Practice-based professional development for practicing elementary mathematics teachers

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The Dev-TE@M Project Team

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Dev-TE@M Project

- Developing online professional development modules
  - Representing and comparing fractions (piloting)
  - Reasoning and explanation (currently developing)
  - Geometry (future work with Clements & Sarama)
- Constructing a set of robust resources for facilitators

Presentation overview:

Designing practice-based professional development

- Background
- The four “Core Elements" of our professional development content
- Approaches to integrating elements of professional development content
- Using our materials
- Questions

1. Background

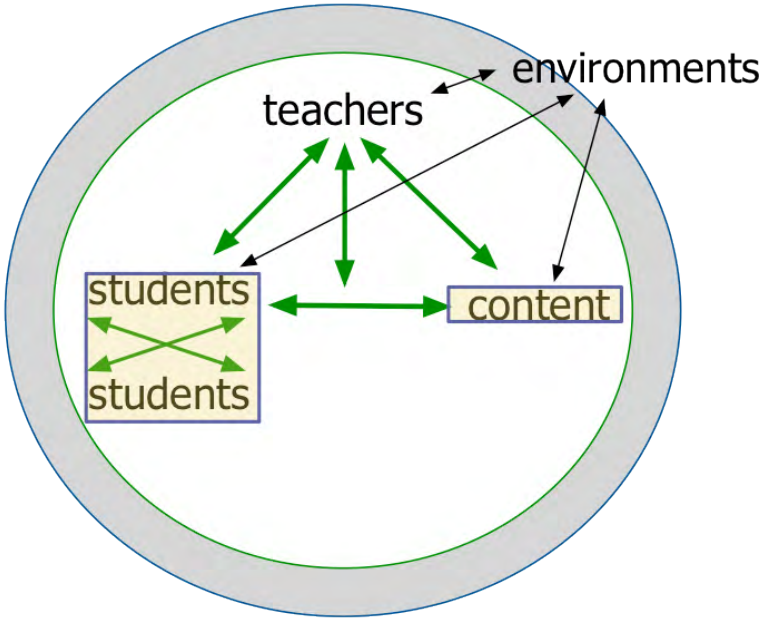
Materials features

Quick facts:

- Ten 2-hour sessions
- Professional development for practicing elementary mathematics teachers
- Web-based materials with multimedia components
- Facilitated sessions conducted in real-time
- Practice-based design
- Integrated content

2. The four "Core Elements" of our professional development content

Introduction to the Core Elements



(Cohen, Raudenbush, and Ball, 2003; Lampert, 2001)

Dev-TE@M materials integrate attention to the following Core Elements

1. Mathematical knowledge for teaching
2. Students' thinking about mathematics
3. Essential teaching practices that support student learning; and
4. Routines for learning in and from practice

Mathematics

Mathematical Knowledge for Teaching (MKT)

The mathematical knowledge, skill, and habits of mind that are entailed by the work of teaching

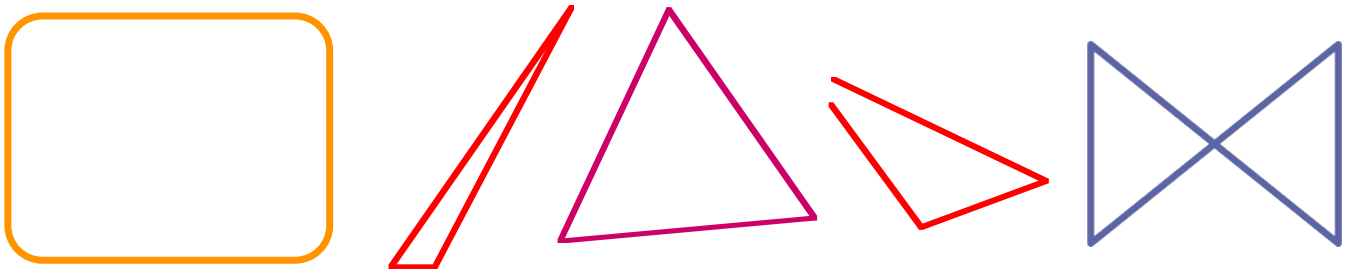
Why focus on this element of content in professional development experiences?

