

The Program Ethnomathematics: A Theoretical Basis of the Dynamics of Intra – Cultural Encounters

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An introduction.

The word Ethnomathematics may be misleading. It is often confused with ethnic-mathematics. I see ethno is a much broader concept, focusing on cultural and environmental identities. The name also suggests different mathematics. My proposal is much broader than only mathematics, which is a late Western concept. In its current acceptance, it goes back to about the 15th century. Former uses of the word “mathematics” have a different meaning. Today, historians conveniently, although abusively, use the word “mathematics” also when they refer to some practices and theories of the Antiquity and of the Middle Ages, which bear some common objectives, concepts and techniques with Mathematics. It is noticeable that the Modern Mathematics diverted from the idea of the *mathema*. In the words of Oswald Spengler “The present-day sign-language of mathematics perverts its real content”¹.

Ethnomathematics is particularly concerned with real contents, and this is implicit in the way I deconstruct the word ethnomathematics: *ethno+mathema+tics(techné)*. This is, clearly a conscious *abus d'étymologie*, which will be explained later. The restoration of this in education is implicit in my proposal for a modern *trivium* in education: literacy, matheracy, technoracy.²

I once presented Ethnomathematics as a Research Program in the History and Philosophy of Mathematics with Pedagogical Implications. This was the title reported in a matter published a few years ago in the *Notices of the American Mathematical Society*. I feel this continues to be an appropriate presentation of the field.³

I insist in naming Program Mathematics the research program, which implies a broader focus than the recognition of mathematical ideas and practices of different cultural groups. Of course, the Ethnomathematics of different cultural groups is the main source for this research program. But the major objective of the Program Ethnomathematics is to propose a broader vision of knowledge and of human behavior, by making sense of the comparison of the ethnomathematics of several cultural groups.

It is not inappropriate the coincidence of the choice of the word Ethnomathematics with Mathematics in its modern acceptance, as practiced in the academy and in schools today. After

¹ Oswald Spengler: *The Decline of the West* (abridged from the revised edition of 1922 by Helmut Werner), The Modern Library/Alfred A. Knopf, New York, 1962; p.56.

² Ubiratan D'Ambrosio: *Literacy, Matheracy, and Technoracy: A Trivium for Today*, *Mathematical Thinking and Learning*, 1(2),1999; pp.131-153.

³ Ubiratan D'Ambrosio: *Ethnomathematics: A Research Program on the History and Pedagogy of Mathematics with Pedagogical Implications*, *Notices of the American Mathematical Society*, December 1992, vol. 39, n°10, pp.1183-1185.

all, Mathematics is the dorsal spine of Modern Civilization. Throughout history, Mathematics has been well integrated into the technological, industrial, military, economic and political systems. Indeed, Mathematics has been relying on these systems for the material bases of its continuing progress. And this has been, corporately, well manned by mathematicians.⁴ To some extent, this has been also the case of Science, Technology, and Philosophy, as well.⁵

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.

Modern World Civilization sprang out of Western Civilization, as the result of 500 years of conquest and colonization. As recognized by philosophers, historians, scientists and even the general population, Mathematics is essential for Modern Civilization. It is the nucleus of every educational system. Metaphorically, we might say that Mathematics is the dorsal spine of Modern Civilization.

The dorsal spine, that is, Mathematics, is beautiful, rigorous and perfect, so respected by everyone, even feared, particularly by children and students. But the body, that is, Modern Civilization, is ugly, plagued with inequity, arrogance, bigotry.

What went wrong with Modern Civilization? How is it possible that a perfect dorsal spine supports such an ugly body?

This has been a guiding quest in my research.

Knowledge, behavior and culture.

How did everything begin? The myths of creation are present in every civilization. We are constantly adding to the about 100 myths explained by Xavier Yvanoff. The founding myths of Western civilization links with the history of monotheistic religions (Judaism, Christianity, Islamism), of techniques, of arts and how mathematics permeates all this. A great insight is gained by trying to identify all this in Non-Western civilizations.

The main difficulty I encounter, and this is true for every one doing cultural studies, is the difficulty of understanding and interpreting these with the categories and analytic instruments other than those that are part of my cultural heritage. I have been trying to avoid, at least to minimize, this difficulty. We rely on informants and a difficulty is to build trust.

