Professional Development that Supports Teachers' Use of Learning Trajectories

Timothy Boerst
Kara Suzuka

University of Michigan

Douglas Van Dine

University of Denver

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Presentation overview:

Designing practice-based professional development

1. Dev-TE@M materials background: Four "core elements" of professional development content
2. Examples: Activities for developing teachers' knowledge of learning trajectories
3. Insights into this professional development approach for learning trajectories
4. Becoming involved: Using Dev-TE@M materials
5. Questions

1. Background:

Four "core elements" of professional development content

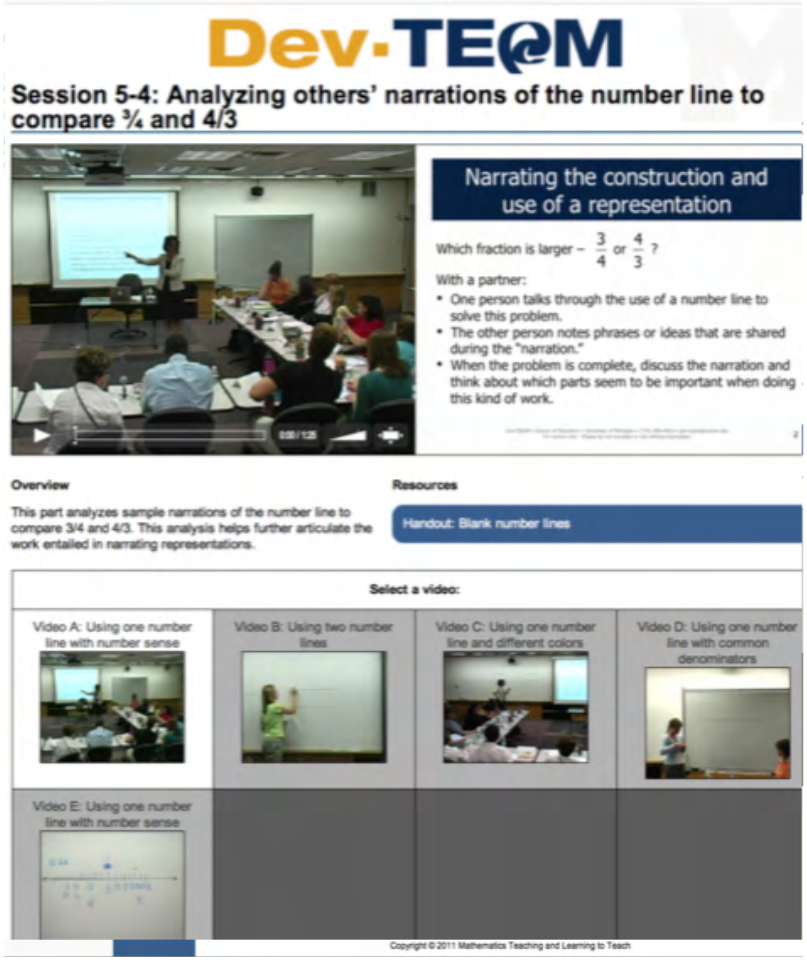
Dev-TE@M project

- Developing web-based professional development modules
  - Representing and comparing fractions (in use)
  - Reasoning and explanation (broad pilot)
  - Geometric measurement & spatial reasoning (initial pilot)
- Constructing a set of robust resources for facilitators

