

## The Ethnomathematics Program and a Culture of Peace

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### Introductory Note

The *Journal of Mathematics and Culture*, founded 10 years ago under the sponsorship of the North American Study Group on Ethnomathematics (NASGEM), was a great achievement in the area. I was privileged to publish a paper on *The Program Ethnomathematics: A Theoretical Basis of the Dynamics of Intra-Cultural Encounters* in the inaugural issue of the journal and now I have the opportunity of submitting a paper on my own ideas about the intimate relation of Mathematics and Culture, which is the supporting basis for the Ethnomathematics Program. This paper deals primarily with Science, Technology and Mathematics and also with other forms of knowledge with the major goal of building-up a culture of peace.

### From the Origins through Pre-history to the Future

What can we say about the beginnings of this movement? *How did it all begin?* This is the most intriguing and an unsolved question: *Can it ever be solved?* I doubt it. Answers have been given with resource to creating myths, religions and sciences, supported by explanations and theories given by philosophers and scientists, all of them questionable in the broadest sense and many are refutable.

Across cultures and time, there have been a repetition of arguments, which can be considered in two main lines of proposals about human origins. One is that it is the result of a supernatural design of gods, of deities, or of a single deity or of a single god (how did they appear?). Another is that it is the result of fortuitous encounters or changes of matter and energy (how these elements originate?).

In both cases, we deal with the *how* as an act of faith and of believing. In the sequel of reflections about the origins, there is the equal challenging concept of life, as a self-sustaining process. *What is the origin of life?* Particularly, how the homo species were originated?

Again, this is a hard dispute, which is polarized in two main lines: creationism and evolutionism, with many variants. For the sake of space, I will not proceed with this discussion.

I side with paleontological and archaeological evidences that from the order of primates evolved, about 5 million years ago, the biped genus *Australopithecus*, which spread through the continent and, about 3 million years ago, evolved as the species *homo*, characterized mainly for an erectus position and increased neurons in the brain. These hominids spread throughout Earth and differentiated into *Homo Sapiens*.

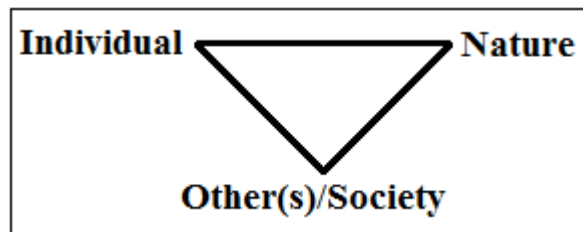
The active research area of paleoanthropology is uncertain about when and where to locate early groups of *Homo Sapiens*. Probably about 300,000 years ago in many places of the Planet. There is evidence that these creatures looked for caves as shelter, learned about fire and developed stone tools. Later they left caves and socially organized as families, clans and tribes and villages, aggregating individuals with some form of affinity (parenthood, physical characteristics, language, beliefs, abilities and other kinds of identity).

A movie, *Quest for Fire*, from 1981, directed by Jean-Jacques Annaud, shows, in a lively and captivating way, the struggle to control fire. The cinematography was admirably successful in combining a travel in space and in time, in the Paleolithic Era. For a discussion of these early stages of humanity (D'Ambrosio & Almeida, to appear) I proceed with accepting the evolution of knowledge as a process.

Every other known animal species has developed strategies for coping and for dealing with the natural environment and with other individuals of the same species, with the objective of the *survival* of the individuals and of the species. Individuals, from birth to death, relate to nature according to principles of physiology, among individuals according to principles of socio-biology and, organized as groups and herds, relate with nature according to principles of ecology.

Thus, they instinctively try to satisfy the pulsion for survival. These three elements, the individual, the other(s) and nature and the three relations between them, that is

individual↔other(s)/society↔nature, constitute the essence of life. I metaphorically represent life as the *primordial triangle* (figure 1).



**Figure 1 The Primordial Triangle**

This is a mathematical metaphor. A triangle is a geometrical figure formed by six associated elements: 3 vertices and 3 sides. Suppressing any one the six, it is not a triangle anymore. All six elements are threatened by the Modern Civilization.

The species *Homo Sapiens* have a differential. Individuals developed unique strategies to keep within the primordial triangle. To intermedate the relationship between the individual and nature, humans created instruments, which gave new possibilities of acquiring nourishment and of clothing to protect the body. The relation of an individual with another individual of the same species makes use of another interaction between the developments of a common language, communication strategies based on complex articulation of sounds, unique to *Homo Sapiens*. The most important consequence was the discovery of the other, of *thee*, as a differentiated individual and, consequently, of the self, of *myself*<sup>1</sup>.

