ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 10, pp.74112-74116, October, 2018

DOI: https://doi.org/10.24941/ijcr.32460.10.2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

INTERCULTURAL SIGNIFICANCE OF ETHNO MATHEMATICS: HIGHER EDUCATION IMPLICATIONS

***Dr. Ireneo C. Abad**

Cebu Normal University, Philippines

ARTICLE INFO

Article History:
Received 20th July, 2018
Received in revised form
09th August, 2018
Accepted 24th September, 2018
Published online 30th October, 2018

Key Words:

Ethnomathematics,
Academic Mathematics,
Cultural Diversity,
Cultural Perspective,
Desired Learning Outcomes.

ABSTRACT

This meta-research synthesizing the assertion for the need of cultural relevance in mathematics instruction revealed these findings that the complementation of ethnomathematics with academic mathematics for students to achieve the desired learning outcomes and the global significance of ethnomathemaics to mathematics through the congruence between culture and mathematics. Furthermore, the local significance of ethnomathematics to mathematics through culture and nativeness and their higher education implications through the desired learning outcomes achievement, creativity toward contemporary civilization, toward trained professionals, well – functioning educational system is imperative. Thus, it has been concluded that the global and local significance of ethnomathematics connects the students' socio-cultural identity toward relevant mathematical thinking. It was recommended that mathematics instruction should start with a relevant ethnomathematical narrative for innate learning interests and that the mathematical academics should have an advancedethnomathematical knowledge preparation prior to instructional delivery. And also, mathematics learners should be involved in gathering ethnomathematical narratives for instructional support and higher education institutional department chairs of mathematics should design and implement a long-range Program of Faculty Retooling-Retraining on Ethnomathematics-Mathematics Instructional Complementation.

Citation: ***Dr. Ireneo C. Abad*, 2018.** "Intercultural Significance of Ethno mathematics: Higher Education Implications", *International Journal of Current Research*, 10, (10), 74112-74116.

INTRODUCTION

Be it basic education or tertiary education in most contemporary classrooms of instruction, almost every student studying mathematics declares a negative attitude toward this subject. It has been observed that most of the students in mathematics instruction complain of their difficulty in understanding mathematical concepts across algebra, geometry, trigonometry, calculus as observed in varied classroom settings and situations. The mathematics instructor usually presents the formula to the learners without even explaining further within the context of the formulaic progression: abstract concepts without reason nor basis on everyday social and cultural aspects that are innate and substantial to the learners' actual existence as human beings.

This scenario, as observed, leads to the students' negative attitude toward mathematics due to the absence of its relevance and meaning behind every formulaic essence. Hence, mathematics seems difficult to students, especially for those who are right-brain dominated in intelligence. Thus, in order to redirect academic mathematics toward meaning and relevance for students, promoting a significant mathematics education, there is a need to connect their learning of mathematics to their cultural and daily experiences, thereby enhancing their competencies to elaborate meaningful connections and deepening their understanding and appreciation of mathematics. This is the rationale of the study: the promotion of a cultural perspective in the school mathematics curriculum toward the development of the students' intellectual, social, emotional and political learning by using their own cultural referents to impart their knowledge, skills and attitudes. According to Rosa and Orey (2011), this curricular integration of ethnomathematics, empowers students to maintain their ethical identity while succeeding academically in mathematics learning. Within the frame of thought and rationale of this situationer, this metaresearch on the intercultural significance of ethnomathematics and its higher education implications is conducted.

Corresponding author:* **Dr. Ireneo C. Abad,
Cebu Normal University, Philippines.

Objectives of the Study

This meta-research synthesizes the existing data on ethnomathematics studies in order to assert the need for Malayan cultural relevance in mathematics instruction.

Specifically, it aims to:

1. assert the complementation of ethnomathematics and academic mathematics;

2. stress the global significance of ethnomathematics;
3. investigate the local significance of ethnomathematics; and
4. collectivize their higher education implications.

Operational definition of terms

In order to preclude the possibility of ambiguity, the following terms are operationally defined as used in the study.

Acculturated refers to the culture-free essence of mathematics as conceived by mathematicians.

Contextualized problems are mathematical problems to be solved within the context of the socio-cultural background of the learners.

Ethnomathematics refers to the mathematical practices of identifiable cultural groups regarded as the mathematical ideas existing in any culture.

Eurocentric refers to the conception of mathematics as a European construct of knowledge of facts, algorithms, axioms, and theorems.

Intercultural significance refers to the relevance of ethnomathematics across cultures and sociological ethos as synthesized in this study.

