ETHNO + MATHEMA + TICS: THE LEGACY OF UBIRATAN D'AMBROSIO

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Abstract

Ubiratan D'Ambrosio has been considered as the father of ethnomathematics. Above all, in his conception of the term Ethnomathematics. In his own words: 'the adventure of the human species is identified with the acquisition of modes, styles, arts and techniques (tics) of explaining, learning, knowing and coping with (mathema) the natural, social, cultural and imaginary environment (Ethno)'. Having worked in the fields of Mathematics Education (for which received the Felix Klein medal from ICMI) and the History of Mathematics (he also received the Kenneth O. May medal from ICHM), he considered ethnomathematics as a subfield of both the History of Mathematics and Mathematics Education, enriched by its connections with cultural studies and political domains. In this lecture, I will try to highlight Ubiratan's most important ideas regarding ethnomathematics and discuss some of their implications for both Mathematics Education and the field of History of Mathematics.

1 Introduction

Ubiratan D'Ambrosio has been considered as the father of ethnomathematics: above all, in his conception of the term *Ethnomathematics*. The word, *father*, however creates an image that he had the ideas and then the ethnomathematics movement was created. It was not really that way. Ubiratan's ideas were encapsulating what was already in motion, reshaping it and giving it a new purpose. In the follow-up, I will highlight Ubiratan's most important ideas regarding ethnomathematics and discuss some of their implications for both Mathematics Education and the field of History of Mathematics.

2 His career

I will start with just a few important themes from his lifelong career.

2.1 His PhD

First, I think it is important to mention his PhD:

In 1963, D'Ambrosio finished his doctorate in pure mathematics and defended his thesis entitled Generalized Surfaces and Finite Perimeter Sets, from EESC, at USP. In January 1964, he was invited to develop his postdoctoral work, from 1964 to 1965, as a Researcher Associate in the Department of Mathematics at Brown University, in Providence, Rhode Island, USA. (Rosa & Orey, 2021, p. 438)

Considering the direction his work took, it is a bit surprising that his doctorate and postdoctoral work were both in pure mathematics.

At the same time, this initial degree meant that he could speak of mathematics from solid ground and with the respect of other mathematicians.

2.2 His efforts to the establishment of ethnomathematics

Ubiratan has made considerable effort to the establishment of ethnomathematics, some of these efforts are considered of vital importance:

It was in 1977 that the term ethnomathematics was first used, in a lecture Ubi gave at the Annual Meeting of the American Association for the Advancement of Science, in Denver, USA. In 1984, the term ethnomathematics was consolidated in an opening lecture entitled "Sociocultural Bases of Mathematics Education" given by D'Ambrosio at ICME-5, in Adelaide, Australia. This is important, as this is when he officially instituted the Program Ethnomathematics as a field of research. (Rosa & Orey, 2021, p. 441).

This period between 1977 and 1984 was decisive to the denomination of the surging movement and to its establishment as a field of research. In this period many different names were proposed but it was Ubiratan's proposal that was widely accepted.

And the program Ethnomathematics, established as a field of research, definitely grew up.

Perhaps the next phase in Ubi's development of Ethnomathematics was his creation of the International Study Group on Ethnomathematics (ISGEm). The ISGEm Newsletter, which often had contributions from Ubi, morphed into the Journal of Ethnomathematics and then the peer-reviewed Journal of Mathematics and Culture (Scott, 2012, p. 242).

We have to say that ISGEm was not really created by Ubiratan, but it was his idea, and together with a few others, it was finally created. ISGEm is the international organization that oversees the organization of the International Conferences on Ethnomathematics (ICEM) every four years.

