

Enacting High Expectations of All Students in Practice: What is Involved?

Deborah Loewenberg Ball

School of Education, University of Michigan, Ann Arbor, MI

Utah Council of Teachers of Mathematics Annual Meeting • Orem, Utah

October 9, 2009

SCHOOL OF EDUCATION UNIVERSITY OF MICHIGAN

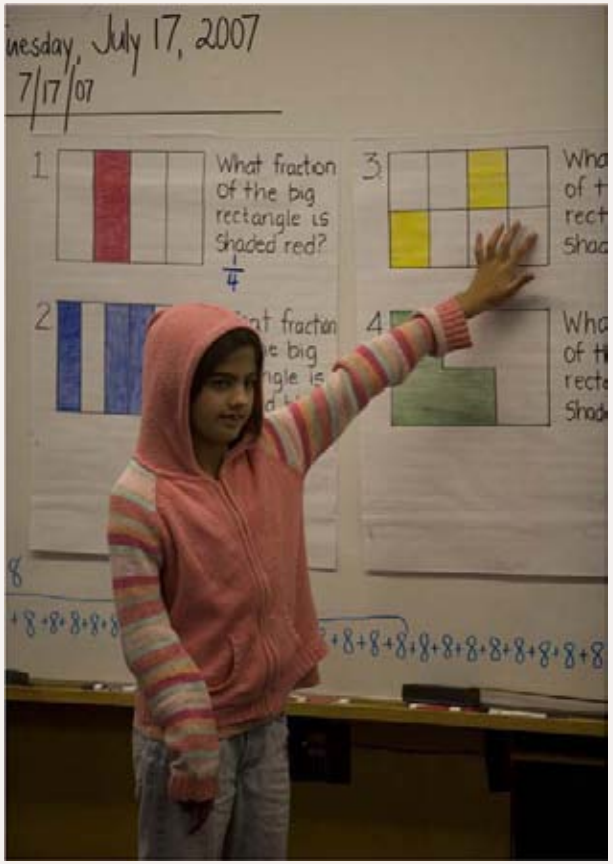
© 2009 Mathematics Teaching and Learning to Teach

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

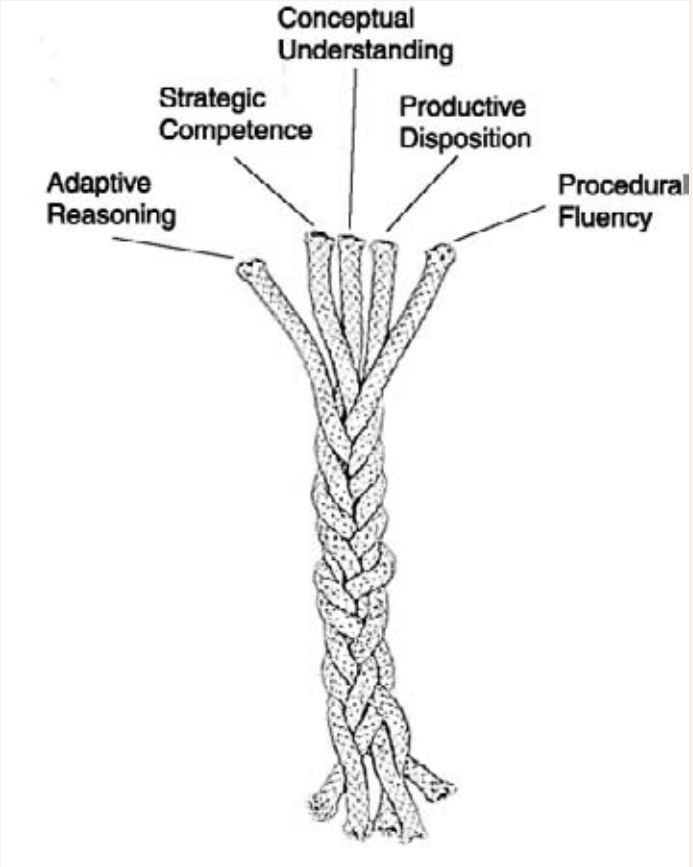
The urgency

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



© 2009 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

Strands of mathematical proficiency



- ***Conceptual understanding*** - comprehension of mathematical concepts, operations, and relations
- ***Procedural fluency*** - skill in carrying out procedures flexibly, accurately, efficiently, and appropriately
- ***Strategic competence*** - ability to formulate, represent, and solve mathematical problems
- ***Adaptive reasoning*** - capacity for logical thought, reflection, explanation, and justification
- ***Productive disposition*** - habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy

Kilpatrick, J., J. Swafford, and B. Findell. (2001). *Adding It Up: How Children Learn Mathematics*. Washington, DC: National Academy Press.

