

# Introduction

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The first *International Handbook on Mathematics Education* was published by Kluwer Academic Publishers in 1996. However, most of the writing for that handbook was done in 1995 and generally reflected the main research and development foci prior to 1994. There were four sections, 36 chapters, and some 150 people contributed to the final volume either as author, reviewer, editor, or critical friend. The task was a monumental one, attempting to cover the major research and practice developments in the international field of mathematics education as it appeared to the contributors in 1995. Inevitably there were certain omissions, some developments were only starting to emerge, and some literatures were only sketchy and speculative. However that *Handbook* has had to be reprinted three times, so it clearly fulfilled a need and I personally hope that it lived up to what I wrote in its Introduction:

The *Handbook* thus attempts not merely to present a description of the international 'state-of-the-field', but also to offer synthetic and reflective overviews on the different directions being taken by the field, on the gaps existing in our present knowledge, on the current problems being faced, and on the future possibilities for development.

(Bishop et al., 1996)

Since that time there has been even more activity in our field, and now seems a good time to take stock again, to reflect on what has happened since 1995, and to create a second *Handbook* with the same overall goals. Two of the four yearly International Congresses on Mathematics Education have taken place, ICME-8 in Seville, Spain in 1996 and ICME-9 in Tokyo, Japan in 2000. As well, many other regular specialist conferences have continued, including the International Group for the Psychology of Mathematics Education (PME), the Commission Internationale pour l'Étude et l'Amélioration de l'Enseignement des Mathématiques (CIEAEM), the History and Pedagogy of Mathematics (HPM), the European Congress of Mathematics (ECM), the International Congress of Mathematicians (ICM), the International Congress on the Teaching of Mathematical Modelling and Applications (ICTMA), the Conferencia Interamericana de Educación Matemática (CIAEM) and the Mathematics Education and Society conference (MES).

So with all this continuing international conference activity, how has the field developed? What are the new issues and trends? What do we know now that

we didn't know then? Also, has international collaboration increased? Is there more collaborative research now taking place? Is research being restructured through these collaborations? These were some of the main questions facing the authors and editors of this *Handbook*.

However, there has also been a large number of regional conferences, and although we cannot mention them all here, perhaps we can pick out as representative the following: The Second Asian Technology Conference in Mathematics which took place in Penang, Malaysia in 1997, CERME, the European group for Research in Mathematics Education, PME-NA, the annual meeting of the North American Chapter of PME, the East Asian regional conference on mathematics education (ICMI-EARCOME), the Southeast Asian Conference on Mathematics Education (SEACME), and the Mediterranean Conference on Mathematics Education. We have also seen the first Interdisciplinary Conference of the International Society for the Arts, Mathematics, and Architecture, ISAMA 99 in San Sebastian, Spain, and the conference on the Future of Science and Mathematics Teaching and the needs of Arab society in Tunisia, 1996. There was a meeting of mathematics educators from Francophone countries in July 2000 in Grenoble, France, under the title "Espace mathématique francophone". The first all-Russia conference on Mathematical Education took place in Dubna, Russia in 2000, with the theme "Mathematics and Society: Mathematical Education at the frontier of centuries".

So does this developing regional activity mean that there is a greater representation of diversity, of both people and ideas, in our knowledge field now? Is there more involvement in research and development of colleagues from countries other than those well represented in the first *Handbook*? Is there more of a regional emphasis to research and development? Is interdisciplinary research growing? These were also some of the other questions provoking those of us who have been involved in putting this *Handbook* together.

In addition, several new books and journals have been published, demanding our attention, and in October, 2000, a famous journal in our field even celebrated its one hundred years' birthday, at a symposium in Geneva with the title: "L'Enseignement Mathématique: moments of mathematics education in the 20th century". Another significant contribution to the recent research literature in our field has come from the several international studies that ICMI has initiated:

- Perspectives on the teaching of geometry for the 21st century, in 1995 in Catania, Italy.
- The role of the history of mathematics in the teaching and learning of mathematics, in 1998 in Luminy, France.
- The teaching and learning of mathematics at university level, in 1998 in Singapore.
- The future of the teaching and learning of algebra, in 2001 in Melbourne, Australia.
- Mathematics education in different traditions: a comparative study of East Asia and the West, in 2002 in Hong Kong.

Thus, our main intention for this *Handbook* was to represent what we editors saw as the most significant changes and developments that have happened in our field over the last ten years, and we did not want to merely up-date the first *Handbook*. The other editors and myself met twice to discuss the format of this present handbook, and it was with these overall thoughts in our minds that we contacted the various authors and critical friends to solicit their help and contributions. As with the first *Handbook* I have been very fortunate to have had as section editors, four internationally respected scholars from different regions of the world: Christine Keitel from Berlin, Germany; Frederick Leung from Hong Kong S.A.R., China; Jeremy Kilpatrick from Athens, Georgia, USA; and Ken Clements from Brunei Darussalam. One of the strengths of the first *Handbook* was its international coverage and we have tried to achieve this level again. One method we used before was to arrange for some joint authoring of chapters, and another was to arrange for an internationally spread group of reviewers for each chapter. Despite some individual conflicts felt by some authors and reviewers we believe that these procedures worked well in the first *Handbook*, and we have therefore used them again as much as possible.

