The Professional Development of Professional Developers:

Supporting the Learning of Mathematics Teacher Educators

Teachers Development Group Leadership Seminar
Mathematics Professional Development
February 17, 2005

University of Georgia

University of Michigan

28
x 6
368

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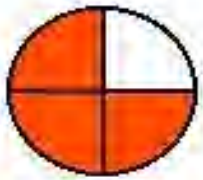
Which of these could be representations for $\frac{3}{4}$?

a) 

b) 

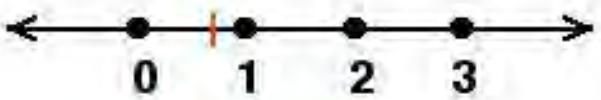
c) 

d) How many 4's are there in 3?

e) 18 crayons out of a box of 24

f) .75

g) I want to share 3 bottles of soda equally among 4 people. How much will each person get?

h) 

i) 

Overview of Session

BLOCK 1

- CPTM and its goals
- What do we mean by "mathematical knowledge for teaching"?

BLOCK 2

- The 2004 CPTM Summer Institute as a case of professional development for teacher educators

BLOCK 3

- Making connections to your own work

BLOCK 1

CPTM and Its Goals

What Do We Mean By "MKT"?

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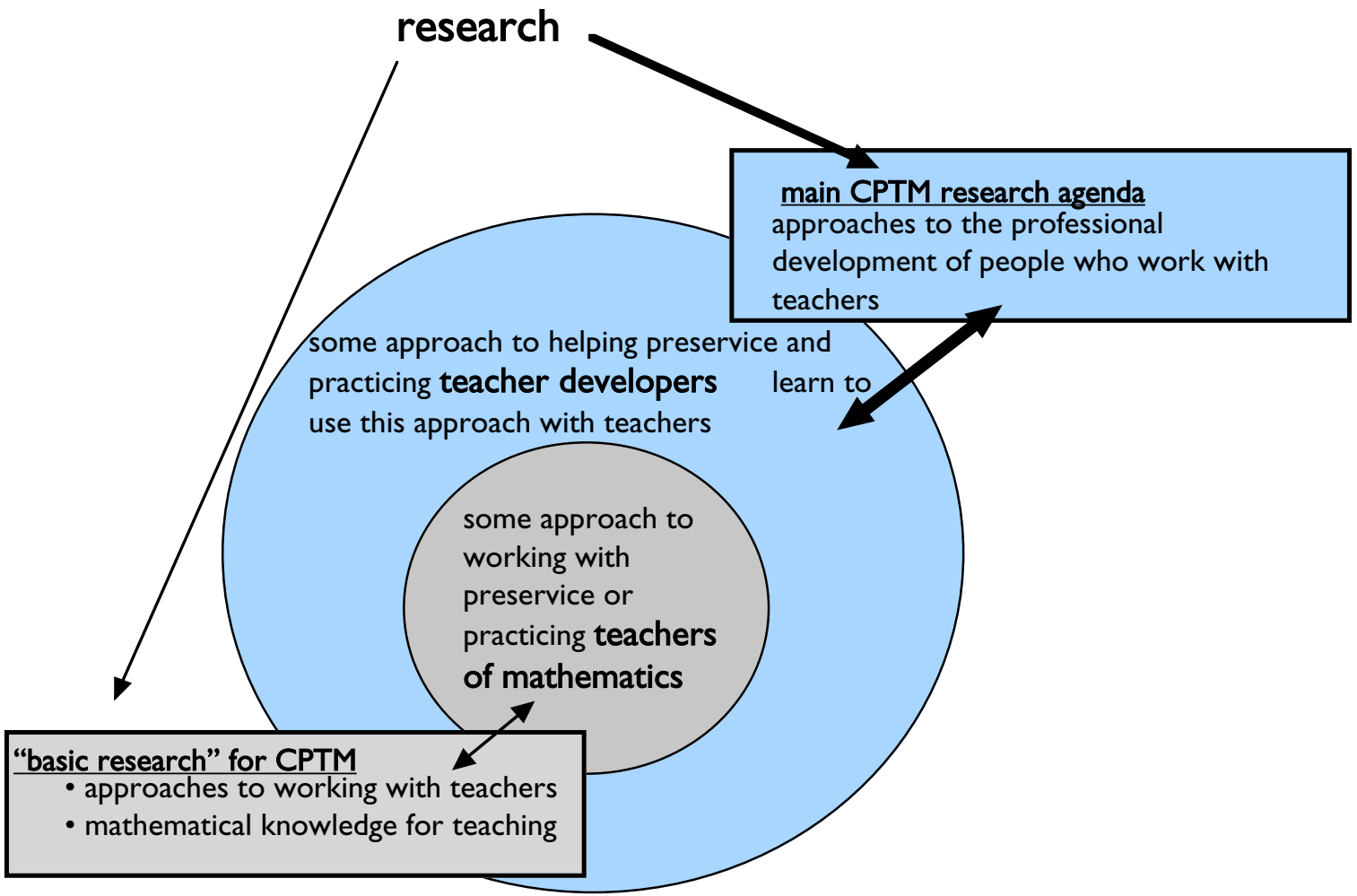
What is CPTM and What Are Its Goals?