The acquisition of will is a decisive step in the evolution of humans. The recognition of the self and of the *thee* affects how humans develop socially. As a consequence of will, the organization of herds or clans or tribes, focus on objectives and on distribution of tasks. Thus,

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<sup>1</sup>How did our species reach these incredibly diverse and beautifully unique strategies? Both evolutionism and creationism recognize specificities in human intelligence. Even more challenging is how beliefs, traditions, religions, arts and sciences, enchaind in the manifestations of humankind throughout history. Curiously, the enchantment is very similar to what happens in child development. Essentially, this is the result of the search for explanations, for understanding, which go together with the search for predictions. One explains in order to anticipate, thus building up systems of explanations (beliefs) and of behavior (norms, precepts). These are, until nowadays, the common grounds on which both religions and sciences are justified.

it leads to transcending one's own space and time and projecting oneself onto the other, which is a step towards transcending one's own existence.

This results in probing beyond the span of individual life, asking *what before* birth and *what after* death. This search outside the limits of anything, both in time and in space is called transcendence. Thus, the human species developed, beyond the pulsion of survival, common to all animal species, the pulsion of transcendence. Both pulsions are of a symbiotic relation and, together, they constitute the essence of being human.

The recognition of the self, and of the *thee* and the search for a *common thee*, for a group of individuals with traits in common, such as sharing a common language, lead to generate emotions, like/dislike, prefer/reject, and to create myths and symbols, traditions and norms, wisdom and knowledge, and to organize themselves as hierarchies, castes and social classes. All these categories, developed by the kind characterize what is called *culture*.

These culturally identify a group as it comes to develop deeper relations with nature.

According to the needs and interests of the group and will of individuals, some shared by the groups. These new relations can often violate spontaneous principles of ecology, essential for maintaining the primordial triangle. Thus, as agriculture and breeding arose and became dominant in the relation to the individual $\leftrightarrow$ other(s)/society $\leftrightarrow$ nature<sup>2</sup>.

These intermediacies continue to affect the primordial triangle. For example, agriculture and breeding demand more water and energy and soil treatment, violating principles of ecology.

Results are seen in changes in soil composition, in flora and fauna and, consequently, in meteorological regimes. In addition, the ever increasing demand on previously untapped resources, such as minerals and fossil fuels is drastically affecting the triangle. This demand has now reached a critical situation, as observed by the eminent mathematician Mikhail L.

Gromov (Raussen & Skau, 2010):

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<sup>2</sup>Interesting that this appears in the Genesis as Adam and Eve were expelled from Paradise.  
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Earth will run out of the basic resources, and we cannot predict what will happen after that. We will run out of water, air, soil, and rare metals, not to mention oil. Everything will essentially come to an end within fifty years. What will happen after that? I am scared. It may be okay if we find solutions, but if we don't then everything may come to an end very quickly. Mathematics may help to solve the problem, but if we are not successful, there will not be any mathematics left, I am afraid!

We are faced with the relations individual $\leftrightarrow$ other(s)/society $\leftrightarrow$ nature and how humans developed, since early times, strategies to deal with these relations, as discussed above.

Obviously, these strategies profoundly affected the behavior of individuals (conflicts with self), the harmony of societies (conflicts with thee), and the equilibrium of natural resources (conflicts with nature).

Humanity needs *peace* in the broadest sense of the word. To avoid the increasingly more complex conflicts is a road to peace in all its dimensions:

- *individual peace* (eliminating conflicts with the self),
- *social peace* (eliminating conflicts with *Thee*),
- *and, environmental peace* (eliminating conflicts with nature).

Consequently, we may obtain *military peace*, eliminating wars in all senses. The continuation of civilization depends on obtaining peace in all dimensions. Yet, we need a true system of knowledge that offers the possibility of peace, relying on respectful, harmonious and constructive relations among humans and between humans and nature, as a response to the *ethics of diversity*:

- *respect* for the other (even if different);
- *solidarity* with the other (even if different);
- *cooperation* with the other (even if different).

The practice of ethics of diversity is the only hope we have for achieving a just relation among humans and between humans and nature, and peace as a consequence. If education is

to contribute to achieving a just social order, we contend that educational practices should be grounded in ethics of diversity.

