

Building *Professional* Education for Teaching Mathematics: Meeting the Challenges

Deborah Loewenberg Ball

National Council of Supervisors of Mathematics

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SCHOOL OF EDUCATION UNIVERSITY OF MICHIGAN

An alternative (stealth) title:

In Praise of Prescriptiveness and Training in Professional Education

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Main argument

We need a system of initial and continuing education that can reliably help prepare ordinary people for effective professional practice in teaching mathematics.

- Doing that requires
  - Basing teacher education on the *work of mathematics teaching*;
  - Focusing developmentally on the highest-leverage practices;
  - Emphasizing the *performance of teaching* in the curriculum and in assessments.

This must draw on past accomplishments and progress. But it will also require significant change.

Overview

1. Teaching in the U.S. in the 21st century
2. The work of teaching mathematics and the need for professional training
3. Teaching practice inside professional education: Toward a curriculum and two examples
4. Next steps

1. Teaching in the U.S. in the 21st century

The urgency

- Enormous gaps in learning opportunities and disparities in achievement (within U.S. and in international comparisons)
- Rapidly changing school population
- Higher, more complex academic goals
- High expectations for all students

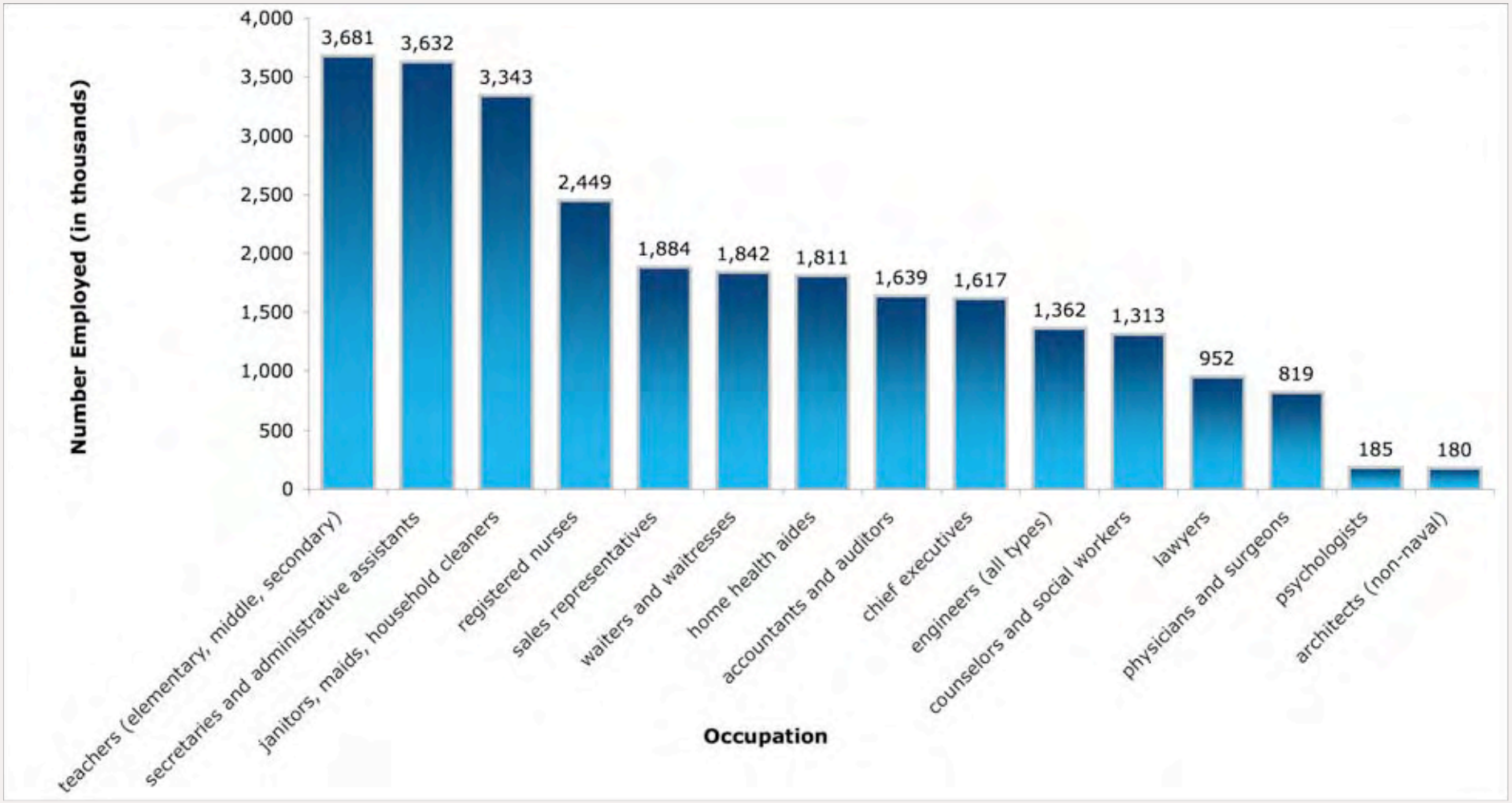
