



Supporting High-Quality Mathematics Teaching

Deborah Loewenberg Ball

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SCHOOL OF EDUCATION UNIVERSITY OF MICHIGAN

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Main argument

We need a system that can reliably equip "regular" people for effective professional practice in teaching.

- Doing that requires:
  - Focusing on the *work of teaching*;
  - Zooming in developmentally on the highest-leverage practices;
  - Emphasizing the *performance of teaching* in the curriculum and in assessments.

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Overview

1. The view from 20,000 feet
2. What is skillful teaching?
3. What is broken with our system of getting high-quality teaching for all students?
4. What does it take to get skillful teaching in every classroom?
5. Concluding thoughts

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1. The view from 20,000 feet

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The urgency

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



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Teachers matter––a lot

- Differences in teachers account for 12%-14% of total variability in children's mathematical achievement in each of grades 1, 2, and 3.
- Children assigned to three effective teachers in a row score at the 83rd percentile in math at the end of 5th grade; children assigned to three ineffective teachers in a row score only at the 29th percentile.
- The cumulative effects of being taught by a highly effective teacher can substantially reduce differences in student achievement that are due to family background.

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And yet…

- We have no reliable system of training teachers in this country

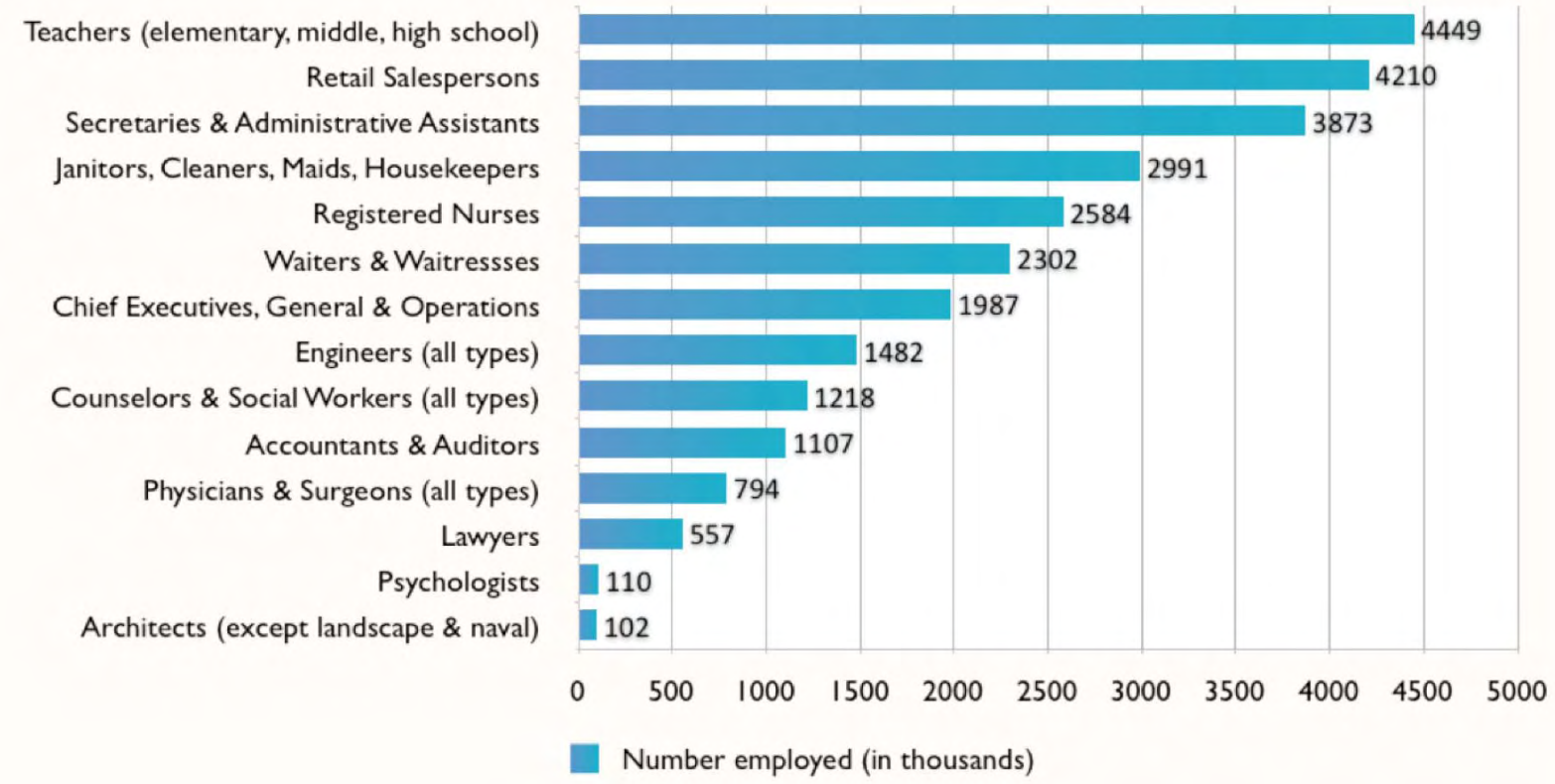
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Why the problem is one of professional training

