

## General Remarks on Ethnomathematics

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The idea of ethnomathematics came as a broader view on how mathematics relates to the real world. Mathematics is an intellectual instrument created by the human species to describe the real world and to help in solving the problems posed in everyday life.

It is so common that teachers and the public in general say that mathematics is a cultural endeavor. But in the classroom we see children learning multicultural activities as a mere curiosity, usually referring to the past, and to cultures usually very remote from that in which the child was reared.

To reaffirm and, in some cases, to restore cultural dignity of children is an important component of mathematics education. A tradition alien to the children supports much of the contents of current programs. On the other hand, children are living in a civilization dominated by mathematically based technology and by unprecedented means of communication.

It is also very important to recognize that improving the opportunities for employment is a real expectation that students and parents have of school. This requires from educators understanding the evolution of the job market. As Viviane Forrester says, we are mostly preparing students for jobs in extinction.<sup>1</sup> Robert B. Reich gives a very clear picture of the opportunities for employment in the future.<sup>2</sup>

Both to acquire cultural dignity and to be prepared for full participation in society requires more than what is offered in traditional curricula. Particularly grave is the situation of mathematics, which is largely obsolete as present in the programs. Classroom mathematics has practically nothing to do with the world the children are experiencing. The same as literacy nowadays means much more than reading and writing, mathematics is much more, indeed different, than counting, measuring, sorting, comparing.

Education nowadays asks for dominating modern *communicative instruments*, dealing with *analytical instruments*, and awareness of the capability and inadequacy of *technological instruments*. In a recent paper I proposed curricular strands dealing with these instruments, which I called respectively *literacy*, *matheracy* and *technoracy*.<sup>3</sup>

Ethnomathematics fits this broad view of education. Rather than another discipline in the curriculum, I view ethnomathematics as a research program on epistemology and history, focusing on science and mathematics, with obvious implications for education.<sup>4</sup>

There has been an overly simplified view of ethnomathematics. We have to place our discussions on the nature of ethnomathematics in a broader reflexion on the nature of knowledge. I see knowledge as something generated and intellectually organized by the individual in response to the social, cultural and natural environment

and, after being shared through communication, socially organized, thus becoming something that is part of a community [culture] and essential for dealing, recognizing, explaining facts and phenomena. Observers, chroniclers, theoreticians, sages, academics, professionals, power "detainees" expropriate this knowledge, classify and label them, and then transmit and diffuse them. Thus we have structured forms of knowledge: language, religion, culinary, medicine, dressings, values, science, mathematics, all interrelated and responding to the way reality is perceived in that social, cultural and natural environment.

I see all these forms of knowledge differently structured, following what we might call different logics. Are these logics inherent to human beings or are they culturally bound? According to current findings about the brain, there may be different neuronal "wirings". Others say there is one human wiring. Anyway, it is impossible to deny that cultural dynamics increasingly plays a role in "broadening" perceived reality, and as a consequence modifies the responses. So, languages, religion, culinary, medicine, dressings, values, science, mathematics are always changing.

Some individuals, groups, societies, nations sometimes freeze these forms of knowledge. Frozen knowledge becomes accepted and all the energy is directed towards keeping the frozen forms.

These frozen forms [language, religion, culinary, medicine, dressings, values, science, mathematics] are subjected to pressures from conservative scholarship and educational systems.

Sri Aurobindo (1872-1950) once said: "For Western Philosophy a fixed intellectual creed is the most important part of a cult, it is the essence of its meaning and what distinguishes it from others. So the believes are formulated to make true or false a religion [a theory, a philosophy, a science], according with agreeing or not with the creed of its critics."

I use the word "ethno" as a form of recognizing the dynamics of different forms of knowledge. There are different ethnomathematicsES (plural), each one responding to a different cultural, natural, social environment.

One of such environments – the Mediterranean basin – gave origin to the ethnomathematics, which we now call simply mathematics. Through the process of conquest and colonization this mathematics was imposed to the entire world. It was accepted because of its success in dealing with the ways conquerors and colonizers managed property, production, labor, consumption, and values. Everything came together.

As every form of knowledge, the ethnomathematics coming from the Mediterranean basin, now simply called mathematics, was subjected to changes and was transformed, but basically reposes on the same ideas originated in the Mediterranean basin.

