**NONKILLING MATHEMATICS?**

**The Ethics of Mathematics in the Final Analysis**

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**The appeal for nonviolence**

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|          |          | But nothing will ever quench humanity and the human potentiality to evolve something magnificent out of a renewed chaos.(D.H. Lawrence, 2001) |

Nonviolence is the magnificent scenario we are struggling for. I want to envisage a road that makes Lawrence believe in man.

Political scientist Glenn D. Paige published, in 2002, a pioneering book on *Nonkilling Global Political Science*, featuring a very provocative and basic chapter entitled *Is A Nonkilling Society Possible?* In it Paige says

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|          | “The structure of society does not depend upon lethality. There are no social relationships that require actual or threatened killing to sustain or change them. No relationships of dominance or exclusion—boundaries, forms of government, property, gender, race, ethnicity, class, or systems of spiritual or secular belief—require killing to support or challenge them. This does not assume that such a society is unbounded, undifferentiated, or conflict-free, but only that its structure and processes do not derive from or depend upon killing. There are no vocations, legitimate or illegitimate, whose purpose is to kill. Thus life in a nonkilling society is characterized by no killing of humans and no threats to kill, neither technologies nor justifications for killing, and no social conditions that depend upon threat or use of lethal force.” (p.30) |

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*. In the last paragraph, it claims that

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|          | “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.” |

In the 8th World Summit of Nobel Peace Laureates, conveyed in Rome in 2007, participants produced the *Charter for a World without Violence*, which states:

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|          | “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. |
|  | 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. |
|  | 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.” |

I agree with the *Seville Statement on Violence* in accepting that I am also responsible for inventing peace and, as invited in the *Charter for a World without Violence*, I join Glenn D. Paige in committing myself to the enormous task of participating in the efforts to create a World society in which there is no killing of humans and no threats to kill.

The great challenge, which I face in writing this chapter, is how, as a mathematician and mathematics educators, to act to fulfill this commitment. How to go beyond the humanitarian dream? I believe an academic quest of the nature and history of mathematics may be helpful. This will be the tone of this chapter.

Introduction

As Peace Educator Leah Wells once said, “Violence comes from fear, fear comes from incomprehension, incomprehension comes from ignorance … we eliminate ignorance with education”. To recognize, to respect and *not to fear* different values is the way to eliminate violence.

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, and, at the same time, to stimulate and favor progress.

Let us consider groups of individuals who share modes and styles of knowledge and behavior, supported by a system of values, which were generated and accumulated throughout a common past. This characterizes a culture. Thus, a culturally identified group, be it a professional guild, a family, a community, a nation, share sets of modes and styles of knowledge and behavior and values, ingrained in traditions, which support knowledge and behavior. Knowledge, behavior and values which come from the past, justify present behavior and, at the same time, entice and make it 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. This leads 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 the human kind. This asks for universal and transcultural knowledge, behavior and values. Examples of transcultural and universal knowledge are mathematics and the sciences in general. Modern, euphemistically called civilized, behavior, 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, as it has historically been, the systems of values.

Education has been focusing on knowledge, behavior and values of culturally identified groups and on past struggles for keeping the identity of the group. 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. The historical narratives are impregnated with hostilities and atrocities, and emphasize moments of success or failure. Although the moments of temporary success are, sometimes, marked by efforts to build up new styles and modes of knowing, behaving and accepting different values, these efforts have not been deserving 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. Taking advantage of natural resources to accumulate wealth to a few, which is perpetrated at a structural level of the economy, generates social injustices which cause violence.

In this chapter I will discuss mathematics, the earliest and most recognized universal system of knowledge. 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* (emphasis added)”[[1]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-1). History shows that Mathematical ideas have been expropriated by the Arts, Religions, Sciences and, in modern civilization, by the technological, industrial, military, economic and political complexes. Mathematics and mathematicians benefitted, and continue to draw resources, from these complexes, relying on them for the material bases of its continuing progress. I will also discuss the origins of mathematics and how a universal set of values, essential for peace, is intrinsic to mathematics.

I raise many issues, leaving most of then unanswered. This text is an introduction to a large and ambitious program of looking into mathematics as the real basis of civilizations, hence into the relations of mathematics 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*, *environmental peace* and, of course, *military peace*. Violations of peace, in all these dimensions, permeate the history of the world.

Violations of peace, in all dimensions, are frequently shown in the media and are dramatized in the arts. Recently, the Academy of Motion Picture Arts and Sciences recognized the violation of inner peace in American society by granting an Oscar to the movie *American Beauty*, which denounced this situation. Research institutions such as The World Watch Institute and many NGOs systematically denounce violations of Social Peace and Environmental Peace.