© 2009 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

Key practices of teaching to enable mathematics achievement

1. Expecting and enabling complex mathematical work of each student
2. Coordinating mathematical, school, and students' language
3. Using contexts with sensitivity to students' funds of knowledge and to the integrity of the mathematics
4. Creating a respectful mathematically-focused learning environment

© 2009 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

Key practices of teaching to enable mathematics achievement

1. Expecting and enabling complex math[illegible] work of each student
2. Coordinating [illegible]ts' lang[illegible]
3. Usin[illegible] students' funds of knov[illegible] integrity of the mathematics
4. Creat[illegible] a respectful mathematically-focused learning environment

Expecting and enabling complex mathematical work of each student,

© 2009 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

Enacting high expectations in mathematics instruction

1. Broaden what it means to be successful in math class
2. Make mathematical practices explicit
3. Support students' mathematical work both publicly and privately
   - Listen carefully to students' talk
   - Notice and improve ambiguous talk
   - Ask mathematical questions
4. Teaching students to be "people who study mathematics"

© 2009 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

Enacting high expectations in mathematics instruction

1. Broaden what it means to be successful in math class
2. Make mathematical practices explicit
3. Support students' mathematical work both publicly and privately
4. Teaching students to be "people who study mathematics"

What is the work of teaching?

1. ENACTING HIGH EXPECTATIONS IN CLASS
2. SCAFFOLDING STUDENTS' EXPECTATIONS AND STANDARDS
3. USING MATHEMATICAL TASKS

© 2009 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

1. Enacting high expectations in class

What is the work of teaching?

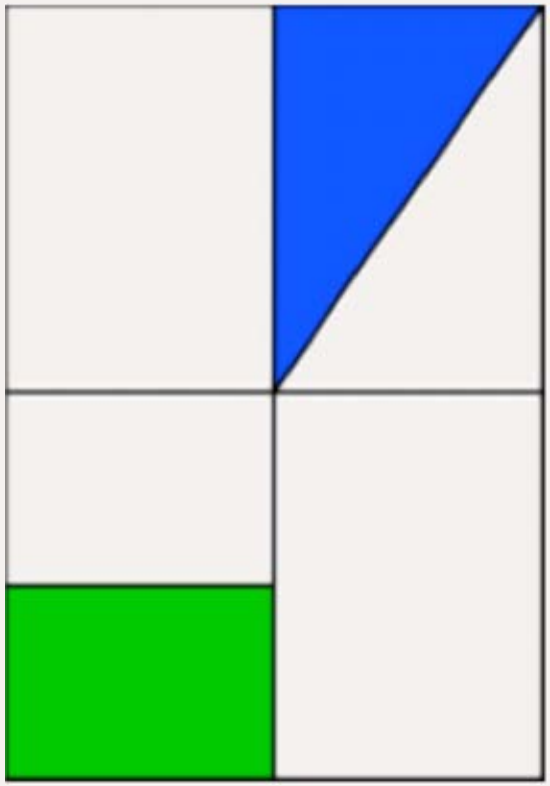
© 2009 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission

Video clip

- Day 7, discussion of warm up problem
- Focused attention on equal parts
- Developing working ideas about fractions
  1. Identify the whole
  2. Make equal parts
  3. Count how many equal parts out of the whole

© 2009 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

Setting up the problem



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?

© 2009 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

Viewing focus

Where are opportunities taken or missed to:

1. Broaden what it means to be successful in math class
2. Use tasks and problems that encourage complex work
3. Make mathematical practices explicit
4. Support students' mathematical work both publicly and privately
5. Teach students to be "people who study mathematics"

© 2009 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



© 2009 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

Viewing focus

Where are opportunities taken or missed to:

1. Broaden what it means to be successful in math class
2. Use tasks and problems that encourage complex work
3. Make mathematical practices explicit
4. Support students' mathematical work both publicly and privately
5. Teach students to be "people who study mathematics"

© 2009 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 teaching in this clip

EXPECTING COMPLEX MATHEMATICAL WORK

1. Selecting tasks
2. Listening to and interpreting students' responses (Mamadou)
3. Relentless press on classroom mathematical practices
4. Supporting error as a fruitful site for mathematical work

© 2009 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

2. Scaffolding students' expectations and standards

What is the work of teaching?

© 2009 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

Student contract

Student Contract

I understand that my ability to succeed in the Elementary Mathematics Laboratory class depends on my commitments and effort this summer. The following are the commitments asked of me to participate in the special class:

1. I will attend class every day.
2. I will keep neat detailed records of my mathematical thinking in my math notebook.
3. I will complete my homework carefully each night.
4. I will seek help or advice from my teacher or parents/caregivers if I have questions or concerns.
5. I will give my best effort to all the work I complete for this class.

I have read, understand and will follow through with the statements in this contract to the best of my ability.

Print student's full name: _____

Student signature:_____
Date:_____

© 2009 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

Teacher contract with

Student's name

I understand that your ability to succeed in the Elementary Mathematics Laboratory class depends on my commitments and effort this summer. The following are the commitments I make to you as your teacher in this special class:

1. I will attend our class every day.
2. I will come to class prepared to teach interesting and appropriate material to you.
3. I will expect you to do your very best work all the time and I will help you learn to do so.
4. I will make sure that you understand the mathematics and problems we work on.
5. I will answer any questions or concerns that you may have about this class or our work.
6. I will keep careful records of my mathematical thinking and ideas.

I have read, understand and will follow through with the statements in this contract to the best of my ability.

Print teacher's full name: _____

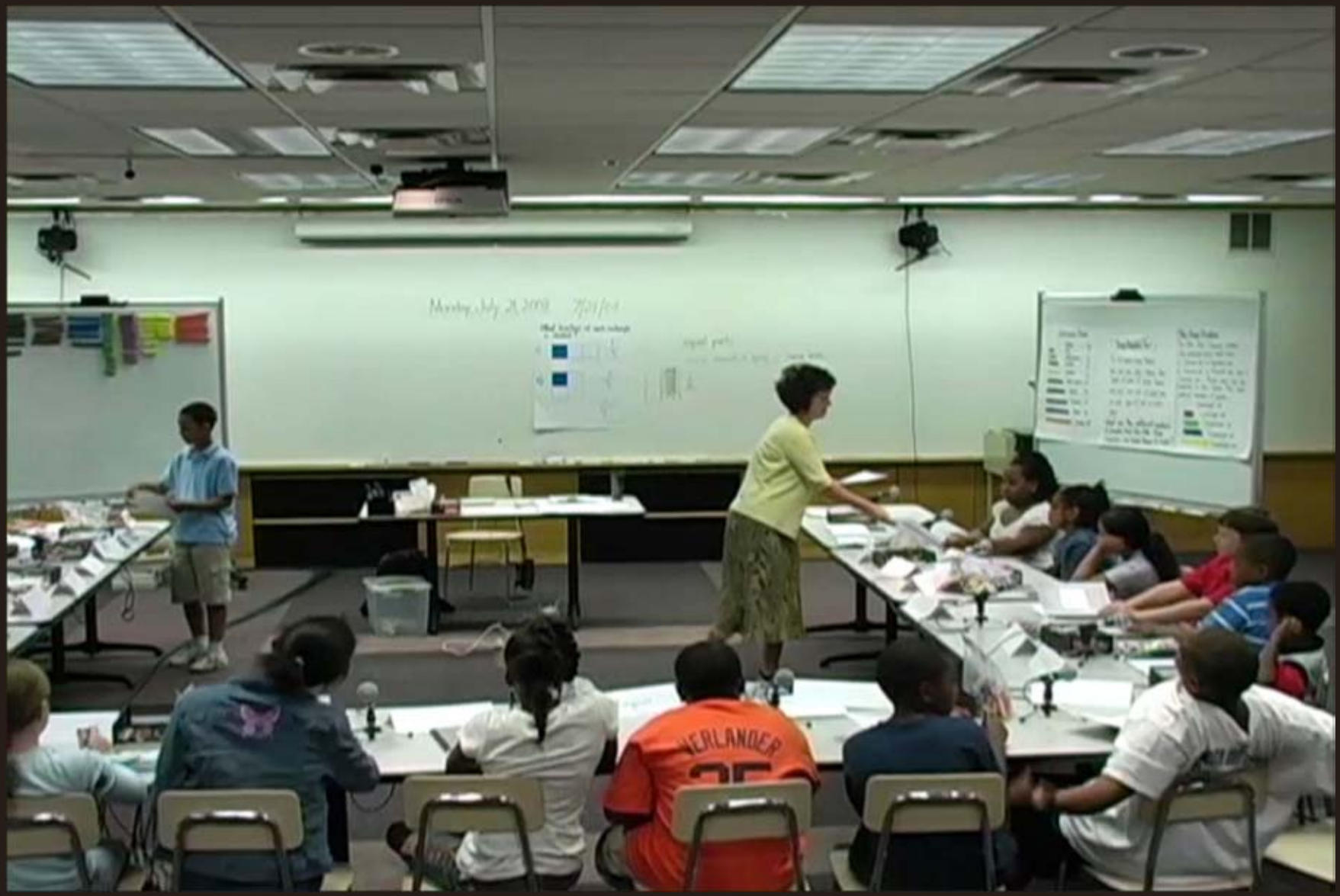
Teacher's signature:_____ Date:_____

© 2009 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

Viewing focus

- What is the teacher doing to expect **complex mathematical work** from students?
- How are high expectations being **communicated** to students?
- Where are **missed opportunities** to communicate such expectations?

© 2009 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



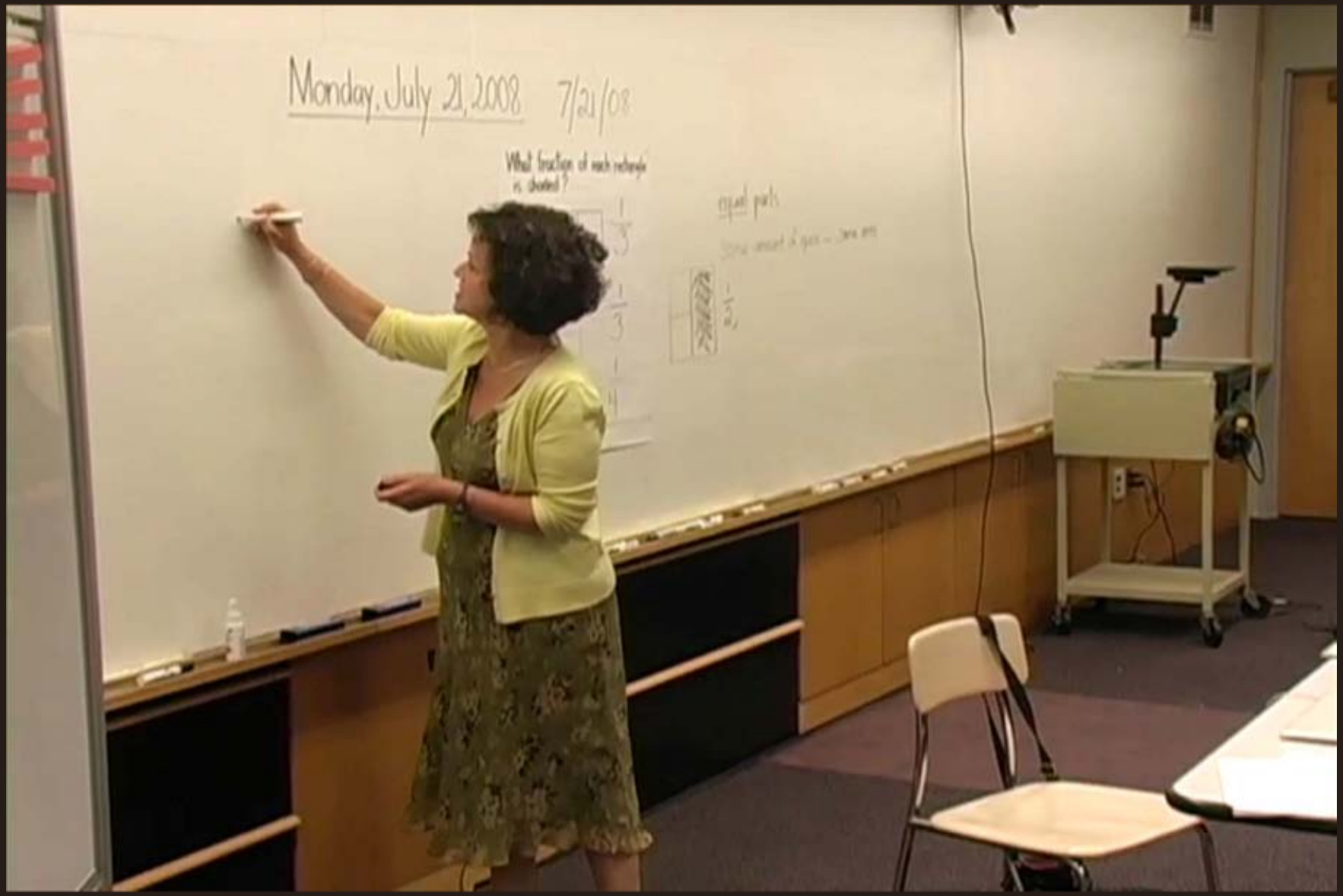
© 2009 Mathematics Teaching and Learning to Teach
School of Education • University of Michigan • Ann Arbor, MI 48109-1259 • (734) 615-7235 • mtlt@umich.edu
Please do not circulate or cite without permission



