

*Teachers as stakeholders in
mathematics education research:*
**remarks from the perspective
of ICMI Study 15 on
teachers professional education
and development**

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International Commission on
Mathematical Instruction

A commission of the International
Mathematical Union (IMU)

*links between mathematicians and
mathematics educators*

Study Conference held in
Águas de Lindóia, Brazil
(May 2005)

2009

ICMI Study programme
(launched in 1985)

New ICMI Study Series

Ruhama Even
Deborah Loewenberg Ball
Editors

The Professional Education and Development of Teachers of Mathematics

The 15th ICMI Study



International Commission on
Mathematical Instruction

Springer

ICME-10

Plenary Lecture by Anna Sfard based on the work of Survey Team 1

What could be more practical than good research?

On mutual relations between research and practice of mathematics education



ICME-10 Proceedings



I C M E
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2 0 0 4

Editor: Mogens Niss

Administrative editor: Elin Emborg

IMFUFA, Department of Science, Systems and Models
Roskilde University, Denmark

“The first thing I wish to say is that I am pleased to find out that the last few years have been *the era of the teacher* as the almost uncontested focus of researchers’ attention. This is quite a change with respect to the last two decades of the 20th century which were almost exclusively *the era of the learner*. And we have certainly come a long way since *the era of the curriculum*, roughly corresponding to the 1960s and 1970s when the main players in the educational game were the developer and the textbook. I consider the re-conceptualization of the relationship between the teacher and the researcher a big leap toward research that plays a genuine role in shaping and improving practice.”

Anna Sfard

ICME-10 Plenary Lecture



Faculté des sciences et de génie

Study 15 — International Programme Committee

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- *Theme decided by the ICMI EC in April 2001*
- *IPC appointed by the end of 2001*
- *IPC meeting in Prague, June 2002*



Discussion Document

Two strands:

- Teacher Preparation and the Early Years of Teaching
(structure & curriculum of teacher preparation, recruitment and retention, entering the profession, evolution in teacher preparation)
- Professional Learning for and in Practice
 - preservice
 - early years
 - continuing practice*(what sort of learning emerges from study of practice, availability of practices for study, types of practices, collaborative frameworks)*

- *DD issued by IPC early 2004
(ICMI Bull 54, June 2004)*
- *Call for submissions by Oct. 31, 2004*

ICMI Study 15 Conference

(Águas de Lindóia, Brazil)



- *Invitations issued by IPC, Dec. 5, 2004*
- *Study Conference held on May 15-21, 2005*



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Study Conference

147 participants from 35 countries

(a larger Study than usual as regards the number of participants)

“The conference was deliberately designed for the active inquiry into the professional education of teachers of mathematics in different countries and settings.” *(p. 7)*

No oral presentations — discussions “in small interactive groups” of papers accepted to the conference

This may help understand the content and structure of the resulting book.

These are decisions of Study IPC, not of ICMI!
(principle: full freedom of IPC inside the theme)