Violations of Military Peace, that is, the insane practice of war, are a recurrent theme of the artistic, religious and scientific discourses. The impact produced by Picasso’s Guernica synthesizes dramatic visualizations of the horror of wars in literature, music, photography and the plastic arts. Appeals to sanity and to stop war are frequent. The exhibit “Thermonuclear Garden”, installed by Sheila Pinkel in several cities of the USA from 1982-1992, is an example of appeal to the American people to protest against production and export of weapons. Ecumenical meetings all over the world call for forgiveness and tolerance, love and harmony. And scientists lead the call for a stop in the insanity of war. 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.”

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, some innovative action is need.

I have a utopia: a world in peace! We need utopias in the sense given by Karl Mannheim, which sees utopia as the substratum of will. And will guides our actions. Mannheim says:

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|          | “The disappearance of utopia brings about a static state of affairs in which man himself becomes no more than a thing. We would be faced then with the greatest paradox imaginable, namely, that man, who has achieved the highest degree of rational mastery of existence, left without any ideals, becomes a mere creature of impulses. Thus, after a long tortuous, but heroic development, just at the highest stage of awareness, when history is ceasing to be blind fate, and is becoming more and more man's own creation, with the relinquishment of utopias, man would lose his will to shape history and therewith his ability to understand it.” (1954:236) |

Global responsibility

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?”

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. Let me make it very clear that this is not an insinuation of an intrinsic malignity of Mathematics. But it is clear that Mathematics has been an instrumental companion in the historical events that we all deplore. Let me make very clear that I see Mathematics playing an important role in achieving the high humanitarian ideals of a new civilization with equity, justice and dignity 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 related are Mathematics and human behavior. Mathematicians, Historians 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 are led to 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 mathematical 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 which initiate and support violence. Paradoxically, the intense rejection of these behaviors sometimes are, themselves, arguments favoring violence.

As a mathematician proposing strict nonviolence, it is for me very difficult to understand why and how the recognized pacifist Albert Einstein sent to President Franklin Delano Roosevelt, in August 2nd 1939, the decisive letter to build an atomic bomb, that killed thousands of Japanese civilians, families, elder and children and deflagrated the Cold War. In his letter, Einstein says

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|          | “Some recent work by E. Fermi and L. Szilard, which has been communicated to me in manuscript, leads me to expect that the element uranium may be turned into a new and important source of energy in the immediate future. Certain aspects of the situation which has arisen seem to call for watchfulness and, if necessary, quick action on the part of the Administration.” |

The USA was then neutral. Only after the Japanese attack on Pearl Harbor, in December 7th, 1941, the USA declared war on Japan and Hitler, drawn by his alliance with Japan, declared war on the USA. But the atomic bomb project was well under way.

This is supported by the concept of being prepared for a just war. The argument is that the destruction and killing of civilians is necessary, although regretted. This same argument is as old as civilization, and it is employed nowadays.

Can the argument of just war be supported? 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 concept of *bellum iustum* is as old as mankind. Laurens Winkel synthesizes it well:

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|          | “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.” (1999:6) |

**The prevailing attitude**

It is not sufficient to say, as it is common in our profession — indeed, in every profession — that we are fulfilling our commitment and responsibility to mankind “By doing good Mathematics” or “By being a good Mathematics teacher” But 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 always be asking “How will my students perform? Will they be conscious of their moral commitment in their professional life?” Our responsibilities include the uses society makes of our intellectual production and what is the influence we have in the behavior of future generations.

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

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|          | “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.” (1967:140) |

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 the theory of numbers are offered by the Department of Defense. It is one of the most important resources 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. Mainly as retaliation, which produce a chain of retaliatory actions, inevitably chastising innocents, although conveniently used as human shields, thus serving as a very efficient argument for cooptation. 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

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|          | “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 restraint." |

History has shown us 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

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|          | “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 chimerical. But by what ways or byways this will come about, we cannot guess.”[[2]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-2) |

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.

Rare, but exemplary, is 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. (*Science*, April 18, 2008, pp. 310–311).

Cooperative subservience is not restricted to specialists in Science and Technology. They are found in Economics, in Communication, even in Philosophy—indeed in all fields of academic specialties and professions. It is extremely difficult to avoid. The cooptation strategies are subtle and, sometimes, intimidate. 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

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|         | “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 it.” (op. cit., p. 12) |

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 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, in recognizing that mathematics is universal.

