

THE ETHNOMATHEMATICS PROGRAM AS A PROPOSAL FOR PEACE

O PROGRAMA ETNOMATEMÁTICA COMO UMA PROPOSTA PARA A PAZ

Ubiratan D'Ambrosio

ubi@usp.br

Universidade Anhanguera

Just as 'wars begin in the minds of men', peace also begins in our minds. The same species who invented war is capable of inventing peace. The responsibility lies with each of us (*Seville Statement*).

ABSTRACT

The *Seville Statement*, elaborated by scientists from many countries and many specialties, says that since humans were capable of inventing war and developing strategies for it, they are also capable of inventing peace and proposing means for keeping peace. I assume, as a mathematician and mathematics educator, it is my responsibility to make such a proposal. Just as every living species, humans satisfy biological needs of nourishment for survival, of mating for continuation of the species and of sheltering for necessary biological resting and protection against predators. Unique among all living species, humans subject these needs to options that follow their wants. This basic theoretical framework is supported by nuances in the evolution of the species. In all living species, due to many factors not well explained, the results of coalescence in hierarchy gave rise to acts of violence and killing. But, in the *homo sapiens* species, coalescence has led to coalitional killing and war. The Ethnomathematics Program is presented here as a way of generating, organizing, and diffusing knowledge in cultural identified groups, which offers a possibility of meeting the challenge of proposing and keeping peace.

Keywords: Mathematics; Mathematics Education; Ethnomathematics; Violence, War; Peace.

RESUMO

A *Declaração de Sevilha*, que foi elaborada por cientistas de muitos países e de muitas especialidades, declara que, desde que os seres humanos foram capazes de inventar guerra e desenvolver estratégias para isso, eles também são capazes de inventar a paz e propor meios para manter a paz. Eu suponho que, como um matemático e um educador matemático, é minha responsabilidade efetivar essa proposta. Assim como todas as espécies vivas, os seres humanos satisfazem as suas necessidades biológicas de alimentação para a sobrevivência, de acasalamento para a continuação da espécie e de abrigo para o necessário repouso biológico e para a proteção contra os predadores. Única entre todas as espécies vivas, os seres humanos sujeitam essas necessidades às opções que acompanham os seus desejos. Este quadro teórico básico é sustentado pelas nuances da evolução das espécies. Em todas as espécies vivas, devido a muitos fatores

não muito bem explicados, os resultados de coalescência na hierarquia originaram a atos de violência e os assassinatos. Mas, na espécie *homo*, a coalescência levou à matança coalizacional e à guerra. O Programa Etnomatemática é apresentado como uma maneira de gerar, organizar e difundir o conhecimento em grupos culturais identificados, pois oferece a possibilidade de enfrentar o desafio de propor e manter a paz.

Palavras-chave: Matemática; Educação Matemática; Etnomatemática; Violência; Guerra; Paz.

1. Framework of my Position

Humans are the product of millions of years of evolution. Although humans are animals, we have the most complex social structure of all other animal species on Earth. Just as every living species, humans satisfy biological *needs* of nourishment for survival, of mating for continuation of the species and of sheltering for necessary biological resting and protection against predators. Uniquely among all living species, humans subject these needs to options and follow their *wants* in the optional satisfaction of needs.

This basic theoretical framework is supported by nuances of *psychoneuroendocrinological* adaptations throughout the evolution of species. Gregariousness, which is common to all living species, leads humans to coalesce as families, tribal groups, professional and corporate groups, societies, nations. In all living species, due to many factors not well explained, coalescence results in hierarchy and gives rise to acts of violence and killing. But, in our species, coalescence led to coalitional killing and war. I will not discuss this fascinating theme of human behavior, which has already been addressed by several authors¹.

A document elaborated by an international group of scientists, convened by the *National Spanish National Commission* for UNESCO, in Seville, Spain, in 1986, and adopted by UNESCO, became known as the *Seville Statement on Violence* and claims that there is biological evolutionary support for claiming that violence is intrinsic to the *homo*² species. But, this is an unresolved question and there are important sectors of the scientific community that disagree with the conclusions of this statement.

I entirely agree with the morality of the *Seville Statement* expressed in the last paragraph, as stated in the caption of this article, which has been a guide for my thinking and proposals.

Just as 'wars begin in the minds of men', peace also begins in our minds. The same species who invented war is capable of inventing peace. The responsibility lies with each of us (p. 2).

I also assume that I have a responsibility for inventing peace.

¹Richard W. Wrangham: Evolution of Coalitionary Killing, *Yearbook of Physical Anthropology* 42, 1–30 (1999).

²www.unesco.org/cpp/uk/declarations/seville.pdf.

Participants of the 6th *World Summit of Nobel Peace Laureates*³, conveyed in Rome in 2007, produced the *Charter for a World without Violence*, which states:

We are convinced that adherence to the values of nonviolence will usher in a more peaceful, civilized world order in which more effective and fair governance, respectful of human dignity and the sanctity of life itself, may become a reality (p. 1).

In implementing the principles of this Charter we call upon all to work together towards a just, killing-free world in which everyone has the right not to be killed and responsibility not to kill others (p. 4).