The professional development of teacher developers

CPTM's Focusing Question

What promising models and methods can support and increase the effectiveness of the many different kinds of people who teach and work with teachers of mathematics?

How We Approach Our Focus



CPTM Goals

Make Visible Two Keys to Improving the Quality of Teachers' Learning

- Awareness of teacher developers' role and the nature of their work
- The need for professional development for teacher developers

1. Develop a professional community of teacher developers
2. Build teacher development into doctoral programs
3. Create portfolio of approaches to professional development of teacher developers
4. Learn from involvement with community of teacher developers

What Mathematics Does Teaching Involve?

- A practice-based approach to asking about mathematical knowledge for teaching:
  - Working "backwards" by studying the work of teaching and scrutinizing the mathematical demands of that work
- Reveals that many routine tasks of teaching depend on mathematical knowledge, skill, reasoning, and habits of mind that are special to teaching

Tasks of Teaching Mathematics: Some Examples

- Generating and using representations
- Building correspondences between a model and the math
- Talking mathematics and having students talk
- Choosing and developing usable definitions
- Understanding and analyzing multiple solution strategies
- Generating and using strategic examples
- Evaluating the mathematical significance of students' comments
- Designing homework and quizzes
- Sequencing of content and problems
- Organizing parent night or writing class newsletters
- Managing the math curriculum
- Talking with a parent

Seeing Teaching as Mathematical Work: What Do Teachers DO with Mathematics in the Course of Their Work?

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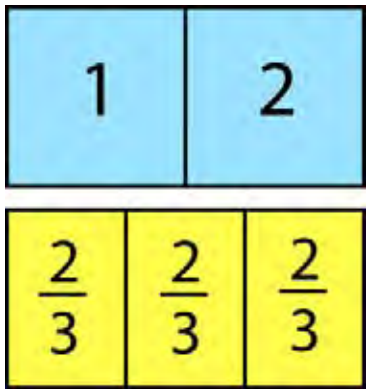
Design Quiz Questions

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

D. These lists are all equally good for assessing whether students understand how to order decimal numbers.

Choose, Develop, and Use Representations

(a)



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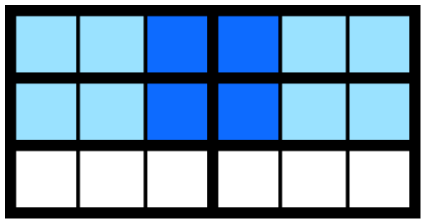

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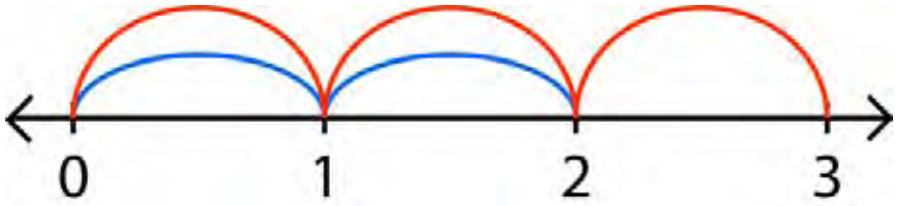

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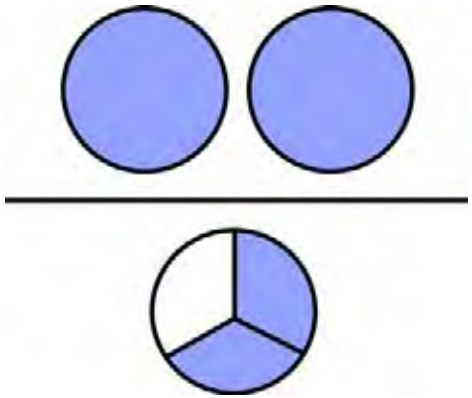
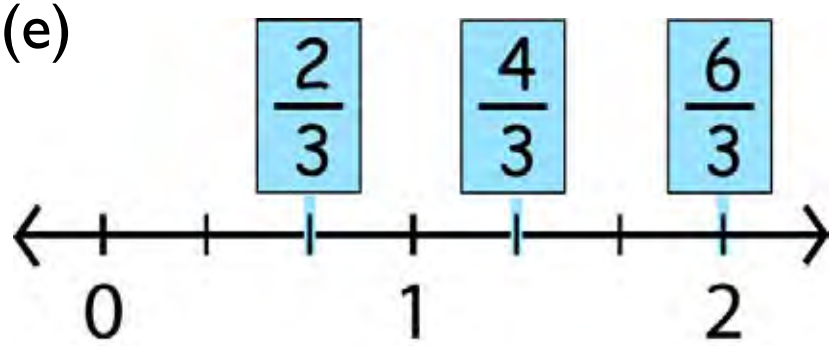


