

## **DG 6: The nature and roles of international co-operation in mathematics education**

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### **The topic and approach**

The aim of the DG was to engage participants in fruitful dialogue about the nature and roles of international co-operation in mathematics education. Mathematics education, both research and practice, is international. This means that it is carried out in most places in the world and that, despite particular national or local characteristics, practitioners experience similar predicaments and share similar bodies of knowledge not only about mathematics but also about teaching and learning phenomena related to mathematics.

Being international, relations among people in different national contexts have always been at the basis for the development of new trends in the field. The history of ICMI as an international organisation promoting coordinated effort towards the betterment of mathematical instruction is a clear example of how the development of the field is international from its outset (Menghini, Furinghetti, Giacardi, & Arzarello, 2008).

The nature and role of internationalisation in relation to the advancement of mathematics education has changed with time. From being an exchange between mainly European and North American mathematicians interested in exploring ideas for instruction at the beginning of the 20th century, in the last decade we have an extensive network of mathematicians and mathematics educators placed in a variety of research and teaching institutions, all around the world. In ICME-10, DG 5 had already taken up this issue under the heading “International cooperation in mathematics education”. The group concluded the following important points (Atweh & Boero, 2008).

- In a globalised world with increasing inequality, international cooperation can be strategic to get access to scarce resources. However, the difference in resources in a partnership can lead to a dominant role of those who have access to the resources and thereby creating an unequal partnership.
- There are clear barriers to cooperation, namely financial resources, language barriers, cultural norms, conflicting agendas and issues of voicing the results of cooperation.
- The search for a genuine, mutually beneficial, equitable cooperation could diminish the impact of the barriers.
- Whether internationalisation leads to homogenisation depends on whether cooperative participants succeed in building strong links “from the bottom” so that diversification of perspectives and forms of contribution in cooperation can emerge.

DG 6 ICME-11 built on the discussions and lessons from the previous group. The following questions guided our discussions.

- What are the goals of international co-operation?
- Cooperation can take many forms, be organised in many ways, and be implemented accordingly. What are the advantages and disadvantages of different forms, organisations, and implementations? What topics best fit into which version of cooperation?
- What are the advantages and disadvantages of using regional versus global cooperation?
- What are concrete examples of international co-operation and what has been learned that can be disseminated to all?
- What are the barriers to international cooperation and how they can be dealt with?
- Would international cooperation lead to homogenisation? Would that be to the detriment of mathematics education or in its favour for acceptance of the discipline at large?

As a response for a broad paper call, we received nine written contributions, which were made available prior to the conference. The sessions during the conference were organised to build on the written contributions but also to integrate the experience of the twenty participants, from countries such as Australia, Colombia, Denmark, Finland, France, Germany, Japan, Mexico, Peru, Thailand, United Kingdom, United States of America and Vietnam. In what follows, a thematic discussion of the main issues that emerged during the sessions as a response to the motivating questions is presented. We will support the points raised using the written contributions submitted to the group.

### **The importance of networking**

At the base of international cooperation there is the fundamental meeting among people who share interest and who find it productive and enriching for their professional and personal goals to enter in dialogue with others. Coming to know and listening to the experiences of colleagues in different countries, institutions, and with different traditions, is the first potential ground for collaboration. We are in the “network society” (e.g., Castells, 2010), and international cooperation is one of the most effective forms of building networks. Sessions were designed so that possibilities for talking, exchanging and coming to know each other emerged. Artigue (Artigue, Cerulli, & Mariotti, 2008) presented the case of the TELMA and REMATH Projects. TELMA (Technology Enhanced Learning in Mathematics) was part of a larger European network of research excellence. It included six European research teams and aimed to promote collaboration towards the construction of shared projects and a shared scientific vision. Artigue highlighted the importance of genuine and long-term interactions that can emerge from researchers having known each other for long time, but that also are sustained because conversation across differences. This leads to thinking about the commonalities of research practices and theoretical approaches. Nguyen (Burrill, Lott, Nguyen, & Voica, 2008) reported that the international seminar of Park City Mathematics Institute helps to build strong professional and personal relationships among teachers and researchers. Such bonds help participants year after year to set a discussion agenda around common important topics. International briefs are published at <http://www.mathforum.org/~pcmi/>.