To address all forms of violence we encourage scientific research in the fields of human interaction and dialogue, and we invite participation from the academic, scientific and religious communities to aid us in the transition to non-violent, and non-killing societies (p. 4).

The great challenge I face is how to act to fulfill this commitment as a mathematician and mathematics educator. How to go beyond a humanitarian dream? I propose a broader look into the history and philosophy of mathematics and a change in our pedagogical action to meet this challenge. This is the tone of this paper, which is a re-elaboration of the chapter on *Nonkilling Mathematics* prepared for the *Interdisciplinary Program on Nonkilling Studies at the School of Nonkilling Studies*⁴.

2. Education

Education is a practice present in every culturally identified group. The major aims of education are to convey to new generations the shared knowledge and behavior and supporting values of the group while stimulating and favoring progress.

Cultures are essentially characterized as groups of individuals who share modes and styles of knowledge and behavior, supported by a system of values generated and accumulated throughout a common past. Thus, a culturally identified group, be it a professional guild, a family, a community or a nation, share sets of modes and styles of knowledge and behavior and values ingrained in traditions. Knowledge, behavior and values come from the past supported by traditions and are used to justify present behavior while enticing and making possible the advancement of knowledge. Inevitably, the supporting values also go through permanent revision. This is the essence of progress.

The phenomenon of globalization leads us to consider a much larger group, indeed the total group of the human kind, and to envisage a universal culture. The major challenge is to recognize shared knowledge and behavior and supporting values for this total group, that is, for humankind. This is a radical divergence of the current state of culture which is reduced to discrete, local, sometimes dychotomic and conflicting, cultures. Universal culture recognizes the dynamics of cultural encounters and historical syncretism, which lead to transdisciplinary and transcultural knowledge, behavior and values.

³www.nobelpeace-summits.org.

⁴http://en.wikiversity.org/wiki/Nonkilling_Mathematics.

Examples of transdisciplinary, transcultural and universal knowledge, generally accepted, are mathematics and the sciences in general. Modern behavior, euphemistically called civilized, as expressed in manners, in dressing, in the appropriation of technology, particularly the media, is advancing worldwide as universal behavior. A strong piece of resistance is the systems of values of discrete cultures and traditions in mythology and theology, in the arts and sciences, in ideology and politics.

Education has been focusing on knowledge, behavior and values of culturally identified groups and on showing struggles of groups throughout history to keep their possessions and identity. The violent facet of the struggles has dominated the historical narratives within education. If we accept the initial premises that action in the present reflects the past, it is undeniable that education has been favoring violence through stressing gains and losses, winners and losers.

The historical narratives are impregnated with hostilities and atrocities, and emphasize moments of success and of failure. It is a history with emphasis on defeats and victories. The opponent is identified with evil. Although the moments of temporary success are, sometimes, marked by efforts to build up new styles and modes of cooperation, behaving and accepting different values, these efforts do not deserve attention in history education.

Every human being experiences biological, physical, social, psychological, spiritual needs and also wants. A road to peace is to achieve a balance between needs and wants. Education for peace must consider the realms of inner peace, social peace and environmental peace, paving the way to military peace. These four are intimately related.

To achieve peace between human beings, we must understand how man is integrated in nature and we must respect the equilibrium that exists in nature. This means to be in peace with the environment. Instead, we recognize, throughout history, that groups take advantage of natural resources to their own benefit, accumulating wealth for a few. This leads to a social structure which perpetrates a structural level of the economy and generates social injustices, which causes violence.

3. Mathematics and Peace

I discuss Academic or Scholarly Mathematics, which originated in the Mediterranean Basin, was developed and organized in the European nations and was imposed to the entire world since the 15th century, after the great navigations, conquests and colonialism. It is identified with Modern Civilization, overcoming religious, linguistic, economic and political divergences. As it has been said by historian Mary Lefkowitz, “the evolution of general mathematical theories from those basics [mathematics of Egyptians, Sumerians and others] is the real *basis of Western thought* (italics mine)⁵”.

History shows that Mathematical ideas have been expropriated by the Arts, Religions, and Sciences and by the technological, industrial, military, economic and political complexes of Modern Civilization. Mathematics and mathematicians benefitted and

⁵Interview given to Ken Ringle, The Washington Post, on June 11, 1996.

continue to draw resources from these complexes, relying on them for the material bases of Mathematics continuing progress.

I raise many issues, although most of them will remain unanswered. This text is an introduction to the Program Ethnomathematics, a large and ambitious research program of looking into the relations of mathematics with the satisfaction of needs and wants and with everyday life, with the arts, religions, sciences, economics, politics and architecture and urban life, hence with *PEACE*.

To achieve peace is essential for the survival of civilization. We are a threatened species. When I refer to peace, I am concerned with peace in its several dimensions: Inner Peace, Social Peace, and Environmental Peace and, of course, Military Peace. Violations of peace, in all dimensions, however, have permeated the history of the world.

Violation of Inner Peace leads to the abuse of drugs, violence and affects all aspects of Peace. Research institutions such as *The Worldwatch Institute* and many NGOs systematically denounce violations of Environmental Peace. Ecumenical meetings all over the world call for Social Peace through forgiveness and tolerance, love and harmony. Military Peace can be achieved through dialogue, agreement, concessions, not as a result of force and war. Violations of Military Peace, the insane practice of war, are a recurrent theme of the artistic, religious and scientific discourses and scientists lead the call for a stop in the insanity of war.