Metaresearch refers to the research which investigates research, which is the type of research utilized in this study, which analytically investigates existing research findings to synthesize a new collective knowledge and its implications as intellectual assertion.

MATERIALS AND METHODS

This chapter details the procedural synergy employed in this study, which discusses the following progression: the method of research used, the sources of data, and the data-generating process.

Method of Research Used

This qualitative study is a *meta-research*, which is a research that investigates researched data. This type of research analytically investigates varied existing research findings to synthesize a new collective knowledge and its implications as *intellectual assertion*. Meta-research is a recent practice of research that investigates research data with the ultimate goal of finding evidence-based improvements. Known as "research on research," it uses research methods studying existing research findings for improvement, application, utility toward improvements. It covers all fields of study and has been describe as "taking a bird's eye view of science." It aims to improve scientific practice toward utilitarianism for the improvement of human and social conditions. It also involves thematic areas of methods, reporting, reproducibility, assessment, and utility of research data. Since one needs to see the big picture to identify similarities and differences, a research effort is needed that cuts across disciplines, drawing from a wide range of methodologies and theoretical frameworks and yet shares a common objective, that of helping science progress faster by conducting research on research itself: meta-research (Gay,2000).

It uses IMRAD (Introduction, Methodology, Results and Discussion) research paper format.

Sources of Data

The verbal data analyzed purposively in this meta-research are sourced out from existing published global and local reference based research on ethnomathematics.

RESULTS AND DISCUSSION

This chapter condenses the verbal data that are analyzed to respond to the metareseach focus on: the complementation of ethnomathematics and academic mathematics, the global significance of ethnomathematic, the local significance of ethnomathematics, and their higher education implications.

Thus, the results and discussion probe into the *new knowledge*: the intercultural significance of ethnomathematics, catapulting logically toward their higher education implications. The chapter ends with the synthesis of all these.

The Complementation of Ethnomathematics and Academic Mathematics

The argument, that the global and local significance of ethnomathematics connects the higher education students' socio-cultural identity to the study of mathematics toward elaborate, meaningful, and relevant mathematical thinking, is based primarily on the congruence between culture and academic studies. This complementation between culture and the academe in mathematics instruction is revealed in the data synthesized in table 1. Academic mathematics consists of a body of knowledge of facts, algorithms, axioms, and theorems. Mathematics for a long time has always been regarded as an academic discipline unaffected by social values (Bishop, 1993). Mathematics is always taught as a culture-free course which involves learning that is supposedly universally accepted facts, concepts, and contents (D'Ambrosio, 1990).This modern view, that academic mathematics is universal, objective, culturally neutral, strongly stress that academics is solely Eurocentric and value-free which misrepresents its universal evolution (Joseph, 2000). Ethnomathematics, as coined by D'Ambrosio (1985), describes the mathematical practices of identifiable cultural groups and may be regarded as the study of mathematical ideas found in any culture. The coinage is made up of the following prefix (ETHNO-), root (-MATHEMA-), and suffix (-TICS):

ETHNO- (the prefix) refers to members of a group within a cultural environment identified by their cultural traditions, codes, symbols, myths, and specific ways to reason and infer -MATHEMA- (the root) means to explain and understand the world in order to transcend, manage, and cope with reality so that the cultural group members can survive and thrive.-TICS (the suffix) refers to techniques, such as counting, ordering, sorting, measuring, weighing, ciphering, inferring, modeling. Within the face-to-face complementation between ethnomathematics and academic mathematics, this cultural relevance toward inner understanding of the learners' computational skills can be achieved. Within ETHNO-, -MATHEMA- develops the –TICS techniques. It involves daily problems people face, larger problems of humanity, and the endeavors of humans to create a meaningful world.

Table 1. The Complementation of Ethnomathematics and Academic Mathematics

Discipline of Study	Instructional Practices	Effects on Learning
Academic Mathematics	Culture-free discipline/study on knowledge on facts, axioms, algorithms, theorems	Solely Eurocentric, misrepresenting universal evolution
Ethnomathematics	Study of mathematical ideas and practices in any culture	Complements academic mathematics to achieve the desired learning outcome

Table 2. The Global Significance of Ethnomathematics

Ethnomathematicians	World View Significance of Ethnomathematics
D. C. Orey (2000)	Forms of mathematics vary according to cultural activities.
U. D'Ambrosio (1990)	Ethnomathematics stresses the social relevance of mathematics.
N.S. Nasir and P. Cobb (2007)	Mathematics practices are developed in different cultural groups.
B. Barton (1996)	Different cultures negotiate their mathematical practices in different modes.
M. Borba (1992)	Ethnomathematics demonstrates how mathematical thinking is inherent to people's lives.
P. Dowling (1991)	Mathematical concepts are embedded in cultural practices.