The importance of networking resides not only in building repeated opportunities to engage in dialogue, but sustaining the encounters with activities that participants find relevant for their own practice. Participants in the group shared diverse experiences of networking that was able to be sustained though their participation in international and regional conferences such as ICME. This indicates that, besides people’s willingness to enter in conversation with others, a structure of support for promoting exchange is a key element in networking.

### **(A)Symmetry of relations**

Cooperation can be of different types and with different intentions. Participants shared examples of symmetrical interactions, where common agendas were built and where all participants experienced gains. Examples are the interactions among mathematics students facilitated by Mathematics Summer Camps where Finish and Hungarian secondary students and teachers met to study and do mathematics. This was exchange across culture and language difference, but with the common interest in mathematics. The teachers’ meeting reported by Nguyen (Burrill et al., 2008) also allow participants to feel that they are dealing with peers.

As for researchers, the meeting of professional researchers for projects such as THELMA and REMAT (Artigue et al., 2008) position participants in a balance of contributions and exchanges. Miller (2008) described the plans for a collaborative workshop between researchers from Middle Tennessee State University (USA) and Northwest Normal University (China) to take place in the Fall of 2008. The workshop will enable American and Chinese researchers in mathematics and science education to advance their work through international collaboration. After eighteen months of preparation, she reflected on the importance of the understanding of cultural differences when dealing with peers. While for Artigue and colleagues it became

evident through the collaboration that different research traditions used similar words to name different educational phenomena, for Miller and her co-organizers differences in language use and research traditions became sharply clear due to the lack of a common language. An effort to understand each other's traditions and practices was a key point in building fruitful relationships. Castela (2008a) confirmed this point in her experience of a network of French and Mexican researchers wanting to bring to theoretical perspectives in dialogue. The importance of awareness on cultural traditions of research and of the language of research is paramount in her experience in building peer, equal relationships with her Mexican colleagues.

Asymmetrical relationships in collaboration are also frequent. This is the case when one of the parts is positioned as a more competent partner in a relationship intending to bring research results, methodologies and theories to the other parts involved. This was exemplified by two of the cases discussed in the group. Lezama (2008) described the creation of an on-line graduate course in mathematics education aimed at training teachers and researchers from Latin America. In this case, The Mexican Instituto Politécnico Nacional has a research base for this programme that is offered to communities wishing to develop mathematics education practice and research in other parts of Mexico and in other Latin American countries. The collaboration agreements position the host institution in a leading role, while the participating partners are positioned as learners. Lezama reported the importance of providing support when technical and academic issues emerge. This may be difficult due to the distant relationships and mediation by on-line technologies. Insufficient technological capacity on the side of the students may contribute to a non-privileged position in the relationship.

Similarly, Bessot and Comiti (2008) reported on the experience of cooperation between Vietnam and France concerning the qualification of mathematics teachers at university level, as part of bilateral agreements of collaboration between governments. In this case, France makes available experts that offer training for Vietnamese teacher educators working at the *École Normale Supérieure* (ENS) and the *Université Pédagogique* (UP). As a result of this cooperation research has been produced on the Vietnamese school system. Castela (2008b) also presented the example of a project funded by a bilateral agreement between the ministries of education of France and Chile. The project brought in contact the DIDIREM and the Pontificia Universidad Católica de Valparaíso, with the aim of engaging in comparative studies of the mathematics curriculum, starting with geometry. As an overall aim there was the intention of introducing Chilean mathematics educators into the field of French 'didactique des mathématiques' for the analysis and improvement of their curriculum. Castela described this project as being one that positioned the Chilean participants as apprentices of the French model to be appropriated in the Chilean national curriculum.