Teachers matter — a lot

- Persistent evidence that a large proportion of the variability in student achievement gains is due to the teacher
- So one obvious strategy for improving students' opportunities and learning is to ensure that they have teachers who are able to help them learn
  - ❑ Recruitment
  - ❑ Professional training

Why the problem is one of professional training

- The scale of the need
- Teaching as unnatural and intricate work

The realities of scale



2. The work of teaching mathematics and the need for professional training

Teaching as unnatural work*

Common ways of being

- Asking questions to which you do not know the answers
- Telling and showing others, doing things for people
- Assuming you know what others mean
- Correcting and smoothing over mistakes
- Assuming others experience things as you do
- Liking/disliking people
- Being "yourself"

Ways of being in teaching

- Asking questions to which you often do know (at least part of) the answer
- Listening and watching others, help others do
- Probing others' ideas
- Provoking disequilibrium and error
- Not presuming shared identity; seeking to learn others' experiences and perspectives
- Seeing people more descriptively
- Being in professional role

*Jackson, 1986; Murray, 1999

Teaching fractions in third grade

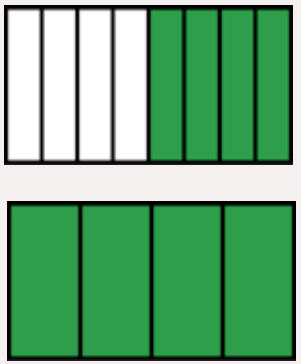
Comparing fractions

Multiple representations: area model, number line

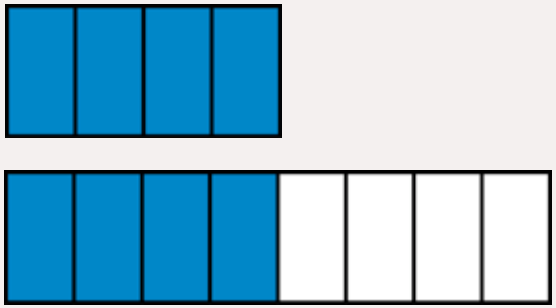
Which is more—

$\frac{4}{4}$ or $\frac{4}{8}$?