Table 3. The Local Significance of Ethnomathematics

Filipino Anthropologist	Cultural Studies	Ethnomathematical Significance
J. Peralta (1998)	Angono Petroglyphs and Petrographs	Prehistoric Filipinos show notions of symmetry and proportion
R. Manapat (2011)	Debt and Usury	Ancient Filipinos show debts are incurred through commodity
A. Postma (1991)	Laguna Copperplate Inscription	Ancient documents reveal the use of cultural system of weights and measures

Table 4. Higher Education Implications

Significance of Ethnomathematics	Implications to Higher Education
Complementation of Ethnomathematics and Academic Mathematics	Achievement of desired learning outcomes through culturally globalized mathematics
Mathematical Thinking in Congruence with Ethnomathematics	Mathematics students' creativity toward contemporary civilization, economy, finances, marketing, etc.
Global Challenges Addressed by Ethnomathematics	Enriched mathematics instruction for specialized workers, builders, artisans, maintenance people, trained professionals
Mathematical Intelligence in a Sociocultural Perspective	Well-functioning educational system through a culturally relevant mathematics curriculum

Ethnomathematics, thus is a cultural construct. Since teachers of mathematics are as human as their mathematics learners, there is a need for these teachers to make applicable teaching techniques to understand how their own ethnicity coordinates with their students' performance to learn mathematics. Thus, ethnomathematics should complement academic mathematics for Filipino students to achieve the desired learning outcomes within the context of ethno-Malayan culture.

The Global Significance of Ethnomathematics

The world view that ethnomathematics is globally significant is supported by postmodernist ethnomathematicians as shown in table 2.Orey (2000) asserts that the global significance of ethnomathematics depends on how the forms of mathematics vary according to cultural activities. Ethnomathemnatics, as a program, studies the cultural aspects of mathematics. It acknowledges that there are different ways of doing mathematics by considering the appropriation of academic mathematical knowledge developed by different sectors of society as well as considering different modes in which different cultures negotiate their mathematical practices. In this regard, ethnomathematics can be characterized as a tool to act in the world. Hence, ethnomathematics is globally significant.

D'Ambrosio (1990), in stressing the global significance of ethnomathematics, insists that ethnomathematics presents the mathematical concepts of the school curriculum in a way in which these concepts are related to the cultural backgrounds of students, thereby enhancing their ability to make meaningful connections and deepening their understanding of mathematics. The field of ethnomathematics studies, students' diverse ways of knowing and learning as well as culturally embedded knowledge needed to be integrated in the pedagogical action of this program. Hence ethnomathematics provides insights into the social role of mathematics. Nasir and Cobb (2007), assert that the learning of can be catapulted across the societal values and humanizing elements of culture as developed in different cultural groups. Within the matrix of social and humane insights, the learning of mathematics becomes meaningful. Barton (1996), in exploring cultural diversity in mathematics, state that ethnomathematics illustrates how different cultural identified as mathematical practices. Ethnomathematics acknowledges that there different ways of doing mathematics by considering the appropriation of the academic mathematical knowledge develop by different sector of society as well as by considering different modes in which different cultures negotiate their mathematical practices. Borba (1992), in affirming the ideology of certainty in mathematics education, stresses that ethnomathematics demonstrates how mathematical thinking is inherent to people's lives. Ethnomathematics may be described 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. Hence, in this perspective, mathematical practice is developed in varied cultures in accordance to everyday problems that proliferate within an ethnic context. Dowling (1991), in contextualizing mathematics toward a theoretical map, asserts that mathematical concepts are embedded in cultural practices. Mathematics is a natural phenomenon across traditional and non-traditional cultures. Thus, ethnomathematics involves mathematical concepts within cultural practices and recognizes that all social cultures develop ethnic methods and explications to their own distinct realities.

It also reveals that these cultural methods are in constant, dynamism. Thus, ethnomathematics is globally significant to mathematics instruction through its dynamic integrative pedagogic approach focusing on the congruencies between culture and mathematics within the duality of Western and Malayan ethnicities.

