Professional Development Approaches to Promote Collaboration among Educators with Different Roles to Promote Student Mathematics Learning

Amy Brodesky Mark Driscoll Pam Buffington

Central Issue

To improve math instruction for students with diverse needs, PD needs to bring together educators with different roles

These educators vary widely in their

- prior knowledge, experiences, and comfort with doing mathematics
- professional roles, responsibilities and status in their schools/districts.

PD for Mixed Audiences Needs to:

- build educators' knowledge/practices in ways that address their diverse professional learning needs
- promote collaboration to improve student mathematics learning
- foster a respectful and supportive learning community that welcomes educators' different areas of expertise and perspectives.

Central Questions

- What are ways to create and implement PD that works well for mixed audiences?
- What are the implications of working with mixed audiences on:
  - Design of PD
  - Implementation of PD
  - Research and Evaluation of PD

Mixed Audiences: Which groups do you work with?

- General Educators/Math Teachers
- Special Educators
- ESL Specialists
- Instructional Coaches
- School/District Leaders
- University professors
- Pre-service Teachers
- Teachers with a wide range of grade levels: K-12
- Other

Session Goals

- Share approaches from different PD projects that work with mixed audiences

- Provide opportunities to discuss common challenges and ways of addressing them

Session Agenda

1. Introduction
2. Visual Access to Mathematics, Part 1
3. Visual Access to Mathematics, Part 2
4. Differentiating Professional Development
5. Topic Discussions
6. Wrap-Up

Visual Access to Mathematics:

Professional Development for Teachers of English Learners

MARK DRISCOLL

Visual Access to Mathematics (VAM) Project

To improve English Learner (EL) access to mathematical thinking and communication, VAM:

- Aims to enhance mathematics teacher skills in making, using, and analyzing mathematical visual representations (MVRs), and in integrating MVRs with language strategies.
- Will offer a 60-hour blended-learning course for mathematics teachers and ESL specialists.

Visual Access to Mathematics (VAM) Project

- Will concentrate on rational number, ratio, proportion, guided by the Common Core Standards of Mathematical Practice, and relying heavily on technology-supported artifacts of student thinking.

Building on Four Previous Projects

- *School Leadership for ELL Mathematics* (NYC DOE) (Middle School Teams)
- *Fostering Mathematics Success of English Language Learners* (DRK12) (Middle and High School Geometry Teachers of EL students)
- *Mathematics Coaching Supporting English Learners* (IES) (Middle School Mathematics Teachers of EL students)
- *Interactive Formative Assessment Tools for English Learners* (Massachusetts DOE) (Middle School Mathematics Teachers, ESL Specialists, and Special Ed. Specialists)