Violations of peace, in all its dimensions, are denounced in literature, in the arts and in all media. The impact produced by Picasso's *Guernica* synthesizes the dramatic visualizations of the horror of wars in literature, music, photography, the plastic arts and narratives in general. Most pungent is the appeal of Albert Einstein and Bertrand Russell in the Pugwash Manifest, 1955: "We appeal, as human beings, to human beings: remember your humanity, and forget the rest" (Roblat, 1972).

The Pugwash Movement or *Pugwash Conferences on Science and World Affairs*, which was awarded Nobel Price for Peace in 1995, has the motto: *Thinking in a new way*. Indeed, to go beyond wishful thinking and inspiring discourses, we need innovative approaches and action. The Program Ethnomathematics is a new way of approaching knowledge.

A special form of narrative, to be considered, is fiction. We may look at fiction as narratives diffused to the common people through media (oral, written and now digital media) and anchored in mythology, in folk tales and even in technological advances and scientific knowledge. Indeed, fiction relies much on scientific advances and in scientific wishful-thinking. In the fictional narrative, scientific knowledge is normally presented in *softened* version and, regrettably, is usually considered pseudo-science. This is a grave obstacle to the diffusion of scientific knowledge to the entire population.

Examples of how scientific advances can be made accessible to large sectors of society are *Frankenstein* (Mary W. Shelley, 1818), *Alice in Wonderland* (Lewis Carroll, 1865), and *Flatland: A Romance of Many Dimensions* (Edwin Abbott, 1884), *Dracula* (Bram Stoker, 1897), *Island* (Aldous Huxley, 1962), *The Dechronization of Sam Magruder* (George Graylord Simpson, 1997), and the movie *Avatar* by James Cameron (2009) plus

several novels of Jules Verne (1828-1905) and current best-seller historical fictions. They are all supported by effective scientific results and by contemporary academic research. The reference to the fictional character of the narrative of sacred books are also very important, but may be very sensitizing and requires much tact to deal with. All these narratives are based on contemporary scientific advances, presented in an accessible way to a general public. Similar considerations clarify the importance of parables and metaphors⁶.

In a recent paper I discussed *The Epic of Gilgamesh*, which is a mythic biography that deals with both the human and the superhuman manifestations and meanings of the character (D'Ambrosio, 2010). The episode of the flood to eliminate mankind, which is the focus of the epic, is also the biography of a myth, that is, the study of the flood, an episode that has been recurrent over the centuries in many cultural settings and places and in various media of narrative, with varied, obviously intentional, powerful interpretations. It is present in most of the sacred books. The apocalyptic flood to exterminate the species is the ultimate violence. In many versions and, very explicitly, in *The Epic of Gilgamesh*, the resource of a privileged group to escape the flood, relies on the application of mathematical concepts and practices.

The primordial mathematics, present in every moment of the evolution of the species *homo*, as well as in the evolution of every individual, since birth, depend on concepts and techniques for observing, comparing, classifying, ordering, measuring, quantifying and inferring. The emergence of Mathematics in the human species is a fascinating theme⁷.

4. Global Responsibility of Mathematicians and Mathematics Educators

This paper deals basically with the global responsibility of Mathematicians and Mathematics Educators. The guiding question is: How do we fulfill, as Mathematicians and Mathematics Educators, our commitments to mankind and our responsibility for inventing peace?

To be highly provocative, I invite people to reflect about the embarrassing fact that people who have attained a high level of cultural development, particularly excellence in Mathematics, have performed the most despicable human behavior in recent times. It is undeniable that Mathematics has been the most efficient instrumental companion in historical events that we all deplore.

Let me make very clear that this is not an insinuation of an intrinsic malignity of Mathematics, since I believe that Mathematics plays an important role in achieving the high humanitarian ideals of a new civilization with equity, justice, dignity and peace for the entire human species, without distinction of race, gender, beliefs and creeds, nationalities and cultures. But, this depends on the way we understand how deeply

⁶These references are part of the list of support material given to my students in *History and Philosophy of Sciences and Mathematics and Mathematics Education*.

⁷Ubiratan D'Ambrosio and Manoel de Campos Almeida: *Ethnomathematics and the Emergence of Mathematics, The Nature and Development of Mathematics: Cross Disciplinary Perspectives on Cognition, Learning and Culture*, editors: Patrick Barmby, John Adams, Alex Mesoudi, Routledge (to appear).

related are Mathematics and human behavior. Mathematicians, Historians and Philosophers of Mathematics and Mathematics Educators rarely consider these questions.

It is undeniable that Mathematics is well integrated into the technological, industrial, military, economic and political systems of the present world. Indeed, Mathematics has been relying on these systems for the material bases of its continuing progress. We may say that Mathematics is intrinsic to today's culture. So, we must examine History of Mathematics as related to World History.

In order to appreciate the real significance and importance of Mathematics in different cultures and in different times, it has to be viewed through what might be termed cultural lens. It is hoped that this approach will illuminate many areas of mathematical thought and indicate new directions of research.