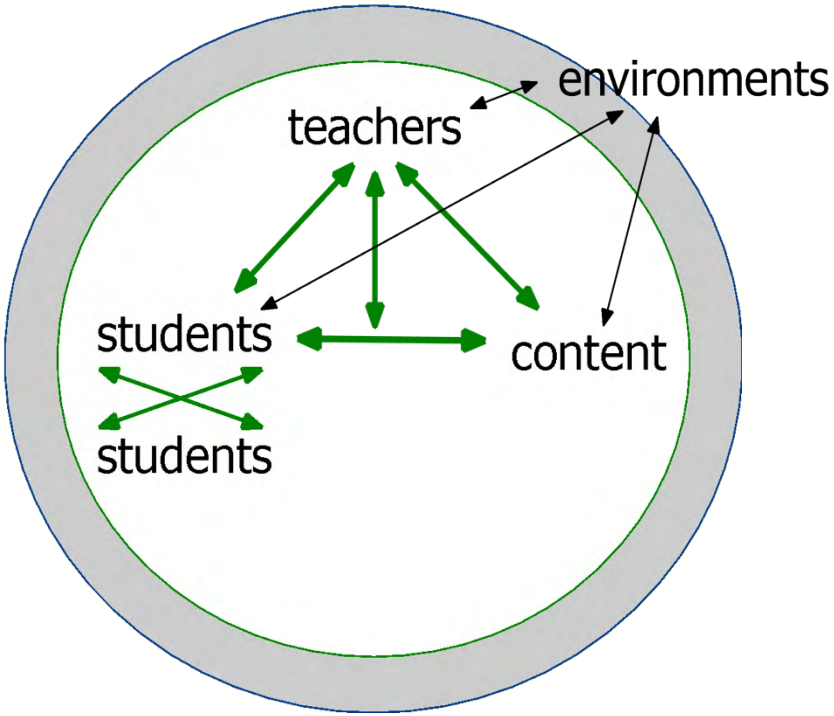
Materials features

Quick facts:

- Ten 1.5-hour sessions
- Professional development for *practicing* elementary mathematics teachers
- Integrated content
- Practice-based design
- Accessible via the web with multimedia components
- Facilitated sessions conducted in real-time



Introduction to the core elements



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

Dev-TE@M materials integrate attention to four 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

Core elements in the "Geometric Measurement and Spatial Reasoning in Elementary Mathematics Teaching" module

- ***Mathematics***: concepts, methods, and tools used in linear, 2D, and 3D measurement
- ***Student thinking***: understanding trajectories of children's reasoning about linear, 2D, and 3D measurement
- ***Teaching practice***: using learning trajectories in assessing and curriculum analysis
- ***Learning from practice***: studying learning trajectories of one's own students through the use of video and anecdotal notes

2. Examples:

Approaches to developing teachers' understanding of learning trajectories

Organization of Module Content

- Three parts of a learning trajectory
  a) Mathematical goal
  b) Developmental progression of student thinking
  c) Instruction and teaching practices
- Three topics within geometric measurement
  - Linear measurement
  - Area measurement
  - Volume measurement

Organization of Module Content

Linear measurement: Sessions 1-3

a) Mathematical goal (session 1)
b) Developmental progression of student thinking (session 2)
c) Instruction and teaching practices (session 3)

Area measurement: Sessions 4-6

a) Mathematical goal (session 4)
b) Developmental progression of student thinking (session 5)
c) Instruction and teaching practices (session 6)

Volume measurement: Sessions 7-9

a) Mathematical goal (session 7)
b) Developmental progression of student thinking (session 8)
c) Instruction and teaching practices (session 9)

Connecting linear, area, and volume measurement (session 10)

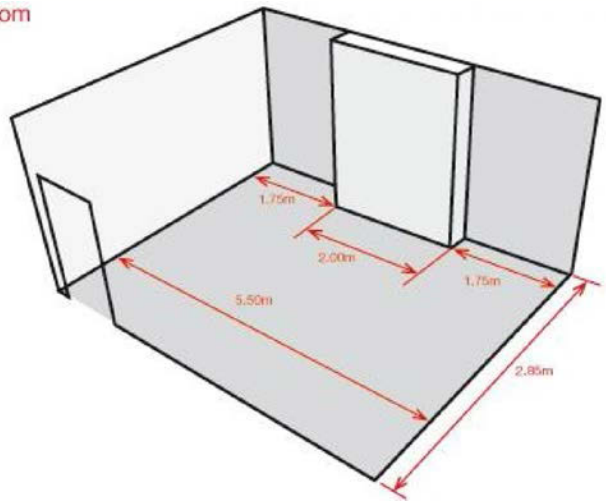
Activity #1: Solving mathematics problems

Measuring the room sequence

How Long is the Room?