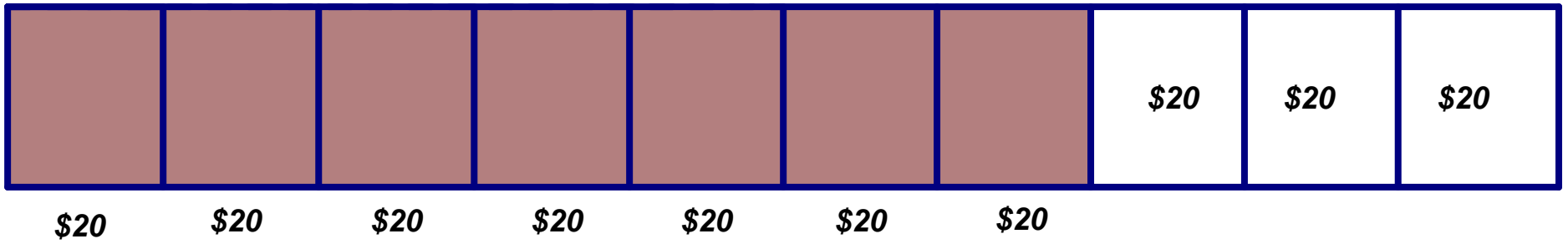
A Missing Piece: MVRs as Thinking Tools

- Competent mathematical thinkers use MVRs flexibly in problem solving (Stylianou, 2002; Stylianou & Silver, 2004).
- Yet, evidence from our work and from others' work (e.g., Stylianou, 2011) suggests that use of MVRs as thinking tools (as opposed to, say, teacher demonstration tools) is scarce at best in U.S. classrooms.
- We hypothesize that to help ELs use MVRs as thinking tools, teachers need to enhance their own representational fluency, especially their knowledge and use of mathematical diagrams and their interpretation of those produced by students.

Special Attention to Certain MVRs

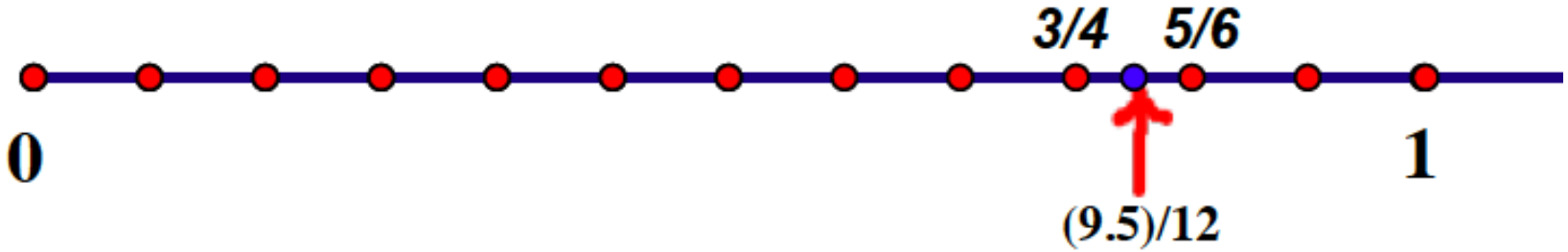
- Tape Diagrams
- Number Lines
- Double Number Lines

Tape Diagrams



Original cost was $140 + $60 = $200

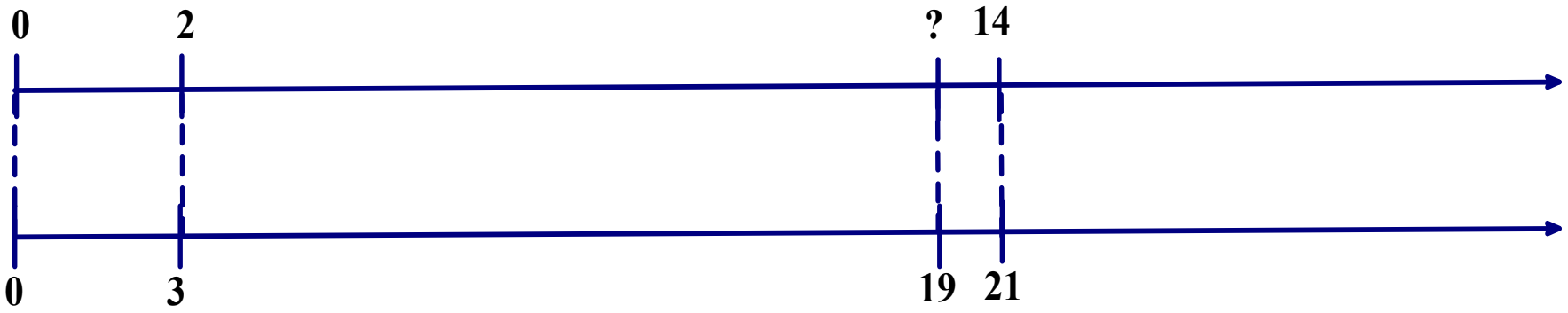
Number Line



(9.5)/12 = 19/24

So, 19/24 is larger than 3/4 and smaller than 5/6

Double Number Line



Promoting Collaboration between Math Teachers and ESL Specialists

- Doing mathematics tasks together
- Sharing their MVRs, examining, and discussing each other's approaches
- Analyzing EL student work together
- Collaborating on planning lessons that integrate mathematics tasks and language strategies, for use with students

Brief Account of Background

- NYC series of seminars emphasizing analysis of student work on mathematics tasks
- Middle schools sent teams comprising mathematics teachers, mathematics coach, ESL specialist, and assistant principal.