We can not disregard the fact that *the most universal problem*—that is, survival with dignity—must have much to do with *the most universal mode of thought*—that is, mathematics. I believe that to find the relation between these two universals is an inescapable companion to the claim of 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 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 the Hippocratic Oath.

It is natural to express the discontentment with the state of the world by chastising Science and Technology, which are recognized as the embodiment of modern society. 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. For generations and generations, access to facts have been controlled by moral and material instruments, among them norms and codes, language and literacy, all organized in systems such as religions, sciences and technology. Reminding the ideological zealots of Senator Joseph McCarthy era, academic mobbing is a powerful control instrument. Paradoxically, the same instruments, which were fragmentarily constructed to preserve the prevailing order, have become so complex that they are no longer effective and became increasingly permeable. An old Spanish refrain says “*Cría cuervos y ellos te comerán los ojos*” [“Raise crows and they will peck your eyes out”]. The creature escapes the control of the creator. The fall in disgrace of Senator McCarthy, as well as metaphors like Adam, Frankenstein, Hal of *2001*, the androids of *Blade Runner*, all point into this direction. Our hope is that a new thinking in Science, mainly in Mathematics, will be able to go through the control mechanisms.

**The reaction to the challenge**

To raise these questions is sometimes interpreted as opening doors to anti-science and irrationality. In his recent book, Carl Sagan cautions about the lure of new directions in inquiry. In his denouncement of the “new Dark Age of irrationality”, Sagan says:

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|          | “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.” (1996: 43) |

It is misleading to denounce discontentment as such. Indeed, these conflicting postures have led to the so-called “Science War”. Research done by Sociologists of Science have been more focused on the relations of Science and Society. But the new field of Social Studies of Science has been chastised. Alan Sokal draw much attention to the theme in a hoax published in one of the cherished journal of the postmodern critics.[[3]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-3)

The polemic thus started is not different from those focusing afro-centrism and feminism. These polemics reveal that the discussion of scientific knowledge by postmodern critics reveal the real issue of the subordination of Science, which is a political one, and that goes much beyond the national arenas. Ideological labels are commonly subtly used to justify fundamentalism in the defense of the prevailing academic order. This is very well illustrated by the fact that Sokal’s hoax was used, a few weeks after its publication, by Brazilian Congressman Roberto Campos to support his political rightist harangue. A few days later, Alan Sokal published a reply to Congressman Campos, in the same influential Brazilian newspaper, explicitly chastising Campos as a rightist and declaring himself as a leftist. Another example is the fact that the television debate between candidates Clinton and Dole, on October 6, 1996, revealed an insistence of Senator Dole on using the word “liberal” as a form of attacking the policies of President Clinton. There is a danger that these polemics result in the deviation of the main objective, which is to “condemn injustices and inequities of the capitalist system and try to eliminate or, at least, minimize them”, using the same words of Alan Sokal, which contradicts his posture in deflagrating a total Science War.

To challenge scientific, religious, socio-political and historical knowledge does not mean retrogress. 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 ratioïd. This is particularly strong when we refer to Mathematics. Metaphorically, Mathematics is manichaestic. Its 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, metaphors, and interests. 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 not so important to claim that although the Egyptian, the Sumerian and other civilizations were ahead of the Greek, the contribution to build up general mathematical theories was indisputably Greek.[[4]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-4) It is irrelevant, though largely accepted, that the medieval scholars received Euclid through the Arabs. What is very relevant is the fact that Mathematics as it is 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. Indeed, 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 its pillars, Science and Mathematics? How can discussions about these pillars 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. 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 is 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 this language 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

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|          | “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.” (op. cit., p. 78) |

**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 approach to knowledge, going from reality to action, owes much to artificial intelligence, biology and sociobiology.[[5]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-5)

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, in the institutions in general. Chiefs of staff are ready to justify sending troops, of young age, even teenagers to the battlefield. I know of no decision taken by a young chief of staff to engage in a war and sending the older generation to the battlefield!

As Fred M. Hechinger (1992: 206) puts it,

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|          | “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* (emphasis added)” |

The real problems facing education are political, essentially the result of an unequal distribution of material and cultural goods, intrinsic to 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 society.[[6]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-6)

Some readers will claim that this has not much to do with the relations among Violence, Mathematics and Mathematics Education. I claim they have everything to do. This relation has been avoided in the discussions about the state of the world and Mathematics and Mathematics Education have been absent of the critical views on the main issues. The cultural consumerism, practiced both in schools and in the academia, has been efficient in trimming processes and focusing only in results. Mathematics and 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 “this belongs to another discipline, not to mathematics classes”.