- Focused on what teachers need to know for the work they do
- Demonstrated positive impact on the mathematical quality of instruction (Hill, Rowan, and Ball, 2005)
- Demonstrated positive impact on student learning outcomes (Hill, Rowan, and Ball, 2005)

Examples of Mathematical Knowledge for Teaching

Choosing and using representations and examples

In what ways could each of these shapes be used to precipitate a discussion of the definition of polygon?



Shapes whose straight sides are connected end to end and make a closed path. The sides do not cross.

Teaching practice

High leverage teaching practice

Practices that, when done well, substantially enhance teachers' capacity to support student learning

Why focus on this element of content in professional development experiences?

- To enhance practices that contribute to the integrity of the mathematics that is taught (Ball et al, 2009)
- To develop common language and structure for describing practice that support working on teaching over time (Grossman et. al, 2009)

Some examples

- Establishing classroom culture (Lampert, 2001)
- Orchestrating discussions (Smith et al, 2009)
- Assessing within a lesson (DIAS, 2011)
- Communicating about a student with a parent or guardian (TeachingWorks, 2012)

Student thinking

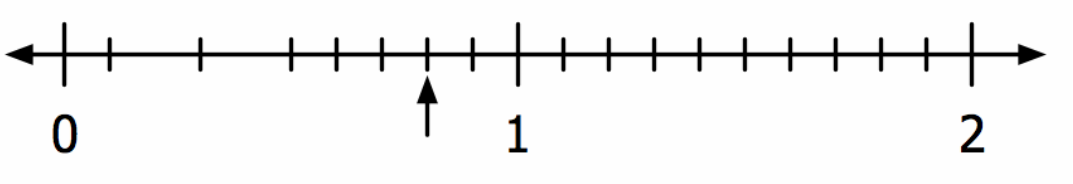
Knowledge, dispositions, and skill in anticipating and interpreting students' ideas and ways of thinking about mathematics

Why focus on this element of content in professional development experiences?

- As the diversity of students increases, teachers need support in recognizing and using a wider range of students' knowledge and experiences (González, Moll, & Amanti, 2005; Lee, 2007; Moje et al., 2004)
- Professional development that is grounded in explicit attention to student thinking has been shown to impact student learning (Fennema et al.,1996)

Examples of student thinking

What value should be written where the arrow is pointing?



Common error (a)

$\frac{6}{8}$

Common error (b)

$\frac{7}{9}$

Common error (c)

$\frac{8}{20}$

Common error (d)

$\frac{1}{6}$

Common error (e)