- Really...how long? How wide?
  - Estimate. Write it in your notebooks.
  - Think: How did you estimate?
  - What did you have to know and be able to do?
  - Write a brief summary in your notes.
  - Brief sharing.
- Now let's measure…

Example Room



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Activity #1: Solving mathematics problems

Measuring the room sequence

How Long is the Room?

- Structure: Individual, pairs, whole group
- Choose a personal ruler* to measure the length of the room

  *any object you have with you, including…
  any part of your body!

  Then, with partner, measure your personal rulers using standard ruler and compute the length of the room in standard units
- Go measure!

How Long is the Room?

- Why did we get different answers?
  - How did different personal ruler selections and methods affect the results?
  - What differences are or are not acceptable?
- How did you deal with partial units?
- Errors—did they propagate multiplicatively?
- How did the results compare with your initial estimate? Why? How did you estimate?

How Long is the Room?

- 2 min. write in notebooks
  - What are the implications for students' measurement activity?
  - What did you notice about your and others' use of language, tools, representations, and structure to justify or critique solutions?
- How about mathematical practices?…

CCSS' Practices

2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.

Advancing knowledge of learning trajectories through solving mathematics problems

- The three parts of a learning trajectory
  - Goal
  - Developmental Progression
  - (Correlated) Instruction
- Such activities focus strongly on the goal: Profound knowledge of early and elementary *mathematics.*
- However, they also motivate reflection on thinking and learning—strategies, concepts, procedures, and so forth (the 2nd part of a learning trajectory)