Exceptions are notable. We have to mention the activities of the research group on “Political Dimensions of Mathematics Education/PDME” and also the movements “critical mathematics” and ethnomathematics.[[7]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-7)

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.

To a great extent, the polemics around the postmodern discourse of sociologists of science is a reflection of the ideology intrinsic to words. Indeed, language has been the main instrument in denying free inquiry. There is an implicit intimidating instrument in the language of academia and society in general. One must be reminded that of the major confrontations of the sixties, particularly the Civil Rights Movement, the demonstrations against the Vietnam War and the student movements of 1968, probably the first of such contestations of the established order was the Free Speech Movement, initiated by Lenny Bruce.

Human mind is a complex of emotional, intuitive, sensorial, rational perceptions, involving all 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 math teacher, one has to teach “serious math”, that is, objective reason, and to stimulate 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 teachers 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?

It comes to my mind the case of a school teacher who asked children to draw a color picture of a tree seen through the window of a classroom. Jane came with a tree painted red. The teacher corrected the child, even suggested to the parents that Jane might have a vision problem! A few days later the teacher was sitting in the same place as Jane was, at the same time of the day, and the Sun was in the same position. The teacher saw the tree red. Many say that this example is misleading, since it does not deal with objective reason.

I see the multi-dimensionality in building up knowledge as a very important aspect of the History of Mathematics, which has been practically ignored. And, of course, this is very important in learning.

There has been a resurgence of interest in the intuitive, sensorial (hands-on projects) and affective aspects in Mathematics Education. We must go beyond education and question the discipline itself. What is the role of emotions in Mathematics? When Gustave Flaubert wrote “Mathematics: the one who dries up the heart” , what did he have in his mind?

The usual reaction to these comments is: “But this is natural, since Mathematics is the quintessence of rationalism.” Indeed. 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,

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|          | “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.” (1980: 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.

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 nonviolence. Do we prefer nonexistence to eradicating violence?

As human beings, we can not 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; solidarity with the other; cooperation with the other. This is a sure road to quality of life and dignity for the entire mankind.

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

This is an unusual piece on Mathematics and Mathematics Education, many will say. 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.

**The essence of being human: survival and transcendence**

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 why we like or dislike, love or hate. This gives rise to the modern theories of consciousness, which claims to be the last frontier of scientific research.[[8]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-8)

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). These are the common grounds of religions and sciences, until nowadays.

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

The analysis of this symbiotic drive is focused in three elements, the *individual*, the *other(s)*, organized as a *society*, and *nature*, plus the three relations between them. Metaphorically, complex life may be represented by a triangle, emphasizing that the six elements are in mutual solidarity. The image of a triangle to relate basic components of the model is very convenient. I owe the idea for this triangle (the *primordial triangle*) as well as for the other two (the *enhanced triangle* and the *humanness triangle*) to a paper of Antti Eskola (1989). A mathematical triangle ceases to be by the removal of any of the six elements. The same occurs with the life of an individual. It terminates with the removal of any of the six elements. Life ceases by the suppression of any of the three vertices or the interruption of the relation between them. The following image of the *primordial triangle* is very convenient.

 INDIVIDUAL -------------------------- NATURE

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 OTHER(s)

 (SOCIETY)

In species with developed neocortex, which we might call superior living species, the pulsion of survival, of the individual and of the species, and gregariousness, are genetically programmed. Reflexes, part of this programming, are usually identified as instinct.

The relations (sides) generate individual and social behavior. The triangle metaphor, meaning the indissolubility of the six elements, is resolved by the principles of physiology and ecology. Basically, the relation between individual and nature is responsible for nurturing, the relation of the individual and the other of opposite sex for mating and continuity of the species. Gregariousness is responsible for individuals organizing themselves in groups and herds, and hierarchy develops, most probably as an evolutionary strategy. The group, thus organized as society, relates to nature aiming at general equilibrium, following basic principles of ecology. Thus, the primordial triangle keeps its integrity. The rupture of each of the six elements eventually causes the extinction of a species.[[9]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-9) Individual and social behaviors are actions taken “here” and “now”.