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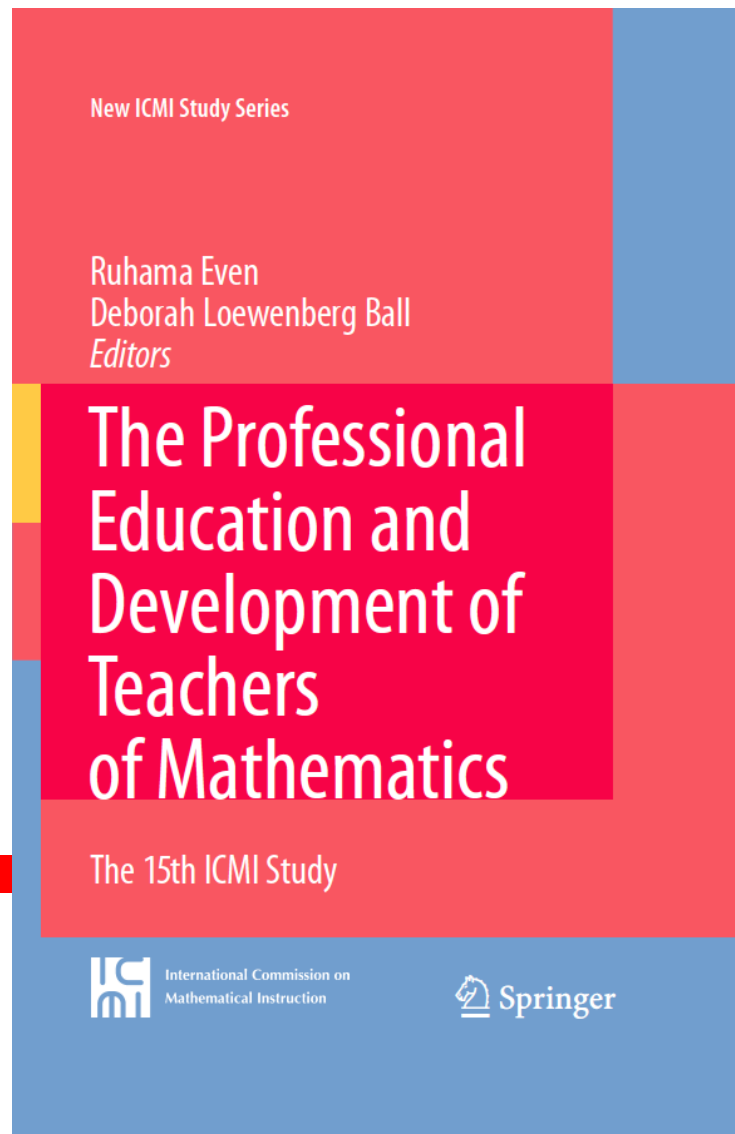
Study Volume

“work with the material submitted as papers for the conference” (p. 231)

still co-chairs allowed space for exploration and innovation in how to organise the material (p. 235)

premise of the Study:
teachers are central to the improvement of math education and to students' opportunities to learn mathematics (p. 1 & 255)

cf. Sfard's *era of the teacher*



Contents of Study Volume

Two main sections (*cf Discussion Document*):

- Initial Mathematics Teacher Education
- Learning in and from Practice

Additional shorter section:

- Key Issues for Research in the Education and Professional Development of Teachers of Mathematics

Section 1: Initial Mathematics Teacher Education

What professional skills and attitudes are to be developed in the preparation of mathematics teachers?

Theme 1: The preparation of teachers

Overview of teacher ed systems across the world (*Chap. 1.1.1*)

Great diversity and complexity

- requirements
- length
- role of mathematicians vs math educators
- “model” — i.e. *concurrent* or *consecutive*
- emphasis on *math content*, or on *general pedagogy*, or on *math pedagogy* (i.e., *didactics*), or on *practicum experiences*

Section 1: Initial Mathematics Teacher Education (*cont'd*)

Components of mathematics teachers education (*Chap. 1.1.2*)

Concern with establishing sound balance and productive relations between such components

“Teacher knowledge”

- SMK *Subject Matter Knowledge*
- PK *Pedagogical Knowledge*
- PCK *Pedagogical Content Knowledge*

- MKT *Mathematical Knowledge for Teaching*

Shulman (1987)

Ball & Bass (2003)



Section 1: Initial Mathematics Teacher Education (*cont'd*)

Comment about preservice secondary teachers:
they are often required to obtain math knowledge of a more academic nature, of a form not obviously relevant to secondary mathematics

“Tradition”: “*Prospective mathematics teachers must first become mathematicians.*”
(pp. 28-29)

Need for mathematics courses specific to secondary teachers and taught by mathematicians

part of the “mission” of the math department

necessary reflection on the role and contribution of mathematicians to teacher education

an objective of ICMI is to foster such a reflection



Section 1: Initial Mathematics Teacher Education (*cont'd*)

Practicum as an integrated part of a teacher education programme

(Chap. 1.1.4)

Danger of “compartmentalised knowledge” in the education of teachers

Practicum has a potential to “bridge this didactic divide”

Concl: Practicum is complex but has educational potentials

“The latter explain why teacher education programmes continue to offer a practicum although it is expensive and difficult to organise.”

(p. 67)

“learning-in” rather than “about-action”

“enacted knowledge in classroom”

(pp. 60-61)



Section 1: Initial Mathematics Teacher Education (*cont'd*)

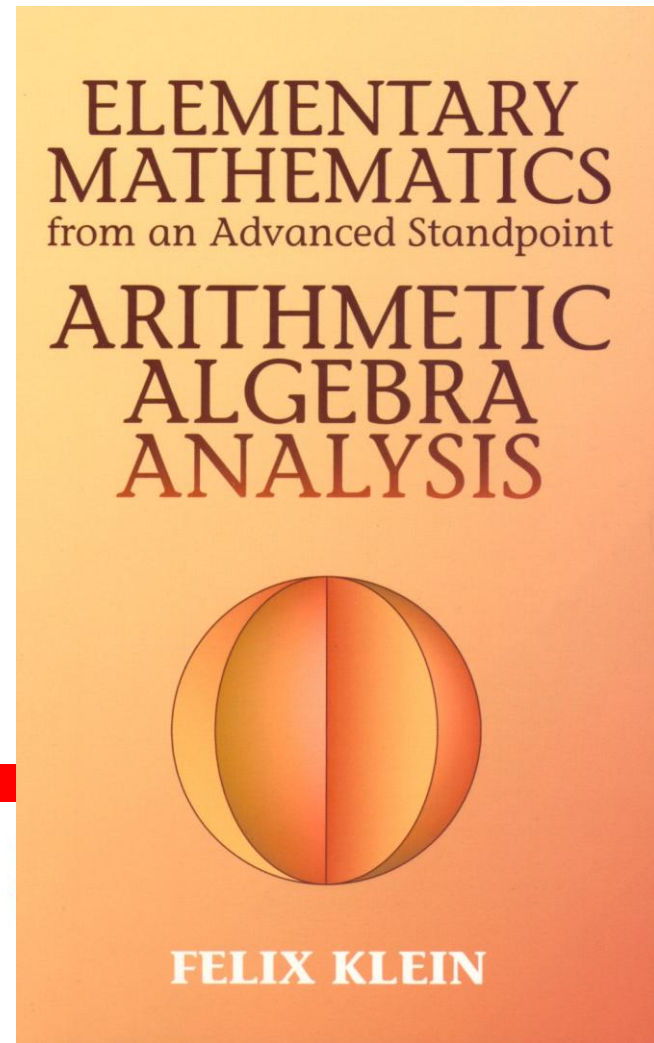
Theme 2: Student teachers' experiences and early years of teaching

Issue: transition from university to
school classroom (Chap. 1.2.2)

Aim:

to mend the *double discontinuity*
that exists between secondary
education and higher education in
mathematics

„*doppelte Diskontinuität*“



From Klein's *Introduction*



Introduction

In recent years¹, a far reaching interest has arisen among university teachers of mathematics and natural science directed toward a suitable training of candidates for the higher teaching positions. This is really quite a new phenomenon. For a long time prior to its appearance, university men were concerned exclusively with their sciences, without giving a thought to the needs of the schools, without even caring to establish a connection with school mathematics. What was the result of this practice? The young university student found himself, at the outset, confronted with problems which did not suggest, in any particular, the things with which he had been concerned at school. Naturally he forgot these things quickly and thoroughly. When, after finishing his course of study, he became a teacher, he suddenly found himself expected to teach the traditional elementary mathematics in the old pedantic way; and, since he was scarcely able, unaided, to discern any connection between this task and his university mathematics, he soon fell in with the time honored way of teaching, and his university studies remained only a more or less pleasant memory which had no influence upon his teaching.