2.3 His awards

Ubiratan has received three major international awards:

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 the evolution of Mathematics Education in Latin America and also for his efforts aimed at the development of international cooperation. In 2001, D'Ambrosio was awarded, by the International Committee of History of Mathematics (ICHM), the Kenneth O. May Award for his important contributions to the History of Mathematics. The award announcement stated that the ICHM awarded this medal to him for his never-ending efforts through writing and lectures that promote ethnomathematics and thereby contributing intensely to the establishment of this research field. In 2005, D'Ambrosio was honored by the International Committee of Mathematics Instruction (ICMI) with the second Felix Klein Medal for the recognition of his contributions to the field of Mathematics Education. In 2016, D'Ambrosio was awarded with the title of Emeritus Member of the Brazilian Society of Mathematics Education (SBEM) for his contributions to the development of mathematics education in Brazil. (Rosa & Orey, 2021, p. 443)

Two things to make us wonder:

1) How come a person who had a doctorate in pure mathematics ended up with awards of his work in the history of mathematics and mathematics education?

2) Why it was only in 2016 that he finally received an award in Brazil?

Both answers have something to do with the military coup that established a dictatorial regime in Brazil. It happened while he was on his post doctorate in the United States which then made him stay there with the family.

3. His ideas

In this section I will bring forth his ideas on some important themes. I will do it by taking excerpts from his most relevant publications in English.

3.1 What is Mathematics?

As to the main ideas of Ubi, let us first look at what he really thought of Mathematics. Here is a first impression, elaborated on a dialogue with another well-known ethnomathematician, Marcia Ascher (she has studied, with her

husband, an anthropologist, the Quipu, from the Incas civilization, elaborating on the mathematics it contains):

When I look at the etymology of “mathematics” I recognize, in *mathema*, or *mathemata*, what is usually recognized as explaining, understanding, a broader sense of coping with the many aspects and challenges that reality presents (Ascher & D’Ambrosio, 1994, p. 37). First there is this identification with the Greek civilization. Mathematics is what was constructed based on the Greeks ways, tied with philosophy and a certain kind of game. The problems that were philosophical impasses to the Greeks are indicators that Greek mathematics was very close to the idea of a game. These intellectual games were related to divine activities, activities which were typical of the gods. I am very much influenced by the scenario given by Herman Hesse in his "Magister Ludi". The most important intellectual activity in Castalia was the glass-beads game, which has much of the same characteristics of the mathematical games the Greeks were playing. (Ascher & D’Ambrosio, 1994, p. 38). And finally, in an enlargement, Mathematics is identified with the region where the roots of Greek mathematics are. So, Mathematics started with coping with the challenges that reality presented, but a reality that belonged to a region around the Mediterranean Sea.

Other regions of the world started differently and could have evolved to a different 'Mathematics':

I understand Mathematics as broad category which is an abstract construct originated in the cultures of the Mediterranean Basin and the Mesopotamic (Ancient Iraq) and Nile valley civilizations. We might say that Academic (School) Mathematics is the Ethnomathematics of that region. This category of knowledge is sometimes referred as the Euclidean style and it is supported by tertium-non-datur, is insufficient and even inadequate as a strategy to deal with facts and phenomena of other different natural and socio-cultural environments. As we learn from eminent historian of mathematics Wu-Wen Tsun, ancient mathematics in China had a different method of thinking and style of presentation of Greek mathematics. (D’Ambrosio, 2020, p. 573)

3.2 On the universality of mathematical ideas

All people in every culture have the need for transcending. That is the basis for the intellectual exercises, or games. So all people end up developing some sort of 'Mathematics':

Yes, we can use the word play in this broader sense of transcending, which is pure existence. It leads to the concepts of religion, which are clearly of the same nature as those of the arts, sciences, and everything else. In every culture you find some form of god. Every culture tries to reach above the mere earthly needs of survival. We have found in every culture these kinds of intellectual exercises, these plays and these games, as practices that allow people to approach the considerations that go beyond pure survival. This I see as the need to transcend one's existence. This is always associated with the search for explanations, for understanding and meeting the challenges, which I call the *mathema*. (Ascher & D'Ambrosio, 1994, p. 39)

3.3 On the word ethnomathematics

This is one grand achievement by Ubiratan: the name, but not only the name, the construction that led to the name, that gives a different sense than other similar names, such as ethnomusicology. It is appealing and has a construction that enables a clear definition of its range:

Browsing a well-known classical Greek etymological dictionary, I found three interesting words: techné (for ways, arts, and techniques), mathemá (for understanding, explaining, and learning), and ethno (for a group within the same natural and sociocultural environment that has compatible behavior). These roots combined would make for techné of mathemá in an ethno. A little modification gives tics of mathema in different ethnos and a different ordering gives ethno-mathematics. (D'Ambrosio, 2016, p. 8)

Different formulation, basically the same construction:

Throughout history and throughout their existence, individuals and peoples have created and developed instruments for reflection and observation, material and intellectual instruments [which I call tics] to explain, understand, come to know, and learn to know and do [which I call mathema] in response to the needs for survival and transcendence in different natural, social, and cultural environments [which I call ethno. Thus, from this derives the name Ethno-mathematics. (D'Ambrosio, 2016, p. 46)

3.4 On ethnomathematics

These next citations are devoted to ethnomathematics, what is, together with some clarification for its connection to culture.

Ethnomathematics is a research program about the history and philosophy of mathematics, with obvious implications for teaching. (D'Ambrosio, 2006, p. 17)

Ubi elaborated on the reason why it is a research program:

Putting all this in the context of ethnomathematics: this is the reason I call ethnomathematics a program in the history and philosophy of mathematics. It's a program with a holistic approach, much broader than current historiography and epistemology which have clearly selected only a few variables for analysis. (Ascher & D'Ambrosio, 1994, p. 40)

And now with a different focus on the connections, again what is ethnomathematics:

Making a bridge between anthropologists and historians of culture and mathematicians is an important step towards recognizing that different modes of thoughts may lead to different forms of mathematics; this is the field which we may call ethnomathematics. (D'Ambrosio, 1985, p. 44)

Different modes of thought may lead to different forms of mathematics: Some ethnomathematicians have taken this further. Two examples follow.

The first is from Paulus Gerdes who has invented a new type of matrices from the study of sand drawings from the north of Angola. And another example, the Tahitian and Maori languages, when locating an object, use two points of origin, the speaker and the listener, and two angles, one at each of the origins. This can be developed into a mathematically valid system. Barton's global conclusion on this point is that each language contains its own mathematical world (Shirley & Palhares, 2016).

This next citation is very important because of the clarification of the manifestations of culture. I don't see it however as restrictive, only as opening possibilities:

As we have mentioned above, culture manifests itself through jargons, codes, myths, symbols, utopias, and ways of reasoning and inferring. (D'Ambrosio, 1985, p. 46)

But what is a culture? Here we find a clarification:

Upon recognizing that the individuals of a nation, community, or group share their knowledge, such as language, systems of explanation, myths and spiritual gatherings, customs and culinary habits, and that their behaviors are made compatible with and subordinated to value systems agreed to by the group, we say that these individuals pertain to a culture. In sharing knowledge

and making behavior compatible, the characteristics of a culture are synthesized. Thus we speak of the culture of the family, the tribe, the community, the association, the profession, the nation. (D'Ambrosio, 2006, p. 10)

Some of the groups are less obvious than others. Of course, nation, tribe, community are perhaps more obvious. Not quite so for the association or the profession. Even these have been used with an expanded meaning: Terezinha Nunes has studied the arithmetic capabilities of a group of children selling items in the streets of Brazil (It is problematic to argue they had a profession, because being children they were not legally allowed to work - yet they were working in practice) [Shirley & Palhares (2016)]

3.5 The Program Ethnomathematics

This citation is also about ethnomathematics. However, I respect Ubi's specification of Program ethnomathematics. It has been defined before that ethnomathematics is a research program. But Ubi thinks it is important to place 'Program' together with 'ethnomathematics' to stress even more the fact that it is a research program.

