Introduction to the theme and the sub-themes of CIEAEM 57

CHANGES IN SOCIETY: A CHALLENGE FOR MATHEMATICS EDUCATION

Changes in society are a complex reality that challenges education at all levels and in most disciplines – mathematics seems to be strongly affected with regard to students' motivation, key contents and skills to be taught, and its social legitimacy.

This document is organised under five themes. The first two concern present trends and the pressures that are exercised at different school levels on the teaching of mathematics from outside the school system. The third and fourth themes concern changes that are directly related to students' skills, attitudes and values. The last theme covers issues more or less explicitly dealt with in two previous CIEAEM conferences – those concerning cultural diversity in the classroom and between different regions of the world. This conference will also consider some recent trends concerning the struggle for legitimacy of cultural diversity (and related educational implications).

Some questions are posed below on each theme, in order to stimulate contributions from participants to the Conference. Contributions could cover both the reflective and theoretical, and the practical side (which involves the craft of teaching and relevant didactic choices).

Cultural and political changes in primary schooling: information, knowledge, technical tools, and education.

Nowadays knowledge tends to be identified (in the political debate about primary schooling) with information on the one hand and useful technical tools – those that can be applied to solve problems -- on the other. But information can be easily accessed through the Internet. And in many countries primary education tends to have an emphasis on sharing social values, as distinct from knowledge acquisition. These trends reinforce each other; as a consequence, primary school is seen as an agency of socialisation and a place to provide students with useful, basic technical tools. Another trend has surfaced since the end of the eighties- the tendency to evaluate every action and institution in terms of costs and benefits, using objective measures. Evaluation of schools, teachers, and teaching does not escape this paradigm – so clearly represented by the "No Child Left Behind Act" in the USA. The importance of providing primary school students with useful basic tools (in mathematics as well as in language) is enhanced by the fact that the acquisition of those tools can be easily measured through objective testing. As a consequence of this approach, mathematics as a cultural, evolutionary heritage tends to be moved to the background in teaching practice and teachers' aims. In particular, those classroom activities that can prepare constructively for mathematics at higher school levels (e.g. the development of logical argument leading to proof; and open problem solving looking for patterns and properties to help develop theories) tend to be considered as a waste of time.

Q: Do people share this perception of change in their environment or country? Can the cultural value of mathematics be preserved (or restored) in primary education (and in that case: what

contentand activities are most appropriate to let students approach the cultural dimension of mathematical knowledge and making mathematics); Or do we need to accept the perspective of a purely "technical" preparation of students in primary school (postponing cultural aspects and mathematical thinking to higher levels of school)? What are the practical implications of these two perspectives for teachers' preparation and teaching?

Changes in people's conceptions about mathematics.

Ongoing medium-term changes can be seen; they concern both the importance of mathematics in modern society (in the workplace as well as for scientific progress), and the importance of performing well in mathematics in high school and university (as a sign of intelligence, a means of preparation for life, and a tool for individual advancement). In people's minds, mathematics tends to be replaced by computer sciences, on the one hand; and economics, on the other. The shift in high school and university mathematics teaching towards an increasing level of abstraction and generality, which was a trend in many European countries during the second half of the last century, can be held partly responsible; but the visibility of computers (and computer-based performances) against the difficulty of recognising where and how mathematics enters into scientific discoveries, technology, etc. could be a deeper and broader explanation. As a consequence, the pressure of parents on high school students and teachers for achievement in mathematics tends to decrease. In high schools, more and more frequently mathematics teachers are left alone in their professional engagement to teach relevant mathematical content to their students. At that level, particularly in some States, in the USA, mathematics tends to become an optional subject for students. At university level in some countries (e.g. Italy and France) students tend to avoid curricula that demand a high level of competence in mathematics (particularly in advanced mathematics), and the number of mathematical courses offered in technical faculties is falling.

Q: Do people share this perception of change in their environment or country? Can the teaching of mathematics allow students to access the "hidden value" of the subject as a crucial component of scientific knowledge, of technology, etc.? What changes are needed in the teaching of mathematics at high school and university levels, in order to cope with this aim?

Changes in everyday life: the impact of technology, and its influences on students' skills and attitudes.