The Local Significance of Ethnomathematics

In Philippine context, the local significance of the idea of ethnomathematics is drawn from the comprehensive study of mathematical ideas in early Philippine society by Manapat (2011) which calls the attention to the existence of a highly developed enumeration and arithmetical system prior to the Spanish conquest. Manapat argues that: *This enumeration system possesses unique characteristics*; *that definitely distinguish the system from other Southeast Asian Society* (2011).Three cultural studies cited in this research point out strongly the local significance of ethnomathematics: *Angono Petroglyphs, Debts and Usury, and Laguna Copperplates Inscription.* The Angono petroglyphs and petrographs, as Peralta (1998), the most seasoned anthropologist from the National Museum asserts, describe and reveal their ethnomathematical significance by showing how prehistoric Filipinos show notions of symmetry and proportion since the rock and cave drawings show a respect for the basic mathematical and aesthetical ideas of symmetry and proportion, as well as the more complicated idea of mathematical scaling, as seen in the successful resizing of the stone etchings from the actual, bigger figures of men and animals they represented. The drawings, more significantly, evidence the important capability of abstraction. They use simple lines to draw their figures, implying a more abstract approach to the subject matter. The Neolithic artists of Angono used lines to draw the figures, which represented themselves and other members of their community, implying at least three different levels of abstraction like: 1. the abstraction necessary to draw and properly utilize a line; 2. the abstraction shown in using a line to depict a figure; and 3. the abstraction required to see that the figures drawn representthe artists and the members of their community (1998). Manapat (2011) reports that the ancient Filipino institution of debt and usury reveals yet another instance of mathematical thinking: an ethnomathematical significance. The universally accepted means of exchange and store of value in ancient Philippine society was not money but rice, the staple food. Debts were, therefore, incurred through this commodity. Repayment of the debt was expected to be accompanied with interest since rice was not the only immediate food but was also seed, or capital, used in planting to produce more rice. The payment of interest represented the alternative cost of rice or the benefits forgone during the period the rice was on loan. The amount of interest *(tubo)* to be charged is directly related to the potential harvest. The interest grew not through simple arithmetical accretion but was doubled every harvest time.

It was conceived of as function of the productive value of rice used as capital or seed. The idea that something grows not just arithmetically but geometrically, by compounding interest over the different harvest seasons, implicitly seeing a relationship between organic growth and interest payment, demonstrates an ability to perceive abstract mathematical relationships and utilize these patterns in everyday life (2011).Postma (1991) reports that the recently discovered *Laguna Copperplate Inscription (LCI)* is an ancient ethnomathematical document showing the use of standard system of weights and measures. The earliest document or artefact relating to early Philippine society, the LCI also reveals the use of mathematics in the ancient history of the country. The LCI, recorded during the equivalent of the last year of ninth century A.D., is a form of legal document engraved on a copper plate absolving a nobleman and his family of debts. The LCI, written in an ancient Malay variation of Sanskrit, Old Bahasa Malay, was inscribed on the plate using the old Kawi script, the ancient basis of Southeast Asian writing systems. The LCI is a document using the Saka calendar system, permitting us to count and to mark the years, and also shows a precise measurement for gold, implying the use of a standard system of weights and measures. The LCI also refers to the phases of the moon to fix the precise day within the month, implying familiarity with the basic conc epts of astronomy. Collectively, the significance of these local ethnomathematical scenarios of ancient Philippine arithmetical implicatures of culture and nativeness focuses on the local students' logical appreciation on how academic mathematics can be connected with popular techniques in accounting for existence in their world in response to the challenges of their endeavors of human survival stressing on their Malayan ethnicity.

Higher Education Implications

The higher education implications of the intercultural significance of ethnomathematics are condensed in table 4 for analytical discussion. Considering the culturally relevant pedagogic perspective in the enhancement of academic mathematics with ethnomathematics, higher education implications are hereby addressed with relevant and great expectations in the Philippine Academia. The complementation of ethnomathematics definitely is geared toward the achievement of desired learning outcome by students through culturally globalized mathematics. The obligation of the higher education mathematics academic is to see to it that ethnomathematics utilizes the social role in the learning of academic mathematics on a Southeast Asian global perspective. Ethnomathematics represents the way the various cultural mathematized their own reality because it examines how both mathematical ideas and practices are processed. Ethnomathematics explores the interaction of academic and cultural ways to provide inclusive developmental programs for diverse populations served be educational institutions. To be more effective, this includes curricular relevance and builds curricula around the learners' culture. Mathematical thinking in congruence with ethnomathematics should foster the mathematics students' creativity toward contemporary civilization, economy, finance, and marketing. Ethnomathematics is dynamic, holistic, transdisciplinary, and transcultural. Its evolution surely benefits academic mathematics, mainly because ethnomathematics advances in a way that is much closer to reality and to the agents immersed in reality. There is a need to modernized the rich resources and cultural heritage of both academic and ethnomathematics and put them in their proper position in today's world. Global challenges addressed by ethnomathematics should lead to enriched mathematics instruction for specialized workers, builders, artisans, maintenance people, trained professionals. This strongly enriched mathematics instruction through the integration of ethnomathematics practical societal challenges is definitely focused on areas of universal interests and reach, such as commerce, industry, technology. These actual real-life needs rely on what people are doing in their daily lives. Hence,