It is a mistake to claim, as many mathematicians do, that this refers to other forms of knowledge, and that mathematicians and mathematics educators have little to do with this situation. We are as responsible as every individual human being is, in facing the serious threats to the future of civilization.

As Gromov said, “Mathematics may help to solve the problem”. However, we ask “what kind of Mathematics?” I believe we have to look into some form of ethics in mathematics, that is, an *ethical mathematics*. It is generally agreed that ethics is a cultural trait. It is undeniable that mathematics is a cultural endeavor. This *Journal of Mathematics and Culture* has been conceived to emphasize Mathematics as a cultural endeavor. What kind of ethics do we recognize in mathematics? There is an ethics of rigor, which permeates most lines of Philosophy of Mathematics, and also a code of behavior, impregnated of corporate concerns (AMS, 2005).

However, there are only a few references to cultural differences in consideration to and the elaboration of strategies of mathematical nature, such as the often diverse strategies humans have develop for observing, comparing, classifying, ordering, measuring, quantifying and inferring. As a manifestation of *abstract thinking*, every culturally identified group has generated specific strategies of a mathematical nature. The recognition of these abstract modes of thinking in every cultural group is the quintessence of the ethics of diversity.

### **The Ethnomathematics Program**

The Ethnomathematics Program began as a research program in the History and Philosophy of Mathematics with the objectives of understanding how strategies of observing, comparing, classifying, ordering, measuring, quantifying and inferring were developed by humans in different natural and socio-cultural environments, in response to the pulsions for survival and transcendence.

The research relied on the history of mathematics and in the history of science and technology. But, the necessity of advancing into the analysis of language, myths and symbols and of other cultural traits was recognized early on in the development of the program. The importance of human relations and socio-cultural institutions, such as education and academies, belief systems and religions, diverse practices of bartering, commerce, money and economics, all of them were essential in building-up civilizations.

These strategies are synthesized in the ways, modes and styles, arts and techniques, developed to cope, to explain, to learn and to understand, to know reality as a whole, that is how the natural, social, cultural, mythical and imaginary environment combine.

An etymological exercise lead me to identify some Greek roots meaning these concepts: *techné*  $\approx$  *tics*: arts and techniques, modes and styles, *mathemá*: to cope, to explain, to learn and to understand, to know, and *ethno*: reality as a whole, the natural, social, cultural, mythical and imaginary environments. This etymological exercise lead me to construct the concept of *tics* of *mathema* in distinct *ethnos*, and, rearranging, *ethno+mathema+tics*, hence Ethnomathematics. This is a broad theoretical concept, indeed a proposal of a general theory of knowledge.

So, it is that the actual concept of *ethno+mathema+tics* is primeval in nature since it recognizes different perceptions of space and time and the emergence of specific ways for observing, comparing, classifying, ordering, measuring, quantifying and inferring as strategies to satisfy the pulsions of survival and transcendence. This means the emergence of abstract thinking, in every corner of the planet.

Hence, I have developed the Ethnomathematics Program to contribute to the restoration of cultural dignity, and to offer the intellectual tools for the exercise of planetary citizenship.

This Program enhances creativity, reinforces cultural self-respect, and offers a broad view of humanity that provides for a theoretical framework that establishes the foundation for

organizing diverse practices and systems of explanations, which have been developed by our species in order to survive and to transcend throughout our complicated evolution.

The Program I developed seeks to add towards building a civilization that rejects inequity, arrogance, and bigotry; where education gives special attention to the redemption of people that have been for a very long time subordinated and that seeks to constitute excluded sectors of societies. Real goals of *empowerment*, a phrase commonly used in education, can be achieved by the implications of the Program Ethnomathematics in the curriculum (D'Ambrosio & D'Ambrosio, 2013).

The concept of Ethnomathematics, as proposed by many authors forms a mathematics that has a distinct Ethnos, or Ethno+Mathematics. Mathematics, as it is understood in the Modern World, is mistaken as a category of knowledge developed as only the elaboration of the *tics* and *mathemá* and forms of *ethnos* of the peoples of the Mediterranean region, which acquired specific style of narrative and criteria of truth in Ancient Greece.

Ethnomathematics is certainly, but limited to, or rooted in the perceptions of the world of the Mediterranean perspective, which include their relation to nature, myths, history, and traditions. These perceptions as synthesized imply the concepts of space and time, which form the base of every *tics* of *mathemá* thinking in western civilization, but differ enormously in other diverse regions of the planet.