Lin's explanation:



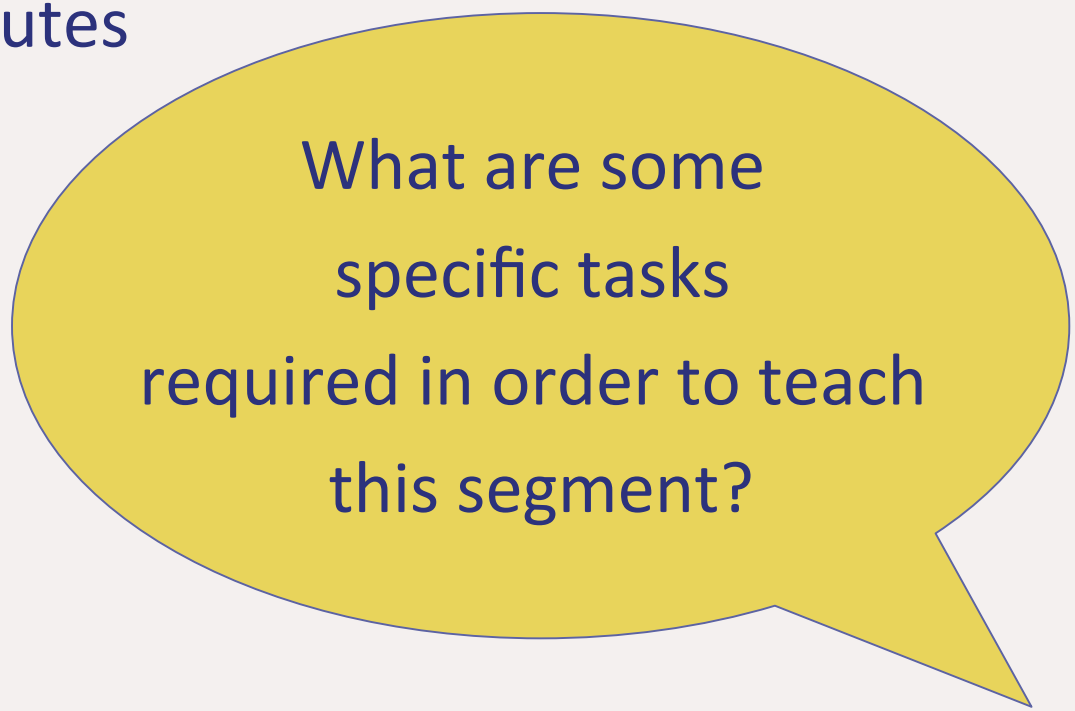
Kevin's error:



Teaching as unnatural work

Teaching mathematics as intricate work: One look

1. "Off camera": Before this episode
2. During these 6 minutes



Teaching as intricate work: One look

"Off camera": Before this episode

1. Learn about individual children and what they know, care about, are worried about, can do, etc.
2. Establish the environment to manage behavior
3. Teach intellectual habits (e.g., drawing, speaking to peers, knowing and being able to choose and make different kinds of mathematical moves)
4. Choose the specific problem: Which is more 4/4 or 4/8? Why that question? Why those numbers? What's a similar or better choice?

During these 6 minutes

12:58:35—Open the discussion: use specific tone, body movement around the room, choose whom to call on, and call on that child

12:58:38—Watch students while walking around; figure out who is drifting and encourage students' attention; maintain tenor of class while Lin draws

1:00:58—Lin completes drawing. Decide what to do about "I took four out of it"; direct her to repeat, "more loudly"; ask others to comment; work to get other students to comment besides Bernadette

