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Um diálogo com Ubiratan D'Ambrosio: uma conversa brasileira sobre etnomatemática

A dialogue with Ubiratan D'Ambrosio: a Brazilian conversation about ethnomathematics

Ubiratan D'Ambrosio[1]

Milton Rosa[2]

Resumo

Neste diálogo, gostaria de oferecer ao leitor, uma introdução ao programa etnomatemática. O que é, de onde vem, sobre o que se preocupa, e o mais importante, qual é a agenda deste programa para o século 21. Assim, elaborei uma entrevista com Ubiratan D'Ambrosio para discutir assuntos importantes relacionados com o programa etnomatemática. Espero que os temas discutidos nesta entrevista sejam uma adição importante ao crescente debate que envolve a etnomatemática.

Palavras Chave: Ubiratan D'Ambrosio, Etnomatemática, Educação Matemática, História, Contexto Sócio-cultural

Abstract

In this dialogue, I would like to offer to the reader an introduction to ethnomathematics. What it is, where it comes from, what it worries about, and most importantly, what is its agenda for the 21st century. In doing so, I generated an interview with Ubiratan D'Ambrosio that discusses important issues related to the ethnomathematics as a program. It is hoped that the themes discussed in this interview will add to the growing dialogue that surrounds ethnomathematics.

Keywords: Ubirtan D'Ambrosio, Ethnomathematics, Mathematics Education, History, Sociocultural Context

Presentation

It is my distinct honor to share an introduction for this vitally important conversation between two Brazilian scholars who I dearly admire. From their own

[1] Emeritus Professor – UNICAMP - Universidade de Campinas, São Paulo, Brazil, ubi@usp.br

[2] Mathematics Teacher - Encina Preparatory High School, San Juan Unified School District, Sacramento, California, USA, milrosa@hotmail.com

particular vantage points as teacher and student, they each have done a great deal to add to the growing body of scientific discourse and understanding between our two countries.

I first met Ubiratan D'Ambrosio over 15 years ago, at a conference in California. I found him sitting on a bench by himself after his speech. I approached him and asked if he needed any help, and we ended up spending the next three days together conversing about life, ethnomathematics, Latin America, and Brazil, where upon he invited me to come to Brazil. I feverishly began a study of Portuguese and wrote a Fulbright application. "Ubi" was generous in sponsoring me and connected me with the right people in Campinas, where I spent time learning about how Brazilian scholars and teachers use mathematical modeling to document ethnomathematics. Thanks to his continued encouragement, I have continued to work, present and live on and off in Brasil. Most recently, with his encouragement I was a CNPq researcher at the Universidade Federal de Ouro Preto in Minas Gerais. His work, love and patience, and his encouragement mean so very much to me, and, I can confidently say, hundreds of other scholars worldwide. He is deeply admired, loved and respected for his work and contributions to the field of mathematics education.

I met Milton Rosa, in 1998, while serving as a Fulbright scholar to the Pontificia Universidade Católica de Campinas (PUC-Campinas). As a member of one of the five teacher-researcher groups, he generously facilitated a series of visits for me to his schools in Amparo. I ended up being adopted by his family, schools, and neighborhood. I spent almost every Friday night for four months (classes at his schools went to 11pm!) learning how his schools worked and functioned. He was selected to participate in the California State teacher exchange, and ended up being the first South American, as well as the first Brazilian to participate in it. We continued the pattern of research in his new classes environment here in the States where I assisted him in adjusting to teaching in a California public school. This opportunity allowed him to earn a master degree in education. His work at the school in Sacramento has been so well received that the school district has offered to sponsor him to extend his visa, which has allowed him to be enrolled in a doctoral program. Together we have collaborated on numerous projects, books, chapter books, and articles

One of my observations from my work here in California and in Brasil is the dearth of sound research and literature related to work in ethnomathematics that is published in English. A few of us have attempted to translate important documents, books, and papers, but the Brazilian scholarship and production rate in ethnomathematics far outstrips the ability of those who translate. The overall movement in ethnomathematics seems to be circumventing the United States, for many reasons. Most notably because of a subtle but notable sense of arrogance towards anything invented or produced south of 0 degrees latitude[3]. One example of this crime, per se, is that a recent special edition of *Scientific American-Brasil* was devoted to ethnomathematics. Despite its success abroad, the editors of the English/USA version of *Scientific American* have no plans to translate or share the same publication for the non-Portuguese speaking audience. This represents a serious loss for the overall scientific community.

Possibly, well over 80% of the research in the field of ethnomathematics is published in Portuguese or lies in university archives in Brasil, awaiting scholars the opportunity to come across it, as I did in PUC-Campinas in 1998. If you visit there, you would see numerous systematic examples of ethnomathematics using mathematical modeling of the highest possible caliber. Along with the research group at the Universidade de São Paulo, the Brazilian national ethnomathematics group is organized and represents a positive and highly respected force in both mathematics education and ethnomathematics in South America. It behooves us all to pay attention to the talented, creative and enthusiastically received work going on "debaixo do equador[4]". Without a doubt, ethnomathematics represents just one of the many new ideas that continue to emerge in diverse locations outside of traditional European-North American paradigms of scientific inquiry.