As a result, we may better understand the implications of mathematics research, its contents and its pedagogical methodologies, for the achievement of peace in its several dimensions: military peace, environmental peace, social peace and inner peace. This is essential for building up a civilization that rejects inequity, arrogance and bigotry, which are the behaviors that initiate and support violence. Paradoxically, the intense rejection of these behaviors sometimes radicalizes and leads to intolerance, aggression and even violence.

As an example, I mention the support of the recognized pacifist Albert Einstein for developing a most destructive armament, the atomic bomb⁸. His argument was to be prepared for a just war. How valid is the argument of just war, in the name of what? The maxim: *For the winners and just, medals and paradise, for the losers and wicked, scaffolds and hell* seems to be universally accepted. The argument is that the destruction and killing of civilians is necessary, although regretted. This argument is as old as civilization. Laurens Winkel synthesizes very well the concept of *bellum iustus*:

The term *just war* is misleading, though, suggesting as it does that at some point in time there has been or may be a conflict in which one side is morally perfect - as if there is an ideal or precedent that may serve as a role model for future just warfare. Yet, historically the concept of holy war has made precisely this claim, and holy war apologists have rendered such conflicts by analogy with heavenly battles between the forces of light and darkness; and even e.g. the cold war concept of ideological war was often expressed in similar terms (Winkel, 1998/1999, p. 5).

The prevailing attitude of mathematicians, as well as of other scholars and professionals in general, is to say that: *By doing good Mathematics* or *By being a good Mathematics teacher* we are fulfilling our commitment and responsibility to mankind. Indeed, all our actions need competence, but competence is not sufficient. It is absolutely necessary also a critical view on the consequences of what we are doing.

Doing good mathematics should be complemented with the question *What will be done with the Mathematics I am helping to develop?* and a good mathematics teacher must

⁸For details, see my paper on *Nonkilling Mathematics* cited in footnote 4 above.

always be asking *How will my students perform? Will they be conscious of their higher moral commitment to mankind in their professional life?* Our responsibilities include the uses society makes of our intellectual production and what the influence we have in the behavior of future generations is.

It is sarcastic or naïve to say, as G. H. Hardy has said, that

Real mathematics has no effect on war. No one has yet discovered any warlike purpose to be served by the theory of numbers. (...) So, a real mathematician has his conscience clear; there is nothing to be set against any value his work may have; mathematics is, as I said at Oxford, a 'harmless and innocent' occupation (Hardy, 1967, p. 140).

Indeed, the theory of numbers is a fascinating subject, even for children in early schooling. But what bothers me is that the most attractive jobs for specialists in theory of numbers are offered by the Department of Defense of the USA. Training in the theory of numbers is one of the most important preparations for military purposes.

The possibility of final extinction of civilization in Earth is real. Not only through war. We are now witnessing an environmental crisis, mounting social crises in just about every country and, above all, the recurring threat of another World War. I can not accept that it is normal to solve regional conflicts by military means and that isolated wars can be tolerated. Even retaliation, which produce a chain of retaliatory reactions, inevitably chastise innocents, which are many times used as human shields.

Although isolated, the violence and violation of human dignity going on in these conflicts are abhorrent. It is perturbing that discourses of obvious pacifists let it open the way for necessary wars and just wars. Even in Tao Te Ching, #31, we read

Weapons are the tools of violence; all decent men detest them. Weapons are the tools of fear; a decent man will avoid them *except* (italics mine) in the direst necessity and, if compelled, will use them only with the utmost restraint⁹.

History shows that regional and limited conflicts eventually lead to larger involvement of nations. The escalation is the door to World War.

Even more alarming, because it is a subtle violation of peace, is the lack of inner peace of individuals, leading to drugs, nihilism and violence.

To survive as a species we have to achieve peace, in its several dimensions: Inner Peace, Social Peace, Environmental Peace and Military Peace. This means peace with dignity. In a correspondence to Albert Einstein, Sigmund Freud said

(...) perhaps our hope that these two factors - man's cultural disposition and a well-founded dread of the form that future wars will take - may serve to put an end to war in the near future, is not

⁹<http://www.wussu.com/laotzu/index.htm>.

chimerical. But, by what ways or byways this will come about, we cannot guess¹⁰.

We all, particularly mathematicians, have a responsibility in finding these ways.

As it was said above, and I repeat, Mathematics is well integrated into the technological, industrial, military, economic and political systems and mathematicians have been relying on these systems for the advancement of their professional career and for material reward.

It is rare, but exemplary, the attitude of Derek Smith, who, in 1992, was working in speech recognition for *Texas Instruments*. When he learned that the results of his work was playing a role in the control systems of an antiradar missile developed by the Pentagon, he decided to quit his job and joined, thanks to his expertise, a research group to model the immune system recognition of influenza viruses (Enserink, 2008).

The cooperative subservience of academics and scholars is not restricted to specialists in Science and Technology. They are found in Economics, in Communication, even in Philosophy, indeed in all academic disciplines and professions. It is very difficult to avoid this. Cooptation strategies are subtle and, sometimes, intimidator. Ideological and even academic zealots play a fundamental role on this.