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

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Number of Employed Persons by Occupation (2009)



Source: Bureau of Labor Statistics, May 2009.
(Included here are just the occupations for which the Bureau of Labor maintains the employment statistics.)

- Total number of employed persons: 130,647,610
- Teachers (elementary, middle, high school) are the largest employment group of those on the 2009 Bureau of Labor report.

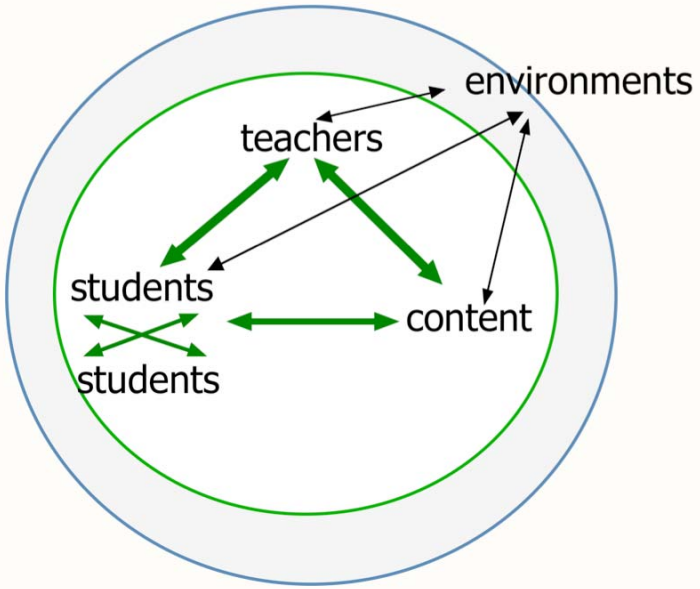
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2. What is skillful teaching?

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From “teachers” to “teaching”

- Teaching is what is co-produced by students and teachers in contexts, around specific content and curriculum
- Teachers are the ones uniquely responsible for increasing the probability that students learn important content and skills, and gain at least a school year’s worth each school year



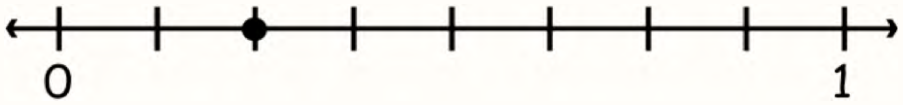
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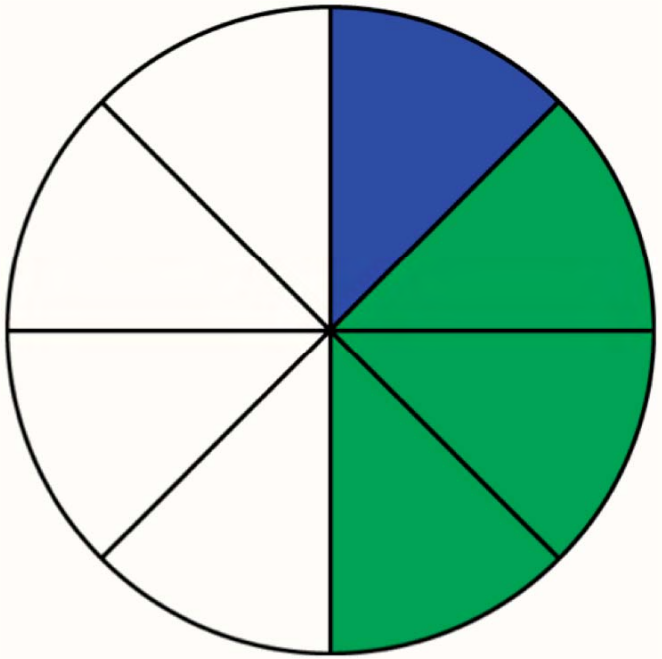
Let's land on the ground . . .