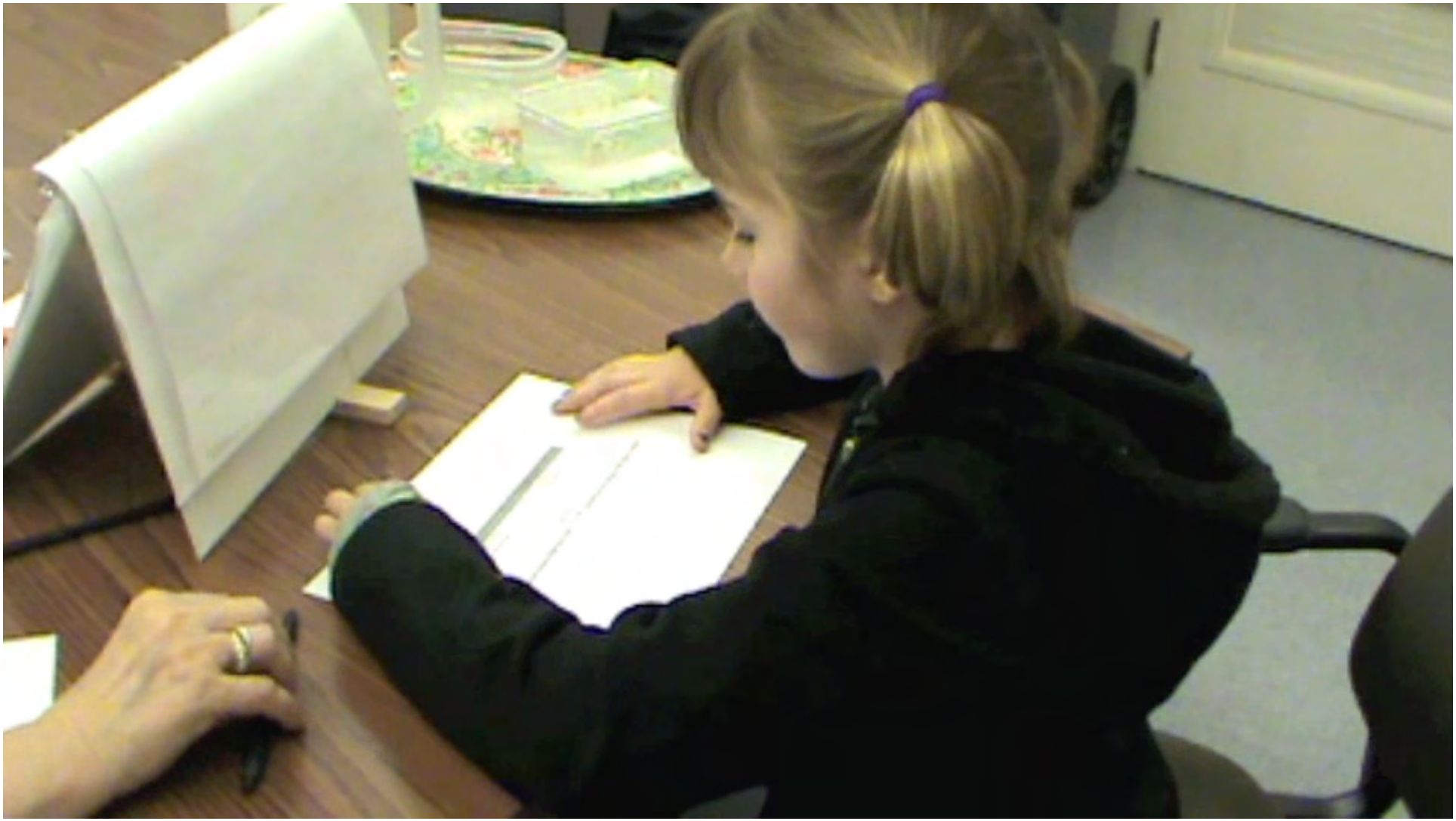
Activity #2: Video analysis

Student performance examples

Focusing fully on the *Developmental Progression*, we study the thinking and learning of students: Those on video and those in teachers' classrooms…

End-to-End Length Measurer

- Lays units end-to-end. May not see the need for equal-length units.
- Another example:
  - Lays 9 inch cubes in a line beside a book to measure how long it is.



Length Unit Relater and Repeater

- Relates size and number of units
  - "If you measure with centimeters instead of inches, you'll need more of them, because each one is smaller."
- Repeats or iterates a single unit to measure. Sees need for identical units. Uses rulers with guidance.
  - Measures a book's length well with a ruler.

Advancing knowledge of learning trajectories through video analysis

- Analyses of these videos helps teachers build integrated concrete and abstract knowledge of the learning
- Each level—see video, think-pair-share, describe, then see the research-based name and description.
- Sets a framework for their observation of their own children, a they repeat the classic task and conduct that and other tasks (level-eliciting tasks) the following week.

Approach #3: Engaging teachers' own students with a "classic activity"

Classroom Connection Activities

Classroom connection activities are "professional homework" that:

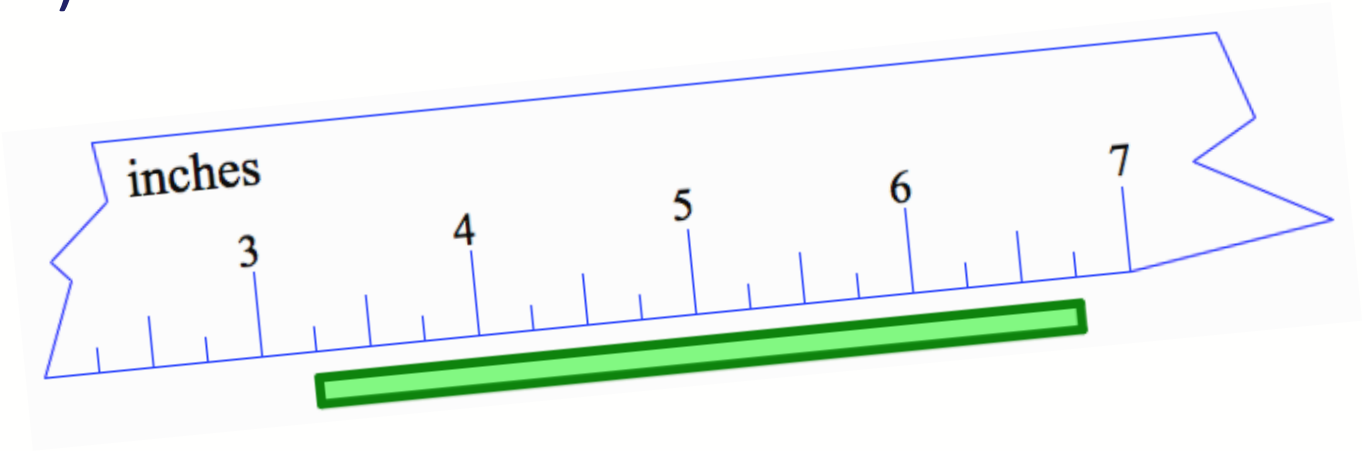
- Connect professional development content with classroom teaching
- Extend thinking about the content of the present and previous sessions