The goal is to develop a generic comprehensive theory of knowledge and behavior. I base my research on universal forms of knowledge (communications, languages, religions, arts, techniques,

⁴ Dorn

⁵ Brett D. Steele and Tamera Dorland, eds.: *The Heirs of Archimedes. Science and the Art of War through the Age of Enlightenment*, The MIT Press, Cambridge, 2005.

interactive, embodied communication, organized as contextual cognition, which is characteristic of human beings. It utilizes codes and symbols, and it is seen in various modalities: oral, written, kinesics, affective-volitional. Emotions are triggered by communication.

Reality is the aggregate of all these triangles. Hence it is universal. I assume that reality is everything. It is composed of facts and phenomena, both natural and artificial. I understand artificial as those added as a result of animal action.⁶ The differences between the categories of facts and phenomena that compose reality is very difficult.

We try to understand these relations (the sides of the triangle) in the human species. Individuals, through their senses, which are sensor-like components, receive information of reality. Of course, of a reachable fraction of reality. To expand the reachable fractions has been an important drive of animal species. Humans have been particularly affected by this drive. The multiplicity and the evolution of the sensorial mechanisms, is a permanent concern of scientists and philosophers.⁷ Memory is such a sensorial mechanism.

The information is processed. Again, this has been a central theme for philosophers, since Antiquity. Most recently, the so-called Sciences of the Mind focus on how information is processed.⁸

It can be easily accepted that this processing generates strategies for action, realized through commands of physiological nature. Again, the way all this chain happens is a permanent research theme.

The undeniable fact is that life and action, be it instinctive, conscious or unconscious, are indissoluble.⁹

Actions are of multiple nature. They may be physiological, artisanship, workmanship, routine behavior, ideas and thoughts. The results of the action are incorporated to reality. Thus, reality is in permanent mutation, through the insertion of the results of the individual action of each agent. These insertions are of two kinds: artifacts, which are accessible to every individual through their sensory mechanisms, and mindfacts, accessible, through memory, only to the agent, the generator of the action.

Mindfacts are organized (maybe the brain is hardwired for this!) in the form of individual knowledge. The transition between artifacts and mindfacts is essential for understanding symbolic knowledge, and consequently the liaison theory \leftrightarrow practice, or knowing \leftrightarrow doing. This is a major question in the Program Ethnomathematics.

⁶ This is a necessary assumption. There are claims of different levels of reality, assumed from from psychoanalysis, Gödelian arguments and even religious proposals. Psychoanalytic and Gödelian arguments are compatible with my assumption. Religious levels are of a different nature.

⁷ Is intuition a sense? And consciousness, as it is claimed by Francisco Varela?

⁸ Mind, consciousness, artificial intelligence and other denominations are academically accepted. To talk about altered states of conscience, of “sixth sense” and several other approaches capture the popular imagination.

⁹ The experiments of Luigi Galvani with animal electricity drew much attention to the meaning of life. Miracles are also a contestation of the fact that life and action are indissoluble.

The discourse above was about one individual. But there are many other individuals in reality, from the most varied species, going through a similar process. For living individuals, the cycle is the same: ... → reality → individual → action → reality → individual → action → The individual agents are permanently receiving information and processing it, and performing action. But although immersed in a same global reality, the mechanisms to receive information of individual agents are different. One may be blind, another may have access to a telescope and so on. Not only the capture of information is different, but the processing is also different. Consequently, the actions are different, normally conflicting.

There are many approaches on how to face the situation. In most species this is done by demonstration of strength, intimidating the other. This is the policy of deterrence, which, eventually, leads to disaster, as we have mentioned above. Throughout history, the human species has tried to avoid the costly and futile path of deterrence. Another approach, somewhat similar, has been constructing defensive strategies, such as silence, lockers and walls. Again, history tells us how inefficient they are.

Another approach is the resolution of conflict through mutual trust and understanding. Treaties, although easy to break, continue to be the best approach, mainly if backed by societal commitment.

The support for this approach is communication, which reached an amazing level of sophistication in the human species. Through communication it is possible to increase the capabilities of accessing and processing information of all the agents involved in their individual cycle ... → reality → individual → action → reality → individual → action →

Communication allows to build some form of trust, and individuals agree and assume a behavior compatible with common interest, based on individual knowledge.

