



Ethno-mathematics and indigenous mathematics: implications for science technology engineering and mathematics education

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ABSTRACT

Mathematics curriculum began as arithmetic where the basic arithmetic operations; multiplication, addition, subtraction and division, were explored. The Mathematics curriculum today with all its numerous have their roots in this basic operations. Mathematics was taught in the indigenous way with the indigenous approach essentially reflecting ethnomathematics. To this end, this study discusses ethno-mathematics with indigenous mathematics and their basic implications for science technology engineering and Mathematics (STEM) education for a sustainable national development.

Keywords: Ethnomathematics, Mathematics, STEM, Education.

1. INTRODUCTION

Ethnomathematics is the art or technique of explaining, knowing and understanding diverse culturally related learning styles which is found to develop the learners in Mathematics (Gilmer and Mulwankee, 2001; Mogari, 2002). This idea of relating Mathematics teaching and learning with tales, stories, and cultural practices facilitate and consolidate students' mathematical thinking ability. It was opined that cultural practices encourage and sustain certain kinds of cognitive processes, which then perpetuate the cultural practices. 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.

According to Bucknall and Howard, (1995) in Warren (2004), many Indigenous students experience difficulties when learning mathematics. Four major factors appear to directly impact on Indigenous students learning mathematics, namely: (i) language, (ii) assessment, (iii) learning style, and (iv) the relevance of the mathematical activity. It posited that the language background of Indigenous students can have a major impact on all educational outcomes. Hence, the call for the indigenous mathematics. Indigenous mathematics simply refer to the teaching and learning of mathematics using the indigenous language, socio-cultural practices, local and primitive ideas in making the teaching-learning process, remarkable, productive, encouraging and rewarding.

STEM, as posited by Elaine (2014), is a curriculum based on the idea of educating in four specific disciplines Science, Technology, Engineering and Mathematics- in an interdisciplinary and applied approach. Rather than teach the four disciplines as separate and discrete subjects, STEM readily integrates them into a cohesive learning paradigm based on real-world applications.

2. ETHNOMATHEMATICS AND INDIGENOUS MATHEMATICS

According to the Wikipedia (free encyclopedia), the term "ethno Mathematics" was introduced by the Brazilian educator and mathematician Ubiratan D'Ambrosio in 1977 during a presentation for the American Association for the Advancement of Science. The term Ethnomathematics requires a dynamic interpretation because it describes concepts that are themselves neither rigid nor singular that is "ethno" and "Mathematics" (D'Ambrosio 1987). The term ethno refers to identifiable cultural identity of a group such as languages, codes, values, jargons, beliefs, food, dress, habits and physical traits. Mathematics expresses broad views of courses which include ciphering, arithmetic, classifying, ordering, inferring and modeling patterns arising in the environment. According to Davidson in Adenegan and Adeleye (2016), Ethnomathematics is the art or technique of explaining, knowing and understanding diverse culturally related learning styles which is found to develop the learners in Mathematics.

As opined by Iluno et al (2013), we can help students realized their full mathematical potentials by acknowledging the importance of culture to the identity of the child and how culture affects the students thinking and learning. We must teach students to value diversity in the Mathematics classroom and to understand both the influence that culture has on Mathematics and how this influence results in different ways in which Mathematics is used and communicated. This cultural mathematical perspective is reflected during instruction in several ways. First, in many classrooms, students are not permitted to construct a personal understand of the Mathematics that is presented. The values, traditions, beliefs, language, and habits reflective of the culture of the students are ignored. In such situations, the ways that students might invent personally meaningful conceptualizations are not respected. In most of our higher institution of learning, students are expected to assimilate prescribed procedures by rote without necessarily gaining deeper and conceptually significant understands of the Mathematics that they are studying. This style of instruction unfortunately restricts learning to the length of time that students accurately remember the procedures. An application of the learning is also often context specific and poorly generalized because it is limited to the types of problems practiced when the procedures were taught. When cultural characteristics of the children invention, experience and application of Mathematics are realized and respected, then these students more closely will resemble the budding Mathematicians desired.

3. IMPLICATIONS OF ETHNOMATHEMATICS AND INDIGENOUS MATHEMATICS ON STEM

We all know that Mathematics is powerful enough to help us to build a civilization with dignity for all, in which iniquity, arrogance and bigotry have no place, and in which threatening life, in any form, is rejected. For this we need to restore Ethics to our Mathematics. History tells us that up to the end of 18th century, Mathematics was impregnated with an ethics convenient for the power structure of the era. So, it makes sense to talk about ethics in Mathematics. We believe Ethnomathematics can help us to reach the goal of Mathematics impregnated with Ethics. Ethnomathematics as a research program in the history and philosophy of Mathematics, with pedagogical implications, focusing the arts and techniques [tics] of explaining, understanding and coping with [mathema] different socio-cultural environments [ethno], its pedagogical strand has answers to the major goals of education which is:

- To promote creativity, helping people to fulfill their potentials and rise to the highest of their capability;

- To promote citizenship, transmitting values and understanding rights and responsibilities in society.

A convenient pedagogy for Ethnomathematics includes projects and modeling. The current scenario calls for a critical views of Mathematics education as the result of stressing its political dimension, but this meets the resistance of a nostalgic and obsolete perception of what is Mathematics. The resistance against ethnomathematics may be the result of a damaging confusion of ethnomathematics with ethnic-Mathematics which is caused by a strong emphasis on ethnographic studies, sometimes not supported by theoretical foundations, which may lead to a folkloristic perception of ethnomathematics.