In so doing, I believe that the elaborations described in this dislogue are key points in clarifying different ways of understanding ethnomathematics because they have everything to do with how many educators are coming to incorporate ethnomathematics

[3] There is serious work being done below the Equator. South American scholars apply what they learn to situations and contexts far different than those that exist here in the United States. From this context are emerging new ideas that serve the changing contexts in the north. One of these new ideas is ethnomathematics.

[4] The English translation of the Protuguese phrase "debaixo do Equador" is "below the Equator".

into the struggle for a better world. I agree with D'Ambrosio who sees a possibility of the development of a new civilization where there is no inequity, bigotry, intolerance, hatred, and discrimination, which allows for cultural dynamics to play its role in the evolution of the human specie.

So it is that I am pleased to present this conversation between Ubi and Milton with hopes that this dialogue will inspire further conversations, research, and scholarship in the field of ethnomathematics.

Daniel Clark Orey
Professor of Mathematics and Multicultural Education
California State University, Sacramento
Sacramento, California

Introduction

In this interview, I have attempted to capture D'Ambrosio's thoughts and to elucidate his ideas in order to clarify some misconceptions about ethnomathematics. We would like to state at the outset here, that there are other perspectives and new views on ethnomathematics emerging from other researchers in the field. Most assuredly they deserve our respect and admiration. I begin here with a conversation with Ubiratan D'Ambrosio.

Seen in this context, I would also like to emphasize that the questions, answers, and comments made in this document are the personal views of this writer and of D'Ambrosio, on ethnomathematics. We are certain that these views will not be agreed upon by all educators, mathematicians, and philosophers, yet we are also confident that in some cases the perspectives presented here are in discordance with views of other ethnomathematicians. In so doing, we believe that this paper may be a good illustration of what happens within a relatively new research field continues to evolve, and which has spread itself to hundreds of universities and communities worldwide, in a relatively short period of time. Ethnomathematics is evolving, and as more and more research is uncovered worldwide, it is also a research field that is not yet crystallized. As it stands to day, it seeks

to document and understand diverse mathematical practices of the very cultures it seeks to empower and study.

The Role of Ubiratan D'Ambrosio in the Development of the Ethnomathematics

It is important to highlight the importance of the Brazilian mathematician and philosopher Ubiratan D'Ambrosio, in relation to the development and evolution of the field of ethnomathematics. D'Ambrosio is also one of the most important theoreticians in this field. By offering encouragement, leadership, and dissemination of new ideas, concepts, and perspectives involved in ethnomathematics around the world and its applications in mathematics education he is without a doubt the primary leader. Powell & Frankenstein (1997a) stated:

> *D'Ambrosio's broader view of ethnomathematics accounts for the dialectical transformation of knowledge within and among societies. Moreover, his epistemology is consistent with Freire's (1970, 1973) in that D'Ambrosio views mathematical knowledge as dynamic and the result of human activity, not static and ordained (p.8).*

D'Ambrosio's studies in the area of socio-political issues established a strong relationship between mathematics, anthropology, culture, and society. In 1983, D'Ambrosio was honored with the title of Fellow of the American Association for the Advancement of Science (AAAS) for his imaginative and effective leadership in Latin American Mathematics Education and his efforts towards international cooperation. Gerdes (1997) and Powel & Frankenstein (1997b) have considered D'Ambrosio "the intellectual father of the ethnomathematics program" (p.13). D'Ambrosio was also selected as one of the most important mathematicians of the twentieth century in the area of sociopolitical issues and ethnomathematics (Shirley, 2000). In 2001, D'Ambrosio was the recipient of the Kenneth O. May Medal of History of Mathematics granted by the International Commission of History of Mathematics (ICHM). Andersen (2002) stated that "The ICHM has awarded the May Medal to D'Ambrosio for his never ending efforts through writing and lectures to promote Ethnomathematics and thereby contributing intensely to make the field established" (p.1). In 2005, D'Ambrosio was awarded with the second Felix Medal of the International Commission on Mathematical Instruction (ICMI) that acknowledges his role in the development of mathematics education as a field of research.