6

Learning from practice

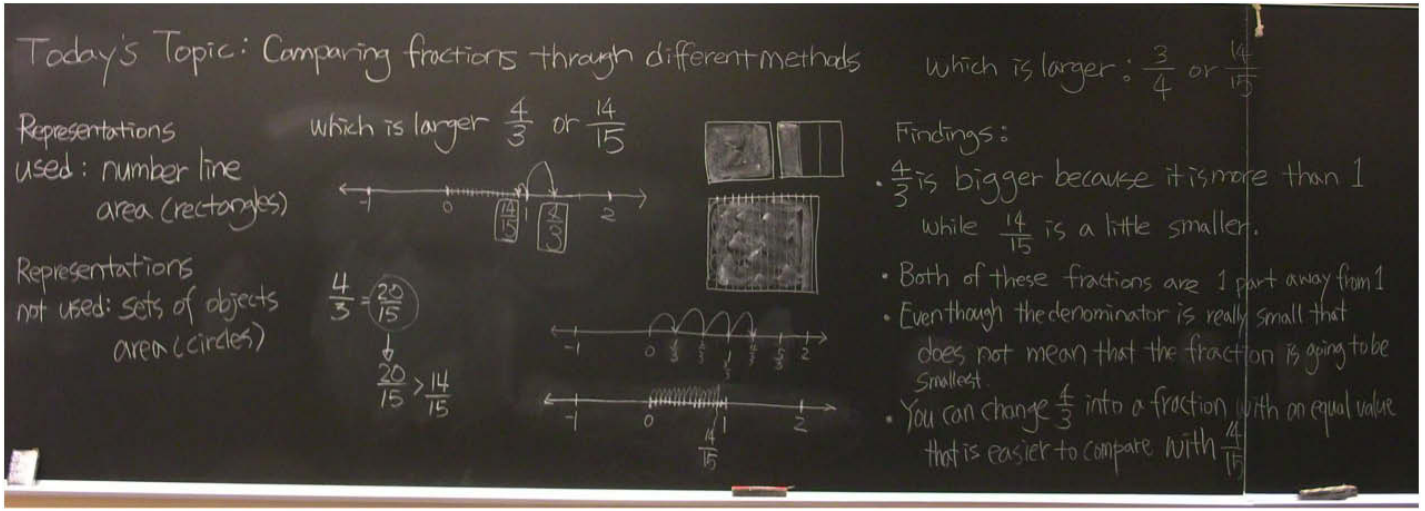
Methods for learning more effectively from the day-to-day work of teaching and/or artifacts of practice

Why focus on this element of content in professional development experiences?

- Integrates the learning and doing of teaching rather than separates (i.e. professional development through teaching) (Lampert, 2009)
- Extends learning beyond a given PD experience (Hiebert et al, 2007)

Example of learning from practice

Nurturing dispositions, processes, & lenses for analyzing the use of public space



Integrating the Core Elements

Why integrate Core Elements of teacher learning?

Teachers must use knowledge flexibly and fluently as they interact with students, with the aim of helping those students become proficient with mathematics. Such work requires integrated use of knowledge and skill. (Lampert, 2009)

Integrated and connected knowledge is more robust (memorable, justifiable, a basis for future learning) (Bransford & Schwartz, 1999)

3. Approaches to integrating elements of professional development content

Three activity structures used to support the integration

1. Solving a mathematics problem
2. Discussing a classroom video
3. Engaging in video workshop

Core Elements in the "Reasoning and Explanation" module

- *Mathematics*: Using mathematical reasoning, explanations, and language
- *Teaching*: Supporting mathematical practices in the classroom
- *Student thinking*: Examining ways students make sense of and explain mathematics
- *Learning from practice*: Studying the teaching and learning of mathematical practices through video workshop (Sherin & van Es, 2009)

Activity structure #1:
Solving a mathematics problem

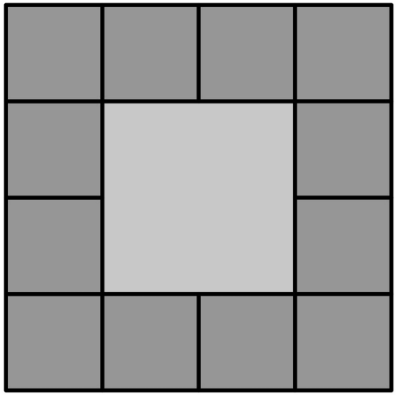
Activity structure #1: Solving a mathematics problem

a. Engagement in mathematical practices

b. A focus on teaching practices

The pool border problem

How many square tiles does it take to build a border around a square "pool"? Find a way to know the number of tiles it will take without having to count, for any size pool.