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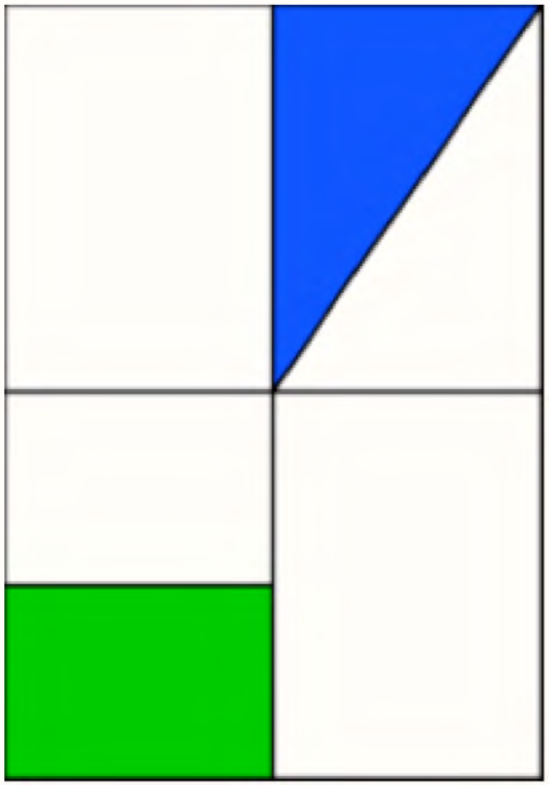
How are fractions typically taught at the upper elementary level?

What difficulties do students frequently have?





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What fraction of the big rectangle is shaded blue?

What fraction of the big rectangle is shaded green?

What fraction of the big rectangle is shaded altogether?

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Context for videoclip

- Intensive summer "turnaround" program for struggling upper elementary students (math)
- Laboratory for professionals' learning and research on "turnaround" instruction
- Focus on integrating concerns for equity with attention to the content

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Teaching as intricate and deliberate work

1. "Off camera": Before this episode
2. During these 5 minutes

What are some specific tasks required in order to teach this segment?

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View videoclip

http://hdl.handle.net/2027.42/78024

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Teaching as intricate and deliberate work

"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: Why that diagram? Why that wording? Why the three specific questions?

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During these 5 minutes

00:00—Open the discussion: encourage participation by more students; establish expectation for explanation; use wait time; choose whom to call on; call on that child.

00:26—Mamadou gives answer of ½. Ask Mamadou to explain his reasoning; make sure other students can hear and are listening; interpret Mamadou's explanation; recognize relationship to key mathematical idea; determine how to respond (whether to take up, whether to clarify question, whether to call on different student).

00:47—Ask Mamadou to come to the board and explain using the diagram. Orient class toward Mamadou's explanation: get student to repeat what Mamadou said without explaining the error; comment about listening carefully; focus students on understanding reasoning.

01:37—Mamadou uses diagram to explain his answer. Invoke the working definition of fractions: ask Mamadou what he is calling the whole, how many equal parts, and how many are shaded.