The Etymological Root of Ethnomathematics

D'Ambrosio (1993) used the resource of etymology to name this program. He used three modified Greek roots, *ethno, mathema*, and *tics* to explain what he understands to be ethnomathematics. D'Ambrosio (1985) defined ethnomathematics "as the mathematics practiced by distinct cultural groups" which are identified as "indigenous societies, groups of workers, professional classes, and groups of children of a certain age group, etc." This *Dambrosian*[5] perspective of ethnomathematics is the motive by which specific cultures (*ethno vs. ethnic*) developed over history, the techniques and the ideas (*tics* = *techné*) to learn how to work with measures, calculations, inferences, comparisons, classifications, and the ability to model the natural and social environments in which we use to explain and understand phenomena (*mathema*). D'Ambrosio (1990) proposes that this program of study represents a methodology for ongoing research and analysis of the processes that transmit, diffuse, and institutionalize mathematical knowledge (ideas, processes, and practices) that originate from diverse cultural groups through history. Ethnomathematics is identified with the history of specific cultural groups.

A Conversation with Ubi[6]

(Milton) I believe that the examination of the historical aspects of ethnomathematics can lead us to develop further critical analyses of the overall generation and production of mathematical knowledge by human beings as well as the documentation and study of diverse intellectual processes of this production, the social mechanisms of institutionalization of knowledge through academics settings, and its transmission through educational systems. In my opinion, this aspect helps to increase understanding of the true universality of mathematics, while revealing mathematical ideas and practices of groups from different *ethnos*.

[5]The *Dambrosian* approach to the ethnomathematics program in the pedagogical strand emphasizes the influences of sociocultural factors on the teaching and learning of mathematics. D'Ambrosio (1990) states that much of the mathematics used in daily practice, as affected by distinctive modes of cognition, may be quite different from that which is taught in school. He indicates that many cultural differentiated groups "know" mathematics in ways that differs from academic mathematics in the school curricula.

[6] Ubiratan D'Ambrosio was my professor at Pontifícia Universidade Católica (PUC), in Campinas, state of São Paulo, Brazil, in 1998, in the *Ethnomathematics and Mathematical Modeling Specialization Course*. Since then, Ubiratan continued as my mentor and, most importantly, my very dearest friend. This is the reason, that, in this paper, I am writing Ubi instead of Ubiratan.

Does a historical study of ethnomathematics provide new insights to mathematical education? How?

(*Ubi*) This question has a double interpretation:

a) Ethnomathematics as a historical fact, and
b) History of the recognition that ethnomathematics is a fact, hence its assimilation by education.

As for the first, Ethnomathematics is as old as the human species. The early examples I give comes from the Neolithic. Our mode of history, which comes from Mediterranean Antiquity, relies on sources, which mean the registry of past facts, events and individuals. The history and philosophy of mathematics, as an organized body of knowledge that we are familiar with is an artifact from the European 18th century. By using an ethnographic approach to mathematical practices of non-European cultures, there is recognition that there are mathematical ideas and practices in every culture evolve along with the beginnings of ethnography and cultural anthropology. Mathematics was not immediately recognized as one other cultural manifestation. The essence of an ethnomathematics program is to give meaning to these ethnographical and anthropological observations and research, by recognizing, in different cultures, including those of the "West", the evolution of ways and modes of explaining and understanding of facts, phenomena and mysteries. Undeniably, looking at these ideas and practices helps us to understand the cultural evolution of human beings, from prehistory to the present, as well as from birth to death of an individual.

The two fundamental objectives of education (preparing for citizenship and stimulating creativity) can hardly be achieved, in a constructive way, by a traditional, formal, catechistic mathematics education, which frequently leads to individual annihilation, and intellectual, even material, enslavement, and favors inequality, bigotry and arrogance. The pedagogical component of an ethnomathematics program aims to achieving the two fundamental objectives of education. Even when practiced in the limited ethnographic style, ethnomathematics helps to build respect of other cultures, hence other individuals, avoiding inequality, bigotry and arrogance.

(Milton) I believe that this is very important to our present historical perspective in relationship to the development of ethnomathematics as a program. The acknowledgment and recognition of the contributions that individuals from diverse cultures have made through history of mathematical understanding, along with the recognition and identification of diverse practices of a mathematical nature may help to develop a sense of value for diverse cultural forms of knowledge by raising the confidence and self-esteem of individuals that belong to these groups.

What kind of critical analysis could be done in the study of the history of ethnomathematics?

(Ubi) Now we refer to the history of ethnomathematics as an academic field. It is impossible to determine in Western cultures, when mathematics started. It is a convenient, forced; *a posteriori* affirmation to say that Euclid or even Newton were mathematicians and they consciously produced mathematics. The subject, as a defined field of knowledge, comes from the 18th century. But we look to the precursors, persons or things that precede what we now call *mathematics*. Ethnomathematics is the recognition that, in every culture, there are ideas and practices that have similarities of objectives, practices, methods and theories, with what, in the Western tradition, we call *mathematics*, is a recent construct. Hence, to speak of a *history of ethnomathematics* is very difficult, because it is an evolving field that is still under construction. Yes, there are precursors in this recognition, mainly mathematicians, historians, philosophers, psychologists, and anthropologists of early 20th century. But we can go further back in history, citing even Herodotus and the travelers of the Age of Discoveries (15th century on).

