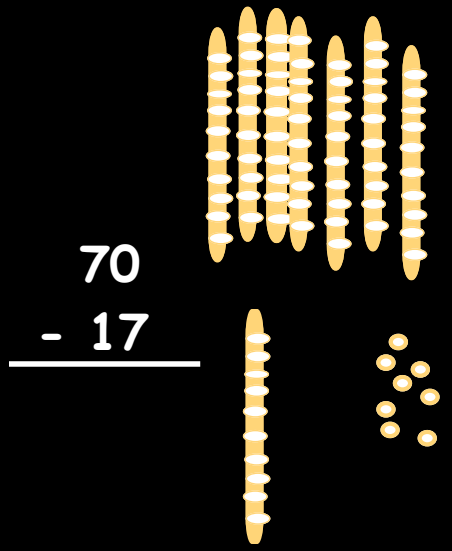




What Are Teachers Learning?

Deborah Loewenberg Ball

University of Michigan

Center for Proficiency in Teaching Mathematics

Learning Mathematics for Teaching Project

Mathematics Teaching and Learning to Teach Project

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

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Overview of Today's Session

1. Framing the problem: The current context and our challenge
2. A field trip inside of practice: What is the work and what is there for teachers to learn?
3. Alternative perspectives on teachers' learning

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

New Possibilities and Challenges for Teacher Education and Professional Development

- Greater emphasis on learning opportunities for teachers
- Better insight into the demands of quality teaching
- Increased expectations for evidence of teachers' learning
- New standards for what counts as evidence

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

What is "Evidence" of Teachers' Learning? Some Examples

DOCUMENTATION OF:

- Teachers' engagement in work on instructional improvement
- Changes in teachers' knowledge and skill related to instructional effectiveness
- Development in teachers' effectiveness in areas of critical need in mathematics teaching

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

A Brief Field Trip to Practice

- What are elements of instruction to work on?
- What does effective teaching demand?
- What are critical needs in mathematics instruction?

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

The Work of Mathematics Instruction

- Before class:
  - Designing
  - Anticipating
  - Preparing alternatives
- During class
  - Listening and interpreting
  - Using students' productions
  - Adapting design
  - Gathering evidence of students' learning
- After class
  - Analyzing evidence, assessing student learning
  - Considering instructional decisions and moves
  - Revising and extending design
- Communicating with students' out-of-school environments
  - Out-of-class assignments
  - Letters or phone calls

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Site for Field Trip: A Few Minutes in Third Grade

- Mid-May, middle of work on fractions
- Discussion of: "Which is more -- 4/4 or 4/8?"
- Students from many different cultural and linguistic backgrounds
- Emphasis on mathematical reasoning, care with language and representation, respect for others' ideas, productive use of error

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission



Ball: Would somebody like to talk about um what they think about this--which is more? Four-fourths or four-eighths?

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

A Brief Field Trip to Practice

- What are elements of instruction on which teachers must work?
- What does effective teaching demand?
- What are critical needs in mathematics instruction?

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

What Considerations Might Be Important in Analyzing Students' Contributions?

- Lin: explains why 4/4 is greater than 4/8
- David: discusses how to decide how many lines to draw when making a representation of a particular fraction
- Bernadette: wants to show it using the number line
- Kevin: "First I did something different and I was wrong"

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

The Work of Mathematics Instruction

- Before class:
  - Designing
  - Anticipating
  - Preparing alternatives
- During class
  - Listening and interpreting
  - Using students' productions
  - Adapting design
  - Gathering evidence of students' learning
- After class
  - Analyzing evidence, assessing student learning
  - Considering instructional decisions and moves
  - Revising and extending design
- Communicating with students' out-of-school environments
  - Out-of-class assignments
  - Letters or phone calls

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

The Work of Mathematics Instruction

- Before class:
  - Designing
  - Anticipating
  - Preparing alternatives
- During class
  - Listening and interpreting
  - Using students' productions
  - Adapting design
  - Gathering evidence of students' learning
- After class
  - Analyzing evidence, assessing student learning
  - Considering instructional decisions and moves
  - Revising and extending design
- Communicating with students' out-of-school environments
  - Out-of-class assignments
  - Letters or phone calls