© 2009 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



© 2009 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



© 2009 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

3. Choosing mathematical tasks

What is the work of teaching?

© 2009 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

Types of tasks in class and on homework: How are they similar and different?

SIMILAR

- Involve the use of mathematical skills as well as concepts
- Routinely require explanation and reasoning
- May have more than one solution

© 2009 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

Analyzing others' solutions

A fourth grade student did the calculations below. For each one, decide whether the answer is correct or incorrect and explain how you know. If the answer is incorrect, try to explain what the error is.

$$\begin{array}{r} 48 \\ +\ 27 \\ \hline 615 \end{array}$$

$$29 + 37 + 18 = 84$$

Is the answer correct or incorrect?

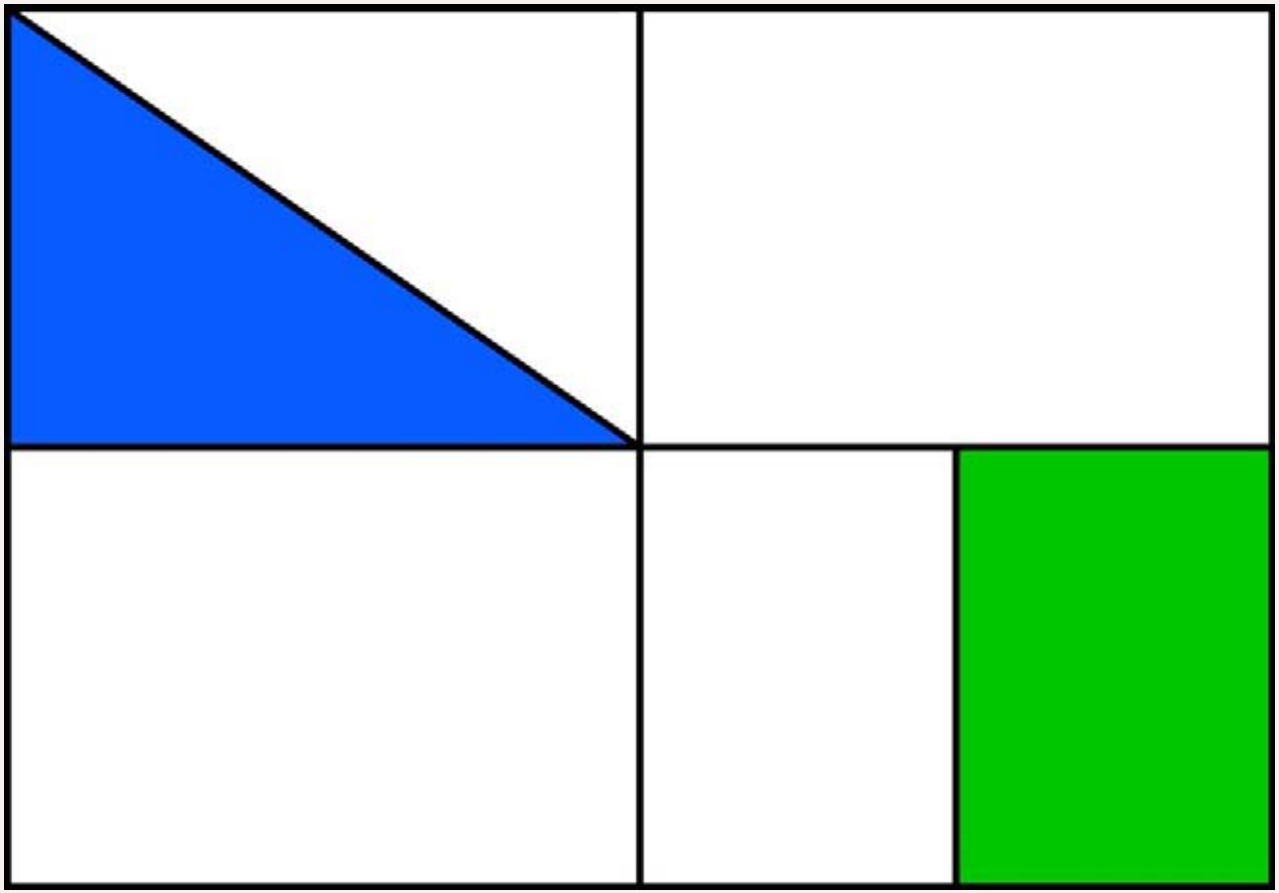
How do you know?