Approach #3: Engaging teachers' own students with a "classic activity"

Classroom Connection Activities

The Broken Ruler Task

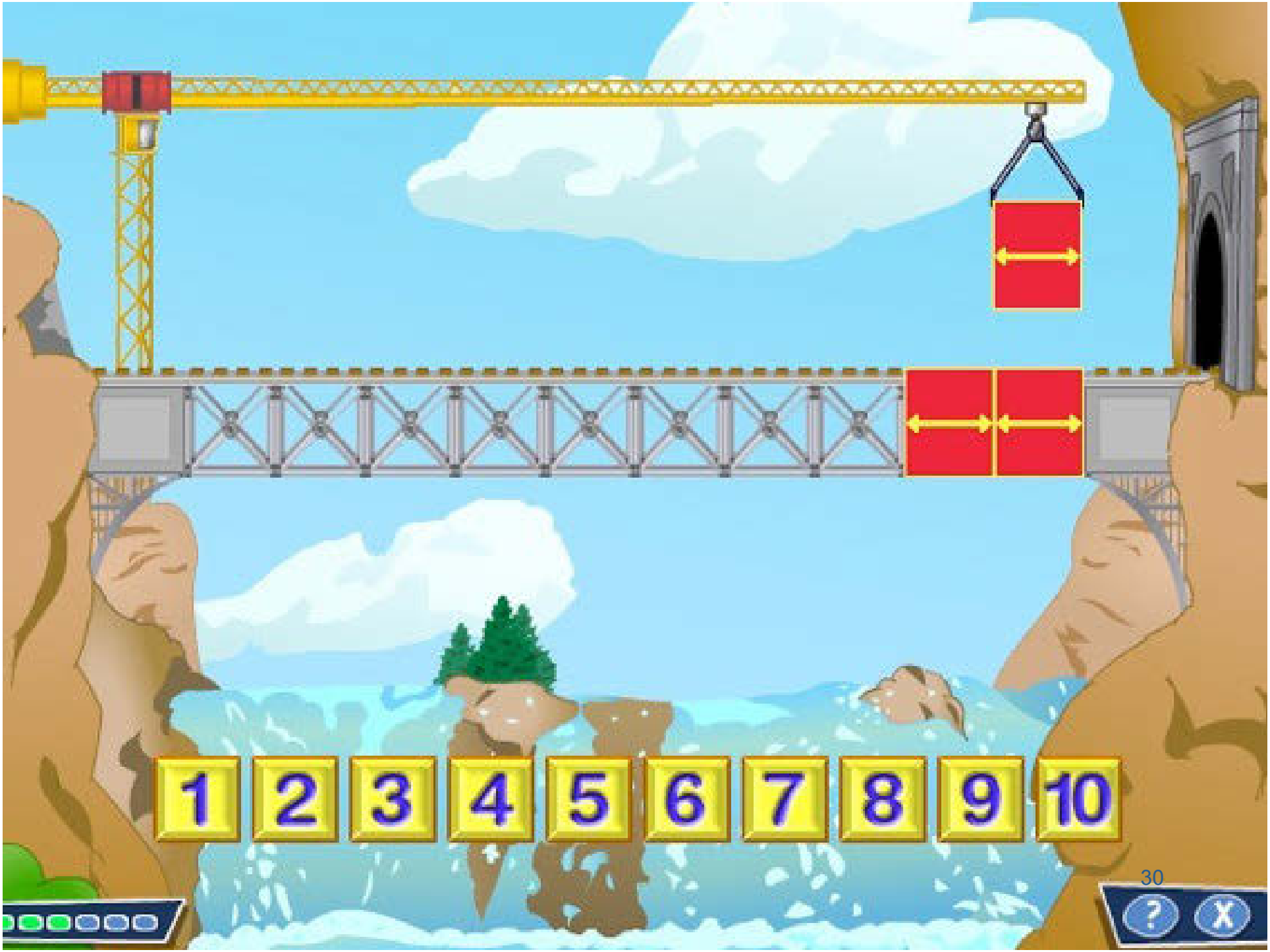
The task is to tell the length of an object measured with a "broken ruler" (one with no origin, or zero point).



