

In Focus ... Mathematics, History, Ethnomathematics and Education: A comprehensive program

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On the Nature of Mathematics and the Goals of Education

The nature of mathematical behavior is not yet clearly understood. Although in Classical Philosophy we can notice a concern with the nature of mathematics, only recently the advances of cognitive sciences have probed into the generation of mathematical knowledge. How is mathematics created? How different is mathematical creativity from other forms of creativity?

From the historical viewpoint, there is a need of a complete and structured view of the role of Mathematics in building up our civilization. For this we have to look into the history and geography of human behavior and find new paths in the measure we advance in the search. History is a global view in time and space. It is misleading to see History only as a chronological narrative of events, focused in the narrow geographic limits of a few civilizations which have been successful in a short span of time. The course of the history of mankind, which can not be separated from the natural history of the planet, reveals an increase interdependence, which crosses space and time, of cultures and civilizations and of generations.

Education is a strategy created by societies to promote creativity and citizenship. To promote creativity implies helping people to fulfill their potentials and rise to the highest of their capability. To promote citizenship implies showing them their rights and responsibilities in society.

Educational systems throughout history and in every civilization have been focusing on two issues: to transmit values from the past and to promote the future. In other words, Education aims equally at the new (creativity) and the old (societal values). Not irresponsible creativity—for we do not want our students to become bright scientists creating new weaponry—neither docile reproduction—for we do not want our students to accept rules and codes which violate human dignity. This is our challenge as educators, particularly as mathematics educators.

Curriculum

The strategy of educational systems to pursue these goals is the curriculum. Curriculum is usually organized in three strands: objectives, contents and methods. This Cartesian organization implies accepting the social aims

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of educational systems, then identifying contents which may help to reach the goals, and developing methods to transmit these contents.

To agree on objectives is regarded as the political dimension of education. But very rarely has mathematics contents and methodology been examined under this dimension. It is generally accepted that contents and methods in mathematics have nothing to do with the political dimension of education.

Because Mathematics is the imprint of the Western thought, our responsibility as mathematicians and mathematics educators is a major one.

I see my role as an Educator and my discipline, Mathematics, as complementary instruments to fulfill these commitments. In order to make good use of these instruments, I must master them, but I also need to have a critical view of their potentialities and of the risk involved in misusing them. This is my professional commitment.

The Political Dimension of Mathematics

Political issues deal with government, economics, relations among nations and social classes, people's welfare, and the preservation of natural and cultural resources.

The possibility of final extinction of civilization in Earth is real. Not only through war. We are witnessing an environmental crisis, disruption of the economic system, institutional erosion, mounting social crises in just about every country and, above all, the recurring threat of war. A scenario similar to the disruption of the Roman Empire is before us, with the aggravation that the means of disruption are, nowadays, practically impossible to control.

It is clear that mathematics is well integrated into the technological, industrial, military, economic, and political systems and that mathematics has been relying on these systems for the material bases of its continuing progress. It is important to question the role of mathematics and mathematics education in arriving to the perverse behavior of mankind.

After all, the most universal problem—survival with dignity—must have something to do with the most universal mode of thought: mathematics.

I believe that to find the relation between these two universals is an inescapable result of the claim of the universality of mathematics. Consequently, as mathematicians and mathematics educators we have to reflect about our personal role in reversing the intolerable situation of the world.

It is difficult to deny that Mathematics provides an important instrument for social analyses. Western civilization entirely relies on data control and management. Social critics will find it difficult to argue

without an understanding of basic mathematics. But, regrettably, the term “basic” has been abusively identified with acritical skill and drilling.

It is an undeniable right of every human being to share all the cultural and natural goods needed for her or his material survival and intellectual enhancement. This is the essence of the *Universal Declaration of Human Rights* (1948), to which every nation is committed. The educational strand of this important profession on mankind is the *World Declaration on Education for All* (1990), to which 155 countries are committed. Of course, there are many difficulties in implementing the effectiveness of the United Nations resolutions and mechanisms. But as yet this is the best instrument available that may lead to a planetary civilization, with Peace and dignity for the entire mankind. Regrettably, Mathematics Educators are generally unfamiliar with these documents.

It is an unrelinquishable duty to cooperate, with respect and solidarity, with all the human beings, who have the same rights, for the preservation of all these goods. This is the essence of the *ethics of diversity*: respect for the other (the different), solidarity with the other, cooperation with the other. This leads to quality of life and dignity for the entire mankind.

Quite unusual as a piece on Mathematics Education, many will say. But if we do not accept, very clearly and unequivocally, our general and global professional commitments subordinated to a global ethics such as the proposed ethics of diversity, it is very difficult to engage in a deeper reflection of our role as Mathematics Educators.