If, as Mathematicians and Mathematics Educators, we try to answer the challenge of Sigmund Freud to Albert Einstein, it is natural for us to reflect about our personal role in putting an end to and avoiding future wars. According to Freud

Thus it would seem that any effort to replace brute force by the might of an ideal is, under present conditions, doomed to fail. Our logic is at fault if we ignore the fact that right is founded on brute force and even today needs violence to maintain it¹¹.

The issues are essentially political. There has been reluctance among mathematicians, to a certain extent among scientists in general, to recognize the symbiotic development of mathematical and political ideas and models of society. Mathematics has grown parallel to the elaboration of what we call Modern Civilization. Historians amply recognize this. Particularly explicit on this is Mary Lefkowitz, as quoted in Note 1 above.

We cannot disregard the fact that *the most universal mode of thought* – that is, mathematics has much to do with *the most universal problem* – that is, survival with dignity. I believe that to find the relation between these two universals must be an inescapable consideration when we claim the universality of mathematics.

Our commitment implies to assume a broad view of the world and of mankind in general. This is possible through a reflection about the future and a broad perception of the state of the world, which is disturbing. It is a general feeling that human behavior has not been ethical. Particularly mathematicians and mathematics educators have not been explicit about a comprehensive ethics guiding their practices. An ethics of

¹⁰The Einstein-Freud correspondence (1931-1932). Retrieved from <http://www.public.asu.edu/~jmlynch/273/documents/FreudEinstein.pdf> on 16 January, 2016.

¹¹The Einstein-Freud correspondence (1931-1932). Retrieved from <http://www.public.asu.edu/~jmlynch/273/documents/FreudEinstein.pdf>. Accessed on January 16, 2016.

responsibility is needed. But, given the universality of mathematics and of its effects, this ethics must go beyond professional codes of behavior and professional ethics, such as in some statement similar to the Hippocratic Oath for mathematicians.

It is natural to express the discontentment with the state of the world by chastising Science and Technology, which are recognized as the support of Modern Civilization. Science and Technology are thus blamed for the malaise of humanity. Mathematics is, obviously, directly affected by this criticism. The challenges and counter-challenges we are witnessing reflect a defensive posture that is growing to contain the wave of discontent.

Societal hierarchy is subjected to groups of power, usually religious, economic and political elites. These groups act upon individuals or groups through strategies of cooptation and threatening and even dispensing punishment and rewards. The groups of power favor the access and development of intellectual and material instruments useful to the group, while they control the broad access to facts and accumulated knowledge which may challenge the group.

The strategies to control the broad access are moral and material instruments, among them ideological patrol, norms and codes, language and literacy, and different forms of intimidation, from harassment and bullying to imprisonment and torture. Examples are the *Inquisition*, the *Index Librorum Prohibitorum* and other forms of censorship, such as the ideological zealots of Senator Joseph McCarthy era, and academic mobbing.

Paradoxically, the same instruments, which were fragmentarily constructed to control and to preserve the prevailing order of the interest of the groups of power usually become so complex that they generate internal subgroups of power that threat and sometimes control the group of power which created these instruments. The creature escapes the control of the creator, as expressed in an old Spanish refrain *Cría cuervos y ellos te comerán los ojos*. Examples are the fall in disgrace of Senator McCarthy, as well as metaphors like Adam, Frankenstein, and Hal of the movie *2001: A Space Odyssey*, the androids of the movie *Blade Runner*.

I hope that a new thinking in Science, mainly in Mathematics, will survive the control mechanisms. A subtle threat comes from the renowned scientist Carl Sagan, who, in a recent book, cautions about the lure of new directions in inquiry. In his denouncement of the *new Dark Age of irrationality*, Sagan says:

Each field of science has its own complement of pseudoscience. Geophysicists have flat Earths; hollow Earths, Earths with wildly bobbing axes to contend with, rapidly rising and sinking continents, plus earthquake prophets (Sagan, 1996, p. 43).

On the other hand, distinguished historian G.E.R. Lloyd says, in his recent book on the origin of disciplines in the Western and Oriental traditions, that

(...) the possibilities of mismatch between what biomedicine [with a battery of tests to call on] pronounces to be the case and what individual patients feel, are unlikely ever to be completely removed. If so, alternative styles of medicine, with their more or less articulate elites to promote them, are likely to continue to bear witness to the

complexities of our understanding of what it is to be truly well, and it would surely be foolhardy to suppose that biomedicine has nothing to learn from its rivals (Lloyd, 2009, p. 92).

To challenge scientific, religious, socio-political and historical knowledge does not mean regress. It has always been a coherent response to the state of society and it can be understood if we look into the full cycle of knowledge in a historical perspective, of course freeing ourselves of the epistemological biases that are adopted to justify the prevailing socio-political and economical order. The essence of these biases is the argument that Science is an object of knowledge of a different nature, in the realm of the ratio. This is particularly strong when we refer to Mathematics, which foundations rely on very strict dichotomies.

Knowledge is generated by individuals and by groups, is intellectually and socially organized, and is diffused. The full cycle of the generation, organization and diffusion of knowledge intertwines with needs, myths, interests and wants and resort to parables, metaphors, fables and other fictional narratives. The human species develops, like other animal species, strategies of hierarchical power. Intrinsic to hierarchical power is the control of knowledge.