Possible methods

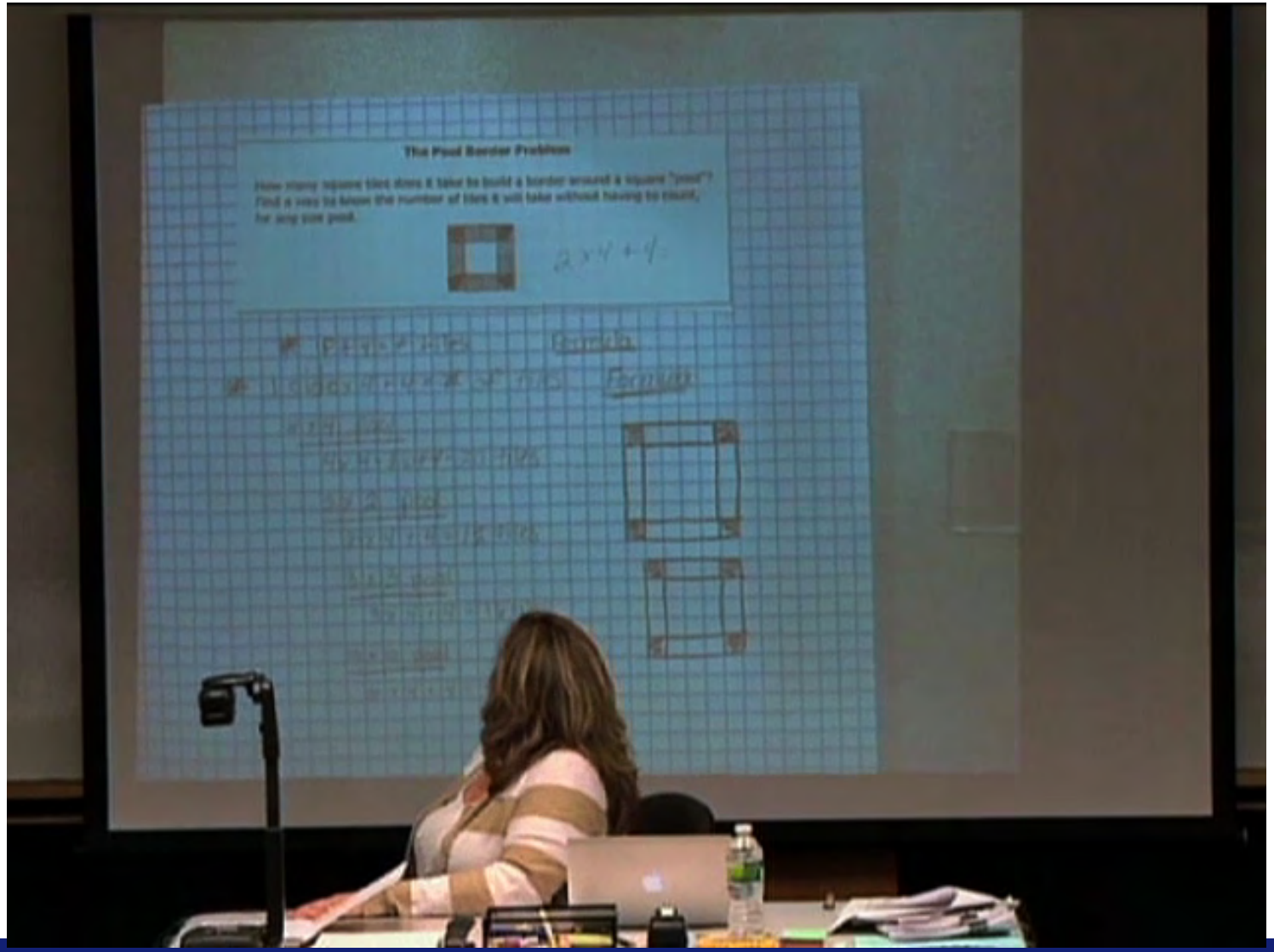
(Examples for a square with a side length of 3)