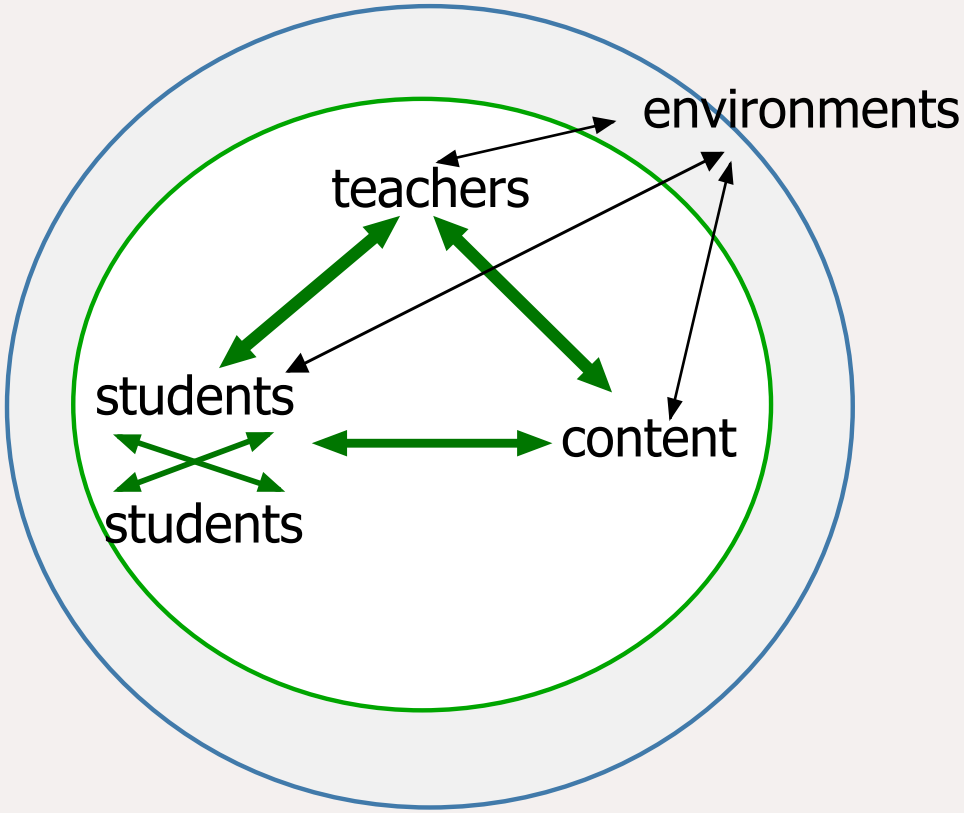
1:01:28—David comments. Work to understand; manage risk of losing class; decide not to take up; close interchange with David kindly.

1:02:40—Bernadette suggests the number line. Decide to have her work on the side; make her a number line to work on.

1:02:57—Kevin agrees and says first he did something else that was wrong. Decide to probe and to take this up; highlight for others; amplify by drawing incorrect picture on board

1:24:57—Pose question to assess students' understanding; make up specific question; decide how to take up answers

Teaching mathematics as unnatural and intricate work



- Coordinating, over time, and with groups of students to accomplish specific goals
- Using resources
- Managing and using environments

Cohen, Raudenbush, & Ball (2003); Lampert (2001); Lee (2007).

Given the scale of the need and the fact that teaching math is both unnatural and intricate work . .

. . .then equipping all students with good teachers of mathematics is a problem of effective *professional* education.

BUT —

We lack a reliable system of professional education

- Inappropriate subject matter preparation
- Inadequate preparation for diversity of U.S. classrooms
- Persistent divides of theory and practice; tensions over "ivory tower" ideas and realities of practice
- Weak coordination of training, licensure, assessment of performance; certification, continuing education
- Passive and ineffective recruitment
- Lack of evidence of effects

What is holding us back? Three possible explanations

1. Professional education is a weak intervention
2. Existing research cannot provide a warranted knowledge base; complex, lacking adequate methods
3. The culture of professional education:
   - Is conservative
   - Swings through fads, without building
   - Is not adequately aimed at professional practice