this would need to prepare higher education students to work in a diverse, multicultural world, with recognition of the contributions the members of other cultural groups have made to mathematics. Mathematical intelligence in a sociocultural perspective produces a well-functioning educational system through culturally relevant mathematics curriculum that balances ethnomathematics with academic mathematics. The role of ethnomathematics, thus, in mathematics higher education is to show, that ethnomathematics provides academic mathematics with an important framework that can help transform mathematics into a discipline that is better able to contribute to attainment of the dream of an equitable and humane society. As logically analyzed through the implications to higher education of the significance of ethnomathematics of Malayan origin in academic mathematics instruction, Philippine higher education can implement a faculty retooling program to enhance the integration of socio culturally enriched instruction of Mathematics in the Modern World, stressing the innate relevance of ethnomathematics in the acquisition of mathematical intelligence across the academic interdisciplinary programs of college students who are of Malayan cultural origin.

Conclusion

It has been proven that the global and local significance of ethnomathematics connects the higher education students' socio cultural identity to the study of mathematics toward elaborate, meaningful, and relevant mathematical thinking within ethno-Malayan culture.

Recommendations

Based on the findings and conclusion, the following recommendations are hereby offered:

1. The mathematics academic should start each unit of mathematics instruction with a relevant ethnomathematical narrative for the learners to strengthen their innate Malayan cultural and social background knowledge to support innate interests in learning mathematical concepts and processes.
2. The mathematics academic across the curricular programs should prepare in advance on relevant and applicable Malayan ethnomathematical components of all mathematics instructional aspects by a whole-brain processing of the existing global source of ethnomathematics by D'Ambrosio, Orey, Nasir, and Cobb, Barton, Barba, and Dowling online.
3. The mathematics learners of Malayan cultural origin must be involved by the mathematics academic in gathering ethnomathematical narratives from the urban, suburban, rural practices of local population that specifically support and relate to mathematical concepts, axioms, algorithms, and computational processing for each mathematical unit of learning.

REFERENCES

Barton, B. 1996.Ethnomathematics: Exploring cultural diversity in mathematics. New Zealand: University of Aukland.

Bishop, A. J. 1988. Mathematical enculturation: A cultural perspective on mathematic education, Netherlands: Kluwer.

Boaler, J. 2000. "Exploring situated insights into research and learning" *Journal for Research in Mathematics,* N.Y.: JRME.

Borba, M. 1992. The ideology of certainty in mathematics education. Brazil: PME.

Cobb, G. 2003. An application of Markov chain Carlo to community ecology.N.Y.: The American Mathematical Monthly.

D'Ambrosio, U. 1995.Ethnomathematics and its place in the history and pedagogy of mathematics. Brazil: EditoraAtica.

D'Ambrosio, U. 1990. Ethnomathematica. Brazil: EditoraAtica.

Dowling, P. 1991. 'The contextualizing of: Towards a theoretical map," InM. Harris (Ed,), Schools, mathematics, and work. London: Falmer Press.

Gay, G. 2000. Culturally responsive teaching. N.Y.: TCP.

Josesph, G.G. 2000. The crest of the peacock: Non-European roots of mathematics. London: Penguin Books.

Ladson-Billings, G. 1995. Toward a theory of culturally relevant pedagogy. N.Y.: AERJ.

Manapat, R. 2011. Mathematical ideas in the early Philippine Society. Quezon: Ateneo de Manila University

Nasir, N.S. and Cobb, P. 2007. Equity in students' access to significant mathematical ideas. N.Y.: TCP.

Nunes, T. 2005.Ethnomathematics and everyday cognition. N.Y.: MacMillian.

Orey, D.C. 2000. "The ethnomathetics of the Sioux tipi and cone." In H. Selin (Ed.).Mathematics across culture. Netherlands: Kluwer.

Peralta, J. 1998. Petroglyphs and petrographs: Kasaysayan. Mla. Asia Publishing.

Postma, A. 1996. The Laguna Copperplate inscription. MM: The National Museum.

Rosa, M. and D.C. Orey, 2003. Wine and Cheese: ethno mathematics and modelling. BOLEMA.

Torres-Velasquez, D. and G. Lobo, 2004. Culturallyresponsive mathematics teaching and English language learners. TCM.

****