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

The Work of Mathematics Instruction

- Before class:
  - Designing
  - Anticipating
  - Preparing alternatives
- During class
  - Listening and interpreting
  - Using students' productions
  - Adapting design
  - Gathering evidence of students' learning
- After class
  - Analyzing evidence, assessing student learning
  - Considering instructional decisions and moves
  - Revising and extending design
- Communicating with students' out-of-school environments
  - Out-of-class assignments
  - Letters or phone calls

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

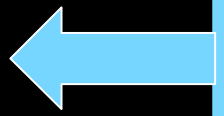
The Work of Mathematics Instruction

- Before class:
  - Designing
  - Anticipating
  - Preparing alternatives
- During class
  - Listening and interpreting
  - Using students' productions
  - Adapting design
  - Gathering evidence of students' learning
- After class
  - Analyzing evidence, assessing student learning
  - Considering instructional decisions and moves
  - Revising and extending design
- Communicating with students' out-of-school environments
  - Out-of-class assignments
  - Letters or phone calls

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Mathematical Knowledge for Teaching (MKT)

- Before class:
  - Designing
  - Anticipating
  - Preparing alternatives
- During class
  - Listening and interpreting
  - Using students' productions
  - Adapting design
  - Gathering evidence of students' learning
- After class
  - Analyzing evidence, assessing student learning
  - Considering instructional decisions and moves
  - Revising and extending design
- Communicating with students' out-of-school environments
  - Out-of-class assignments
  - Letters or phone calls



- common content knowledge (CCK)
- specialized content knowledge (SCK)
- knowledge of students and content (KSC)
- knowledge of content and teaching (KCT)

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Comparing Fractions

Common Content Knowledge (CCK)

Designing, Assessing Students' Learning

OPEN-ENDED

Put the following fractions in order and explain your ordering.

7/8 2/3 4/7 19/20
7/5 0/11 19/11

MULTIPLE CHOICE

Which of the following fraction pairs is ordered with the smallest fraction first?

a) 3/5 3/4

b) 6/11 2/5

c) 3/2 3/4

d) They are all in order with the smaller fraction first.,

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Representations for Comparing 4/4 and 4/8

Knowledge of Mathematics and Teaching (CKT)

Designing for Instruction

OPEN-ENDED

Evaluate two different representations for comparing fractions, and explain what each affords and what each might limit in terms of students' learning.

MULTIPLE-CHOICE

Which of the following available representations is best for helping third graders begin to learn to compare fractions?

a) Fraction bars

b) Pictures of pizzas

c) Students' own drawings

d) Colored linking cubes

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Numerical Examples for Comparing Fractions

Specialized Knowledge of Content (SCK)
Knowledge of Students and Content (KSC)
Designing, Responding to Students

OPEN-ENDED

What would be a strategic fraction pair to pose next? Explain what makes it strategic in light of the content and the students.

What would be a less good choice and why?

MULTIPLE CHOICE

Which of the following would be a strategic fraction pair to pose next to these students?

a) 2/2 and 2/4

b) 4/4 and 5/5

c) 2/5 and 2/8

d) Any of these would be equally good to pose next.

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Explaining What is Difficult About Comparing Fractions

Specialized Content Knowledge (SCK)

Knowledge of Content and Students (KSC)

Communicating with Students' Other Adults

OPEN-ENDED

Write one paragraph to include in a class newsletter. Explain why comparing fractions is more difficult than comparing whole numbers. Illustrate with a strategic example.

MULTIPLE CHOICE

Which of the following is the most important reason why comparing fractions is difficult for students?

a) There are so many different fractions for students to learn to interpret.

b) Students' habits from comparing whole numbers sometimes interfere.

c) There are so many different representations for fractions.

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

What Are Teachers Learning? Gathering Evidence

1. Connect to the work of instruction
2. Attend to mathematical knowledge for teaching
3. Multiple types of evidence
4. Develop different item formats of high quality
5. Collaborate with experts
6. Use for improvement of teachers' opportunities to learn
7. Build better links to instruction and student learning

© 2004 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission