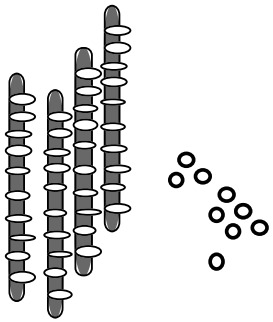
The Mathematics Methods Planning Group at the University of Michigan



Deborah Loewenberg Ball

Laurie Sleep

University of Michigan

Center for Proficiency in Teaching Mathematics

NCTM Research Presession

April 5, 2005



$$\begin{array}{r} 28 \\ \times\ 6 \\ \hline 368 \end{array}$$

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Overview

1. History
2. Our current methods course
3. Purposes, participants, activities of current MMPG
4. Problems and challenges
5. New developments
6. How would we know if this was effective?

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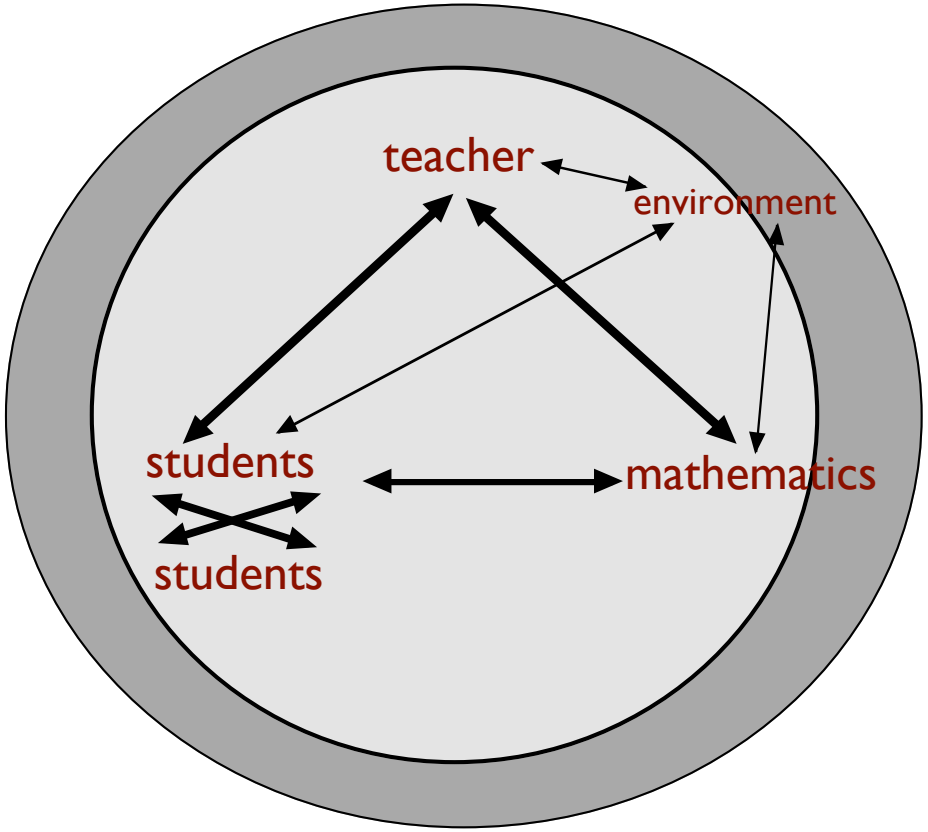
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History

- Began in 1996 at University of Michigan, all new faculty
- Need to teach 3 - 5 sections per year
- Focus on developing the math methods course
- Interest in developing mathematical knowledge for teaching, using records of practice to develop skills of inquiry and analysis as a teacher

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What is the Content of Learning to Teach Mathematics?



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The Work of Teaching Mathematics

- Creating an environment in which mathematical reasoning is central
- Promoting access, interaction, and work by all students
- Hearing students' mathematical ideas
- Analyzing pupils' errors
- Evaluating claims and solutions (often quickly)
- Giving and evaluating explanations
- Modeling operations, concepts
- Appraising and modifying textbooks
- Inspecting equivalences
- Judging representations
- Using mathematical notation and representations
- Choosing and developing usable definitions

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Mathematical Content of Course

MATHEMATICAL "CONTENT"

- Place value
- Whole and decimal numbers
- Operations (addition, subtraction, multiplication, division)
- Algorithms for multi-digit computation, focus on conventional algorithms; some examination of transitional or alternative algorithms

MATHEMATICAL PRACTICES AND SENSIBILITIES

- Concern for mathematical language, including care with definitions
- Mathematical explanations and reasoning
- Modeling operations and algorithms
- Establishing correspondences
- Examining equivalences
- Careful attention to and skill in working with contexts, mathematical (numerical, geometric) and other

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Course Framework

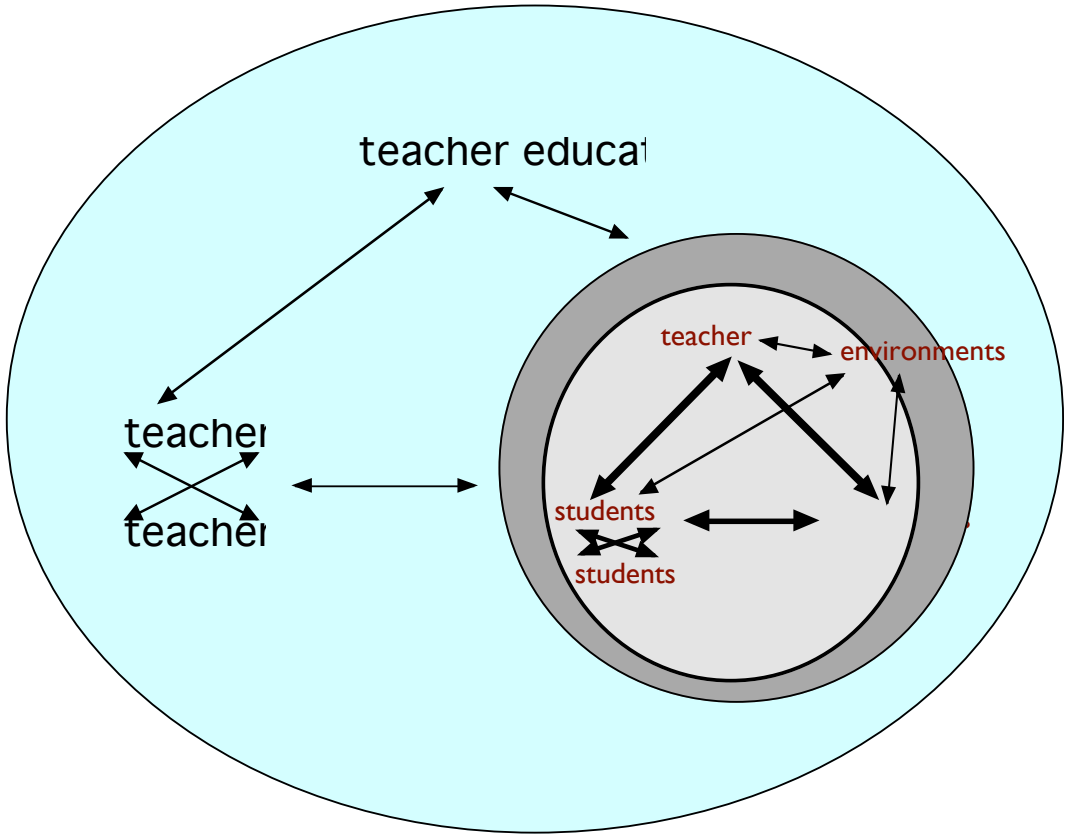
MAJOR DOMAINS OF TEACHERS' WORK	CRUCIAL RESOURCES FOR EFFECTIVE TEACHING: Using mathematics in teaching	CRUCIAL RESOURCES FOR EFFECTIVE TEACHING: Promoting equity
Establishing classroom culture		
Interpreting and developing students' thinking		
Designing, teaching, and improving instructional sequences		

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What is the Content of Learning to Teach Teachers to Teach Mathematics ?



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What Does Teaching Math Methods or a Mathematics Content Course for Teachers Require?

Mathematical knowledge for teaching

Knowledge of the practice of elementary teaching, and of schools

Knowledge of elementary students

Knowledge of the environments of teaching (society, policy, parents, etc.)

