Mathematics Education Research: A Perspective

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What do we mean by Research?

- The aim of research, broadly speaking, is to contribute to the growth of knowledge in a particular domain.

- The method followed is the scientific method, conceived broadly (including the method followed in the social sciences). The essence of this method is to validate knowledge on the basis of evidence.

- Applying the scientific method may include: systematic observation, uncovering patterns or laws, making hypotheses about cause and effect, testing hypotheses, formulating theories, applying theories to particular problems.

- And of course, research includes peer review and publication.
But most important ...

- Openness
- Critical stance
- Honesty
- Rigour
Is Education Research different?

- Education is a complex domain.
- A large part of education research at present is of an exploratory nature aimed at
  - Richer understanding of complex phenomena
  - Better description and categorization
  - Formulation of better hypotheses and better theories
- Many studies narrowly interpret the scientific method as “hypothesis testing” using quantitative data. The findings of such research are usually not useful and not convincing.
What about mathematics education research?

- We might say the eventual goal of mathematics education research is to improve mathematics education.
- So it has an eventual practical orientation and is situated in particular contexts.
- It is connected to questions of policy, planning and practice.

Systematic, rigorous, critical and reflective study, using the methods of scientific inquiry, of problems of mathematics education and their possible resolution.
Mathematics Education Research across the world

- As in other fields, research in mathematics education, is led by developed Western nations.
- However, there has been a trend of growing internationalization or globalization.
- The reasons and circumstances of this globalization are interesting.
- This will be my focus.
- Some trends in mathematics education research
- Organization of mathematics education and research
Mathematics Education Research Journals

- Journal of Research in Mathematics Education (JRME)
- Educational Studies in Mathematics (ESM)
- ZDM
- International Journal of Science and Mathematics Education
- Research in Mathematics Education
- Journal of Mathematics Teacher Education
The PME Conference

- The “Psychology of Mathematics Education” conference.
- An international mathematics education conference held in July every year. (Submission deadline always Jan 15th)
- Next year will be PME 37.
- A few hundred participants.
- Very regular, serious conference. Blind peer reviews of every research submission by three reviewers.
- Go to website
Globalisation of Mathematics Education Research through the PME conferences

- PME conferences since 1980 have been in several countries outside Europe/ North America/ Australia:
  - Mexico (2), Japan (2), Brazil (2), South Africa, Israel (2), Korea, Turkey, Taiwan
- In East Europe: Hungary and Czech Republic, once in Finland.
- Holding a serious research conference like the PME is an indicator of a sizeable community of researchers in mathematics education
Growth in Graduate Programs in Mathematics Education – some examples

- South Korea has 18 universities offering a Ph.D. in mathematics education (as of 2008).
- It publishes at least two research journals in mathematics education, besides other types of journals in mathematics education.
- In the decade of 1990s there were 3214 master's and doctoral dissertations in mathematics education. (Choi and Song, 2000)
- Turkey has graduated 71 Ph.D.s in mathematics education in the last 10 years. 134 students are currently enrolled. (Presentation at PME, 2011)
- More than 50 doctoral dissertations in mathematics pedagogy defended in Russia since 1999. (Karp & Leikin, 2011)
Globalization of mathematics education research: external factors

- The role of ICMI and similar international organizations
- Ethos that welcomes diversity
- Supporting regional conferences
- Research journals that explicitly seek to represent the diversity of international perspectives
  - Zentralblatt für Didaktik der Mathematik (ZDM)
  - International Journal of Science and Mathematics Education
Globalization of mathematics education research: International comparisons

- TIMSS and PISA
- The most striking result was the consistent top performances of East Asian countries in both TIMSS and PISA.
- This led to a flurry of debates, reform efforts as well as research.
## TIMSS Performance

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Research following international comparisons

- What accounts for the superior performance of some countries?

- The TIMSS 1995 and 1999 video studies looked closely at classroom teaching in a variety of countries: Japan, U.S., Germany, Hong Kong


- Followed up by closer analysis of the 1999 study.

