PME XXIV, Athens, Georgia

What Do We Believe About Teacher Learning and How Can We Learn With and From Our Beliefs?

Deborah Loewenberg Ball
University of Michigan

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http://www-personal.umich.edu/~dball

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Opportunity and challenge: Combining action with inquiry

- Rising demand
- More and different resources

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Three premises about the contemporary context of mathematics teacher education

- Widespread interest, strong beliefs
- Pressures to claim that an approach "works"
- Weak warrants for knowledge claims

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Commonly-held and sometimes competing beliefs about mathematics teacher learning

- Pedagogy and curriculum of teacher education
- Structure of teachers' opportunities to learn
- Nature and scope of the mathematics that teachers need to know
- The role of curriculum materials in teachers' practice

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The pedagogy and curriculum of mathematics learning opportunities

- Should model the pedagogy to be used with students, *or*
- Teachers need to experience mathematics in the same ways as their students

Consider:

- What is "modeling"?
- Why – or when – might this idea make sense?
- Why – or when – might it not make sense?

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$$1\frac{3}{4} \div \frac{1}{2}$$

Calculate the answer.

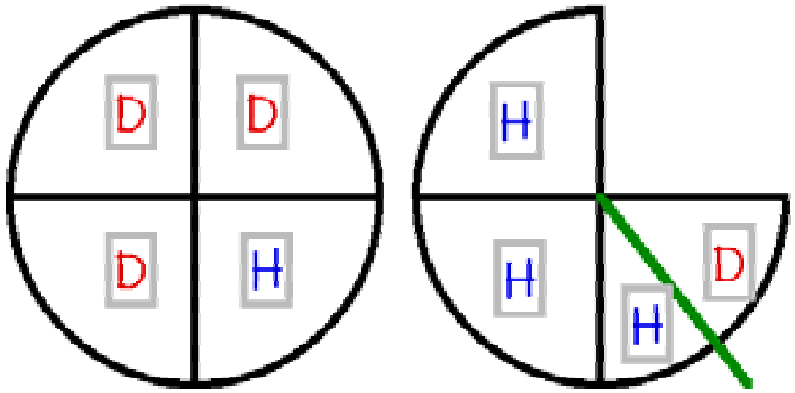
Write a story problem for the expression:

$$1\frac{3}{4} \div \frac{1}{2}$$

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Common adult approach

I had two pizzas . My roommate ate 1/4 of one of them, and then I had 1 3/4 pizzas left. I shared the remaining pizza with one of my friends. How much pizza did we each get?



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1. The pedagogy and curriculum of mathematics learning opportunities

- Should model the pedagogy to be used with students, *or*
- Teachers need to experience mathematics in the same ways as their students

Consider:

- What is "modeling"?
- Why – or when – might this idea make sense?
- Why – or when – might it not make sense?
- What would it take to learn from modeling?
- What are some of the risks?

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2. The structure of teachers' learning opportunities

- One-shot workshops are bad; long-term work is good, work with colleagues is good, lesson study is good.

Consider:

- How does the curriculum of teachers' learning opportunities interact with the structure?
- What structures are important –– time, social, knowledge –– and how do they interact with what is being learned?

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3. The nature and scope of the mathematics that teachers need to know

- Teachers need to understand in depth the content they teach.
- Teachers need to know mathematics beyond what they will teach.

Consider:

- What are the mathematical tasks central to teaching?
- What are the mathematical issues with which teachers contend?
- How do students and contexts shape the mathematical work of teaching?
- How might the issues differ across mathematical domains or practices?
- How different or the same are the answers at the elementary, middle, and secondary levels?

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Subtraction

$$\begin{array}{r} 1002 \\ -\ \ 493 \\ \hline \end{array}$$

$$\begin{array}{r} {\scriptstyle 0}\ {\scriptstyle 9}\ {\scriptstyle 9}\ {\scriptstyle 12} \\ 1\not{0}\not{0}\not{2} \\ -\ \ 493 \\ \hline 509 \end{array}$$