Knowledge of the above in ways that relate to the learning of beginning teachers

Ways to design learning tasks for preservice teachers that relate to the work of teaching

Ways to assess preservice teachers' learning

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MMPG Purposes

- **Supporting the development of novice teacher educators**
  - gradual immersion
  - access to and participation in the development of detailed lesson plans
  - observing and being observed
- **Supporting the continued growth of experienced teacher educators**
  - making practice visible; critical analysis of curriculum and teaching
  - interaction with new members
  - observing and being observed
- **Building organizational culture** for the development of professional knowledge, practice, and learning
- **Developing materials and practices** that become part of a professional archive and norms in our teacher education program

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MMPG Participants

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Gabriel Stylianides
Alison Castro
Dana Gosen
Laurie Sleep
Tim Boerst
Teresa McMahon
Mark Thames

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Core MMPG Professional Activities

- **Designing the course** (curriculum)
- **Planning for teaching**
  - Collectively work on plans and tasks for five sections of elementary school math methods
- **Developing practices of teaching**
  - Observing lead teacher's class, discuss, modify plan
  - Studying videotapes of others' classes
  - Attend one another's classes, debrief, and use the shared experience to study teaching
- **Instructional support**
  - Constructing assignments and assessments, as well as joint grading
- **Analyze and revise course goals and activities**
  - Revise and annotate instructional materials serve as a resource for future years

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Three Kinds of MMPG Planning Work

Learning to use existing material

- Problems we have developed over several years
- Course projects

Modifying existing material

- Adapting existing lesson plans, change timing, enactment of activities, examples
- Improving specific criteria for professional work

Developing new material

- "Teaching segments"
- Performance final exam for the course

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Problems and Challenges

- Time and effort involved
- Need to learn mathematical knowledge for teaching
- Creating professional culture of common work and critique
- Rethinking authorship of products of practice
- Making opportunities available
- Staging doctoral students' participation through the sequence

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New Developments

- Expanding to the mathematics content courses
- Coordination with secondary mathematics methods
- Working with faculty at other institutions (Georgia, Delaware, Cal State Northridge)
- Developing course on the pedagogy and curriculum of math methods
- Working across institutions to identify mathematical knowledge for mathematics educators
- Prelim exam on mathematical knowledge for teaching

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How Would We Know If This Was Effective?

- Studying doctoral students' learning across the program, e.g.:
  - Developing syllabi
  - Creating tasks
  - Assessing students' learning
  - Performances of teaching
  - Mathematical knowledge for teacher education
- Studying faculty development, quality and effects on preservice teachers' learning

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A Slice of MMPG Work- Mathematical Problems of Teaching

- Analyzing error
- Evaluating claims and solutions (often quickly)
- Giving or evaluating explanations
- Using mathematical notation and representations
- Judging representations
- Inspecting equivalences
- Modeling operations
- Appraising and modifying textbooks
- Choosing and developing usable definitions
- Choosing numerical examples

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Modeling Operations

$$\begin{array}{r} 28 \\ +\ 15 \\ \hline \end{array} \qquad \begin{array}{r} 40 \\ -\ 17 \\ \hline \end{array}$$

- Represent the quantities
- Explain each step with objects corresponding to a step in the symbolic form; close conceptual mapping, "recording"

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Learning to Support Movement Toward Proficiency

- Active engagement in acts of teaching with social and material scaffolds
- Exploring new ways to support and assess proficiency

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Support Movement Toward Proficiency

- Active engagement in acts of teaching with social and material scaffolds
- Progressive consideration of increasingly complex dimensions of teaching
- Finding new ways to support, expect and assess proficiency

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Domains of the Work of Teaching Mathematics

1. Establishing classroom culture
   - Creating environment in which mathematical reasoning is central
   - Promoting access, interaction, and work by all students

2. Interpreting and analyzing students' mathematical thinking
   - Hearing students' mathematical ideas
   - Analyzing pupils' errors
   - Evaluating claims and solutions (often quickly)

3. Designing, teaching, and improving instructional sequences
   - Appraising and modifying textbooks
   - Choosing and developing usable definitions
   - Using mathematical notation and representations
   - Choosing numerical (and geometric) examples carefully
   - Giving and evaluating explanations
   - Modeling operations, concepts
   - Inspecting equivalences
   - Judging representation

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Mathematical Problems of Teaching

- Analyzing error
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Our Learning

Participating in professional development embedded in doing and studying the work of teacher education

- Gradual immersion – from participant observer to instructor
- Teaching supported with well-developed lesson plans, observing other instructors, and getting feedback on own teaching
- Learn to observe and study teaching with more experienced others
- Developing tools (resources, ideas, models, strategies, syllabi, activities, pedagogy) -- things that can be shared

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Our Learning

Developing and furthering research interests

- Working on developing the knowledge base for teaching and teacher education and mathematics (e.g., what *is* mathematics for teaching)
- Exploring ways to connect teachers' opportunities to learn mathematics to teaching practice
- Designing and analyzing resources and approaches for teachers' learning

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