Individuals of the human species, differently than other species with neocortexes, are provided with *will*, that subordinates instinct.[[10]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-10) Every individual has the ability to generalize and to decide actions that go beyond survival, thus transcending survival. Individuals acquire the sense of before/now/after and here/there. Individual and social behavior transcend here and now. Thanks to will, individuals develop preferences in nurture and in mating. They protect themselves and their kin and they plan ahead and provide. Physiological and ecological principles are not enough. Humans have to go beyond them and the relations (sides) and increment the primordial triangle by creating intermediacies. Between individual and nature, humans create instruments; language intermediates individual and the others; the relation between groups/society and nature is intermediated by production. In the process of recognizing the potential of these intermediacies, humans acquire an enlarged perception of nature. It becomes what is generally understood as *reality*, comprising natural, cultural and social environments. The primordial triangle becomes an *enhanced triangle*:

 instruments

 INDIVIDUAL -------------------------- REALITY

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 language \ / production

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 OTHER(s)

 (SOCIETY)

The three intermediacies are, clearly, related. Instruments, both material and intellectual, are shared through language and decisive in the production system. The distinguishing feature of language is that it goes beyond mere communication and is responsible for the formation of new concepts. Language becomes essential in forming thought and determining personality features. It is the roots of emotions, preferences and wants, which determines the enhanced relations of the individual and the other(s). Language is also essential in the definition and distribution of tasks, necessary for organizing systems of production. Thus, the intermediacies have also a form of solidarity which synthesizes what is called culture. Culture may be thus metaphorically expressed as a triangle, which I call the *humanness triangle*:

 instruments

 INDIVIDUAL ------------..------------ REALITY

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 language .............. production

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 OTHER(s)

 (SOCIETY)

Human life is, thus, synthesized as the pursuit of the satisfaction of the pulsions of survival and transcendence. It is a mistake to claim, as many mathematicians do, that this refers to other forms of knowledge and that Mathematics has little to do with these pursues. A holistic view of History of Mathematics traces the origins of mathematics in pursuing the satisfaction of these two pulsions.

Engaging in survival, humans develop the means to work with the most immediate environment, which supplies air, water, food, necessary for nurturing, and with the other of opposite sex, necessary for procreation. These strategies, common to all superior living species, are absolutely necessary for the survival of the individuals and of the species. They generate modes of behavior and individual and collective knowledge, including communication, which is a complex of actions, utilizing bodily resources, aiming at influencing the action of others. In the species *homo*, behavior and knowledge include instruments, production and a sophisticated form of communication, which uses, as its means, language, as well as codes and symbols.

In the search of transcendence, the species *homo* develops the perception of past, present and future and their linkage, the explanations of and the creation of myths and mysteries to explain facts and phenomena encountered in their natural and imaginary environment. These are mentifacts incorporated to the individual memory and retrievable only by the individual who generated them. Material representations of the real, which we generally call artifacts, are organized as language, arts and techniques. Artifacts are observable and interpreted by others. In this process, codes and symbols are created. Shared mentifacts, through artifacts, have been called sociofacts by biologist Julian Sorell Huxley (1887-1975), who also introduced the words artifacts and mentifacts. The concept of culture for Huxley contemplates artifacts+mentifacts+sociofacts.

Explanations of the origins and the creation of myths and mysteries lead to the will to know the future [divinatory arts]. Examples of these arts are astrology, the oracles, logic, the *I Ching*, numerology and the sciences, in general, through which we may know what will happen—before it happens! The strategy of divinatory arts is deterministic.

Divinatory arts are based on mathematical concepts and ideas: observing, comparing, classifying, ordering, measuring, quantifying, inferring. Indeed these concepts and ideas are present in all the steps of the search for survival and transcendence.

As every form of knowledge, mathematical artifacts, in the form of practices and tools, and mentifacts, in the forms of aims or objectives, concepts and ideas, are first generated by individuals trying to cope and to deal with the natural and social environment, to resolve situations and problems, and to explain and understand facts and phenomena. These *ad hoc* artifacts and mentifacts are individually organized and are transmitted to other(s) and shared. They attain objectives, they serve, they are useful, they become methods, which are shared and acquired by the other(s), by society. They are part of the sociofacts of the group. How are they transmitted and shared? These are the basic questions when we ask for the origins of mathematics. Was the transmission and sharing through observation, mimicry? Eventually, using language. But when? This is historically unknown. We have indications of the emergence of mathematical ideas thanks to artifacts, as it will be discussed later in this paper.