(e)

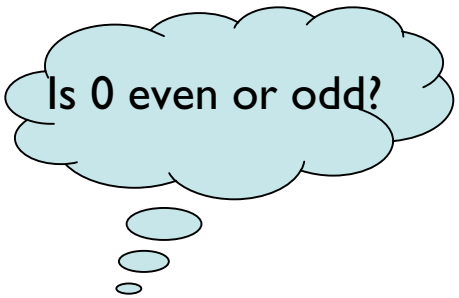


Use and Teach Definitions

Examine Textbook Definitions

How well does any of these help to answer the the question?

1. An even number is a number of the form 2k, where k is an integer.
2. An even number is a natural number that is divisible by 2.
3. An even number is any multiple of 2.
4. An even number is a number that has 0, 2, 4, 6, or 8 in the ones place.



Define Terms

What is a mathematically appropriate and usable definition of "even number" for third graders?

BLOCK 2

The Summer Institute and Lab Class as a Case of Professional Development for Professional Developers

CPTM 2004 Summer Institute

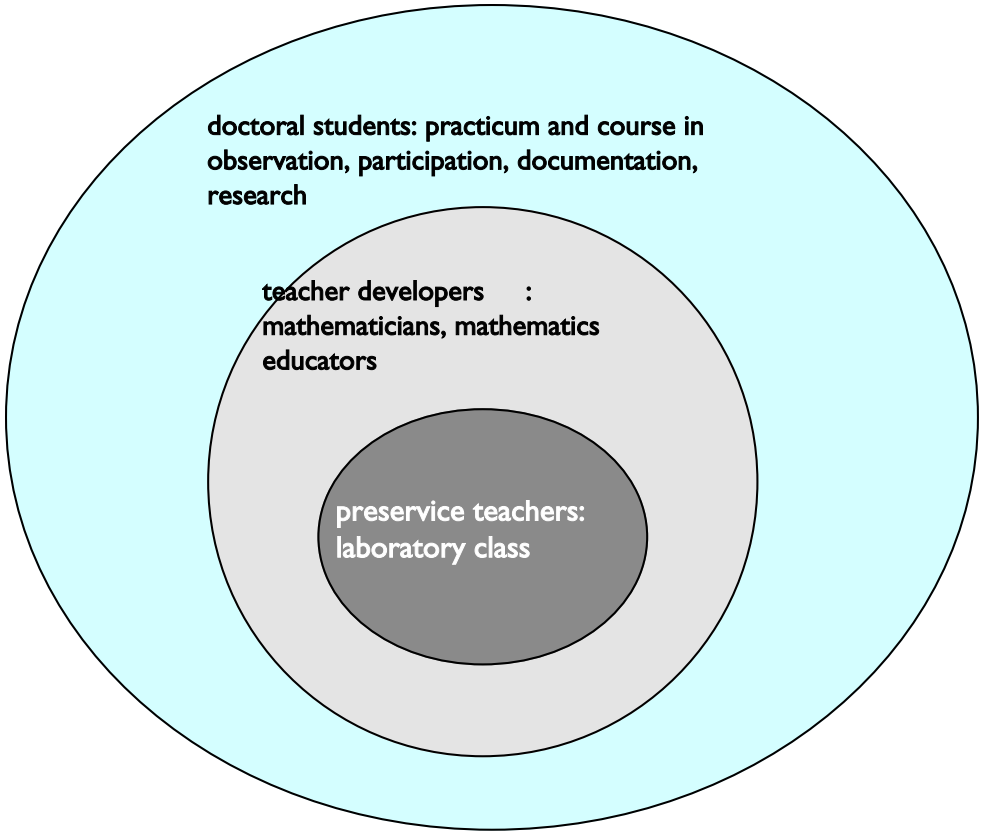
68 teacher developers

18 prospective elementary teachers

Summer Institute Focal Questions

- What mathematical knowledge and practices play a central role in the everyday work of teaching?
- What are promising approaches for helping teachers learn mathematics for teaching and learn to use it in their work?