In the discussion about the current state of the World, it is very relevant the fact that Mathematics, as it is worldwide recognized today in the academia, developed parallel to Western thought (philosophical, religious, political, economical, artistic and, indeed, every sector of culture). It would lead to a redundant boredom to give examples justifying this assertion. It is not so important to claim that although the building up of Western Academic Mathematics was indisputably Greek, even if we recognize that Egyptian, Sumerian and other civilizations were ahead of the Greek. The undisputed claim that medieval scholars received Euclid and Greek Mathematics and Philosophy through the Arabs do not change the recognition that Mathematics and Western Civilization belong to each other.

When we question the current social, economical and political order, we are essentially questioning the righteousness of Western Civilization in face of a real threat to its continuation. How is it possible to avoid questioning the pillars of Western Civilization, which are Science and Mathematics? Broad and complex questions about the pillars of Western Civilization cannot be closed to non-scientists and non-mathematicians. The resource to arguments of authoritative competence leads to intimidation and to passionate arguments, as discussed above about the ideological zealots.

New interpretations are needed. How can we reach the new by refusing, discouraging, rejecting, denying the new? Indeed, a subtle instrument of denial is discouragement through intimidation. Language plays an important role in this process, as every schoolteacher knows. Particularly in Mathematics, the use of a formal language, inherent to Academic Mathematics, has been a major instrument in deterring critics.

The organization of the language of Academic Mathematics is the realm of epistemology. Epistemologies and histories, the same as norms, differ from group to group, from society to society, and are incorporated in what is called culture. The crux is the dynamical process of encounters of cultures and the resulting mutual expositions,

which underlie the construction and reconstruction of knowledge and the maintenance, substitution, dissolution and modification of epistemologies and norms.

When authority dominates this process, as it was in the colonial process and equally characterizes conservative schools, the outcome is predictable: contest. The problem thus resides with authority and the denial of participation in the dynamics of this process.

Social and political scientist Marcus G. Raskin and physicist Herbert J. Bernstein, in their analysis of the linkage between the generation of knowledge and political directions, claim that

(...) science seeks power, separating any specific explanation of natural and social phenomena from meaning without acknowledging human attributes (such as love, happiness, despair, or hatred), the scientific and technological enterprise will cause profound and debilitating human problems. It will mask more than it tells us about the universe and ourselves (Hardy, 1967, p. 78).

5. The Nature of Mathematics

The criticism inherent in reestablishing the lost connection of the sciences, technology and human values is causing unavoidable conflicts. This is particularly true with Mathematics, in which the acknowledgement of human attributes is conspicuously absent in its discourse.

This has not been so in the course of history. Mathematics, the same as the other sciences, used to be impregnated with religious, as well as social and political considerations. Current Epistemology and History, and above all the educational framework, were constructed to justify the prevailing socio-political and economical order, in which we recognize different *theories of science*.

The theories of science largely fail to recognize that the generation of knowledge is the result of a complexity of sensorial, intuitive, emotional and rational factors. We are *informed* by these factors and process the information in a way as yet unknown. We need more understanding on how the human mind functions. A holistic view on knowledge, going from reality to action, owes much to artificial intelligence, biology and sociobiology¹² (D'Ambrosio, 1981).

Let us now turn to the question of political power. There are indicators that students spend less time studying or doing homework and that they are bored in class. There is no point in putting the blame on youth, claiming that the current generation is uninterested in learning and intellectually *lost*. Maybe we should look into the blamers. The problem does not reside in youth, but in the older generation, in family, in schools,

¹²I am particularly indebted in my reflections to Norbert Wiener: *Cybernetics. Or Control and Communication in the Animal and the Machine*, New York, NY: The Technology Press, 1948, to Humberto R. Maturana & Francisco J. Varela: *The Tree of Knowledge. The Biological Roots of Human Understanding*, Boston, MA: Shambala Publications, 1987, and to Charles J. Lumsden and Edward O. Wilson: *Genes, Mind, and Culture. The Coevolutionary Process*, Cambridge, England: Harvard University Press, 1981. The ideas in these books were important in building up my holistic view on knowledge.

in the institutions in general. In times of war, chiefs of staff are ready to justify sending troops, of young age, even teenagers to the battlefield. I know of no decision to send older generations to the battlefield!

As Fred M. Hechinger (1992) puts it, “the drift toward a society that offers too much to the favored few and too little to the many, inevitably raises question among young people about the *rewards of hard work and integrity* (italics are mine)” (p. 192).

The real problems facing education are political, essentially the result of an unequal distribution of material and cultural goods, intrinsic to a modern economy. There is no need to elaborate on these issues. I suggest a few sources where we find discussion of property, production, and global issues in modern society¹³.

Some readers will claim that this has not much to do with the relations between Mathematics and Mathematics Education and Violence. I claim they have everything to do with them. This cultural consumerism, practiced both in schools and in the academia, has been efficient in trimming processes and focusing only on results. Mathematics and the History of Mathematics are delivered as frozen systems of knowledge, conforming to the *status quo*. A frequent argument when one calls for a broader view *is that this belongs to another discipline, not to the mathematics classes*. This is a gross mistake.