Learning trajectories, part 3

The three parts of a learning trajectory

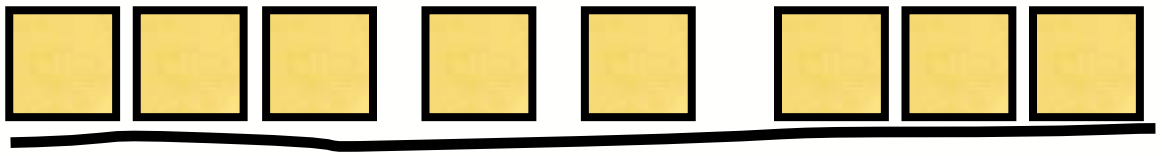
- Goal
- Developmental Progression
- **(Correlated) Instruction**



Mr. Mixup's Measuring Mess

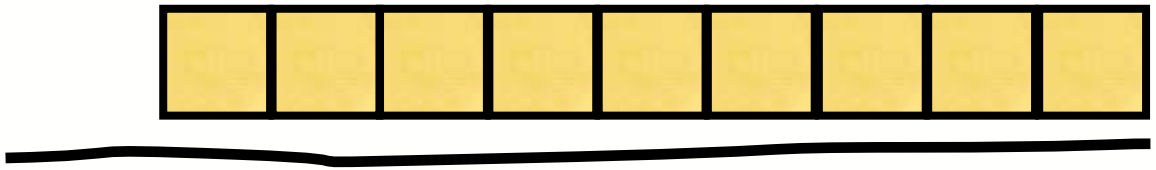
Mr. Mixup measures string with connecting cubes