For example, calendars, forms of territorial demarcation, shelter and nourishment of the people originating in Mediterranean cultures are absolutely meaningless for the Inuit or Amazonian populations. The same can be said for people and traditions of people of Mayan and Andean descent and the Aboriginal populations in the Pacific.

Each one is strange to the others. Obviously, each one developed their own *tics* of *mathema* in their *ethnos*, which have nothing to do, conceptually, with mathematics developed by the



Greeks. Some coincidences, mainly in dealing with quantities and forms, may occur, but are fortuitous.

This is why, the question whether ethnomathematics is considered as true research or practice is recurrent. The school practice of ethnomathematics arises from the research, and this is the reason for calling ethnomathematics as a research program. I have come to guide my investigation to three basic questions:

1. How do *ad hoc practices* and solution of problems develop into methods?
2. How do *methods* develop into theories?
3. How do *theories* develop into *invention*?

As discussed in the first section of this paper, the main objective for the Program Ethnomathematics is based on the interconnectedness, as it were, of these relations as given by *practices*  $\Rightarrow$  *methods*  $\Rightarrow$  *theories*  $\Rightarrow$  *invention*.

This is fundamental to the evolution of our species. The work of many ethnomathematicians with different cultural environments, describes the diverse practices and theoretical ideas of other cultures, mainly those dealing with strategies for observing, comparing, classifying, ordering, measuring, quantifying, and inferring. This has come to form an essential component of the Ethnomathematics Program.

It is important here to note that the many cultural groups studied by researchers seeking to apply aspects of the Ethnomathematics Program most certainly include indigenous populations, but also cultures of labor and artisan groups, communities in urban environments and in the periphery, farm communities, and all types of professional groups. All these groups have specific strategies of a mathematical nature, that is, they have their own strategies for observing, comparing, classifying, ordering, measuring, quantifying and inferring.

We must devote special attention to how these ideas, which I believe are essential for peace, and how they are incorporated into distinct pedagogical practices. This requires us to explore programs that develop a disposition of teachers and leaders to conceptualize goals for education and consider the well-being of all humanity as the main concern of education, which needs to rethink teacher preparation (D'Ambrosio & Kastberg, 2012).

### **As a Conclusion**

Most pungent is the appeal of the Manifesto of Albert Einstein and Bertrand Russell (1955) seems most important here:

There lies before us, if we choose, continual progress in happiness, knowledge, and wisdom. Shall we, instead, choose death, because we cannot forget our quarrels? We appeal as human beings to human beings: Remember your humanity, and forget the rest. If you can do so, the way lies open to a new Paradise; if you cannot, there lies before you the risk of universal death<sup>3</sup>.

The Pugwash Movement or *Pugwash Conferences on Science and World Affairs*, which were awarded a Nobel Prize for Peace in 1995, was founded to give sequence to the Manifesto of Einstein and Russell, in the small village of Pugwash, in new Scotia, Canada<sup>4</sup>.

The Pugwash Movement adopted the motto *Thinking in a New Way*. Indeed, in all sectors of societies, everywhere in the World, we need new thinking, a new institutional order, mainly in economy, in styles of governance, in cities, urban and rural structures, in demographic demarcation.

It is obvious that the capitalistic system has reached a point of exhaustion; the war-like structures it has created increasingly reveal inefficacy to keep its economic, political and social order, with ethical and moral values to be ignored. These are problems that must be solved for the survival of our civilization.

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<sup>3</sup><https://pugwash.org/1955/07/09/statement-manifesto/>

<sup>4</sup>The Russell-Einstein Manifesto. *Scientists in the Quest for Peace: A History of the Pugwash Conferences*. Ed. Joseph Rotblat, Cambridge: The MIT Press, 1972; pp. 137-140.

We need to develop a culture of peace associated with mathematics and mathematics education. This requires new thinking. Repeating, once again, what Gromov said, “Mathematics may help to solve the problem”. I, as well repeat this by asking “what kind of mathematics?”.

The strategies of a mathematical nature are a very powerful instrument to propose new thinking and new institutional order, as they were determinant in every moment and in every region of the planet in the evolution of the human species.

The kinds of mathematics we need are those complex strategies of a mathematical nature impregnated with the ethics of diversity, which are the basic pillars of the Ethnomathematics Program.

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