3. Teaching practice in professional education

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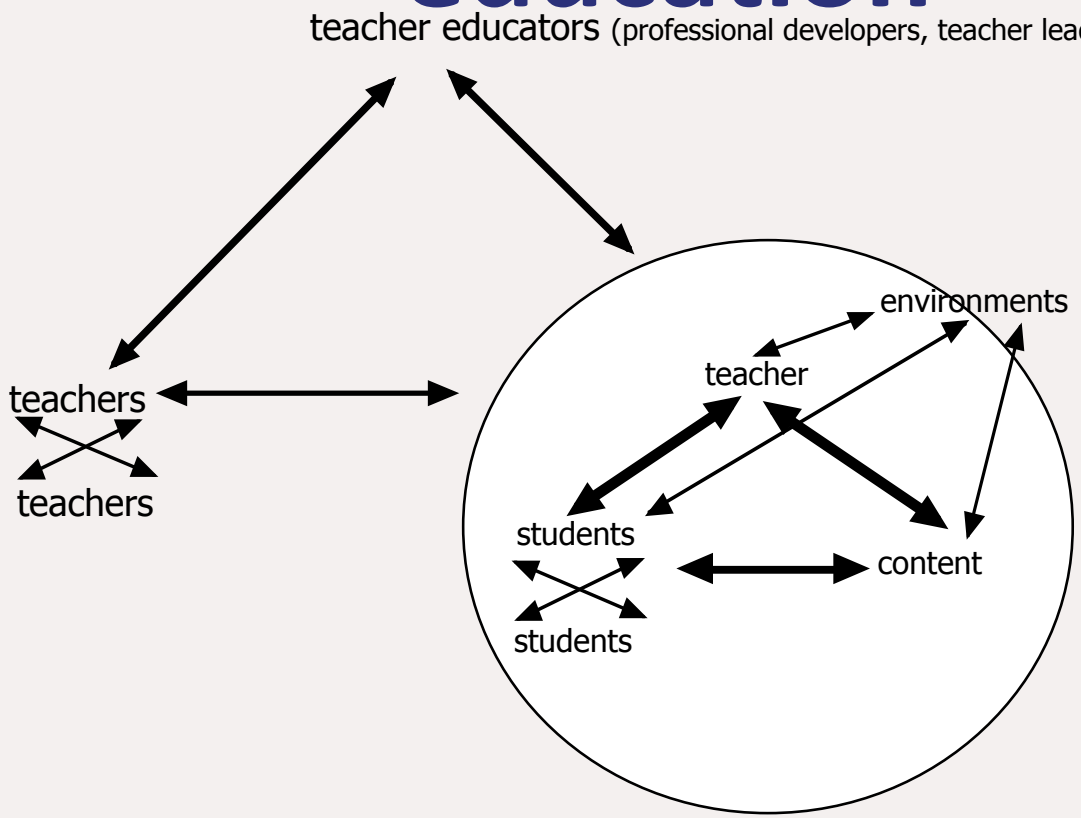
Teaching practice as the content of professional education



Toward a curriculum and pedagogy for teaching practice

- *What* is the "content"?
  - How to "decompose" and articulate the work of practice (Grossman and her colleagues)
  - How to see it when so much is invisible (Lewis, 2007)
  - What is generic and what is subject-specific or context-specific
- *How* can practice be practiced?
  - Rehearsal
  - Approximations to real practice
  - In real time
- *Where* can practice be practiced?
  - Virtual, designed, real settings (Lampert)
- How can practice be *taught and assessed* in ways that do not convert it to propositional knowledge and analysis?

Identifying what to teach

- De-compose the work of teaching into smaller practices that:
  - can be articulated, unpacked, studied, and rehearsed
  - can be reintegrated into real-time teaching
- Choose practices that are "high-leverage" for beginners
  - Occur frequently in teaching
  - Core to different approaches to teaching
  - Crucial to improve the learning and achievement of all students
  - Can be articulated and taught
  - Accessible to preservice teachers

Grossman & Shahan, 2005; Boerst, Sleep, and Ball, 2006

A few examples . . .

