

ICSU SURVEY ON ACTIVITIES AND EXPERIENCES IN SCIENCE EDUCATION

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Organization: IMU (International Mathematical Union)

1. What is the importance of Science Education to your organization?

The International Mathematical Union (IMU) regards mathematics education as a major base for the future of mathematics and other sciences. Our concern includes the quality of mathematics teaching, a core world wide qualification relevant for all sectors of society, and the dynamic evolution of curriculum to adapt to new and emerging sciences and technologies. The importance we put on mathematics education is demonstrated by the special commission of IMU dedicated to mathematics education - the International Commission on Mathematical Instruction (ICMI), which has 85 member countries.

2. What are your organization's major challenges regarding Science Education?

Establishing a quality mathematics education worldwide for all students: those intending to major in mathematics, those aiming towards careers in science and technology, and all others, in order that every one becomes informed citizens.

Promoting international exchange and collaboration, with particular attention to cultural, social and economical diversity and to the specific needs of developing countries.

Raising public awareness of the importance of mathematics and mathematical education to human culture in its modern form where understanding of new ideas in mass-communication, information technology, business and economics, science, and technology is essential knowledge.

3. What has your organization done in Science Education that has been particularly effective,?

IMU activities and involvement in education is functioning mainly via The International Commission on Mathematical Instruction (ICMI). ICMI main activities are as follows.

The ICME Congresses, organized every four years (the eleventh one took place for in Monterrey, in July 2008, and the next one will be held in Seoul in July 2012). These are the major international congresses of mathematics education attracting 3,000 to 5,000 participants.

The ICMI Studies, whose aim is to provide a synthesis of the state of the art with respect to both educational research and innovative practice about a particular issue in mathematics education. ICMI Studies are piloted by an international program committee nominated by the ICMI Executive Committee. The Study leads to a volume published by Springer in the NISS Series. 17 Studies have been completed and 4 are on-going: ICMI Study 18 on statistics education (joint study with IASE, the International Association for Statistics Education), ICMI Study 19 on reasoning and proof in mathematics education, ICMI Study 20 on educational interfaces between mathematics and industry (joint study with ICIAM, the International Council for Industrial and Applied Mathematics), and ICMI Study 21 on the teaching and learning of mathematics in multilingual environments.

The on-going Affiliated Study Groups, each devoted to a specific topic: PME (research in math education), HPM (links between history and pedagogy of mathematics), IOWME (gender issues in mathematics education), WNFMC (mathematics competition and popularization), ICTMA (applications and modelling).

The regional networks and their associated regional conferences, which especially target regional dilemmas and collaboration: IACME in Latin-America, EARCOME in East Asia, AFRICME in Anglophone Africa, and EMF, the Francophone space for mathematics education.

Activities in Developing Countries operates in collaboration with another IMU body, The Commission for Developing Countries (CDC). The **Solidarity Fund of ICMI** emphasises the participation of mathematics educators and teachers from developing countries in ICMI activities, as well as the development of local or regional projects.

.....and why do you think it has been so effective

Effectiveness of ICMI activities is deduced from the emphasis put on globalization, cooperation, networking, interdisciplinarity and translationality. In particular we note the following.

Internal cooperation between the different communities with interest in mathematics education: mathematicians, mathematics educators, teacher educators and teachers (from different generations).

Trans-continental collaboration fostering better North-South and South-South outreach.

Attention to cultural diversity, which is essential for sustainable improvement in mathematics education.

Linking research and practice, so that both may improve through the experiences of the other despite institutional separation.

Joint activities with other international bodies such as UNESCO, ICTP, CIMPA, IASE, ICIAM. Our recent contacts with UNESCO have been promising, with ICMI writing the policy document, and on-going negotiations underway to develop joint programmes.

4. **What have you done in Science Education that has not been particularly effective, and why do you think it was not successful?**

The ambition of ICMI in terms of outreach activities have been limited due to the following difficulties.

Financial barriers. Despite significant annual grants from IMU, the total amount available is insufficient to address needs worldwide, and especially in developing countries. A mathematical education of quality is a universal need, and starts from the early years of schooling. The required investment is not available from professional organisations such as IMU. Currently, ICMI is not structured to engage in development aid projects.

Language barriers. ICMI activities normally take place in English, which limits their international outreach, especially towards the teachers population. Translation and republication that might overcome this difficulty have not been as extensive as we wish, mainly because of funding issues, but also expertise and available time.

Membership barriers. Even though every country is concerned with mathematics education, only the countries where mathematics researchers, educators and teachers exist in organised institutions are able to join ICMI. Hence some countries, indeed some of those most desperate for support in the field, are not able to be reached. Contact

from a distance is not usually effective in such situations, but ICMI does not have the resources to conduct major on-the-ground initiatives to establish effective programmes.

5. What are your major current activities in Science Education?

The current activities are mainly the regular activities as detailed in response to question 4- (ICME Congresses, ICMI Studies, ICMI regional networks and conferences, Affiliated Study Groups, activities in developing countries,). In addition IMU/ICMI are undertaking three special projects, developed to face some major contemporary education-related challenges.

The Pipeline project, investigating the evolution of mathematical science student population from school to university and employment in different countries.

The Klein project, aiming at making accessible to senior high school teachers the evolution of mathematics in the twentieth century with specific focus on the increasing connections with other scientific fields and especially new emerging fields. The outcome of this project will be a book simultaneously published in ten different languages, and a Wikipedia website complementing the book with a diversity of educational resources.

The Travelling Exhibition “Experiencing Mathematics!” organized by UNESCO with the support of ICMI, is aiming at popularising mathematics, and its relationships with science, technology and society.

6. What do you view ICSU’s role in Science Education to be?

From the point of view of IMU and ICSU, an important role for ICSU is to reinforce with us the vital importance of building capacity in mathematics through enhanced and universal mathematics education. A second role is for ICSU to work closely with IMU and ICMI to strengthen the relationships between modern science and modern mathematics. The “queen and servant” relationship of mathematics to science remains, but it has evolved in important ways that need to be highlighted and publicized. Mathematics, like other sciences, has diverged and grown at a tremendous rate. Only by working together can we ensure the mutual strength of all our fields.

Particular activities that we could envisage are as follows.

Building a curriculum database of the different curricula and qualifications in secondary schools, aiming at international exchange and comparison, and helping policy makers to make sensible decisions.

Supporting popularization activities stressing the modern links between mathematics and sciences at large as well as highlighting the (almost invisible) impact that mathematics has on everyday life.

Making accessible educational resources of many kinds by developing new types of resources and facilitating better access to these through appropriate web structures;

Making sustainable improvement in the preparation of teachers, in the *sine qua non* of any agenda for capacity building in sciences.