A Study of Four Urban Cases of Improvement for EL Students

Succeeding With English Language Learners: Lessons Learned from the Great City Schools

October 2009

Horwitz, A.R. et al, Council of Great City Schools

NYC Factor: Shared Ownership

"As improving ELL instruction became a broader mission, …schools, teachers, and subject area departments were encouraged to work together, sharing common planning periods and attending joint trainings. At the classroom level, the instruction of ELLs became the joint responsibility of ELL teachers, subject area teachers, coaches, and the principal. This was a marked change from the time when ELLs and ELL teachers were isolated from others." (Pages 45-46)

School Teams in VAM: Potential Advantages

- Analyzing (EL) student work together brings different, and potentially complementary, lenses to understanding student mathematical reasoning and use of language
- The ESL specialists can be agents in teacher development of "Pedagogical Language Knowledge" (Bunch, 2013)
- Perhaps, as in NYC, collective ownership will grow for enhancing EL access to mathematical reasoning and communication.

Discussion Questions

- What's one *strategy* that you find works well in your mathematics PD to meet the needs of educators with different professional roles?
- What's one *challenge* that arose in your mathematics PD when working a mixed audience of educatorswith different roles?

Visual Access to Mathematics:

Professional Development for Teachers of English Learners

PAM BUFFINGTON

Related Work Informing Technology Use

- Interactive Formative Assessment Tools for English Language Learners with Disabilities
- Project Massachusetts Empowering Educators with Technology (MEET)/SELECT Math Boston
- Research & Practice Collaboratory: 1 to 1 Mobile Technology DBIR
- Maine's Impact Study of Technology in Mathematics / MLTI

Strategic Use of Technology

- Findings from a number of studies have shown that the **strategic use of technological tools** can support both the **learning of mathematical procedures and skills** as well as the development of **advanced mathematical proficiencies, such as problem solving, reasoning, and justifying** (e.g., Gadanidis & Geiger, 2010; Kastberg & Leatham, 2005; Nelson, Christopher, & Mims, 2009; Pierce & Stacey, 2010; Roschelle, et al., 2009, 2010; Suh & Moyer, 2007).

The Power of Technology

- Interactive Technology
  - *Technology Principle:* Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances learning. (NCTM, 2000, p 24)

Technology can provide **accurate, interactive, visual images** of mathematical concepts and ideas, it can make **thinking explicit** (screencast)

Instructors can provide a targeted instruction & intervention for learners' specific needs and remove potential barriers to learning

Technology Integrated in VAM Course

Integrated in Online and Face-to-Face Course Sessions

- Screen Recordings (Mobile and Computer)
- Interactive Applets
- Digital Resources
- Multimedia/Videos
- Synchronous Interactions– Shared Problem Solving
- Asynchronous Components