How was the Summer Institute Designed, and Why?



Layers of learning

68 participants

18 preservice teachers

A Typical Day

- Plan for lab class (8:00 - 8:45)
- Observe lab class (9:00 - 11:00)
- Analyze what happened in lab class (11:30 - 12:30)
- Lunch (12:30 - 2:00)
- Issues involved in helping teachers develop mathematical knowledge for teaching (2:00 - 3:00)
- Mini-courses (3:30 - 5:30)
- Dinner (6:30 - 8:00)
- Work with colleagues and explore resources (8:00 -)

Cookie Jar Problem

There was a jar of cookies on the table. Kira was hungry because she hadn't had breakfast, so she ate half the cookies. Then Steve came along and noticed the cookies. He thought they looked good, so he ate a third of what was left in the jar. Niki came by and decided to take a fourth of the remaining cookies with her to her next class. Then Kayla came dashing up and took a cookie to munch on. When Pam looked at the cookie jar, she saw that there were two cookies left. "How many cookies were there in the jar to begin with?" she asked Kira.

The Lab Class: Context

- A one- or two-credit mathematics content course for teachers
- 18 preservice elementary teachers:
  - 7 master's level certification program students; 11 undergraduate certification program students
- Second day of class
- Content course (MKT):
  - fractions
  - mathematical practices: using representations, making and evaluating mathematical explanations
- Laboratory

Video from Lab Class

- What stands out to you about —
  - the students
  - the mathematics problem as the students work on it
  - the teaching
  - the classroom
  - the class as a "lab" class

Student Work from Lab Class

- What stands out to you about the students' work?
- What are they asked to write about? What do they write and draw?
- What did they not record or write about?

Shifting Our Focus: The Lab Class as an Opportunity for Teacher Developers' Learning

- What is available for participants to learn from observing the lab class?
  - *about mathematical knowledge for teaching?*
  - *about preservice teachers as learners?*
  - *about teaching preservice teachers?*

- How do you think participants may have reacted to the lab class? What do you think teacher developers would notice and attend to?

2. Prepare for Lab Class #2

- Review plan, discuss goals
- Possible changes? Things to try
- Observing today:
  - Hearing students' names
  - Change seats?
  - Small groups?

Foci for Observing and Analyzing Today

1. What **mathematical work** was afforded by this problem? What mathematical practices were being worked on? What mathematical content? What sensibilities (habits, norms) about mathematics were elicited by the problem?
2. What contributions did different **students** make to the mathematical work? What was their reaction to the work? What mathematics did they learn?
3. What specific things did the **teacher** do today, mathematically, with respect to building mathematical knowledge, skills, habits, norms? What did the teacher learn from this lesson?

Reflecting and Anticipating

- What are you curious about for today's lab class?
- Is there something you want to watch particularly closely?

Video from Participants' Discussion

- What strikes you about the participants? What do you notice?

- What are the participants doing in these clips? What do they notice and attend to?

Definitions as a Crucial Component of Mathematical Knowledge for Teaching

How Do You Answer These Questions?

Is 0 even or odd?

An even number is an integer multiple of 2.

What is 7 divided by 0?

For any a and b (real numbers), a/b = c if and only if cb = a.

A polygon is a simple closed plane curve formed by straight line segments.

An exterior angle is the angle formed between the side of a polygon and the extension of an adjacent side.

What is the sum of the exterior angles around a polygon?

What is a Fraction?

PROPOSED CRITERIA FOR A MATHEMATICAL DEFINITION

- Mathematically precise—correctly identifies the kind of object, process, property
- Usable by user community — based on already-defined and understood terms
- Anticipates changes as mathematical environment changes

(NOTE: Definitions emerge as concepts develop.)

Write a definition for "fraction."

- Check to see whether your definition works to resolve the examples from yesterday (of 3/4).
- Refine your definition as needed.
- Consider how your definition works for other examples.

Teacher Developers' Work

- What stands out to you about the teacher developers' work in their notebooks?
- What kinds of things do they attend to, and in what ways? What do they not comment on?

BLOCK 3
Connecting to Your Own Work

Questions

- How might you be able to use any of what we explored today in developing the professional development you could do?
- What are the design and content principles you would consider important for the education of professional developers?

Design Principles

- Practice-based (live and records)
- Intensiveness of time spent together
- Shared experience provides common context
- Allow for and take advantage of diversity of participants
- Participants contribute to the content of the institute
- Provide public time and private time
- Provide formal and informal opportunities for learning
- Make teaching visible
- Mathematical knowledge for teaching
- Developing preservice teachers' MKT
- Alternative images of mathematics courses
- Alter views of preservice teachers