We have no idea when language was used in this socialization. Indeed, the origin of language was an academic “forbidden” theme about one hundred years ago. When language occurred, most probably systems of codes and symbols and specific words were created to design mathematical objects and ideas. This is major research subject for oral cultures. With the appearance of graphic registry, like cave drawings and bone carving, we have more elements to understand the development of mathematical concepts and ideas. The progress of mathematics through history, in different cultural environments, is a central issue to understand the nature of mathematics. In a recent book, Ladislav Kvasz (2008) discusses the historicity of linguistic tools as a major factor in the development of mathematics. We may infer that, socially, this factor, which isolates mathematics from consideration of those that are outside the restricted circle of professional mathematicians, is a form of censorship. This kind of obstacle to critical views on the advances of mathematics, of its purpose and appropriation for interest, sometimes, non-acceptable, was already discussed above. Research that can not be disclosed, is euphemistically identified, in academic circles, as “classified” research, not as “confidential” research. This was clearly illustrated in the movie *A Brilliant Mind* (2001), directed by Ron Howard, a fiction based in the real life of John Nash.

To share mathematics advances with the general population requires demystifying mathematics language. In an emblematic phrase, David Hilbert (1862-1943), probably the most eminent mathematician of the 20th century, said, in the major conference of the 2nd International Congress of Mathematicians:

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|          | “An old French mathematician said: ‘A mathematical theory is not to be considered complete until you have made it so clear that you can explain it to the first man whom you meet on the street’” (1902: 438) |

Demystifying mathematical language may open the way to a new form of mathematical education, with more space for critical analyses of mathematical development.

**The threat of extinction**

The only possibility of escaping the threat of extinction of civilization is to attain peace in its broadest sense, in all its dimensions, that is inner peace, social peace, environmental peace and military peace.

I see peace not as the inexistence of conflicts, since, as discussed in the beginning of this paper, every human being experiences different biological, physical, social, psychological, spiritual needs and also different wants. Since the individual and the other are different, conflicts are to be expected. The crucial point is to resolve the conflicts without violence. Violence ranges from evident confrontation and aggression and the resource of prepotency, but also in more subtle forms of arrogance and bigotry, intolerance and fanaticism.

The only road to peace is through conflict resolution, based on a global understanding of the life phenomenon and intermediacies created by man, which implies the acknowledgement of differences in the inter- and intra-cultural dialogue.

A primordial ethics recognizes the mutual essentiality of the three vertices and three sides of the primordial triangle and aims at the preservation of its integrity and survival with dignity. This primordial ethics is synthesized in the box:

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| • respect for the other with all the differences [which are inevitable, since the individual and the other are different]; |
| • solidarity with the other; |
| • cooperation with the other. |

**Mathematics in General Education**

I repeat what I said above. Many will say that this is an unusual piece on Mathematics and Mathematics Education. Without denying the fundamental importance of nonviolence, they claim that the role of a mathematician and of mathematics educators is to act, seriously and with competence to attain the specific objectives of the discipline.

But this competence, without a firm ethical commitment, may be directed to reproachable consequences. Particularly, to military innovation. An unsustainable argument of the neutrality of analytical treatment is a resource to support reproachable actions. The seduction of mathematics is responsible for “promoted tricks in technique and the assimilation of dogma at the expense of considered thought” (Hodgson; Screpanti, in Keir, 2006:22).

This is coherent with what some philosophers of science claim. There is, indeed, a seduction in mathematics. Based on remarks of Thomas Reissinger, Sanford L. Segal says:

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|          | “mathematical training, however it prepares the faculties for analysis, is not only of no aid in judging historical/political situations, it perhaps inclines toward misjudgment. Furthermore, intellect has no necessary connection to the ability to reason. ... the ability to reason about ideas depends upon free exchange with others leading to critical examination. The solipsistic aspect of mathematical training and practice does not, however, favor such uses of reason.” (2003: 13) |

This attitude does not differ from what other professionals say of their responsibility *vis-à-vis* their discipline. But if we do accept, very clearly and unequivocally, that our commitment to mankind is much more important that our commitment to the discipline and to their objectives, we can not, passively, relinquish our action and give this responsibility to other educational constituencies.

Our professional commitments must be subordinated to a global ethics, such as the primordial ethics, proposed above. Otherwise, it will be impossible to engage in a deeper reflection about our role as mathematicians and mathematics educators.

It is an undeniable right of every human being to share all the cultural and natural goods needed to material survival and to 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 of faith in the future of mankind is the World Declaration on Education for All (1990; see Haggis, Fordham and Windham, eds. 1992), to which 155 countries are committed. Of course, there are many difficulties in implementing the resolutions contained in the document. But as yet this is the best instrument available that may lead to a planetary civilization, with peace and dignity for the entire mankind.

The crux is to understand how Mathematics and Mathematics Education can be directed as a response to these principles.