(Milton) A basic tenet of an ethnomathematics program is that all cultural groups develop unique ways to look for and accumulate knowledge, and have evolved ways to *quantify*, *count, classify, measure, explain* and *model* the phenomena of their own daily occurrences. To further a growing dialogue in relation to this topic, and to assist in dispelling misconceptions in relation to ethnomathematics, I believe that a historical description of the development of this program of study is necessary.

If we are going to study the history of ethnomathematics and if we need to be more focused rather then general, what areas could we choose toplace our focus?

(Ubi) We have to be aware that modern academic-scientific mathematics is a western category, beginning in the late Middle Ages and early Renaissance, when we recognized new forms of space and time. These ideas started to develop in the 16th, 17th and early 18th century, and were more clearly identified in the late 18th and the 19th century. Any traditional history of mathematics looks into the past using this paradigm.
However, for a history of ethnomathematics, I would look into the ways and modes of explaining and understanding facts, phenomena and mysteries, focusing on how diverse people relate to space and time. Cultural anthropology is very important. A recent book by Peter J. Richerson and Robert Boyd (2005) entitled *Not by Genes Alone: How Culture Transformed Human Evolution* is a good starter. Then proceed to classical history, mainly Herodotus and then the chroniclers of the discovery (15th, 16th and 17th centuries) and then, the ethnographers and early anthropologists of the 19th century. Then, modern historians came and anthropologists of the 20th century, mainly Oswald Spengler, Alfred L. Kroeber, and Leslie A. White. Then we have mathematicians aware of the cultural components of mathematics, such as Y. Akizuki (1960) and Raymond Wilder (1967). These are what we might call the precursors. In ICME 3, in Karlsruhe, in 1976, Ethnomathematics started to build its profile, although the name was not used (except for a couple isolated and only recently noted cases). There is a bibliography of precursors in my conference at ICME 3. Then came ICME 5, in Adelaide, 1984, when the name and concept of Ethnomathematics where explicitly exposed. The text of my plenary conference in ICME 5 has a bibliography of works easily identified as being on Ethnomathematics.

After that, the books by Michael Closs (1996) *Native American Mathematics* and Elaine Selin (2000), *Mathematics Across Cultures: The History of non-Western Mathematics*, are also basic references. Both contain a vast bibliography, which provide the most relevant sources for Ethnomathematics.

(Milton) The sociocultural context of mathematics should be emphasized in the field of mathematics because it suggests that the study of mathematics, as it is traditionally

practiced in western societies, does exhibit a cultural bias. I believe that any given mathematical idea or practice is a product of a particular culture and I am primarily concerned with the way in which mathematics is taught in schools. In my opinion, a mathematics curriculum should have two objectives:

1) Include the mathematical knowledge experiences and contexts of non-Western civilizatons along with their contributions to the development and discoveries of the mathematical knowledge in general,
2) Avoid racial stereotypes and cultural bias in the elaboration of curricular and classroom materials, textbooks, and examinations.

This perspective into the curriculum should also address cultural issues when elaborating and communicating expectations about the students mathematics attainment in order to guarantee the effectiveness and unprejudiced methods that distinguish achievements between individuals from different cultural groups.

What constitutes the merging ideas into the mainstream mathematics curriculum?

(*Ubi*) I see merging ideas as the result of cultural dynamics. Both inter and intra. Example of inter: the encounter of Christian and Islamic views on the reality of the late Middle-Ages and an example on intra: the theoretical rigor of analysis and the still open practical problems of algebra in early 19th century.

(Milton) The history of mathematics can be seen primarily as an investigation into the origin of new discoveries in mathematics and also as the study of historical facts and standardized mathematical methods, procedures, and notations of the past. However, in my point of view, the history of ethnomathematics is the study of the mathematical ideas, procedures, and practices of individuals in different cultures as manifested and transmitted in diverse modes through generations.

What constitutes a parallel development between ethnomathematics and mathematics? Is there any common points?

(*Ubi*) In my understanding, there are no parallel developments of mathematical ideas in ethnomathematics. Ideas result from a complexity of factors, for which parallelism (as commonly understood) does not apply.

> ***(Milton)*** The verifcation of the analyses of the history of the production of mathematical knowledge by students verifies the contributions of cultures that were not afected by political hegemony. For example, in the comparative study of the systems of numeration, students can verify the process of supremacy of the Hindu-Arabic number system that people still use today. Students may conclude that the forced adoption of this system brought by European colonists, also came with prejudices against peoples of darker skin color and non-Christian cultures. In the light of this fact, other examples may be found by researching the production of mathematical knowledge in other cultures such as Chinese, Mayan, Roman, and in indigenours cultural groups in Africa and South America. This aspect may be one of the possibities of the insertion of diverse mathematical practices into the mathematics curriculum. The problem of calculating the area of a circle is a prime example of this line of thought.
>
> *How is it possible to insert into school curricula or acknowledging in accounts of history of mathematics various mathematical practices through the ages?*

(*Ubi*) Either through examples focusing techniques and even theories (as ensembles of explanation) or through a broad genetical (in the sense of Piaget's genetical *epistemology*) evolution of mathematical ideas.