In remarkably promoting and achieving STEM education, ethnomathematics and indigenous mathematics have strong and pivotal roles. Scientific and technological ideas leading to new and innovative ideas today could be better explored from the primitive ideas and locally sourced educational materials that can build a strong tie for a functional mathematics curriculum. Much of the STEM curriculum is aimed toward attracting underrepresented populations. For example, female students are significantly less likely to pursue university careers to the highest obtainable degree. A well taught mathematics with good and sound background always builds a foundation for future learning which will essentially promote the STM education.

The research studies carried out by different scholars, Individuals and research institutions at one point or the other had examined the relative impact of Ethnomathematical study on student's academic achievement or performance. According to the research conducted by Emmanuel E. Achor et al (2009) on the effect of ethnomathematics teaching approach on senior secondary students' achievement and retention in locus. The research study has shown that students taught with Ethnomathematical Teaching Approach (ETA) had a higher mean achievement score in Locus than their counterparts taught with conventional approach. The reason for this higher achievement by the ETA group could be that the students were able to integrate or link their background of study and their immediate environment with the foreign aspect of the learning of Locus.

achievement and retention in Mathematics in this study depend on the approach of instruction. The students exposed to ETA were superior in achievement and retention than those exposed to conventional teaching method. In general, ETA has proved to be a viable option in promoting meaningful learning in Mathematics. Hence, it is recommended that Mathematics teachers and lecturers should be trained on the use of ethnomathematics teaching approach in their lessons for a better future. This study exposed the fact that Ethnomathematics Teaching Approach is more effective than the Conventional Teaching Method.

4. CONCLUSION

In line with the 1948 UNESCO declaration on education and the 2004 OEDC declaration on mathematical Literacy, ethnomathematics clearly gained a more prominent role (Adenegan and Adeleye, 2016). Within Western curricula, ethnomathematics became meaningful to explore as an alternative, implicit philosophy of school mathematical practices. The extended notion of ethnomathematics as dealing with pupils' cultural diversity and with their everyday mathematical practices brings Mathematics closer to the social environment of the pupil. Ethnomathematics is an implicitly value-driven program and practice on Mathematics and Mathematics education. It is based on an emancipatory and critical attitude that promotes emancipation and equality. Where the so-called academic Western Mathematics still is locked in the debate on whether it is impartial or value-driven, the ethnomathematics' purposes stand out clearly right from the start.

It has been observed that these studies have inspired a growing interest in the cultural embedding of mathematical practices, including 'Western' ones. Within the philosophy of Mathematics, this has added to the array of studies, arising since the middle of the twentieth century, that collectively propose themselves as 'alternative' to foundational studies, by bringing back the nature of mathematical knowledge to where it seems to belong: in the practices of concrete, limited and fallible human beings. In the developed world itself, the interest has moved (or widened) from exotism to cultural diversity: Ethnomathematics in school no longer means a minute break from technical drill, but has become one of the instruments for better learning to deal with cross-cultural differences within or without the immediate environment.

The decision-makers on mathematical education in Nigeria are faced with a double challenge. On one hand, they have to endorse the changes of information technology to prepare students for tomorrow's jobs and to proceed to further education. On the other hand they should include cultural issues which could help students in learning Mathematics. There is, however, no doubt that every culture has its own "science", which is part of its inheritance and the result of the struggle for its survival. This "science" must not only be preserved in the museums, but it must also be used to achieve better results in the development and education, thus by incorporating it into the school curricula. This may also be the role an ethnomathematics program can play in mathematical education. The goals of such a program are also addressed to those students belonging to specific populations, whether they are in a mono- or a multicultural society.

One of the significant ways to reduce Mathematics learning difficulties among school students is to develop the Mathematics curriculum that takes into account the rich out-of-school mathematical experiences that children bring into the formal classroom. The use of traditional counting systems in teaching the formal English arithmetic strategies in schools is one such example that provides meaningful and relevant learning experience for school children at the same time bridging the knowledge gap between school Mathematics and the existing Indigenous knowledge-based systems found in the respective cultures. The suggestion is to cover the gap between the past and the future by collecting examples from the traditional culture on one hand, and examples from information technology and software on the other. In doing so, a student may enrich his experience and enlarge his vision, both resulting in a better understanding and learning of Mathematics.

Recommendations

The following recommendations are hereby made:

- 1) In order to maintain and improve on the nature and level of mathematics performances, there is the need to include the use of Ethnomathematics in the Mathematics curriculum of educational institutions in Nigeria. This in order to allow learners, teachers and parents to understand issues and problems in their society. Emphasis on the use of Ethno-Mathematics teaching materials should be made in the National Mathematics curriculum for Senior Secondary Schools, as technique to be used in teaching the concepts of Mathematics. This will in turn discourage rote learning of Mathematics and reduce drastically the alarming rate of failures in Mathematics subject.
- 2) Education and enlightenment programs should be organized for teachers in the field of Mathematics at various strata of education on the ethno mathematical Teaching techniques. Professional bodies such as Science Teachers Association of Nigeria (STAN), Mathematical Association of Nigeria (MAN), Nigeria Mathematical Society (NMS), National Association of Mathematical Physics (NAMP), among others, should organize workshops and seminars to popularize and sensitize Mathematics teachers on the use of ethno-Mathematics and indigenous mathematics teaching materials as approach in teaching students.
- 3) Mathematical Cultural values, techniques and activities should be carefully arranged and modified in line with the Modern day Mathematics, and to be included in curriculum content to be implored in the teaching of Mathematics.
- 4) Teacher training institutions of learning should include the use of ethno-Mathematics teaching materials as method in the Mathematics method course content. This will guarantee that after the teacher training, they will be equipped on how to teach mathematical concepts effectively.
- 5) 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-centered approaches to teaching and learning, utilization of multi-varied historical and culturally oriented instructional materials, assigning and marking homework, assignment and test, organizing quiz competitions , use of mathematics laboratory method, etc.

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