There have been few writings about values attached to Mathematics and even less about the moral quality of our action. To search for a correlation between the current state of civilization and mathematics has been uncommon among mathematics educators. Particularly the political component, which was so well studied by Paulo Freire, Michael Apple, Henry Giroux and others with respect to education in general, seem to have drawn little attention of Mathematics Educators. There are notable exceptions. I mention the activities of the research group *MES/Mathematics Education and Society*, the movements *Critical Mathematics Education* and *Ethnomathematics*.

The human mind is a complex set of emotional, intuitive, sensorial, rational perceptions, involving all of them at the same time. Maybe we have been emphasizing too much the rational perception and denying, rejecting and repressing the others. Indeed, there is a general feeling that, as a mathematics teacher, one has to teach *serious mathematics*, that is, objective reason and results and rational thinking among the students. It is not uncommon to see a child punished for being *too happy* in the classroom. And we always know of adults saying to a boy: *Stop crying. Men do not cry!* Is it possible to build knowledge dissociating the rational from the sensorial, the intuitive and the emotional?

I see multi-dimensionality in understanding knowledge as a very important factor, particularly in Mathematics. *What is the role of emotions in Mathematics?* It is interesting to discuss what led Gustave Flaubert to write “Mathematics: the one who dries up the heart” (Flaubert, 1987). These considerations have been practically ignored by historians and philosophers of mathematics. Fortunately, there has been a resurgence

¹³See, for example, Ubiratan D'Ambrosio: *Economic Development and Global Financial Institutions: Basis for a Restructuring in Security, Cooperation and Disarmament: The Unfinished Agenda for the 1990s*, Joseph Rotblat (Ed.), Singapore: World Scientific, 1999, pp. 453-461. It is also interesting the book by Avishai Margalit: *The Decent Society*, Cambridge: Harvard University Press, 1996. The *INES/International Network of Scientists and Engineers for Global Responsibility* offers a good electronic forum for discussion of these basic issues available on <http://www.inesglobal.com/news-2014.phtml>.

of interest in the intuitive, sensorial, affective and even spiritual aspects in Mathematics, in the History and Philosophy of Mathematics and in Mathematics Education. An example is hands-on projects. Very interesting is the study of Klaus Witz (2007) on spiritually influences among mathematics students and researchers.

The usual reaction to these comments is: “These aspects are not relevant, since Mathematics is the quintessence of rationalism”. But much of the polemics going on relate to the prevailing acceptance of the superiority of rationality over other manifestations of human behavior. This was one of the main concerns of the mathematician-writer Robert Musil in his masterpiece *The Man without Qualities*. Commenting on scientists and engineers, the main character Ulrich says,

(...) why they do seldom talk of anything but their profession? Or if they ever do, why do they do it in a special, stiff, out-of-touch, extraneous manner of speaking that does not go any deeper down, inside, than the epiglots? This is far from being true of all of them, of course, but it is true of a great many; (...) They revealed themselves to be men who were firmly attached to their drawing-boards, who loved their profession and were admirably efficient in it; but to the suggestion that they should apply the audacity of their ideas not to their machines but to themselves they would have reacted much as though they had been asked to use a hammer for the unnatural purpose of murder (Musil, 1980, p. 38).

Musil’s oeuvre anticipates the intellectual framework of Nazi Germany, in which he identifies the incapacity to tolerate pluralism. Indeed, much of the reactions against irrationalism are mixed with a latent emotional incapability of accepting the different. The denial of access to knowledge is a strategy for the exclusion of the different.

6. The Ethnomathematics Program

Peace, in all its dimensions, depends on an ethical posture not only on human behavior, but also in the production of knowledge. Current systems of knowledge give to the prevailing social, economical and political order a character of normality. Both the religions and the sciences have advanced in a process of dismantling, reassembling and creating systems of knowledge with the undeniable purpose of giving a sense of normality to prevailing human individual and social behavior.

The fundamental problem in this capability is the relation between brain and mind. It is possible to know much about the human body, its anatomy and physiology, to know much about neurons and yet know nothing about why we like or dislike, love or hate. This gives rise to modern theories of consciousness, which some scientists claim to be the last frontier of scientific research.

Through a sophisticated communication system and other organic specificities, man tries to probe beyond the span of one’s existence, before birth and after death. Here we find the origins of myths, traditions, religions, cults, arts and sciences. Essentially, this is a search for explanations, for understanding, which go together with the search for predictions. One explains in order to anticipate. Thus, builds up systems of explanations (beliefs) and of behavior (norms, precepts), which are, until nowadays, the common grounds of religions and sciences.

The drive towards survival is intrinsic to life. But incursions into the mysteries beyond birth and death, which are equivalent to the search for past, present and future, seem to be typical of the human species. This is transcendence. The symbiotic drives towards the *pulsion of survival* and the *pulsion of transcendence* constitute the essence of being human.

These reflections lead naturally to questions about the emergence of mathematical thinking since the early moments of the human species. We must take into account other influential contextual factors such as ecological, climatic, etc. The investigation of the original prehistoric mathematics is necessarily interdisciplinarian, involving multiple sciences: (*ethno*)*mathematics*, archeology, genetics, neurophysiology, climatology, anthropology, linguistics, developmental psychology, paleoanthropology and many others¹⁴.