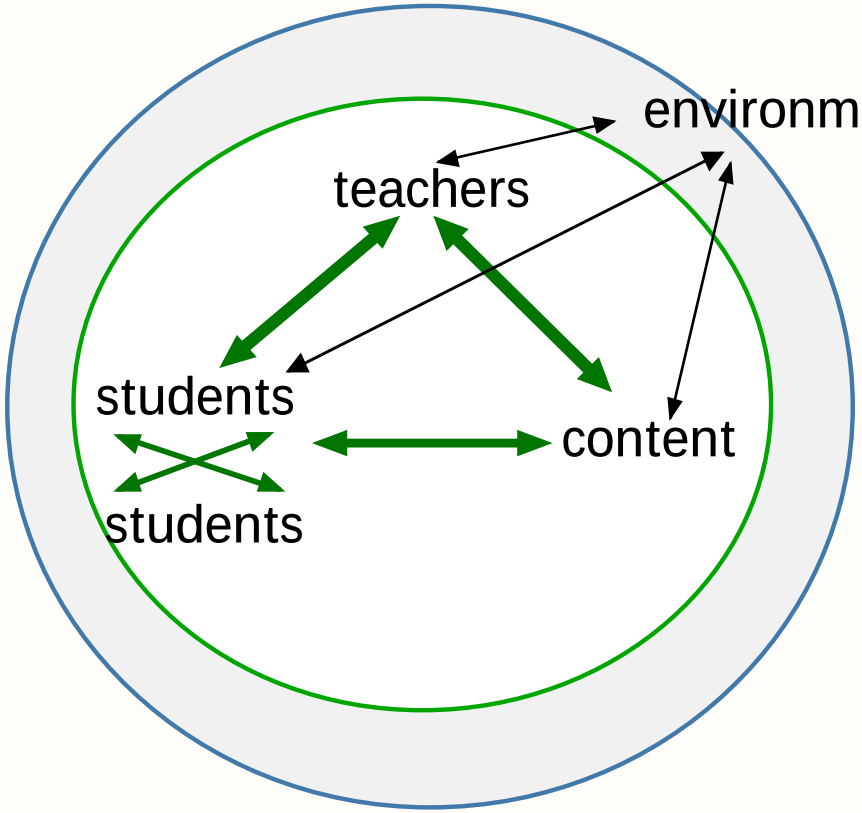
02:26—Check class' understanding and manage risk of losing rest of class: call on student to explain Mamadou's solution; trace whole on diagram; establish correctness of Mamadou's answer given his selection of the whole.

03:00—Clarify the whole in the original question. Validate Mamadou's work, while establishing that the problem is asking something different. Ask student to read question and show on the diagram what is meant by "big rectangle"; ask Mamadou if he is watching; restate question and trace whole on a new copy of diagram.

04:06—Ask Mamadou to explain the difference between this question and the one he answered. Decide how to handle language "whole square" and "half the rectangle." Elicit answer to original question.

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Teaching as unnatural, intricate, and deliberate work



- Instruction as the "black box" of interactions among students, teachers, content, technology and materials
- Requires lots of complex coordination

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

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3. What is broken with our system of getting high-quality teaching for all students?

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We lack a reliable system to support high-quality teaching

- A curriculum off-center, emphasizing knowledge and beliefs rather than practice
- Inadequate and inappropriate subject matter preparation
- Inadequate support for diversity of U.S. classrooms
- Assessments that do not appraise professional effectiveness

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Standards for medical practice

e.g., Conduct a chest examination:

- Observe respiratory efforts and note presence/ absence of respiratory distress
- Confirm midline tracheal position with gentle palpation anteriorally
- Percuss the chest on left and right
- Ascultate the chest using using the diaphragm of the stethoscope on both right and left sides

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Standards for flying a plane

- e.g.,
- Conducting a preflight inspection
- Normal and cross-wind approach and landing
- Straight turns and climbing turns
- Effective visual scanning
- Runway incursion avoidance
- Crossed control stalls
- S-turns across a road

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No equivalent in teaching

- We lack similarly precise, professionally-determined and agreed-upon learning objectives
- Huge faith in and reliance on "having experience"
- Performance expectations underspecified and weakly assessed – this leaves the profession vulnerable

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No reliable *system* for preparing and developing teachers in the U.S.