(Milton) It is generally acknowledged that ethnomathematics has cultural and social dimensions. However, in reality, the pedagogy that is developed in mathematics classrooms deals with unspoken political goals and issues that cannot cope with different students cultural and social backgrounds. It is my understanding that these views do not consider the relevance of cultural and social dimensions of mathematics when developing and elaborating school curricula. One important objective of mathematics education should be to analyze learning opportunities that certain historically underrepresented minority groups should have in order to make their learning process a meaningful experience that is related to the cultural experiences and social needs of the students.

How is it possible to link indigenous knowledge and mathematics into the mathematics curriculum?

(*Ubi*) Sometimes it is impossible to make this link. It is possible to identify questions and problems that occur in the different complex natural, cultural and social atmospheres of the native and the alien, and to discuss the different approaches to the questions and problems. In a few cases, these are points of tangency or intersection (in both cases, there can be a common point).

(Milton) In my opinion, currently, the ethnomathematics program has an agenda that offers a broader view of mathematics, which embraces ideas, processes, methods, and practices that are related to different cultural environments. This aspect leads to increased evidence of cognitive processes, learning capabilities, and attitudes that may direct a learning process occurring in our classrooms. In addition, by reflecting on the social and political dimensions of ethnomathematics, I believe that another important aspect of its agenda is to offer an important perspective for a dynamic and globalized modern society, which recognizes that all cultures and all people develop unique methods and explanations that allow them to understand, act, and transform their own reality**.**

What is the agenda for the ethnomathematics program for the 21st century?

(*Ubi*) The agenda for ethnomathematics for the 21st century is to continue this continuing trajectory. I believe an ethnographical approach will continue to be attractive for teachers and students. This opens the discussion to critics, and we will see more attacks, aiming at what they call the non-serious, or folkloristic, or "Donald Duck" approaches to mathematics. It is natural, in the view of many educators, that by making children happy and at the same time building a recognition and respect for other cultures, there is a concern for losing "precious" instructional time, which could be used to teaching mechanical techniques [mostly useless!]. This futile and perverse criticism will persist, and as more research comes to light we will answer these concerns. But at the same time, the theoretical strand of an ethnomathematics program is growing as a valid alternative to traditional studies of history, philosophy, and pedagogy of mathematics. This will be more difficult to dismiss by futile criticism.

(Milton) In my point of view, ethnomathematics has with it a philosophical consciousness and contributes to a theoretical movement in the field of mathematics education that is looking for an improvement of the way we teach and learn mathematics by incorporating the knowledge of human values such as cooperation, solidarity, and ethics. Seen in this context, this is a hard task to accomplish but it may occur by developing values for different cultural backgrounds and promotion of a respect for all the different ways humans use to explain, understand, comprehend, and deal with new situations daily.

What is the importance of ethnomathematics perspective in terms of mathematics education?

(*Ubi*) Ethnomathematics develops a sense of respect [by knowing the other], a sense of solidarity [by recognizing the need of sharing knowledge] and cooperation [to face complex, non-standard and non-artificial, questions and problems]. Respect, solidarity and cooperation lead to the rejection of bigotry, inequity and arrogance between humans.

> ***(Milton)*** One of the objectives for an ethnomathematics program is learning to understand the student's own reality and create a pedagogical action in a natural manner by using a cognitive focus and a cultural basis for the curriculum. Therefore, the study of the history of mathematics and ethnomathematics is very important in this context, in order to understand and explain the dynamic of the production and transmission of mathematical knowledge acumulated by different cultures.

What is the evidence that support the need of the study of the history of ethnomathematics?

(*Ubi*) As every evolving field of study, it is important to recognize the evolution of ethnomathematics, as a response to the dangerous course of humanity towards a destruction of individual dignity, of tense and violent societal relations, of unviable environmental relations and of increasing armed confrontations. Ethnomathematics naturally leads to PEACE in its various dimensions [dignity of the individual, just social relations, environmental equilibrium, and non-violent resolution of conflicts]. This is my hope for the future.

(Milton) Many discussions have been raised by some researchers about the epistemology of an ethnomathematics program. Renowned researchers come to recognize ethnomathematics as a "science", located in the confluence zone between mathematics and cultural anthropology. For example, Ferreira (1997) defines ethnomathematics as a methodological proposal with its own pedagogical action, which is stimulated by ethnographical studies and uses mathematical modeling as a tool to reach the educational goals of the investigated cultural group. On the other hand, Ascher (2002) highlighted the presence of the mathematics of peoples from a variety of traditional cultures by illustrating how their mathematical ideas play a vital role in diverse human endeavors. These perspectives show two of the numerous dimensions of an ethnomathematics program. In my point of view, there are different interpretations of this program that are often interrelated. In accordance to one's belief, I believe it is possible to identify six dimensions for this program: *conceptual, historical, cognitive, epistemological, political*, and *educational*.