I see my role as an Educator and as a teacher of my specific discipline, Mathematics, as complementary instruments to move toward my utopia of a world in peace.

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. Of course, this has everything to do with ethics.

I believe most mathematicians and mathematics educators share these views. No doubt they are authentically concerned with nonviolence, quality of life and dignity for mankind. But sometimes the relations between concerns and professional practice are not clear. Particularly in Mathematics, there is a general acceptance that if we do Mathematics well, thus instilling attitudes of rigor, precision and correctness in the students behavior, we are fulfilling our broad responsibilities. Undeniably true. But this is not enough. This must be subordinated to a much broader attitude towards life and towards how mathematics can be used for good or for bad.

The first issue is to understand how Mathematics, as a knowledge system, emerges as a result of the search of survival and transcendence.

My proposal to achieve this understanding is to discuss the elements of the primordial and the enhanced triangles. Then to proceed into the knowledge and behavior acquired in the search of survival and transcendence. Mathematics, as manifest in the techniques of observing, comparing, classifying, ordering, measuring, quantifying, inferring, is inherent to these searches.

The curriculum I propose below is organized in two steps. The two steps must be integrally covered, but the level of exposition and the required complementary reading is absolutely flexible. I have been developing this curriculum in courses for both future mathematicians and teachers. It is very frequent to have, among my students, individuals coming from other specialties. It is the teacher responsibility to adapt the exposition to the level of the students. It has been possible to develop the curriculum in elementary classes.

**The Proposed Curriculum**

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| \* | **Step 1**. Life explained as the solidarity of individual, other(s), nature and how they relate. A methodology is to discuss the *primordial triangle* and explain the biological factors keeping its integrity. A first mention of the *primordial ethics* is important in this moment. |
| \* | **Step 2**. In discussing the evolution of the human species, to reach the *enhanced triangle*, we elaborate on individual, other(s), reality, instruments, language and production. Attention should be given to the concept of reality, as enlarged perception of nature, comprising natural, cultural and social environments. A return to the *primordial ethics* is needed. |

I have been using an image of the evolution of the species which is very convenient, since it allows for talking about the emergence of the basic ideas of mathematics, particularly observing, comparing, classifying, ordering, measuring, quantifying, inferring. There is much to be explored in this image. Particularly, the autonomy of the individual, which is symbolic represented by its erect posture.



It is very important to pay attention to the various phases of human evolution. *Bipedism*, the first differential from apes, allowed the new species to move using two feet and to discover other things to do with the idle hands (equilibrium is the mathematical manifestation in such step); among these discoveries: *stone tools*, for which the mathematical concept of comparison of dimension, rendering the tool appropriate for the designed use, became necessary; the invention of the *spear*, later developed into arrows and bows, which required the identification of a target in a distant complexity and the development of the mathematical concepts of distance, direction and force (nowadays characterized as a vector, with has magnitude and direction). In this phase, there is a good motivation for philosophical reflections about the autonomy of the individual, well exemplified by the possession of a sword in medieval times, and about the generation of a sense of accuracy through mental discipline, as seen in archery. Next phase, leading to history and modern human behavior, is the invention of *agriculture*, and the necessary consequence of coordinated labor, hence hierarchy and power of a different nature (not deriving from physical strength), and of property. It is appropriate, in this phase, to discuss the roots of the capitalistic system. Next phase is the development of industry, due to the invention of non-animal power. A reflection about the mathematics involved in this invention is very appropriate. Again, it is the appropriate moment for socio-political reflections on the condition of the new character of being a worker and the emergence of modern capitalism. The next phase, *humans-with-media*, represents the dominating presence of informatics in all sectors of the modern world.[[11]](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_note-11)

The figure reflects a very relevant fact: the ascent of man to individual autonomy, through bipedism, stone tools and culminating with the spear and derivates, arrow, bow and sword. The symbolic status of possessing a sword in medieval times is most relevant for reflections about autonomy. In a sense, with the emergence of agriculture, individual autonomy was lost. The attachment to the small group of family and tribe was subordinated to an increasingly complex social structure. Agriculture brought the end of nomadism, the concept of property and collective labor and the development of astronomy, a very important moment in the development of mathematics. Industry paved the way to modern capitalism. The age of informatics requires new concepts of privacy. Every one of these phases marked the emergence of new directions for mathematics. Each of these steps demands a deeper discussion of the *primordial ethics*, which is the most important pedagogical practice leading to nonviolence and peace.