The arrangement of the sections and chapters in this *Handbook* is however rather different from the first. With the first *Handbook* it was necessary to achieve as much coverage of our field as we could, with chapters on, for example, elementary, secondary, tertiary, further and distance mathematics education. Here we have taken a different approach, and rather than attempting to cover everything, we have attempted to structure what we have seen as the significant trends and developments in our field that have happened in the last ten or so years. In particular, we have considered the increased international activity in our field and the increased range of publications and educational media now available. We have therefore organised this *Handbook* into four sections which we believe represent the most significant areas of our field at this time. Also within each section we have chosen foci for the chapters which we hoped would enable the authors to reflect on what has happened in the last ten years, and on what might develop in our field in the near future. As with the first *Handbook*, we intend this *Second Handbook* to be an essential resource for those who are serious students and researchers of the field of mathematics education, as well as being a resource for those in governments and educational systems who shape educational provision and curricular policy in mathematics education, in order to ensure that the voice of research enters fully into that decision-making.

One recent and highly significant factor affecting developments in our field has been the increase in global communication of all kinds. Migration has increased into most countries, and globalisation, that familiar if not well understood phenomenon, is affecting education at all levels. It is easy to state that mathematics education is an international field, but it is less clear what to make of the effects on it of increasing globalisation, not to speak of the ways our field, and that of mathematics itself, is contributing to the influences of globalisation on other aspects of our complex lives. Globalisation is thus an explicit or an implicit issue in several of the chapters of this *Handbook*. Of course we can feel

that these influences are not always positive, but by what academic criteria should they be judged? How can research contribute to clarifying these criteria, influences, and other attempts to interpret our changing global context?

As a research-based contribution to the new global discussions, the first section of this *Handbook*, edited by Christine Keitel from Berlin, focuses on policy dimensions of mathematics education. Global economic and political tensions have increased, creating the need for more effective inter-national and inter-cultural education. How is our field responding to these challenges? For example, the last ten years have been marked by heated policy debates about the role of mathematics in education, the place of numeracy in the curriculum, the quality of teacher education, etc. What other developments can we see that are enabling our students and educators to deal with the challenges that the new global society is creating? More specifically what are the policy implications of the new global situation? The first section of this *Handbook* launches out into these uncharted waters, and the six chapters there represent an important beginning in coming to grips with the key issues involved.

As a second driver of our field, technology has also continued to develop and influence significantly, yet in a way almost stealthily, our professional lives. For example, it is hard to realise that when the first *Handbook* was being created the mobile phone was in its infancy. Now it plays a taken-for-granted central role in many people's lives, as well as strengthening peer-group cultures and fostering new modes of communication such as text messaging. Likewise the internet has provided educators, parents and politicians with an amazing array of material and information, some of which can have direct applications for mathematics education. Statistical data-bases, graphical representations of all kinds, games, puzzles, architectural programs, geographic and demographic information, communication possibilities with schools and students everywhere, all are potentially interesting for mathematics educators. But how should this new technology be used to maximize its benefits and minimize its drawbacks? What can be gained but what might be lost by engaging new technologies in the mathematics education endeavour?

As might be expected therefore, technology is also present in several chapters, but it is also a major theme in the second section of this *Handbook*. It is edited by Frederick Leung from Hong Kong S.A.R., and has the title "Responses in mathematics education to technological developments". This section deals with the different technological influences being felt by mathematics educators, and it includes a first chapter based on a significant research project attempting to map the burgeoning literature in IT/mathematics education. This we hope will help to organize what is a rather disparate if active part of our research field at present.

One of the main reasons for creating this second *Handbook* is that our field has moved on in various ways, and new areas of research and developmental activity are attracting international attention, due to the new global situation in which we now all operate. In relation to this research, the third section of the

*Handbook* is edited by Jeremy Kilpatrick from Athens, Georgia, and has the title “Issues in research in mathematics education”.

However, as well as new areas of research developing, there has also been a strongly growing interest in the different introspections and self-analyses of the research field itself, in terms of both people and processes. For example, ethics and values clearly play a strong role in any research endeavour, but they have become more significant as more research is government and corporation funded, raising questions from many scholars about these institutions’ agendas in commissioning this research. Also the fact that research is taking place in very different cultural and social contexts, including situations of social and political conflict, means that the research methods themselves that are being currently used are also being critiqued and analysed for their appropriateness in these ‘new’ situations.

Moreover, realising the increasing significance of research in helping to come to terms with ever-increasingly complex social and political contexts has meant that there is correspondingly more concern with who is doing this research, the quality of their training, and with their motivation for doing it. For example, PhD level research exists now in many countries, alongside mathematics education as a university development but is research just to be pursued in universities? What role do, and should, teachers and other practitioners play in the research process? What kinds of preparation do they need to be recognized contributors to the research process? The chapters of Section 3 deal with some of the complex issues raised by the self-analysis and critiques of research practices referred to above.

The fourth and final section of the *Handbook* is edited by Ken Clements (Brunei Darussalam) and has the title “Professional practice in mathematics education”. It is the largest section, and reflects the enormous growth in research and interest in professional issues, especially those related to policy, and professional development. As the growing global situation creates more conflicts and challenges for us in mathematics education, as technology offers us more and more educational decision-making choices, and as more and more practitioners are engaging in different ways with research, so mathematics educators are having to develop their professionalism. If we want our professional voices to be heard in the policy-dominant arenas, then we must look to our own professional standards, professional practices, and professional futures.

Principally of course it is what happens in the mathematics classroom that remains of most concern in most countries. One often hears at international conferences discussions about why classroom practices don’t change in line with research developments, and about the supposedly increasing gap between research and practice. The seven chapters in this last section deal in different ways with aspects of this issue, but they all discuss interesting developments in research and practice that seem to be aimed at reducing this gap. Whether it is the teachers who are the focus, or teacher educators, or mathematicians involved in some way in teacher education, the research and practice being reviewed here deserve to be known by all practitioners involved with mathematics education.

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