The Ethnomathematics Program is a theoretical framework that establishes the foundation for organizing practices and systems of explanations developed by the species, throughout its evolution, in order to survive and to transcend. This program contributes to restoring cultural dignity and offers the intellectual tools for the exercise of citizenship. It enhances creativity, reinforces cultural self-respect, and offers a broad view of humanity. In everyday life, it is a system of knowledge that offers the possibility of a more favorable and harmonious relation among humans and between humans and nature. It offers the possibility of harmonious relations in human behavior and between humans and nature, since it has, intrinsic to it, the *ethics of diversity*:

- respect for the other (the different);
- solidarity with the other; and
- cooperation with the other.

The practice of this ethics of diversity is the only hope we have for achieving a just social equilibrium. We contend that education practices should be grounded in the ethics of diversity, if education is to contribute to achieving a just social order.

To build a civilization that rejects inequity, arrogance, and bigotry, education must give special attention to the redemption of peoples that have been for a long time subordinated and constitute excluded sectors of societies. The real goals of empowerment, a phrase commonly used in education, can be achieved by the implications of the Ethnomathematics Program in the curriculum, as it has been amply discussed elsewhere (D'Ambrosio & D'Ambrosio, 2013).

Readers may be wondering whether Ethnomathematics is research or practice. The concept of ethnomathematics arises from research, and this is the reason for calling it the Ethnomathematics Program. There are several ways of defining ethnomathematics, some with focus on identifying mathematical practices and theories of different ethnos. They are valid, but they presuppose a category of knowledge named mathematics, which is in

¹⁴Ubiratan D'Ambrosio and Manoel de Campos Almeida: Ethnomathematics and the Emergence of Mathematics, *The Nature and Development of Mathematics: Cross Disciplinary Perspectives on Cognition, Learning and Culture*, editors: Patrick Barmby, John Adams, Alex Mesoudi, Routledge (to appear).

itself very difficult to define and is rooted in the perception of the world in the Mediterranean environment, which include nature, myths, history, and traditions. This perception is synthesized implying concepts of space and time, which are the bases of every mathematical thinking.

Examples of Ethnomathematics in a specific environment are the ways people deal with calendars and territory and their techniques of observing, comparing, classifying, ordering, measuring, quantifying and inferring in that environment, which may be entirely meaningless in other environments. For example, days, territorial demarcation and shelter of *Inuit* populations are absolutely meaningless for Amazonian populations.

My concept of Ethnomathematics is primeval, recognizing the different emergence perceptions of space and time and of techniques of observing, comparing, classifying, ordering, measuring, quantifying and inferring and, as a result, of abstract thinking in every corner of the planet. In each one, individuals develop strategies to satisfy the pulsions of survival and transcendence. In every corner of the planet, these strategies are synthesized in arts and techniques, modes and styles (*techné* \approx *tics*) for coping with reality, for explaining, for learning and understanding, for knowing (*mathemá*) the natural, social, cultural, mythical and imaginary environment (*ethno*).

This etymological exercise leads me to construct the concept of *tics* of *mathema* in distinct *ethnos*, or *ethno* + *mathema* + *tics*, hence, Ethnomathematics. There is no contradiction with the universally accepted concept of academic or scholarly mathematics. Simply, Western Mathematics is an elaboration of the *tics* of *mathemá* of the peoples of the Mediterranean Basin, which acquired specific style of narrative and criteria of truth. This has been amply discussed in my papers and books.

The work with different cultural environments to describe mathematical ideas and practices of other cultures, an important component of the Ethnomathematics Program, is the recognition that the concept of ethno goes beyond ethnic groups. The different cultural groups that are studied in the Program Ethnomathematics includes indigenous populations, but also labor and artisan groups, communities in urban environments and in the periphery, farm communities, and all different types of professional groups. All these groups are frequently submitted to violations of peace.

We must devote special attention to how these ideas, which I believe are essential for peace in all dimensions as discussed above, are incorporated in pedagogical practice. This requires exploring programs that develop a disposition of teachers and leaders to reconceptualize goals for education and considering the well being of all humanity as the main concern of education, which needs to rethink teacher preparation (D'Ambrosio & Kastberg, 2012). I will not elaborate further on this.

7. As a Conclusion

The threat of extinction is a fact. Paraphrasing Martin Luther King Jr. in his 1963 speech, the change to nonviolence instead of violence is, indeed, a decision between nonexistence and existence. Do we prefer nonexistence to eradicating violence?

As human beings, we cannot relinquish our duty to cooperate with each other, with respect and solidarity, for the preservation of the natural and cultural patrimony. This is

the essence of an ethical behavior of respect for the other, who is different in many natural and cultural aspects; respect for the other; solidarity with the other; and cooperation with the other. This is a sure road to quality of life and dignity for the entire mankind.

Our main goal is nonviolence. Otherwise, we are in the road of extinction. I am simple in my proposal and didactic in my style- we need ethics - every individual, whether the sophisticated intellectual or the common man, has a responsibility and should find the means to direct his/her energies towards socially constructive goals.

Many will say that this is an unusual piece on Mathematics and Mathematics Education. But if we accept very clearly and unequivocally that our professional commitments are subordinated to a more vital commitment to nonviolence, it is absolutely necessary to understand how and why mathematics became such a central instrument, both intellectual and material, in human knowledge and behavior and to propose new pedagogical action.

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