Common Core Standards of Mathematical Practice

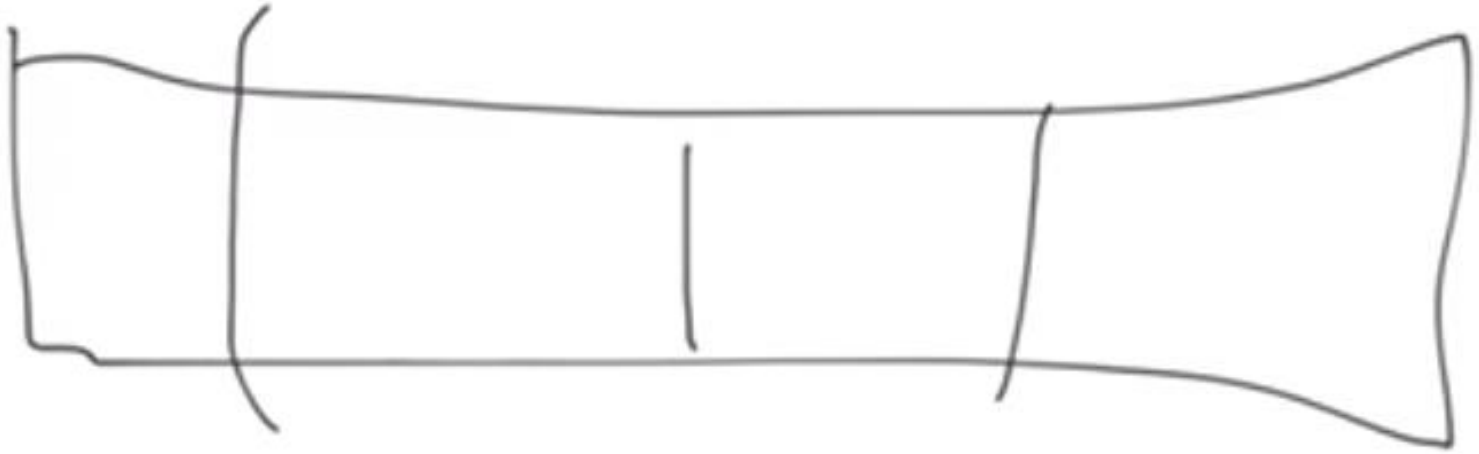
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Student Explanations: EE Screencasts

- Makes thinking and sequence of solution explicit
- Provides media rich evidence
- Provides opportunity to capture teacher/participant questioning
- Provides and opportunity to identify misconceptions
- Provides opportunity to confront assumptions

Gus & Ike Task

Gus's and Ike's combined running distance this week was 48 miles. If Gus ran three times as far as Ike, how many miles did Ike run?



EE Screencasts: Cross Role Access

Multimodal representations of student thinking (pictures, diagrams, written, spoken) provide varying sites of access or entry into the artifact analysis across roles

- Diagram or computation entry point for math content or mathematical structure discussion
- Potential for language access or language production analysis

EE Screencasts: Cross Role Access

Critical Friends across roles

- included EL specialists, math specialists
- collaborated on artifact collection/creation
- artifacts incorporated content and structure questioning
- artifacts incorporated language strategies/questioning (ex. revoicing, differentiated questioning, support developing language,…)

Student Explanation: Sharing Candies

Sharing Candies

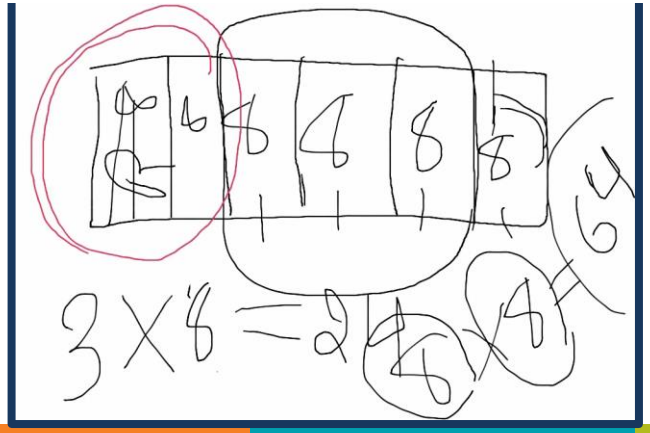
Sara had a bag of candies.