In your opinion what are the other interpretations or dimensions of the ethnomathematics as a program?

(Ubi) I am really concerned about the emphasis given to ethnographic studies because my proposal focuses on history and it is also transdisciplinary and transcultural in nature. There are concepts that are mathematical in nature (= space/form + time/quantity) that are universal even in the "trans" concessions.

(Milton) In order to allow the ethnomathematical perspective to enter into classrooms, it is necessary to work with an open mathematics curriculum. In this perspective, what will be covered and in which order this will happen, depends on the development of the class and how students become interested and motivated in the mathematical content. In order to do this, teachers must go through a different pedagogical process that identifies the cultural bases of the mathematical content they are trying to teach in order to integrate contributions from different cultures into their lessons.

1) How can teachers integrate the contributions of diverse cultures into the school curriculum? Could you please give an example?

(*Ubi*) Teachers can integrate the contributions of diverse cultures into the school curriculum by talking about them. For example, they can read classics such as "One Thousand and One Nights" or they can study the Orixás[7] but without looking for mathematics in it.

2) Are students going to study the contributions of all cultures?

(*Ubi*) This is not possible. They are going to study just one or another example, according to the motivation of students and teachers. The given examples will be only used to exemplify the existence of different intellectual options of distinct cultural groups.

(Milton) The absolutist view of mathematical knowledge such as *formalism, logicism, abstraction,* and *rigor*; has for the most of two thousand years dominated much of the mathematics curriculum. This view is still the one currently held by many modern and traditional educators, mathematicians, and philosophers. In this perspective, the current methodological practice of teaching and learning mathematics consists in discovering the already existing formal logic through decontextualization of mathematical concepts that have no meaning and are divorced from daily experiences, activities, and practices of the students. This traditional pedagogical practice is still predominant in most school settings.

What is the mathematics all students have to study?

(*Ubi*) It is everything that refers to space and time in our "fast" world, with many models and simulations, and ample uses of technology for technical mathematics. It is the same as when artisans make a chair, they also use modern technology not only old saws.

(Milton) One of the objectives of an ethnomathematics program, is to show that mathematics is a cultural endeavor deeply rooted in tradition. In so doing, every civilization developed a system of mathematical ideas, which are ways of coping with their own reality through diverse cultural instruments such as measurement, comparison, quantification, classification, inference, and modeling. In this context, it is very difficult to

[7] Orixás are the deities worshipped in the Candomblé religion and brought to Brazil by slaves, especially the Yoruba people. In Africa, these were the kings, queens, mythical heroes and other ancestors rose to the status of gods. In Brazil and other nations of the Americas, as in Cuba with the Santería, the African deities were disguised through their association with Catholic saints in order to practice the religion in spite of it being forbidden. In the Brazilian Candomblé, for example, Xangô corresponds with Saint Hieronymus and Oxossi with Saint George.

reach such perceptions if the academic system deals only with the mathematics that since early antiquity, grew out of the Mediterranean context. Since an ethnomathematics program is culturally rooted, there is no syllabus and mathematical content must be selected by using cases that are ethnomathematical in nature and related to a student's cultural environment.

Is the mathematics being tied to what is discovered in the culture, thus motivating those specific students to study it?

(*Ubi*) No. Mathematics is a Western construct, was invented to deal with space/measurement and time/counting and its own sacralization[8]: sacred space/abstract geometry, sacred time/arithmetic of cultures centered on the Mediterranean basin. Other cultures have developed different ways of explaining these four categories.

(Milton) It is evident that there is an intention to investigate the interrelationship between mathematics education and the social, cultural, environmental, and political aspects of the learning process of mathematics. There is also a necessity that educators should search for different ways to overcome the cultural oppression that is implicit in the teaching and learning of mathematics. In so doing, by drawing on the cultural backgrounds, experiences and mathematical practices of the students, we should allow for a natural understanding of mathematical concepts, whose objective is to reduce the effects of cultural differences that are imposed by dominant culture over minority groups.

If certain minority groups in our schools today are known to employ particular ethnomathematical practices, in which case these ethnomathematical practices are viewed as cultural? Should individuals in such groups be bound by such practices? In this context, are studies of historical practices of mathematical nature in these diverse minority cultural groups of primary importance?