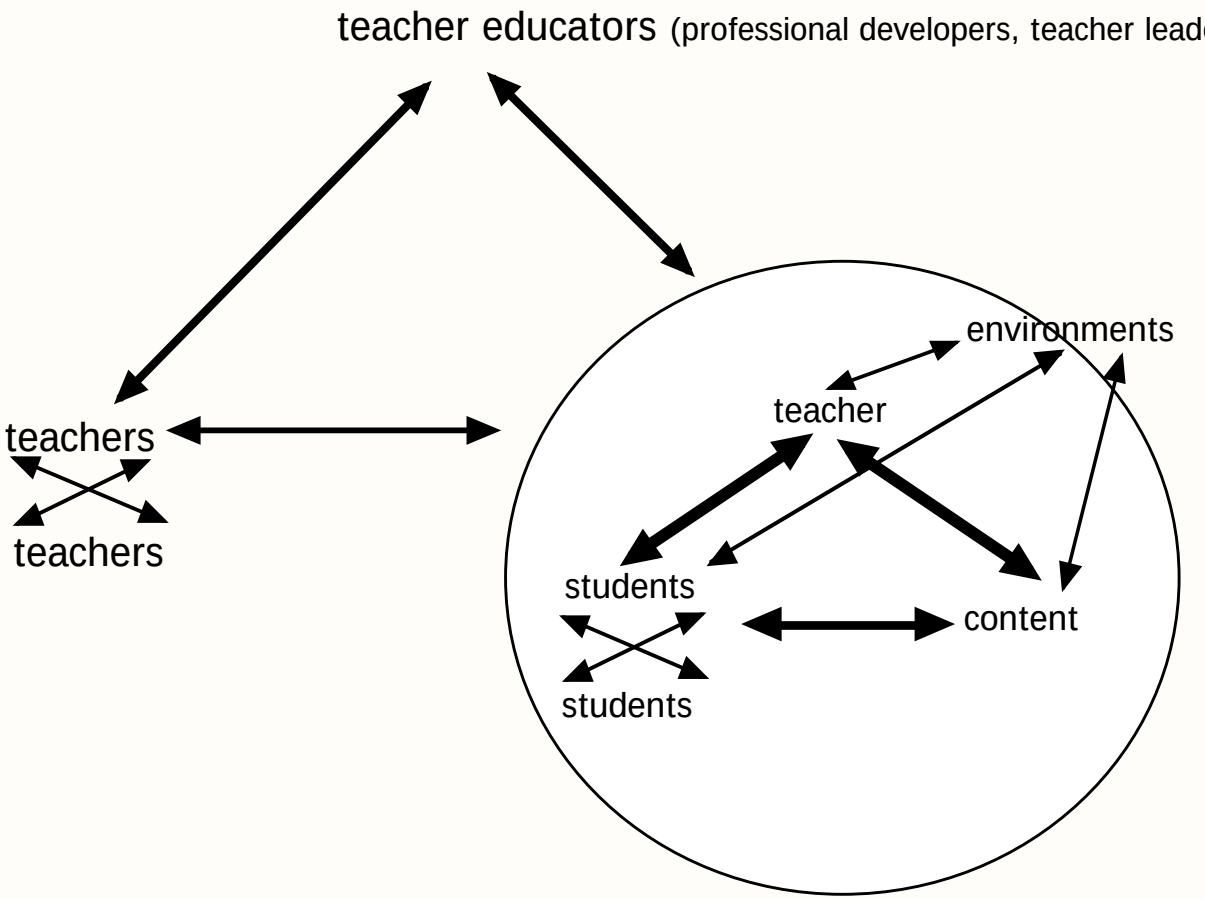
- No common curriculum for teacher training — specific, professionally-agreed upon learning objectives for new or practicing teachers
- Over 2,000 independent providers of initial teacher training, uncountable professional development providers
- No common standard of performance for independent practice with (on) young people
- Teachers report doing most of their learning on the job

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4. Teaching practice: Essential to getting skillful teaching in every classroom

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Teaching practice as the content of teacher education



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Teaching involves special kinds of mathematical work

1. Solving special kinds of mathematical problems
2. Engaging in specialized mathematical reasoning
3. Using mathematical language precisely but accessibly

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Choosing pedagogically-strategic examples

Which of the following lists would be best for assessing whether your students understand decimal ordering? Justify your choice.