There is now a movement to abolish this double discontinuity, helpful neither to the school nor to the university. On the one hand, there is an effort to impregnate the material which the schools teach with new ideas derived from modern developments of science and in accord with modern culture. We shall often have occasion to go into this. On the other hand, the attempt is made to take into account, in university instruction, the needs of the school teacher. And it is precisely in such comprehensive lectures as I am about to deliver to you that I see one of the most important ways of helping. I shall by no means address

Section 1: Initial Mathematics Teacher Education (*cont'd*)

First years of teaching

(*Chap. 1.2.3*)

This transition from being a student in the academy to being a teacher in the school is addressed at three levels:

- *epistemological*

math for school teaching

- *institutional*

from univ to school environment

- *personal*

from being a student in a community of students to a professional in a community of teachers



Section 1: Initial Mathematics Teacher Education (*cont'd*)

First years of teaching

(*Chap. 1.2.3*)

This transition from being a student in the academy to being a teacher in the school is addressed at three levels:

- *epistemological*

Klein — MKT

- *institutional*

a scientific approach to the knowledge underlying the teaching profession (ATD)

- *personal*

need for collaborative frameworks

Section 1: Initial Mathematics Teacher Education (*cont'd*)

Theme 3: Mathematics educators' activities and knowledge

What is entailed in becoming a math teacher educator?

Who are educating the teachers?

Where are they?

“The vast majority of people who become teacher educators in England are successful teachers looking for a change.” (*p. 114*)

“In the US, the role of teacher educators generally involves teaching math content courses, math methods courses, supervising field experiences, and/or supervising student teaching.” (*p. 116*)

Section 1: Initial Mathematics Teacher Education (*cont'd*)

Importance for educators of reflecting on or researching their own practice
(*Chap. 1.3.3*)

Such studies serve as an important means of professional learning for the teacher educators concerned

Increasing recognition in the US of the need for math departments and mathematicians to become involved in training math teachers for **primary** and secondary schools
(*Chap. 1.3.4*)

collaboration between the communities of mathematicians and math educators
an aspect of particular relevance to ICMI



Section 1: Initial Mathematics Teacher Education

(cont'd)

There seems to be a growing consensus on the identification of the various kinds of knowledge that are necessary for teaching, as well as of the specificity of the mathematical knowledge for teaching

Personal concern: what is the exact role mathematicians will accept / be allowed to play in this endeavour?

This is part of what math education research should tell us concerning teacher preparation



Section 2: Learning in and from Practice

Four themes:

- *Development of teaching in and from practice*

What is known about characteristics of the process of developing professional expertise in the teaching of maths?

What factors are recognised?

When “operationalising” these factors (i.e., translating them into vg tools of observations or structures of intervention, are there recognised benchmarks in teacher development?

Section 2: Learning in and from Practice *(cont'd)*

- *Processes of learning in and from practice*

What is the role of reflection, collaboration, communication, social institutional and socio-cultural environments?

Issues of learning and communities of practice, of addressing inequality and diversity, of scaling up

Section 2: Learning in and from Practice *(cont'd)*

- *Models, tools, strategies to support teachers' learning in and from practice*

Settings, instructional tasks, analysis of instructional episodes, video cases, lessons studies, learning communities, especially virtual communities, etc.

Section 2: Learning in and from Practice *(cont'd)*

- *Balance of mathematical content and pedagogy*

Framework of Shulman and Ball & Bass

Relationship between teachers' mathematical content knowledge and their pedagogical practices

Importance of teachers' social knowledge of institutional and societal expectations

Section 2: Learning in and from Practice *(cont'd)*

Commentaries by Ed Silver

“Toward a more complete of Practice-Based Professional Development for mathematics teachers” *(PBPD)*

PBPD treats math content, math pedagogy and student thinking in an integrated manner

However little is know about if and how teachers actually learn math or pedagogy in such settings

Empirical evidence is lacking to support, refute or modify such a claim

Section 2: Learning in and from Practice *(cont'd)*

Need to develop conceptual tools allowing to examine such a framework

Need to identify realistic dynamics of professional evolution based on practice

(vg, as suggested by Aline Robert, by adapting Vygotsky's theory of the Zone of Proximal Development to the practice growth for the teachers involved)

Concluding remarks (by the Study co-chairs)

Three main problems needing more efforts and attention:

- Need to focus *effectively* the education of teachers on practice
- Identification and development of teacher developers
- Need for valid and reliable assessments of teachers' learning

The Study has installed the education and continuing development of teachers of mathematics as a central problem of mathematics education.

Review of Study Volume by
Ken Ruthven, *ESM* 73 (2010)