- Gaps between cubes

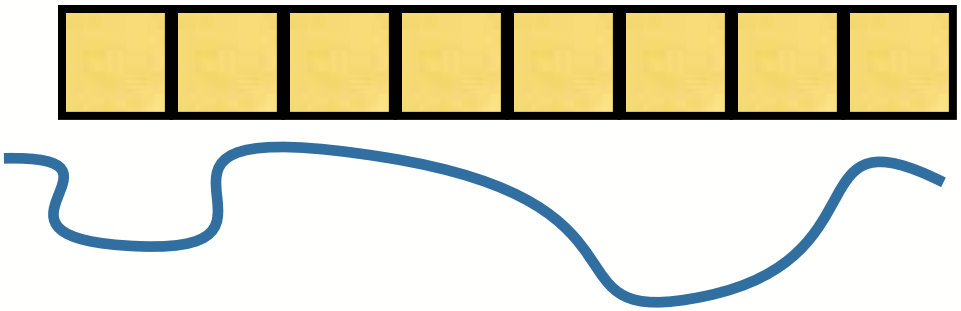


Mr. Mixup's Measuring Mess

- String end misaligned with cubes



- String or cubes not in a straight line

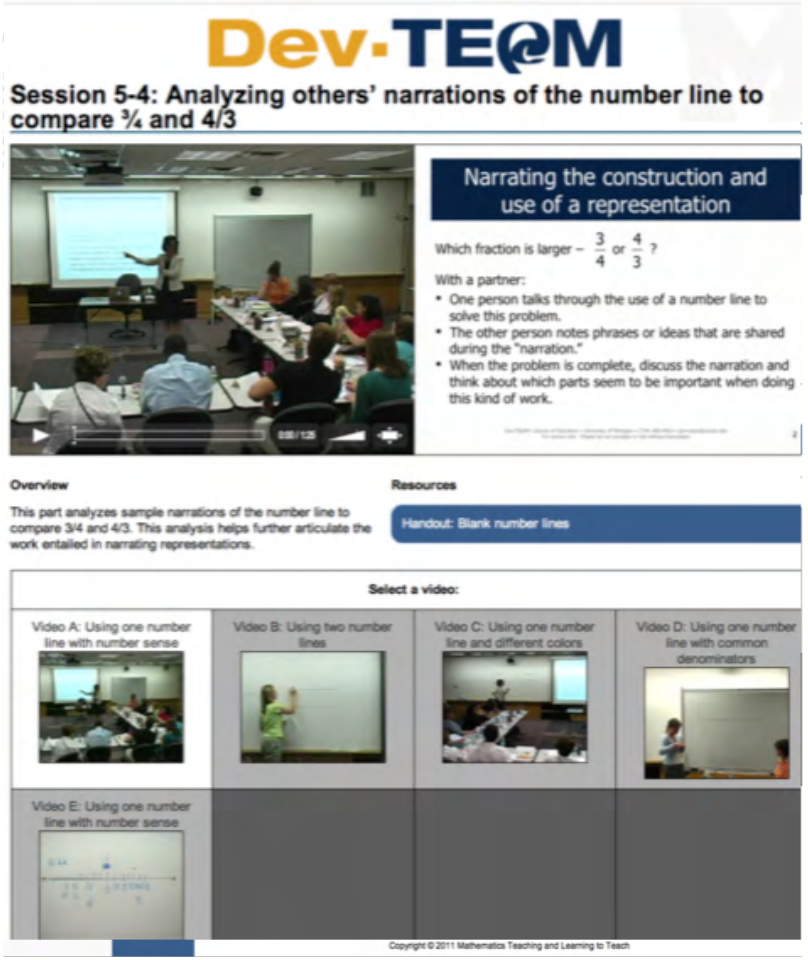


Connect with instruction…

- The key is to *connect* the tasks to the developmental levels.
- Then teachers modify their own tasks, video them, and discuss.

A glimpse inside

- Videos of –
  - Classroom interactions
  - Student interviews
  - Experienced facilitation of professional development
  - "Virtual colleagues"
- Slides
- Resources for sessions
- Classroom Connection Activities
- Supplements



Insights into this PD approach for learning trajectories

Advantages:

- Connecting PD content with teachers' own students and curriculum
- Using familiar activities to introduce new dimensions of measurement
- Leveraging "virtual colleagues" to support professional learning

Challenges:

- Recruiting districts and participants willing to engage in extended PD experiences

and at the same time...

- Needing more depth of experience to connect learning trajectory levels to particular instructional activities

3. Becoming Involved:

Using the Dev-TE@M materials

"Geometric Measurement and Spatial Reasoning in Elementary Mathematics Teaching" module
Fall 2015 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

Visit our website to learn more:

http://www.umich.edu/~devteam/

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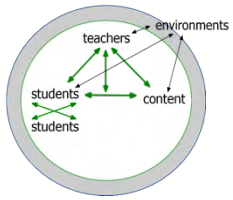
Dev-TE@M Modules

Module 1: *Representing and comparing fractions*

Module 2: *Reasoning and explanation*

Module 3: *Geometric measurement & spatial reasoning*

Credits



Graphic on slide 6:
Cohen, D. K., Raudenbusch, S., & Ball, D. L. (2003). Resources, instruction, and research. *Educational Evaluation and Policy Analysis*, *25* (2), 119-142.

Image on slide 9:
Watterson, B. (1986). *Calvin and Hobbes* [Cartoon]. Retrieved from http://www.gocomics.com/calvinandhobbes/2011/06/20

Image on slide 15:
IKEA. (2013). *Shoe measurements* [TV commercial].

Credits

Image on slide 30:
Clements, D. & Sarama, J. (2006). Triad/Building Blocks. *Workin' on the Railroad*. Retrieved from http://triad-research.du.edu