The great motivator for the research program known as Ethnomathematics is to seek to understand mathematical knowing/doing throughout the history of humanity, in the contexts of different communities, interest groups, communities, peoples and nations. (…). Why do I talk about Ethnomathematics as a research program and, at the same time, often use the term Program Ethnomathematics? The principal reason results from my concern regarding attempts to propose an epistemology, and as such, an explanation for Ethnomathematics. Upon insisting on the name Program Ethnomathematics, I seek to make evident that the intention is not to propose another epistemology, but rather to understand the adventure of the human species in the search for knowledge and the adoption of behaviors. (D'Ambrosio, 2006, pp. 8-9)

3.6 On mathematical activities

What do we look for when researching in a culture? What is related to mathematics and what is of interest for the ethnographer but not for the researcher in ethnomathematics?

Ubi was giving some ideas, but at the same time probably didn't want to restrict the possibilities and what results is that different sets were advanced, sometimes in the same article or book.

Let us start with these three citations below, where I underline the activities he mentions:

Of course this concept asks for a broader interpretation of what mathematics is. Now we include as mathematics, apart from the Platonic ciphering and arithmetic, mensuration and relations of planetary orbits, the capabilities of classifying, ordering, inferring and modelling. This is a very broad range of human activities which, throughout history, have been expropriated by the scholarly establishment, formalized and codified and incorporated into what we call academic mathematics. But which remain alive in culturally identified groups and constitute routines in their practices. (D'Ambrosio, 1985, p. 45)

...recent research, mainly carried on by anthropologists, shows evidence of practices which are typically mathematical, such as counting, ordering, sorting, measuring and weighing, done in radically different ways than those which are commonly taught in the school system. (D'Ambrosio, 1985, p. 44)

(…) we have practises such as ciphering and counting, measuring, classifying, ordering, inferring, modelling, and so on, which constitute ethnomathematics. (D'Ambrosio, 1985, p. 46)

The three citations above were all from the same article, and we could even see differences between them. Let us see some more:

Ethnomathematics are these corpora of knowledge derived from quantitative and qualitative practices, such as counting, weighing and measuring, comparing, sorting and classifying. (D'Ambrosio, 1999, p. 35)

Among the different ways of doing and knowing, some privilege comparing, classifying, quantifying, measuring, explaining, generalizing, inferring, and, in some way, evaluating. We are then talking of a knowing/doing mathematics that seeks explanations and ways of dealing with the immediate and remote environment. Obviously, this knowing/doing mathematics is contextualized and responds to natural and social factors. Everyday life is impregnated in the knowledge and practices of a culture. At all times, individuals are comparing, classifying, quantifying, measuring, explaining, generalizing, inferring, and, in some way, evaluating, using material and intelectual instruments that belong to their culture. (D'Ambrosio, 2006, p. 13)

The first article shown above, with the three different lists, was from 1985, the next from 1999, and this last one is from 2006, it seems that Ubi finally came to terms with this list.

It is comparable with the list of universal mathematical activities from Bishop (1988):
counting, measuring, localizing, designing, explaining, and playing.

I have seen Bishop's list more used in research than Ubi's list. I personally prefer it too, due to the inclusion of playing, and locating. And yet no one can ignore Ubi's list, that contains some important activities that are not in Bishop's list (generalizing!). Possibly in the future someone can come up with a synthesis of the two that is more satisfying.

3.7 On knowledge

How is knowledge produced, considering the list of mathematical activities above?

Basically, artifacts and mentifacts are produced, which become part of the reality of the group:

My reflections on multicultural education have led me to see the generation of knowledge as primordial in this whole process. The truth is, this generation occurs in the present, in the moment of transition between the past and the future. That is, the acquisition and elaboration of knowledge occur in the present, as a result of an entire past, individual and cultural, projected into the future. The future is understood as immediate and, at the same time, very remote. As a result, reality is modified, incorporating new facts into it, i.e. "artifacts" and "mentifacts". This behavior is intrinsic to the human being, and results from the drives for survival and transcendence. (D'Ambrosio, 2006, pp. 37-38)

In the next citation, an explanation of what mentifacts are:

We simply assume reality in a broad sense, natural, material, social and psycho-emotional. Now, we observe that links are possible through the mechanism of information (which includes sensorial and memory, genetic and acquired systems) which produces stimuli in the individual. Through a mechanism of reification these stimuli give rise to strategies (based on codes and models) which allow for action. Action impacts upon reality by introducing facti into this reality, both artifacts and "mentifacts". (We have introduced this neologism to mean all the results of intellectual action which do not materialize, such as ideas, concepts, theories, reflections and thoughts.) (D'Ambrosio, 1985, pp. 45-46)

3.8 On Education

Ubiratan has written extensively about education, and has some bold proposals. I selected here three citations from different sources, the first is about his big proposal of a new trivium.