(*Ubi*) No, except if they want to communicate and deal with the dominating group, they have to master their ways of doing. This is why the prairie Indians started to use guns

[8] Neologism used by Ubi. From the Portuguese word *Sacralização* to *Sacralization*. In this context, Ubi introduces this new word in English, which applies to the ethnomathematical context, which means the act or effect to attribute a sacred characteristic to one or more categories. That is, when a specific category becomes sacred.

instead of arrows and bows. Their schools were only teaching them how to use bows and arrows!

But, then why bother with ethnomathematics since it is not useful? It is useful; in vary limited and restricted ways, that is, to communicate and to deal with local, communitarian, and tribal issues within their own cultures. However, ethnomathematics is very, very important in stressing cultural dignity, respect for a past mode of thought, which had much, enormous, importance and coherence, but which was stopped and suppressed by the alien intervention. This means restoration of cultural dignity, which gives strength to the individual for being intellectually free and creative. The studies of their mathematical practices are the utmost importance in order to value their cultural background.

(Milton) All societies have developed mathematical practices appropriate to their daily lives and their cultures. Different indigenous communities use a diversity of ideas, processes, and practices in order to deal with their physical and social environments. Some of these practices may be transformed with interactions and contact with other cultural groups. It is necessary to question the effects of a student's cultural background and their ability to learn mathematics. Another question is related to indigenous mathematical ideas and the pedagogical procedures that allows for an effective relationship between different cultural practices.

Are indigenous mathematical practices not allowed to evolve and expand based on newer forms of social and cultural lives of people who engage with others outside their own cultures?

(Ubi) Not because of this aspect, but because of the lack of cultural dignity, the lack of respect and valorization of indigenous history and philosophy.

(Milton) The relatively young field of ethnomathematics may have much to offer to mathematics education because it opposes formal school orientation that are not related to socio-cultural and political aspects of mathematics. As a program, ethnomathematics seeks to understand the diverse processes of thinking and ways of explaining. It seeks to find ways to act on a student's reality by first considering the student's own cultural context. This may be considered as a relative new issue in the field of mathematics education.

> *If ethnomathematics represents a promising program of research in the field of mathematics education, where should the energies be focused?*
>
> ***(Ubi)*** It should be focused into learning about the history and philosophy of ethnomathematics and this is a very, very, very difficult kind of research.

(Milton) In your perspective, individuals from different cultural groups, created and developed, throughout history, diverse techniques of reflection, observation, and abilities, that is, their own *tics,* in order to explain and understand, to comprehend and to know, to learn and to do, in response to their own necessities of survival and transcendence. This means that they have to deal with their own *mathema* in their own natural, social, and cultural environments, which means that they have to deal with, their own *ethnos*. They also developed, simultaneously, theoretical instruments that are associated with these techniques and abilities. In this context, you also affirmed that "To distinguish the close relation of these *tics* of *mathema* in distinct environments we introduced the prefix *ethno*." (D'Ambrosio, 1994, p. 234).

1) Could you please explain how do you understand the difference between Mathema of Tics and *Tics of Mathema?*

(Ubi) I never thought about this. This is very interesting. Being coherent with my use of the root *mathema*, we might consider it as the explanations and understandings of the *techné*. In another words, it is similar to the history and philosophy of *techné*, which includes art, techniques, ways of doing, manual labor, etc.

2) How does this difference influence the pedagogical actions of the Ethnomathematics Program in classrooms?

(Ubi) Very challenging question. The *tics* of *mathema* are what we, teachers, do, that is, we look for the ways, the arts, the techniques, of understanding, explaining, coping with a situation or problem or fact. The *mathema* of *tics*, in the classroom, might be considered a METAETHNOMATHEMATICS, that is, similar to what is done in METAMATHEMATICS.

(Milton) Freire was able to draw upon, and weave together, a number of strands of thinking about educational practice and liberation. He certainly made a number of important theoretical innovations that have had a considerable impact on the development of educational practice, particularly on *informal* and *popular education*. Education may be seen as a cultural action, seen in this perspective, the teaching practice is much more than the transference of knowledge because it may be considered a cultural activity that should introduce students to the creation of knowledge. This approach in education is the antithesis of turning students into containers to be filled with information (Freire, 1970). The main objective of Freire's work was to situate educational activity in the live experience of individuals in their own socio-cultural-economical contexts. This aspect of his methodology opened up a series of possibilities for the way many informal educators can approach educational practices. In so doing, Freire's work has influenced many educators around the world.

1) What were the influences of Paulo Freire and his work on ethnomathematics?

(Ubi) In the early stages of the developing of the ideas of ethnomathematics program, I would say practically no influence. I was not familiar with his books and ideas. Later on, when I met Paulo Freire, we had good conversations and, naturally, these opportunities enriched my reflections on education and on ethnomathematics.

2) Who are the educators, mathematicians, and philosophers who influenced your work with ethnomathematics? What kind of influences?