- See Stigler & Hiebert (2009) “Closing the teaching gap”
Classroom teaching comparison

- The classrooms in the high-ranking countries like Japan, Hong Kong, the Netherlands, Czech Republic, Australia follow different strategies and pedagogical approaches.

- What is common?
  - Students are actively and intellectually engaged in the tasks.
  - There is a focus on important mathematics by the teachers and the students.
  - In countries like the U.S. teachers spoke about new pedagogy, but their understanding of mathematics was weak.
Is there a difference in the teachers' knowledge of mathematics, and their attitude to mathematics?

Brought out in a dramatic fashion by a study by Liping Ma published in 1999 in the book “Knowing and Teaching Elementary Mathematics”

U.S. and Chinese teachers were compared, and the knowledge of Chinese teachers of elementary mathematics was profoundly deeper.

Famous example: $1\frac{3}{4} \div \frac{1}{2}$

Led to a flood of studies on subject knowledge needed for teaching mathematics
Studies of teacher development

- The Teaching Gap described in great detail a practice followed by Japanese teachers to improve their teaching called "Lesson Study".
- Principles were simple: teachers would get together to plan a lesson in detail. One of them would teach it while the others sat at the back.
- After the lesson there would be a detailed discussion and critical analysis. The lesson would be polished and taught a second time by another teacher.
- It would then be written up and published.
- This practice was over 100 years old!
Response to International comparisons by East Asian researchers

- There is much variation in the curriculum and pedagogy in the East Asian countries.
- There is also a dynamic tradition of curriculum reform, of changing the organization of teacher preparation, influence of ideas from the West.
- East Asian researchers identify cultural and social factors as being very important in accounting for the high performance.
- A tradition that highly values learning, high status of teachers, competitive culture, etc.
- Leung & Li (eds.) Reforms and Issues in School Mathematics in East Asia
What topics in mathematics education are more researched?
From Hannula, 2009

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ICME-12 Topic Study Group submissions

- In-services professional development of math teachers
- Mathed in a multilingual and multicultural environment
- Preservice math education of teachers
- Research on classroom practice
- Technology in the teaching of math
- Assessment and testing in Mathed
- Motivation, beliefs and attitudes towards math
- Teaching and learning of statistics
- Teaching and learning of algebra
- Math curriculum development
- Teaching and learning of geometry
Theoretical frameworks and methods

- Psychology and mathematics education: errors, alternative conceptions, beliefs about mathematics
- Large scale assessment
- Co-relational studies of process and outcomes
- Experimental studies
- Design experiments
- Classroom studies; discourse analysis
- Case studies
- Studies of affect
- Wide range of theoretical perspectives
Location of research in mathematics education

- Universities
- Departments and colleges of education
- Scientific research institutes
Mathematics education research in India

- Good summary in Banerjee (2012)
- Relatively few research studies in education focus on mathematics
- Surveys by Buch, Joshi & NCERT (1991); Kapur (1997); NCERT (abstracts of research)
- Dominance of psychometric designs and data analysis
- Low impact on policy and curricula
- Probably because the research designs do not lead to insight and understanding
Mathematics education research in India: New trends

- A few research studies after 2000, published in peer reviewed international conferences and rarely in international journals
- **Elementary level pedagogical studies**: Usha Menon; Rakhi Banerjee; Jayasree Subramanian; Jayanthi Sivaswamy; Shweta Naik; Subramaniam...
- **Out of school mathematics**: Farida Khan; Bose
- **Teacher beliefs, teacher professional development**: Hridaykant Dewan, Ruchi Kumar, Satyawati Rawool
- **Secondary and higher education**: Revathy Parameswaran; Jonaki Ghosh; Parvin Sinclair
Some important research conferences on mathematics education in India

- Conferences on mathematical education in South Asia: 1956 & 1960 – TIFR, Mumbai
- Conferences held under the Indo-US and Commonwealth collaborations
- Conferences by NCERT
- EpiSTEME conferences by Homi Bhabha Centre for Science Education, Mumbai
- The National Initiative on Mathematics Education (NIME)
Thank you !