My proposal has been to reorganize school curricula in three strands: Literacy, Matheracy, and Technoracy.

Literacy. Clearly, reading has a new meaning today (...) Nowadays, "reading" includes also the competency on numeracy, interpretation of graphs, tables, and other ways of informing the individual. But, if dealing with numbers is part of modern literacy, where has mathematics gone?

Matheracy is the capability of drawing conclusions from data: inferring, proposing hypotheses, and drawing conclusions. It is a first step towards an intellectual posture, which is almost completely absent in our school systems. Regrettably, even conceding that problem solving, modeling and projects can be seen in some mathematics classrooms, the main importance is given to numeracy, or the manipulation of numbers and operations. Matheracy is closer to the way Mathematics was present both in classical Greece and in indigenous cultures. The concern was not with counting and measuring, but with divination and philosophy. Matheracy, this deeper reflection about man and society, should not be restricted to the elite, as it has been in the past.

Technoracy is critical familiarity with technology. Of course, the operative aspects of it are, in most of the cases, inaccessible to the lay individual. But the basic ideas behind the technological devices, their possibilities and dangers, the morality supporting the use of technology, are essential questions to be raised among children in a very early age. History shows us that ethics and values are intimately related to technological progress. (D'Ambrosio, 1999, p. 36)

One reflexion about multiculturalism so present in schools nowadays:

Multiculturalism is becoming the most notable characteristic of education today. With the great mobility of people and families, intercultural relations will become more intense. Intercultural encounters will generate conflicts that can only be resolved based on ethics that result from the individual knowing him/herself and knowing his/her culture, and respecting the culture of the other. (D'Ambrosio, 2006, p. 32)

Finally, an apology for creativity:

The adoption of a new educational posture, in truth the search for a new paradigm of education that substitutes for the worn-out teaching. Learning, based on an obsolete cause-effect relation, is essential for developing creativity that is uninhibited and leads to new forms of intercultural relations, providing the appropriate space for preserving diversity and eliminating inequality in a new organization of society. (D'Ambrosio, 2006, p. 64)

3.9 On Mathematics Education

Mathematics Education is a subset of Education, and deserves some specific attention from Ubiratan. Let us see three reflections about mathematics education, the first about the dichotomy ethnomathematics/mathematics from the utilitarian point of view:

From a utilitarian point of view, which cannot be ignored as a very important goal of school, it is a big mistake to think that ethnomathematics can substitute good academic mathematics, which is essential for an individual to be an active being in the modern world. In modern society, ethnomathematics will have limited utility, but at the same time, much of academic mathematics is absolutely useless in this society, as well. (D'Ambrosio, 2006, p. 31)

Second is about the pursuit of equality:

Mathematics education is deeply affected by priorities of this period of transition to a planetary civilization. The pursuit of equity in the society of the future, where cultural diversity will be the norm, demands an attitude without arrogance and prepotency in education, particularly in mathematics education. (D'Ambrosio, 2006, p. 55)

Third is about contextualizing:

Contextualizing mathematics is essential for everyone (D'Ambrosio, 2006, p.59). Probably this one is the most useful for research intending to apply ethnomathematics findings in schools; the justification is often to help contextualize mathematics that would otherwise be presented abstractly. And let us not forget that some believe that ethnomathematics, the mathematics of identifiable cultural groups (D'Ambrosio 2006), can help in this process of contextualization and, furthermore, the humanization of mathematics (Shirley & Palhares, 2016).