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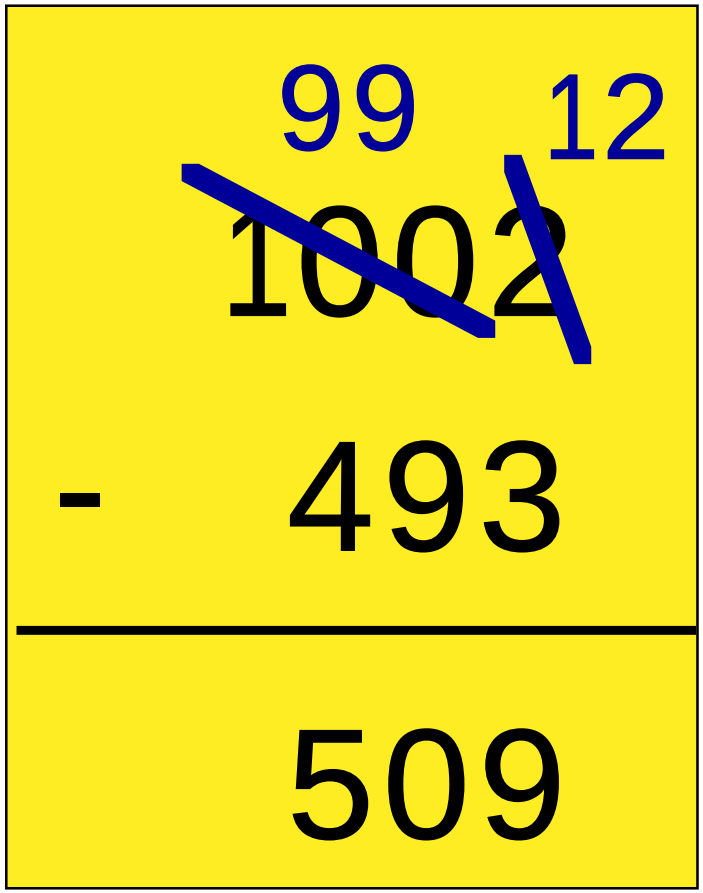
Subtracting “across zeroes”

$$\begin{array}{r} 1002 \\ -\ \ 493 \\ \hline 509 \end{array}$$

$$\begin{array}{r} {\scriptstyle 0\ 9\ 9\ 12} \\ 1\cancel{0}\cancel{0}\cancel{2} \\ -\ \ 493 \\ \hline 509 \end{array}$$

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A student proposes a different way:



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How should the teacher respond?

What mathematical questions must the teacher consider in order to decide what to do?

Make these questions explicit.

Answer them.

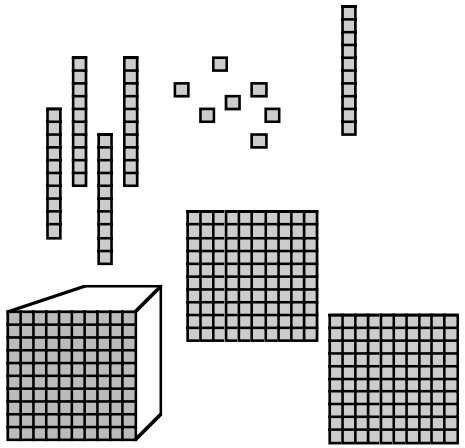
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Modeling subtraction: Building correspondences between objects, numbers, operations, and algorithms

Use base ten blocks to show how any of the methods for

$$\begin{array}{r} 1002 \\ -\ 493 \\ \hline \end{array}$$

work.



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Using contexts for

$$\begin{array}{r} 1002 \\ -\ 493 \\ \hline \end{array}$$

- Sensitivity to and familiarity with students' **experience**
- Concern for mathematical **integrity**
- Attention to possible **distortion** or distraction
- Cultivation and care for **interest**

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Making connections and anticipating the mathematical horizons

Examples

- Place value structure and the power of algorithms
- Renaming and rewriting numbers
- Developing more efficient methods
- Considering generalizability
- Examining equivalences across methods

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Conclusion:
What mathematical knowledge is needed for teaching subtraction?

$$\begin{array}{r} 1002 \\ -\ \ 493 \\ \hline \end{array}$$

$$\begin{array}{r} {\scriptstyle 0}\ {\scriptstyle 9}\ {\scriptstyle 9}\ {\scriptstyle 12} \\ 1\cancel{0}\cancel{0}\cancel{2} \\ -\ \ 493 \\ \hline 509 \end{array}$$

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4. The role of curriculum materials in teachers' practice

- Good teachers make their own problems, task, don't follow textbooks. Teachers' guides "de-skill" and "de-professionalize" teaching.
- Textbooks provide teachers with structure, sequencing, ideas, guidance, tools.

Consider:

- How do teachers use textbooks and teachers' guides?
- What does it mean to use materials and tools professionally?
- Is there a difference between "prescriptive" and "elaborated"?
- How do (or can) teachers learn from curriculum materials?
- How does this differ by teachers' experience, knowledge, or by mathematical topic, or by level?

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Using and challenging our beliefs to create better knowledge

- Subjecting our beliefs to examination and test
- Unpacking favorite (and not favored) ideas
- Considering different teachers and contexts, different content and levels
- Investing more in explicit design, so that we can compare alternatives with more precision
- Developing methods and tools to gather valid evidence
- Engaging in more public exchange based on evidence

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