It has been a belief that the great architect of the Universe was a mathematician. This great architect is, according to the Mediterranean traditions, Yahweh=God=Allah. The knowledge of the great architect was learned and captured by the Mediterranean civilizations of Antiquity, even since pre-history, and indeed

expropriated in modern times [Laplace: I did not need this – God – hypothesis] and shared with believers [converts].

When ethnomathematicians say "more than one mathematics", they are recognizing different responses to different natural, social, cultural environments. As more than one religion, more than one system of values, there may be more than one way of explaining, understanding, coping with reality.

I see a possibility of new civilization, through elimination of inequity, bigotry, intolerance, hatred, discrimination, as the result of unfreezing the forms of knowledge [removing fundamentalisms] and allowing cultural dynamics to play its role in the evolution of the species.

I am particularly concerned with the fact that efforts to do better in mathematics education are sometimes interpreted as a reduction of the importance of mathematical contents. This is indeed the mail fuel to keep the so-called math wars growing in intensity.

I believe this is a gross mistake. We need more and *better* mathematical contents, but this does not mean the traditional contents, which exhaust current programs. The big mistake is to consider math contents as something final, subordinated to criteria of rigor, which are also considered final.

Compromising rigor, in benefit of generating interest and motivation, cannot be interpreted as conceptual errors or a relaxation of the importance of serious mathematical contents of a modern nature.

Examples are the use of calculators [in lieu of drill with operations], geometric ratios [not formal operations with fractions] and the resource of paper folding for the teaching of geometry.

Multiplication tables may be important not because of the values associated with two numbers, but rather if one recognizes that the product of two one-digit numbers may result in a two-digit product. In modern terms, when pressing one key times one key you get two digits as a result in the screen. In fact, our calculators represent the highest level of realizing the positional system.

An exercise for children: with a 8-place calculator, when you press 2 then  $\times$  and then 50000000, an E appears in the screen, while pressing 2,  $\times$ , and 49999999, we read 99999998 in the screen. Why?

In the early years of my career, I was very much influenced by a book written in 1904 by a couple of very strong pure mathematicians, Grace C. Young (1868-1944) and William H. Young (1879-1932). It is called *Beginner's Book of Geometry*.<sup>5</sup> This is an example of geometry springing out of the ethnomathematics of paper folding. Paper airplanes must have been very appealing to children in the beginning of the century. This is an example of linking mathematics with children's imagination.

Why do we teach mathematics in schools? I see mathematics playing two fundamental roles of education:

- 1) enhancing creativity;
- 2) facilitating full achievement of citizenship.

Particularly this second role requires an individual to be prepared to be in the production system, to be a responsible consumer and to be able to take responsible

decisions.

The production system requires a broad and updated technical knowledge, mainly capability of dealing with instruments, which have, increasingly, characteristics of computers.

To be a responsible consumer an individual must be able to deal, critically, with the optimization of the relation cost/benefit. But it is important to say that optimizing does not mean only to fulfill one's own satisfaction, but also taking into account environmental and social concerns. This is the ethical goal of education. It is a high priority that children learn how to deal critically with the major issues of inequity and environmental decay. The best tool to deal critically with these issues is provided by mathematics.

To be able to take responsible decisions, through political awareness and participation, the individual must understand consequences of his/her options. Again, this requires analytical instruments, mostly in the form of models.

While multicultural math activities are important, they should not be the final goal. Experience of multicultural mathematical activities of people coming from other cultural environments may serve to develop the respect for the different.

In ICME 9, in Makurari, Japan, Topic Study Group 21 met twice, in a total of 3 hours, chaired by U. D'Ambrosio. About 100 participants attended the sessions. Although the time given to the TSG was very limited, it was possible to schedule 6 short presentations, giving a broad coverage of the several strands of ethnomathematics.

We have selected four papers for this issue of ZDM. The selection will allow for a coverage of some of the main directions of ethnomathematics, which focuses on the philosophical, social, pedagogical and anthropological dimensions.

Andy Begg, of the University of Waikato, New Zealand, gives a paper on "Ethnomathematics: why, and what else?"<sup>6</sup> The paper presented a constructivist perspective, considering the implications of enactivism and other ways of thinking on ethnomathematics. The conclusion is that the influence should be broader – that different cultural groups may have different ways of knowing, that we may be asking the wrong questions, and that we might need to consider "ethno-education".