3.10 On the history of mathematics

We know that Ubiratan was a historian of mathematics but he was quite critical, as we can understand in this conversation:

Regrettably, the history of mathematics, and history in general, has put so much emphasis on the need of man to survive, as if survival and transcendence were separate states of human behavior. The originality of man among the other species is the association of drives towards survival and towards transcendence; man's behavior reveals both components. (Ascher & D'Ambrosio, 1994, p. 39)

And he has a proposal for the transformation of History of Mathematics:
About History of Mathematics, there is need of a broader historiography. History of Mathematics can hardly be distinguished from the broad history of human behavior in definite regional contexts, recognizing the dynamics of population exchanges. This is a way of identifying the origin of exclusion of populations and entire civilizations through denial of knowledge, which allows for the proposal of corrective measures. By looking into the bodies of knowledge which have been integrated in the syncretic evolution of Mathematics, Ethnomathematics allows for a better understanding of the cultural dynamics under which knowledge is generated. The proposed historiography can be seen as a transdisciplinary and transcultural approach to the History of Mathematics. (D'Ambrosio, 1999, pp. 35-36)

And now more specifically, connecting with the universal mathematical activities:

A broad view of the history of mathematics, focusing on anthropological, social, political, religious, and other issues as well the cultural dynamics of encounters, is a very clear illustration of the full cycle of knowledge. It looks into how the processes of observing, comparing, classifying, evaluating, quantifying, measuring, counting, representing, and inferring originated in different cultures. It also examines how cultural dynamics played an important role in the development of these forms of knowledge, leading, as a result, to local institutionalization and local ways of thinking and doing. (D'Ambrosio, 2016, p. 10)

3.11 Educating for peace

Ubiratan was very fond of peace and thought peace should be the absolute priority for educators. I found this theme broader than formal education and so I separated it. The absolute priority of our mission as educators is to obtain

PEACE in future generations. We cannot forget that these generations will live in a multicultural environment, that their relations will be intercultural, and their day-to-day lives will be impregnated with technology. (D'Ambrosio, 2006, p. 33)

And what does it have to do with mathematics education:

In the current state of civilization, it is fundamental to focus on our actions, as individuals, as a society, in the realization of an ideal of Education for Peace and a for a happy humanity. When I speak of Education for Peace, many come with the question, "But what does this have to do with mathematics education? and I respond, "It has everything to do with it. (D'Ambrosio, 2006, p. 65)

Most important is achieving the state of inner peace:

Achieving a state of inner peace is difficult, above all due to all the problems we face in our daily lives, particularly in our relationship with the other. Could it be that the other also finds it difficult to achieve a state of inner peace? Without a doubt, the state of inner peace can be affected by material difficulties, such as the lack of security, lack of employment, lack of a salary, and often even the lack of housing or food. Social peace is a state in which these difficulties do not present themselves. Solidarity with our fellow man to overcome these difficulties is a first manifestation in order for us to feel part of society and move toward social peace. (D'Ambrosio, 2006, p. 65)

And what should the effort for scientific and technological advancement be for:

The multiple dimensions of peace [inner peace, social peace, environmental peace, and military peace] are the first objects of any educational system. The greatest justification for efforts for scientific and technological advancement is to achieve total peace, and, as such, it should be the substrate of every planning discourse. This should be the dream of the human being. (D'Ambrosio, 2006, p. 66)

4. On the person

Final theme, how did Ubi saw himself as a mathematics educator?

It is beautiful and it is the best way to finish this lecture:

How do I see myself as a mathematics educator? I see myself as an educator whose field of ability and competence is mathematics, and who uses it, but

not as a mathematician who uses his position as an educator to impart and transmit his mathematical abilities and competencies. My science and my knowledge are subordinated to my humanism. As a mathematics educator, I seek to utilize what I have learned as a mathematician to realize my mission as an educator. In very clear and direct terms: the student is more important than programs and content. Spreading this message is my aim as a teacher of teachers. (D'Ambrosio, 2006, pp. 67-68)

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