

Closing Remarks

Deborah Ball, University of Michigan

DB remarks that it was interesting to reflect on the three questions and that she noticed that at the conference we have focused much more on issues of the learning of algebra and less so on issues of teaching of algebra.

She wonders why teaching remains invisible in analysis and situates this concern within a larger theoretical concern about the current approach to the study of teaching. She notes that in English we lack language for talking precisely about teaching. She compares this situation with the Japanese language in which there are more refined words to describe teaching practice (segments of a sequence, very beginning problems, distinguishing problems, problems for practice, etc). In general, we lack the ability to discriminate things for which we don't have terms.

DB remarks that she uses the word "instruction" to approximate the word that would describe the fundamental transaction in teaching/learning interactions. (How one helps students to learn something and the interactions that make that happen). This lack of vocabulary is indicative of a lack of frameworks for observing and understanding the work of teaching. When you don't have a framework, you miss things that are right in front of you. She cites an example of a psychological study of people directed to pay attention to the dribbling technique of a basketball player completely missing and not noticing a huge gorilla who crosses the court at the same time.

So, one issue we need to attend to is grain size—at what scale should we be studying teaching. DB remarks that she hopes the National Math Panel report has put to rest the gross distinction between teacher centered and student centered classroom organization. She remarks that a lot of research on teaching is incredibly micro—perhaps too micro to be helpful (breaking down teaching into "moves"). There are disciplinary frameworks and perspectives that closely focus on the work of teaching. Unfortunately, to some extent teaching is not valued or understood. It tends to be seen as something easy that any educated adult could do.

Teaching as mathematical work: Inside teaching there are disciplinary questions and being able to do that work means you have to sense of the discipline.

- Using and analyzing representations, and mapping across different kinds of representations
- Defining terms and attending closely to language
- Lots of other things...

Teaching and learning of algebra (Teachers, student, content). DB characterized teaching as the black box of interactions among students, teachers, and content. [See slides for relevant figures].

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Cohen: “Teaching is a thoughtful human construction designed to improve learning.”
“Teaching practice is both deliberate and attentive.” “What defines teaching is that practicing teachers seek to connect their teaching to students’ learning.” DB remarks that
“Random talking in front of students is most extreme form of constructivism”

[See slides] Alternative optics on the learning of algebra:

(math)

(student-math) particular ways of thinking about math

(groups of students interacting around mathematics)

(teacher, student, mathematics) what does teacher do to help

other two aspects

In this conference, we focused more on the top three and we need to highlight more on the bottom three [see slide].

Some background on inter-relation and alignment between discipline and pedagogy:

- Knowledge and practice (1902): Logical and psychological structures of a subject. Experts in field argue about big ideas this may or may not aligned with psychological issues in learning about the big ideas.
- Bruner (1960) intellectual honesty—take any subject and teach it in an intellectually honest way. For example, How much do we hide about the number system? [reference to Hy Bass’ comment in the Thursday session]
- Schwab (1971) Substantive and syntactical disciplinary structure (nature of knowing). One needs to be careful about constructing pedagogies that are NOT aligned with the structures of the field. Need for proving or language/precision. We need to talk about content and epistemology of the field.
- Shulman (1986) When we think about teachers—thinking carefully about what teachers need to know about a field.

In fact, teachers have to understand the ideas more deeply or differently than mathematicians. Teaching is both mathematically “natural” and “unnatural”.

Teaching as mathematically “natural” work:

- Some aspects of teaching depend on mathematical habits of mind and practices
- So from this perspective, an additive view of learning to teach may make sense—add other knowledge to math knowledge and habits (a lot of policy in this country looks this way...) There are some pretty significant problems with this perspective.

But teaching mathematics also involves doing things that are mathematically unnatural:

Examples of math teaching as math unnaturally work:

- Unpacking math ideas
- Listening to math imprecise language use by learners

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- Not automatically affirming correct statements
- Hearing what others say, not what you think [not just explaining how you see things]
- Surfacing “errors” [need to find ways to provoke errors in order to understand where students might not understand]

Core problems of teaching math

- Managing the journey towards compressions [cf the discussion after the panel which Hy Bass and Ed Silver participated in]
- Keeping one eye on the math horizon (number system)...while avoiding what Ball termed “compression impatience.”
- Keeping an eye on the students and on the mathematics and recognizing opportunity moments for compression [showing the USE of new notations at opportune moments]
- Coming to understanding teaching and learning as a form of language work whose tools are definitions, representations, symbols and language

Example: an intricate look at teaching:

DB shares a video clip and asks the audience to consider “What would a teacher need to know in order to teach this segment?” In the clip, the teacher is modeling addition of negative and positive fractions [using area models] [Problem: $-4 \frac{2}{3} + 1 \frac{5}{6}$]

She uses red pies to represent negative numbers and green pies to represent positive numbers. What work of teaching might there to be done before the episode? What is there to see about the work of teaching?? [The participants watched the clip]

Some comments from the participants:

- Attention to the actual production of models—DB notes that in Japan, teachers make on charts before class. The production of drawing is a central part of work.
- Someone notes that every model is imperfect and commenting on it is actually a practice. One can draw attention to the particular ways a model is inaccurate rather than leaving this unsaid in the classroom.
- Performance with the model could take some practice to make the explanation focus more clearly on the instructional goals.
- Perhaps this wasn’t the best example to start with. The numbers were messy and detracted from the point of the lesson. Choosing a more appropriate task to start with in working with a model would be easier for both the teacher and the students. DB comments that the actual choice of numbers is a hugely skillful piece of work.
- Comment that in terms of Ball’s framework diagram, the teacher in the clip is having to concentrate more on the teacher-math arrow. Because of this, her ability to manage the other dimensions (teacher-students, student-content, etc) is compromised. Others also commented that when one teaches something new, they lose contact with the mathematics and need to manage this above other things.