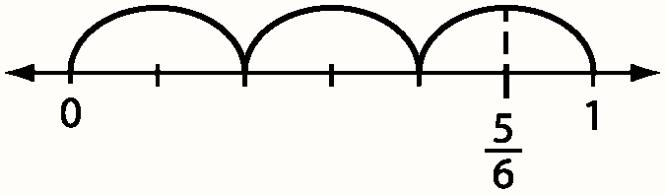
A.	**.5**	**7**	**.01**	**11.4**
B.	**.60**	**2.53**	**3.12**	**.45**
C.	**.6**	**4.25**	**.565**	**2.5**

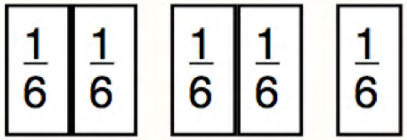
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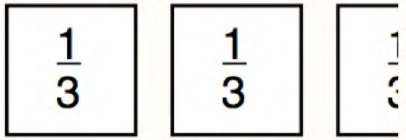
Analyzing –– and "talking" –– representations

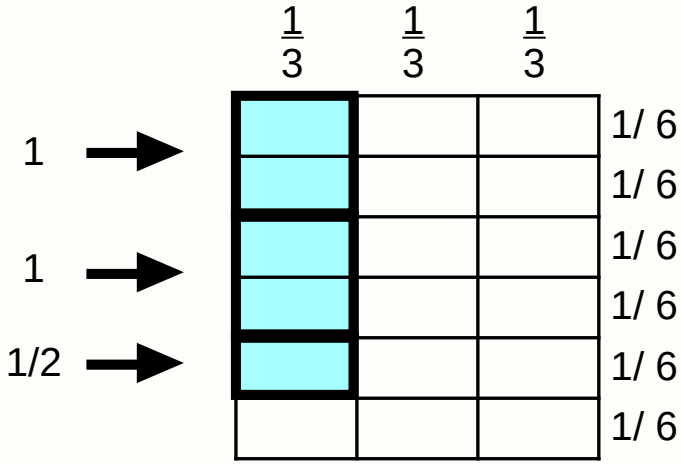
Which of these can be used to represent $\frac{5}{6} \div \frac{1}{3}$?

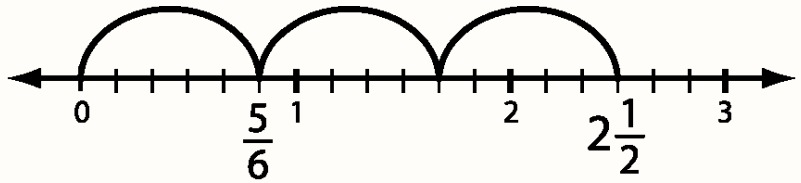
Explain with reference to all parts of the expression.











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Analyzing errors

What mathematical steps could have produced this answer?

(a)

$$\begin{array}{r} 49 \\ \times\ 25 \\ \hline 405 \\ 108 \\ \hline 1485 \end{array}$$

(b)

$$\begin{array}{r} 49 \\ \times\ 25 \\ \hline 225 \\ 100 \\ \hline 325 \end{array}$$

(c)

$$\begin{array}{r} 49 \\ \times\ 25 \\ \hline 1250 \\ 25 \\ \hline 1275 \end{array}$$

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Analyzing non-standard (but correct) responses

Which student is using a method that could be used to multiply any two whole numbers?

Student A	Student B	Student C
35 x25 125 +75 875	35 x25 175 +700 875	35 x25 25 150 100 +600 875

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Context for the videoclip

- Intern teacher in a one-year training program
- Teacher educator and interns rehearsing and closely preparing before practicing with students:
  - Learning to talk about and read a book
  - Practicing articulating and integrating different instructional goals

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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



See Lampert, M. & Graziani, F. (2009). Instructional activities as a tool for teachers' and teacher educators' learning in and for ambitious practice. Elementary School Journal, 109 (5), pp. 491-509.

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Teaching practice

1. Outside the classroom (but still “in practice”)
2. Real pieces of the work
3. Roles of colleagues and of the teacher developer
4. Subject-matter focused

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CONCLUDING THOUGHTS

What are the challenges ––and the resources –– for making teacher development more detailed and more centered in and on practice?

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Challenges of centering teacher education on 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
4. Lack of people prepared to teach practice
   - Unspecified professional group, with no preparation for the work
5. No common K-12 curriculum in the U.S. and lack of agreement about what to make core

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Resources for centering teacher 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

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Summary, and the mission

- We urgently need to improve all students' opportunities and learning.
- This requires skillful teaching.
- Teaching 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 supporting many ordinary people to carry out expert practice.

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THANK YOU!

Slides will be available
at Deborah Ball's website

(Google "Deborah Ball")

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Credits



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