Communication also allows for sharing knowledge. This requires a common understanding of the artifacts and symbols associated with mindfacts. This is how syntax and semantics come together for building meaningful languages. Shared knowledge is thus socially organized and is an asset of the group.

Shared knowledge supports the agreed compatible behavior, and constitutes what we call the set of values of the group.

A culture is identified by their compatible behavior and shared knowledge. Hence, a culture has the same set of values.

Linking the discussion of this section, culture results from the fraction of reality that is reachable by the group.

The dynamics of cultural encounters.

Repeating what was said above, the culture of a group results from the fraction of reality that is reachable by the group. Thus, the multiplicity of cultures, each one with a system of shared

knowledge, of compatible behavior and a set of values. They are normally different, not universal. The only universal is that human existence is driven by the pulsions of survival and transcendence. Survival must be here and now, transcendence breaks the limitations of here and now.

The pulsion of survival is satisfied by humans, just like by any other complex animal species, through strategies of dealing with the immediate environment, which supplies air, water, food, and the other individual, necessary for procreation. Essentially, all that is necessary for the survival of the individual and the continuation of the species. These strategies are the result of individual and collective knowledge and coherent modes of behavior, which include communication and, in the species *homo*, language and instruments.

For the satisfaction of the pulsion of transcendence, the species *homo* develop means of perception of past, present, future and their linkage, and means of explaining facts and phenomena encountered in their natural and imaginary environment. These means are incorporated to the memory, individual and collective, and they are organized as ideas, which are organized as systems about explanations of the origins and the creation of myths and mysteries. These ideas, mindfacts, are organized as representations of the real [models and theories] and materialize as artifacts, such as images and the arts and techniques (*techné*). The explanations about the origins, organized as myths and traditions, and eventually as religion and history, give rise to the possibility of knowing something about the future, through the divinatory arts, which are, naturally, linked to the myths of the origin. Throughout history we find a number of divinatory arts, like astrology, the oracles, logics¹⁰, the *I Ching*, numerology and, in the Modern Western Civilization, Religion and Science.¹¹ All give hints of what will happen.

The modes and styles of survival and transcendence of a group of individuals are the result of shared knowledge and compatible behavior, and are intrinsic to the set of values of the group. Indeed, culture is identified with the modes and styles of survival and transcendence.

The intra-cultural strategies for incorporating individuals to a culture range, which include codes of behavior, extend from mimicry through education. For deviants, corrective measures are applied. These corrective measures are subtle threats inbuilt in codes of behavior, explicit physical punishment and death, and the most cruel perspective of eternal punishment. These intra-cultural strategies are intrinsic to Modern civilization.¹²

My thinking about diffusion, particularly public understanding of Science, and transmission, which deals essentially with education and school systems, relies on the dynamics on intra-cultural encounters.

¹⁰ For example, the classical syllogism “All men are mortal, all Greeks are men, so all Greeks are mortal” tells about the future.

¹¹ Religion and Science have developed in close connection, as well as with the other institutions of a society. I understand both Religion and Science in the Western tradition, as the complex of practices and theories which originated in the Mediterranean basin.

¹² These strategies are discussed in Dante Alighieri’s *La Divina Comedia* (1320), probably the most important precursor of the Renaissance, in Cesare Bonesana, Marchese di Beccaria’s *Essays on Crime and Punishment* (1764) and most recently in Anthony Burgess’ *The Clockwork Orange* (1962).

As Jose Antonio Fernandes de Rota, from the *Universidad de la Coruña*, said,

“The normally simple and objectifying vision of what many think of as culture leads them to conclude that ‘different cultures’ are being gradually but inexorably invaded by features that the ‘dominant culture’ imposes...[but] we should thus understand culture not as a common, dynamic and semantic space, which sometimes gives rise to integrating the cosmovisions, but rather also as a driving force of diversity, tension and strategy.”¹³

This implies a reflection of a typical intra-cultural encounter of youth culture and adult culture.

¹³ José Antonio Fernández deRota y Monter: The new concept of citizenship and intercultural comprehension, *Transculture. Les Assises de la Connaissance Réciproque*, direction: André Le Pichon, Le Robert, Tombouctou-Paris-Bruxelles, 2003; pp.195-200.