**Final remarks**

In this curriculum proposal, the right moment for a discussion about the search of survival and the search of transcendence is the move from *Step 1* to *Step 2*. This discussion shall emphasize the nature of mathematics as an instrument to deal with the human pulsions of survival and transcendence. This is the moment to elaborate on examples of the relation between Mathematics and religion, Mathematics and tool making, Mathematics and art.

It is of fundamental importance to stress the fact that breaking the primordial triangle implies nonexistence. The enhanced triangle does not change this. The only reason for the enhanced triangle is to make it possible to keep the integrity of the primordial triangle.

Again, this is a discussion of how essential is the behavior according to the primordial ethics for avoiding total destruction of civilization. Paraphrasing Martin Luther King Jr. it is either adherence to the primordial ethics or nonexistence.

How about a nonkilling mathematics? This is an ill-posed question. Mathematics is in the realm of ideas and, as such, is abstract. For reasons not explained in human nature, its results, methods and language may be appropriated, but do not master, as it was made very explicit by eminent physicist Eugene Wigner in a classic paper:

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|          | “Mathematics, or, rather, applied mathematics, is not so much the master of the situation in this function: it is merely serving as a tool...The miracle of the appropriateness of the language of mathematics for the formulation of the laws of physics is a wonderful gift which we neither understand nor deserve. We should be grateful for it and hope that it will remain valid in future research and that it will extend, for better or for worse, to our pleasure, even though perhaps also to our bafflement, to wide branches of learning.” (1960) |

Regrettably, Mathematics is practiced, both in its pure and applied forms, and also presented as a cold and austere sequence of formal steps. In a figurative, somewhat imprecise way, we might say that it emphasizes syntax over semantics. I believe this is responsible for the easy cooptation of mathematicians, as well as of other educated individuals, to put mathematical results, methods and language at the service of material and ideological wants and needs. We might identify this facility to coopt mathematics, a cold and austere sequence of formal steps, as prone to be a killing mathematics. On the contrary, a practice and presentation of mathematics, critically and historically grounded, as proposed in my model of curriculum above, emphasizing semantics over syntax, may resist cooptation and be prone to be used for humanitarian and dignifying purposes. This might be a nonkilling mathematics.

**Footnotes**

1. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-1) Interview given to Ken Ringle, *The Washington Post*, June 11, 1996.
2. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-2) <http://www.public.asu.edu/~jmlynch/273/documents/FreudEinstein.pdf> (27/01/09).
3. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-3) See the polemics around the article by Alan Sokal published in *Social Text*, criticizing postmodernism, particularly Sociologists of Science, and also the article by Steven Weinberg: "Sokal's Hoax,” in *The New York Review of Books*, August 8, 1996, pp.11–15. Particularly interesting are articles by Sullivan (1996) and Harrell (1996). It is illustrative to look at the exchange of letters between Noam Chomsky and Marcus G. Raskin in the book by Marcus G. Ruskin and Herbert J. Bernstein (1987: 104-156).
4. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-4) This is the main issue of the polemics about Afrocentrism. See Lefkowitz (1996).
5. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-5) See Ubiratan D’Ambrosio (1981). I am particularly indebted to Wiener (1948), Maturana and Varela (1987), and Lumsden and Wilson (1981).
6. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-6) For example, see Ubiratan D’Ambrosio (1999). Also interesting the book by Avishai Margalit (1996). The International Network of Scientists and Engineers for Social Responsibility offers a good electronic forum for discussion of these basic issues.
7. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-7) Three conferences of the PDME movement were realized: 1995, Bergen; 1993, Cape Town; 1990, London. Proceedings of all three are available. In the Eighth International Congress of Mathematics Education/ICME 8, in Seville, Spain, July 14-21, 1996, the WG 22 chaired by Richard Noss, entitled “Mathematics, education, society, and culture,” focused on the political dimensions of Mathematical Education. Frankenstein’s work (1989) is representative of this movement. Also see the book by Powell and Frankenstein (1997).
8. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-8) See the important *oeuvre* of Oliver Saks, particularly *An Anthropologist on Mars*. Theories of consciousness also give rise to several academic controversies. See for example the review by David Papineau (1996) of the book by David J. Chalmers, *The Conscious Mind: In Search of a Fundamental Theory*.
9. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-9) For inspiring reflections, see the novel of paleontologist George G. Simpson (1995).
10. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-10) Will is a recurrent theme in philosophy, religion, and neurosciences.
11. [↑](https://en.wikiversity.org/wiki/Ethics/Nonkilling/Mathematics#cite_ref-11) I use the expression humans-with-media after the important book by Marcelo de Carvalho Borba and Mónica E. Villarreal (2005).

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