(Ubi) It is practically, impossible to trace this. I read avidly: much history, philosophy, religion, art, mythology, anthropology, education, and particularly the history and philosophy of sciences. And I traveled much. I was very curious in my understanding and learning about other cultures, particularly myths, art, and religion. I believe what backed my early ideas for ethnomathematics was this diversity of interests and a permanent fixation on relating and finding commonalities in different lines of thought throughout history.

(Milton) One of the ways that ethnomathematics affects mathematics education is by making mathematics a living subject. Traditional mathematics education aims at

transmitting a certain amount of techniques and uses them in artificial situations, which are presented to students as problems. These problems are artificially formulated, in such a way that they only help in the memorization of skills. These techniques and problems are usually boring, uninteresting and obsolete, and unrelated to the modern world. I think these characteristics of traditional mathematics education are responsible for a downgrading of school satisfaction and student's achievement.

1) How is it possible to differentiate ethnomathematics and mathematics?

(Ubi) I have written about this many times Mathematics, as understood in the academic world, is the ethnomathematics of the Mediterranean Basin, transformed through the dynamics of cultural encounters with many traditions.

2) What are the consequences for the development of ethnomathematics and mathematics for mathematics education?

(Ubi) The more we understand transdisciplinarian and transcultural ways, the evolution of human knowledge and behavior, the better equipped we are to work towards specific goals, objectives, and methods. Mathematics, as well as mathematics education, art, religion, economics and development, have specific goals and methods. So, they surely will benefit from the transdisciplinarian and transcultural nature of ethnomathematics.

(Milton) Studies and discussions concerned about issues in ethnomathematics are happening in a succession of meetings, working groups, newsletters, theses, dissertations, conferences, and congresses. These events collaborate to the ongoing evolution of this field of study. The growing number of books, chapters, and articles published in journals, magazines, and newspapers of diverse languages, and the diversity of studies, theories, thesis, and dissertations submitted in universities in many countries are indicators of the vitality of the ethnomathematics program. At the beginning of the 21st century, greater and more sensitive understandings of mathematical ideas and practices from diverse cultural groups have become increasingly available through the growth of the fields of ethnology, culture, history, anthropology, linguistics, and ethnomathematics. The insight from many ongoing theoretical investigations and research studies in many countries demonstrate the

possibility of the sensitive internationalization of mathematical practices and ideas expressed in different cultural contexts.

Currently, what are your feelings in relation to ethnomathematics? Are you able to follow the evolution of the field?

(Ubi): No. So many things are occurring, so much field work, which is a main source of ideas for ethnomathematics that my work is limited to learning what other researchers are doing. What I do is try to follow and learn about their work and trying to relate and make sense of their findings. Since so many people are working and so many new things are appearing, I feel I am missing much of the advancements in the field.

Final Reflection

I first met Ubi in 1998 when he was teaching the History of Mathematics in the specialization course in Mathematics Education (emphasizing ethnomathematics and modeling) at the Pontifícia Universidade Católica de Campinas in Brazil. At that time, I understood Ubi's role as an educator in the field of mathematics education and his ethnomathematics program as a complementary instrument that fulfilled his commitments to a better social order with more dignity and quality of life for mankind. Currently Ubi is seeking new directions in order to provide new references to his work in mathematics education. It has been particularly interesting, to further this exploration of Ubi's reflections about globalization, myths, religion, which are more concerned with the "mathema of tics".

In Ubi's perspective, religion and sciences have focused on giving a sense of normality to prevailing human individual and social behaviors. According to Ubi's point of view, the survival of humanity depends on our relation with nature, which is regulated by ecological principles. To understand the human being, as well as other species, depends essentially on the analysis of his *triad* - individual, society, and nature, and the effectiveness of the relations between them. In this aspect, survival and transcendence have been, throughout history, the roots for conflict, which develops into confrontation, violence and the submission of individuals and nature. The big challenge for us all now is to be able to deal with conflicts, which are intrinsic to life. In this new phase of Ubi's work, it is an

undeniable right of all human-beings to share the cultural and natural goods needed to our material survival and intellectual enhancement and transcendence. This is the best instrument available that may lead to a planetary civilization, with peace and dignity for entire mankind.

From this conversation documented here, we conclude that mathematicians, scientists and engineers are not the only ones who use and construct mathematical knowledge. This knowledge is made by developing different processes, common to all socio-cultural groups that enable the elaboration and use of mathematical abilities, which include *counting, locating, measuring, drawing, representing, playing, understanding, comprehending,* and *explaining* the necessities and interests of diverse groups and individuals. Here Ubi shared with us his vision as how fundamental it should be that the teaching and learning of mathematics values the cultural context of mathematical knowledge and connect this aspect to the learning process for goals important to academic curricula. To know and understand the value of the plurality of the nature of socio-cultural-economical-political aspects of diverse peoples and cultures is a necessity in order to take a firm stand against the prejudices based on cultural differences, social classes, beliefs, gender, sexual orientation, ethnics, or other social and individual characteristics.

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