- Interacting with pupils' caregivers
- Asking questions of students about the content
- Putting material up for pupils to use (diagrams, terms, tasks)
- Assessing and diagnosing pupils' skills and knowledge
- Learning about pupils' contexts

Two cases

1. Teaching students to use mathematical knowledge for teaching (modeling and critique)
2. Teaching students to read aloud (rehearsal and feedback)

Teaching practice

#1: Modeling subtraction

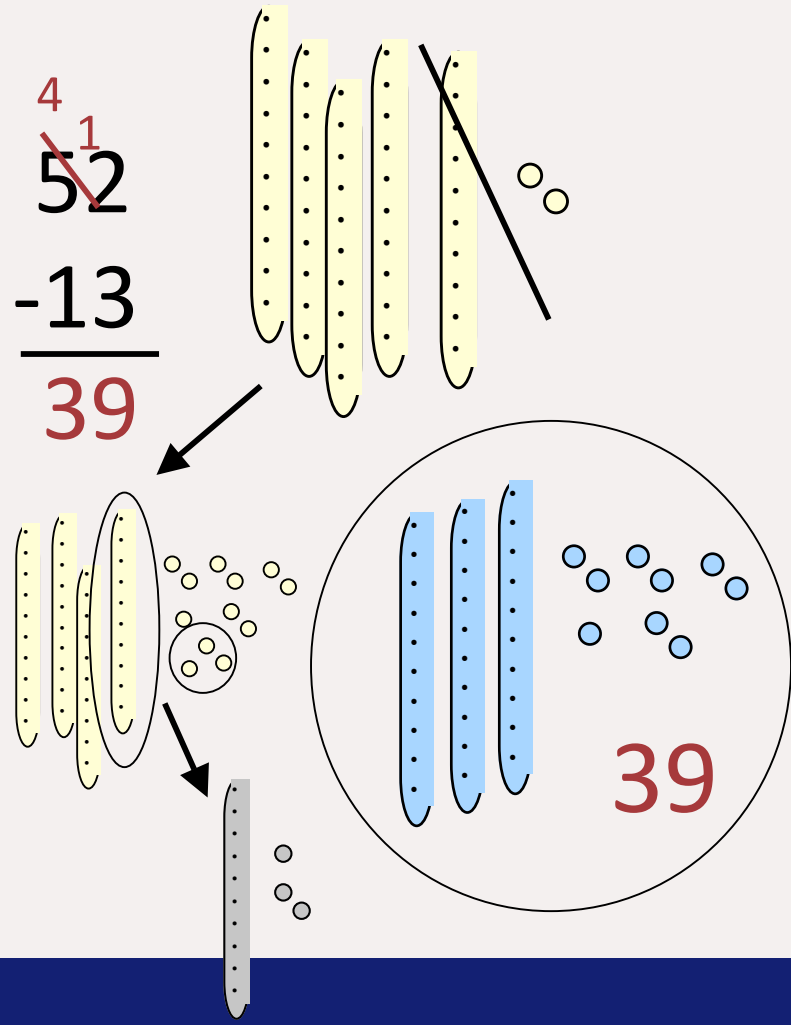
- Learning mathematics for teaching
- Developing skill and precision with modeling

#2: Rehearsing read-aloud

- Learning to talk about and read a book
- Practicing articulating and integrating different instructional goals

Using specialized content knowledge:
Modeling subtraction with base-ten materials

- Mapping closely between actions with the materials and the symbolic representation
- Showing that "borrowing" is actually regrouping, or "re-writing" a number
- Developing fine attention to details of doing the representing