Technology enters students' everyday life in different ways, with different consequences for their skills and attitudes. Technology involves quick and mainly visual interaction with the information provided on the computer screen (e.g. in computer games and in access to all kinds of information); technology allows easy access to solutions to many standard problems (e.g. elementary statistical analysis, graphing data and functions, etc.) through powerful statistical and mathematical software; technology allows students to share school tasks with schoolmates elsewhere and offers possibilities of dialogue with teachers elsewhere. Some skills are enhanced by the simple fact of using the computer, other skills can be enhanced by access to software conveniently managed by the teacher (or another mediator). But we must consider also the other side – those skills and attitudes that are damaged by the facilities offered by the computer. For instance, memorising may not be practised because of the support provided by computers; and learning how to use technical tools incorporated in the computer seems to be more important than understanding the theory behind those tools.

Q: Do people share this perception of changes in their environment or country? Rather than a-priori "pro" and "contra" positions, can we establish a reasonable balance between the opportunities and dangers related to information technology, as concerns the teaching and learning of mathematics? Can we make some evaluation criteria explicit? Can we give some examples of clearly "productive" integration of new technologies in the teaching and learning of mathematics and in the development of relevant mathematical skills?

Changes in students' life: evolution and conflict concerning values

"Things that are worth while" for young people are changing: social acceptance has become the most important value for them, with important consequences for their intellectual engagement in school subjects. Subjects like music, computing and even some aspects of humanities are easier to discuss with schoolmates, and thus become preferred subjects. Mathematics as usually conceived and taught by teachers needs a strong long term commitment from the individual (based on deep mental concentration and cumulative, systematic appropriation of knowledge), within an appropriate environment (...silence). Some students still engage a lot in mathematics, but the price that they pay can be very high, in terms of social isolation from widely accepted ways of spending time, consuming, etc.

Q. Do people share this perception of change in their environment or country? Can mathematics be taught in such a way as to become a subject that can be shared with schoolmates, a "social medium"? Can the cultural values inherent in some aspects of mathematics be linked to other more popular subjects? How should we change our content and teaching methods in order to cope with this issue?

Another change concerns the importance of rigorous and systematic thinking. Affective and emotional thinking are going to take on increasing significance in students' minds and even in the educational commitment of teachers. To perform a sequence of logically connected steps of reasoning is no longer a shared, crucial value for students or even for teachers (apart from mathematics and science teachers). And personal and collective discoveries gained through emotional involvement (discoveries that "come from the heart") are likely to be considered more important for human beings than those gained through systematic scientific enquiry.

Q: Do people share this perception of change in their environment or country? Can the creative side of mathematical activity be incorporated into classroom tasks? Can the "embodied cognition" perspective (and other recent trends of research in cognitive sciences and epistemology of mathematics) help to reconcile the "mind" with the "body" in the teaching and learning of mathematics? And what about the implications of research concerning affects and emotions in the teaching and learning of mathematics?

Cultural diversity and the teaching and learning of mathematics.

During the last century, cultural diversity has been considered by mathematics teachers and mathematics educators under different perspectives, depending on their more general political and cultural orientation. Up to the 1960's the prevailing educational focus was to find ways to make school mathematics (as related to mathematicians' mathematics developed in the more advanced western countries) accessible to students coming from other cultures, or from socially and culturally

deprived environments. Then some mathematics educators started to conceive mathematical experience outside school ("street mathematics") and mathematical experience developed as topics worth investigating in the context of different cultures, as contrasted with ordinary school mathematics, which was referred to cultural values and practices different from those inherent in western civilisation. But those studies had no practical effect in most countries of the world. The situation is likely to change rapidly at the beginning of this century: there is increasing evidence that one part of the world does not accept western civilisation's cultural values, its approach to rationality, etc. And in many countries the composition of public school classes is more and more mixed, with students who come from different cultures (and parents who in many cases insist that their children should not lose their cultural identity – a new development if we compare the current situation with the past, when children's "integration" into the host country culture was a shared value for most parents).

Q: Do people share this perception of change in their environment or country?

Together with the traditional issues dealt with by ethnomathematics (the richness of mathematical experience of "other cultures", its relationship with traditional school mathematics, etc.), new questions are arising – how to frame and investigate the differences in ways of reasoning, cultural values and their consequences for mathematical performance? How to consider, within this perspective, the current strict integration between western rationality and mathematics (especially evident in mathematical modelling of natural and social phenomena – from physics to the economy)?

And how should we prepare mathematics teachers, and teach mathematics in school, in order to cope with a perspective that takes into account the relevance and legitimacy of cultural differences concerning mathematical experience and the role of mathematics in different cultures?