Cinzia Bonotto, from the University of Padova, Italy, offers a paper on "How to connect school mathematics with students' out-of-school knowledge"<sup>7</sup>. She presents an explorative study for which special cultural artifacts have been used, i.e. supermarket receipts, to try to construct with 9-year old pupils (fourth class of primary school) a new mathematical knowledge, i.e. the algorithm for multiplication of decimal numbers. She also discusses estimation and approximation processes which have been introduced in the lectures.

Lawrence Shirley, from Towson State University, USA, in his paper on "Ethnomathematics: a fundamental of instructional methodology"<sup>8</sup>, claims that ethnomathematics is no longer an add-on, a frill, an enrichment topic. Rather it is at the heart of instructional methodology.

Teachers see their diverse classrooms and must reach out to their entire class. Beyond boosting minority interests, it is necessary to prepare majority students to work in a diverse, multicultural world, with recognition that not only the majority has or can make contributions to mathematics. Teacher education programs have incorporated study of multicultural classrooms into the pre-service preparation of teachers. Teachers must learn special instructional skills to accommodate different backgrounds and different learning strategies.

In her paper on “People of my side  $\approx$  people of the other side: Socionumerical systems in Central Brazil”, Mariana K.L. Ferreira<sup>9</sup> inquires into the structures of Xavante mathematical thought, resorting to cultural anthropology in order to show that to dialectical societies of central Brazil “numbers“ are not necessarily numerals, but social categories that represent a way of bringing together a group or collection of individuals.

#### Annotations

- <sup>1</sup> Forrester, Viviane (1999): *The Economic Horror*. – Blackwell Publishing, London
- <sup>2</sup> Reich, Robert B. (1992): *The Work of Nations. Preparing Ourselves for 21<sup>st</sup> Century Capitalism*. – Vintage Books, New York
- <sup>3</sup> D’Ambrosio, Ubiratan (1999): *Literacy, Matheracy, and Technoracy: A Trivium for Today* – In: *Mathematical Thinking and Learning* 1(2), pp.131-153
- <sup>4</sup> For an exposition of ethnomathematics, see the book Ubiratan D’Ambrosio: *Ethnomathematics. The art or technique of explaining and knowing*, transl. by Patrick B. Scott, ISGEm/NMSU, Las Cruces, 1998.
- <sup>5</sup> An edition, done in the fifties by Chelsea Publishing Co., is out-of-print.
- <sup>6</sup> Begg, Andy (2001): *Ethnomathematics: why, and what else?* – In: *ZDM Zentralblatt für Didaktik der Mathematik* 33(3), pp. 71-74 (from 6.2001 - 6.2002: <http://www.fiz-karlsruhe.de/restricted/zdm/articles/zdm013a2.pdf>, then: <http://www.fiz-karlsruhe.de/fiz/publications/zdm/zdm013a2.pdf>)
- <sup>7</sup> Bonotto, Cinzia: *How to connect school mathematics with students' out-of-school knowledge*. – In: *ZDM Zentralblatt für Didaktik der Mathematik* 33(3), pp. 75-84 (from 6.2001 - 6.2002: <http://www.fiz-karlsruhe.de/restricted/zdm/articles/zdm013a3.pdf>, then: <http://www.fiz-karlsruhe.de/fiz/publications/zdm/zdm013a3.pdf>)
- <sup>8</sup> Shirley, Lawrence: *Ethnomathematics: a fundamental of instructional methodology*. – In: *ZDM Zentralblatt für Didaktik der Mathematik* 33(3), pp. 85-87 (from 6.2001 - 6.2002: <http://www.fiz-karlsruhe.de/restricted/zdm/articles/zdm013a4.pdf>, then: <http://www.fiz-karlsruhe.de/fiz/publications/zdm/zdm013a4.pdf>)
- <sup>9</sup> Ferreira, Mariana K.L.: *People of my side  $\approx$  people of the other side: Socionumerical systems in Central Brazil*. – In: *ZDM Zentralblatt für Didaktik der Mathematik* 33(3), pp. 89-94 (from 6.2001 - 6.2002: <http://www.fiz-karlsruhe.de/restricted/zdm/articles/zdm013a5.pdf>, then: <http://www.fiz-karlsruhe.de/fiz/publications/zdm/zdm013a5.pdf>)

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