These examples of asymmetrical collaboration are representative of a frequent form of exchange between countries with more expertise in areas such as mathematics education. Participants discussed how and when asymmetrical cooperation become productive for the participants in a less privileged position. It was highlighted that more often than not those in a dominant position become aware of their own cultural limitations and limitations in expertise when meeting problems that their partners have. The cooperation experience, even if asymmetrical, can also be transformative for partners in a privileged position.

## **Sustainability**

Discussion suggested that the sustainability of cooperation depends on both the institutions and the individuals involved. As mentioned above the links among people as part of networking are fundamental. But also a great part of cooperation may depend on political support from local or national institutions, as well as on the number of individuals involved. For sustainability, participants must form a community with their practice, friendship, common concerns, and a sense of shared theoretical approaches. But none of this happens in a hurry. Time is necessary to build relationships, networks and shared practices; and this type of

collaboration is hardly compatible with short-term projects of two or three years. Therefore institutional commitment for collaborative projects becomes important for their sustainability.

This was illustrated by Valero (2008) with discussion of inter-institutional agreements for doctoral education, as a way of promoting research collaboration between research teams at different universities. The case of collaboration between Aalborg University and Universidad de los Andes and Universidad Nacional Pedagógica in Colombia illustrate a scheme of doctoral studies where the universities involved co-finance doctoral studies of very experienced academic staff who engage in research that is of relevance for both Denmark and Colombia. In this case, the institutional bounds created by the research collaboration become a platform for the establishment of new initiatives in joint educational programmes and publications. This case also illustrates that researchers in places with access to more economic and networking resources can redirect those resources to promote the visibility of researchers in the international scene and, in that way, attract new and more resources for the collaboration.

## **Resources**

The issue of the resources invested in cooperation emerged in the group discussions. It was evident that sustained collaboration requires financial resources, time and personal investment. Some of the papers presented evidenced how the provision of institutional resources for collaboration enhanced the possibilities of exchange (e.g., Burrill, et al., 2008; Castela, 2008b; Miller, 2008). However, more than discussing economic resources, some of which sometimes are beyond the reach of personal control, language as the key resource for communication in cooperation occupied the group's attention. Castela (2008b) reported how the beginning of the cooperation between French and Chilean researchers was highly dependent on the language competencies of the people involved. Similarly Miller (2008) addressed the intensity of effort invested in communicating and establishing relationships when the native languages of the partners are as far apart as English and Chinese. Even if we think that we may have the common language of mathematics to communicate, as soon as we start dealing with problems of learning and teaching the diversity of native languages—with their social and cultural nature—as well as theoretical languages will produce multiple meanings and potential misunderstandings. Participants again emphasised time and involvement as the only ways of facing the challenge of building bridges of communication in international cooperation.

In particular, attention was given to ICME conferences as an important space for meeting, networking and cooperation. Using English as the official language of ICME creates a situation of dissymmetry, between the native and non-native speakers of that language. Expressing one's ideas with precision and self-confidence while understanding what is at stake in the interactions are major challenges. Recommendations included making better use of screens with different translated versions of papers and PowerPoint presentations, especially in large sessions. Smaller sessions may allow presenters to work in their native languages as long as translated copies of the presentation are shown.

With paper submissions to ICME, native languages could be accepted with an adequate board of experts who are “multilingual” to review the papers. Papers should not be rejected only because the level of the language of submission is problematic.

## **Towards the future**

International collaboration has been and will remain an important feature of mathematics education. The four points that emerged in the group discussions —networking, a/symmetry, sustainability, resources— will continue to be issues of interest as more mathematics educators around the world engage in dialogue and thinking with colleagues from other countries about the learning and teaching of mathematics and researching them.

Since cooperation is escalating and is being considered a desired characteristic of this historical period of growing globalisation, participants in the group proposes to ICMI that

collaboration/cooperation should be the theme of a study to recognise and give voice to projects for disadvantaged regions in the world, and in particular how to produce symmetry in international cooperation.

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