If the answer is incorrect, try to explain what the error is.

If the answer is incorrect, please do it correctly here:

© 2009 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

Reasoning with representations



© 2009 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

Reasoning with tools

Which Cuisenaire rod is three times as long as a red one?

Which rod is half as long as an orange one?

One rod is one-fourth as long as another rod. What colors might they be?

Which rod is one-third as long as the dark green one?

Which rod is five times as long as a red one?

The blue rod is how many times as big as the white Cuisenaire rod?

© 2009 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

Differences between in-class and homework tasks

HOMEWORK

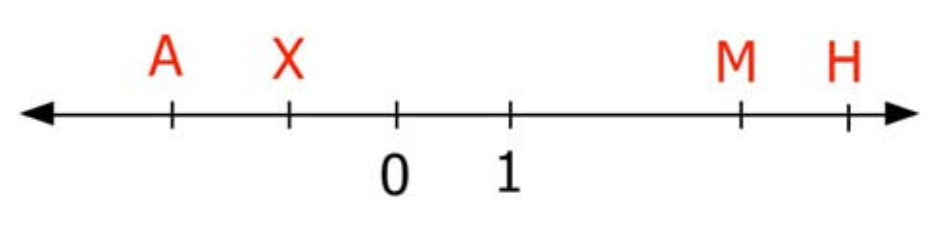
- Can be done independently
- As unambiguous as possible
- Structures the workspace more explicitly

IN-CLASS

- Profits from exchange with others
- Requires interpretation
- Requires more decisions about representation and recording
- Likely to yield multiple solution methods or solutions

© 2009 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

Homework



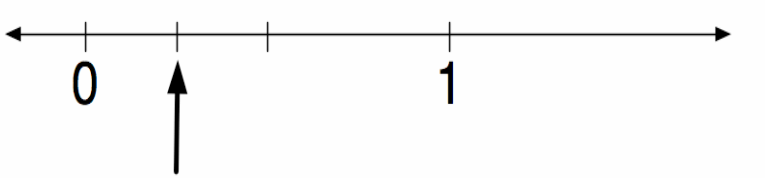
Is A less than or more than H? How do you know?

Is A less than or more than X? How do you know?

Label what numbers go at A, X, M, and H. Then, explain how you know what M is.

© 2009 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

In-class



What number can be written at the mark where the blue arrow is pointing?

Circle your answer:

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

© 2009 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

Cautions about "high expectations"

- Helping students to do hard work
- Scaffolding complex work appropriately
- Making wise judgments about what to leave open and what needs to be made explicit
- Commenting on mathematics, and mathematical productions, not features of students
- Supporting error as a fruitful site for mathematical work, and teach students to use error productively

© 2009 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

Thank you!

- Google “Deborah Ball” for slides and resources related to this talk

© 2009 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