics is always imbedded in a cultural context. In order to understand how mathematics (tics) is created, it is necessary to understand the problems (mathema) that precipitate it. It is necessary to understand those problems (mathema) by considering the cultural context (ethnos) that drives them. D'Ambrosio (1993) stated that the mission of the ethnomathematics programme is to acknowledge that there are different ways of doing mathematics by considering the appropriation of the academic mathematical knowledge developed by different sectors of the society as well as considering different modes in which different cultures negotiate their mathematical practices. Barton (1996) stated that in this conception, ethnomathematics is a programme that investigates the ways in which

different cultural groups comprehend, articulate and apply concepts and practices that can be identified as mathematics practices.

Borba (1997) describes ethnomathematics as a way in which people from a particular culture use mathematical ideas and concepts for dealing with quantitative, relational and spatial aspects of their lives. This way of viewing mathematics validates and affirms all people's experience of mathematics because it demonstrates that mathematical thinking is inherent to people's lives. Further evidence of this assertion is given by Orey (2000), who stated "The paradigm that diverse cultures use from within evolves out of using interactions between their language, culture and environment" (p. 248). Similarly, D'Ambrosio (2006) argued that in an ethnomathematical perspective, mathematical thinking is developed in different cultures in accordance with common problems that are encountered within a cultural context. This implies that many cultural differentiated groups know mathematics in ways that are quite different from academic mathematics as taught in schools. Ethnomathematics can therefore be said to refer to mathematical concepts embedded in cultural practices and which recognize that all cultures and all people develop unique methods and sophisticated explication to understand and to transform their own realities.

From the forgoing definitions, there should be a balance in the mathematics taught in our schools; that is, the mathematics learnt in the classroom and the mathematics experienced by the learner outside the classroom setting. There must be congruence in these two aspects of learning, that is, mathematics and culture. Traditionally, mathematics is seen as a school subject which involves learning and practising procedures using numbers and symbols written as algorithms. It is also usually presented as a set of inflexible and rigid rules developed by ancient people and having no connection to solving current problem. This has perhaps contributed to the students' poor performance in mathematics over the years. Most of the times, mathematics teachings are usually devoid of students' previous experience and background knowledge. Ogunkunle (2007) had noted that students are not taught mathematics to solve problems in their cultural background.

Carraher (1991) argued that mathematics practices existing out-of- school are shown by students who developed the understanding of numbers before they come to school. Bishop (1993) affirmed that informal or out-of-school mathematics is an organized, systematic mathematics education activity carried on outside the framework of the formal school system. Apparently, there should be a link between the formal (mathematics taught in schools) and the informal out of school mathematics. This actually forms the basis of ethnomathematics. Educators should therefore search for problems taken from students' reality that translate into their

deepened understanding of real life through the application of culturally relevant activities. This process would enable students to take a position such as socio-cultural, political, environmental and economic positions in relation to the system under study. According to Rosa (2000), the main objective of this pedagogical approach is to rehearse the established mathematical context that allows students to see the world as consisting of opportunities to employ mathematical knowledge that help them to make sense of any given situation.

Learning is a process of acculturation by which individuals can learn to construct mathematical knowledge in a cooperative way. Good mathematical learning occurs with social and cultural interaction through dialogue, language, and through the negotiation of meaning of the symbolic representations between teachers and students. Ethnomathematics therefore presents an alternative view towards the teaching and learning of mathematics. Ethnomathematics teaches that both students and teachers can learn to model and value diversity in the classroom especially as it touches diversity in cultures.

### **The Challenge of Applying the Concept of Ethnomathematics**

A challenge for most teachers exists in how to incorporate students' out-of-school mathematical experience with classroom instructional activities. This task becomes even more challenging when the teacher's cultural background differs significantly from that of the students. Nevertheless, the teacher remains as a pivotal element of students' school experience. In order to provide ample opportunity to learn, teachers need to acknowledge that different discourse patterns may exist between home/community and school, and that these differences do not connote inferior or superior forms of knowledge. A larger part of teacher's role in the classroom, especially in mathematics is to help students connect scholarly mathematics with everyday mathematics (culturally related mathematics). Many times, teachers and students do not recognize the mathematics in everyday activities. By using these everyday out of school mathematics to contextualize and solve mathematics problems, the teacher can make mathematical concept more accessible and enjoyable to the students. Furthermore, the ways teachers structure lessons, assign tasks and respond to students' comments send messages, positive or negative, regarding what type of mathematical concepts are valued and how students are expected to interact.

### **Conclusion and recommendation**

The aim of mathematics and mathematics education has been to prepare students to succeed in the current world. Mathematics education needs to empower students to use mathematical knowledge to confront issues of social justice and an unequal power relationship. In addition, the level of and nature of mathematics required for

success today differs significantly from that required in the past, and the requirements will continue to change and advance as technology and the needs of the society evolve.

For the students to assume a productive and successful role in the future, they need to have developed critical thinking skills that will enable them to effect change in positive ways. Clearly, culture significantly impacts the types of mathematics students learn and the methods they learn. Hence, emphasis should be placed on ethnomathematical programs at all level of studies including secondary schools, teacher education and the National Mathematics Curriculum.

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