- Multiply the side length x 4 and then add 4 for the "corners" (e.g. 3x4= 12 then add 4, which would make an answer of 16)
- Extend two of the sides by two each and then add 2 of the side lengths (e.g. 2(3+2) + 2(3)= 16)
- Extend all side lengths by 2, multiply by 4, and then subtract 4 (e.g. 4(3+2) – 4=16)
- Extend the side length by 1 and multiply by 4 (e.g. 4(3+1) =16)
- Square the side length and then subtract that from the square of the side length plus 2 (e.g. $5^2 - 3^2 = 16$)

Discussion of the problem

In the discussion, participants:

- Explain how they know that their solution always works
- Attend to the logic of others' explanations and ask questions or restate their colleagues' explanations.



Activity structure #1b: Solving a mathematics problem

Use of videos of other teachers engaged in the same activity

Videos of other teachers engaged in the same activity:

- Provide opportunities to surface patterns of thinking that may or may not emerge in a particular professional development
- Support a focus on the ideas, not the individual participants
- Can be replayed if needed during the discussion

Activity structure #1: Solving a mathematics problem

Elements of content

a. Mathematics
   - Making conjectures and generalizations
   - Explaining mathematical representations

b. Teaching practices
   - Analyzing others' thinking and making connections across representations
   - Producing clear, logical explanations geared toward listeners

c. Student thinking

d. Learning from practice

Activity structure #2: Discussion of a classroom video

Activity structure #2: Discussion of a classroom video

a. A focus on mathematics

b. A focus on student thinking

c. A focus on teaching practices

Activity structure #2: Discussion of a classroom video

Context for the video

- Entering 5th graders (10-year olds)
- Two week summer program (8th class session out of 10)
  - Number theory, geometry, and pre-algebra
  - Combined work on missing skills and understanding with challenge and acceleration
  - Explicit work on reasoning, using representations, and using definitions
- Students came with a wide range of mathematical skills and varying degrees of interest in mathematics

Focus questions

- How are students reasoning about the problem?
- How are students supporting/explaining their approaches using words, drawings, or tools?
- What is the teacher doing to establish and maintain an environment that nurtures student reasoning practices?

The discussion

- Participants typically notice and discuss:
  - The student's method (extending the side length by 1 and multiplying by 4)
  - The student's use of representations
  - The teacher's focus on having students explain their methods
  - The teacher's asking the class to test another student's method with different examples

Activity structure #3: Engaging in video workshop

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Opportunities to engage in all four elements of content:

- Mathematics
- Student thinking
- Teaching practices
- Learning from practice

Activity structure #3: Video Workshop

Structure of the video workshops

- Small group workshops
- Videos from participants' classrooms
  - Participants try variations of problems from the professional development (such as the pool border problem)
- Steps of the video workshop process:
  - *Set-up:* Participant provides context for the clip the group will watch
  - *Viewing of video:* Group members jot notes
  - *Discussion*: Group discusses focus questions related to student thinking and teaching practices seen in the video
  - *Debriefing:* Group discusses the aspects of the workshop that went well or could have been improved

Activity structure #3: Engaging in video workshop

Elements of content

- Mathematics
  - Offers opportunities to appraise mathematical explanations
- Teaching practices
  - Shows examples of teaching moves that facilitate discussion focused on reasoning
  - Offers opportunities to receive feedback on practice and to develop skills that enhance reflection
- Student thinking
  - Expands awareness of, and extends opportunities to, analyze students' reasoning
- Learning from practice
  - Offers an opportunity to learn a method of learning from practice

4. Using the Dev-TE@M materials

"Reasoning and Explanation" module Fall 2013 pilot

We are seeking teacher educators doing real-time professional development with practicing elementary teachers in:

- School/district professional development
- University courses
- Teacher institutes or workshops
- Teacher study groups

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Supporting work on integrated content

- Videos of an expert facilitator
- Facilitator guides
- Facilitator implementation study group
- Access to materials developers and technical support