It is impossible to understand the process of exclusion of large sectors of the population of the World, both in the developed and undeveloped nations, without a deep reflection on the colonial period. It is not the case of putting the blame in one or another, neither to attempt to redo the past. But to understand the past is a first step to move into the future. To persist in former paths and styles is irrational and may lead to disaster. Maybe the real threat to humanity are not people looking for aliens coming in UFOs, but the earthlings nostalgic of a fading order anchored in inequity, arrogance and bigotry. Mathematics has everything to do with this past. A New World order is urgently needed. Our hopes for the future depend on learning—critically!—the lessons of the past.

Ethnomathematics and the History of Mathematics

The Program Ethnomathematics looks into history and epistemology with a broader view. With its intrinsic pedagogical action, it is a program motivated by the commitment to fulfill the major responsibilities of an educator.

Essentially, what are the main goals of the Program Ethnomathematics? We have to look into history, particularly the History of Science and Mathematics, with new lenses in order to realize why Ethnomathematics is important in building up a civilization that rejects inequity, arrogance and bigotry.

The great navigation since the 15th century mutually exposed forms of scientific knowledge from different

cultural environments. The several ethnosciences involved in the encounters, which obviously include European Science, have been subjected to great changes as a result.

Much research is needed to understand the sciences of the encounter. This needs a new historiography, since names and facts, on which current history of science heavily rely, have not been a concern in the registry of these cultures, which have been mostly denied and even excluded in the colonial process. A history “from below, which might throw some lights in the modes of explanation and of understanding reality in these cultures, have not been common in the History of Science. The response to this need is the proposal of the Program Ethnoscience and, in particular, of the Program Ethnomathematics.

How to conceptualize Ethnoscience? and Ethnomathematics?

Ethnosciences are corpora of knowledge established as systems of explanations and as ways of doing, which have been accumulated through generations in *distinct natural and cultural environments*.

This does not differ from the current concepts of Science and Technology, except for the emphasis given in recognizing the specificity resulting from the natural and cultural environment.

Ethnomathematics are these corpora of knowledge derived from quantitative and qualitative practices, such as counting, weighing and measuring, comparing, sorting and classifying.

The two have obviously a symbiotic relation.

The denial and exclusion of the cultures of the periphery, a very common practice during the colonial process, still prevails in modern society. Large sectors of the population do not have access to full citizenship. Some do not have access to the basic needs for survival. This is the situation in most of the world and occurs even in the most developed and richest nations.

In order to build up a civilization which rejects inequity, arrogance and bigotry, education must give special attention to the redemption of cultures that have been for a long time subordinated and must give priority to the empowerment of the excluded sectors of societies.

Ethnomathematics contributes for restoring cultural dignity and offers the intellectual tools for the exercise of citizenship.

With the growing trend towards multiculturalism, Ethnomathematics is recognized as a valid school practice, which enhances creativity, reinforces cultural self-respect and offers a broad view of mankind. In everyday life, Ethnomathematics is increasingly recognized as systems of knowledge, which offer the possibility of a more favorable and harmonious relation in human behavior and between humans and nature.

The denial of knowledge that affects populations is of the same nature as the denial of knowledge to individuals, particularly children. To propose directions to counteract ingrained practices is the major challenge of educators, particularly of mathematics educators.

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.

Advances in Ethnomathematics

The amount of available material on Ethnomathematics is considerable. The academic world faces several challenging questions, as yet unexplained, about the generation, intellectual and social organization, and diffusion of knowledge. These can be approached with advantages from the ethnomathematical viewpoint, thanks to the richness of transcultural and transdisciplinary methodologies intrinsic to ethnomathematics.

The First International Congress of Ethnomathematics, which took place in Granada, Spain, from 2 to 5 September 1998, was a good opportunity to exchange and enrich very different theoretical actions and to expose ethnomathematic practices in the classroom.

From Basques to Maoris, passing by African and Native American cultures, diverse cases supporting epistemological proposals—with a variety of school environments, from pre-school to adult education, covering both informal and formal educational systems—were presented in the Congress.

The talks were organized in three strands: theoretical, including history and philosophy, native cultures, and classroom action.¹

Proposal of a New Conception of Curriculum

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

Literacy. Clearly, reading has a new meaning today. We have to read a movie or a TV program. It is common to listen to a concert with a new reading of Chopin! Also socially, the concept of literacy goes through many changes. Nowadays, “reading” includes also the competency on numeracy, interpretation of graphs, tables, and other ways of informing the individual. And also understanding the condensed

language of codes. These competencies have much more to do with screens and buttons than with pencil and paper. There is no way for reverting this trend, as there was no successful censorship preventing people to have access a books in the last 500 years. Getting information through the new media precedes the use of pencil and paper and numeracy is dealt with calculators. 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.

The three together constitute what is essential for citizenship in a world moving fast into a planetary civilization.

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Note

¹ The full set of papers presented in the congress is available in a CD-ROM through Dr. Maria Luisa Oliveras, Departamento de Didáctica de las Matemáticas, Universidad de Granada. The biannual Newsletter of the International Study Group on Ethnomathematics (ISGEM) and the compendia of all the issues are available, in English and in Spanish, from Dr. Patrick J. Scott, New Mexico State University, Las Cruces, NM.