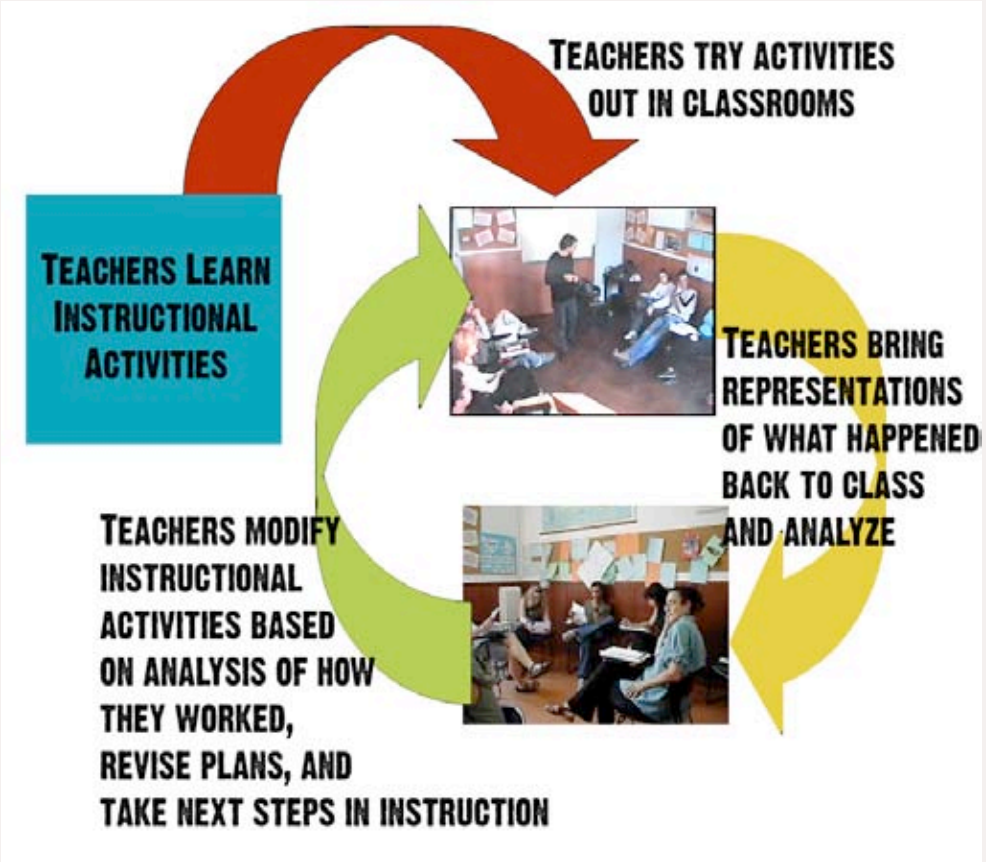
Performing instructional moves:
Rehearsing reading aloud

1. Word study:

   wind — wind

   (whined)

2. Setting up reading with specific guiding questions
3. Anticipating and providing directions
4. Using one's voice, writing on clipboard



(Lampert & Scott, 2007)

Cases of teaching practice

SIMILARITIES

1. Outside the classroom (but still "in practice")
2. Subject-matter focused
3. Real pieces of the work
4. Roles of other students

DIFFERENCES

1. Reading: whole chunk of the work
2. Math: isolated element
3. Role of teacher educator

4. Centering professional education in practice: What are the challenges —and the resources?

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Challenges of centering professional education in practice

1. Lack of an adequate knowledge base about teaching practice
   - Inadequate language (in English)
   - Difficulty parsing the work into basic elements
2. Problem of expertise and tacit knowledge
3. Widely held view of teaching as uncertain, artistic, and unable to be specified
   - Resistance to seeing teaching as high-precision work, requiring high levels of skill
   - View of detail as "prescriptive" and as de-skilling professional work

Resources for centering professional education in practice

- Our past history of microteaching and competency-based teacher education
  - Analyze similarities and differences
  - Integrate subject matter knowledge for teaching, skills, discretionary adaptation and judgment
- Progress made on content knowledge for teaching
- Other professions (Grossman)
  - Developing an agreed-upon curriculum of practice
  - Broadening idea of "clinical" and ways to structure and support it
  - Attention to relational work

In Praise of Prescriptiveness and Training in Professional Education

- We urgently need to improve all students' opportunities and learning.
- This requires skillful teaching.
- Teaching mathematics is intricate work, and not natural, and needs to be learned and, hence, taught.
- Seeing teaching as skilled, high-precision work, that is not a matter of personal style and preference, is to acknowledge its professional nature, not to repudiate its "creativity."
- We need a reliable system of preparing many ordinary people for expert practice.

Slides will be available
at Deborah Ball's website

(Google "Deborah Ball")

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