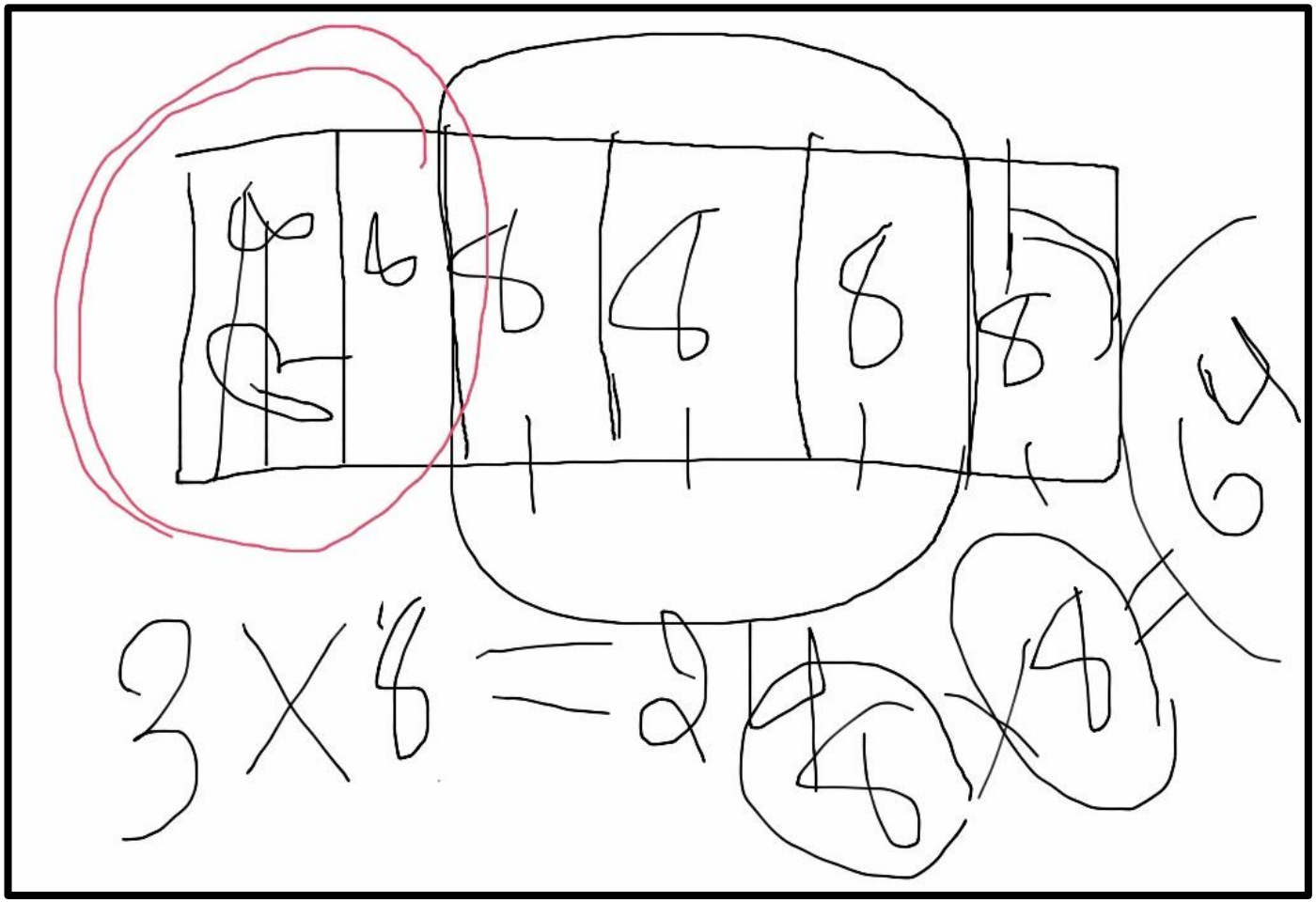
She gave 1/3 of the candies to Raul.

Then Sara gave ¼ of the candies she had left to Jasmine.

After giving candies to Raul and Jasmine, Sara had 24 candies left in her bag.

How many candies did Sara have at the beginning?





EE Screencasts: Cross Role Access

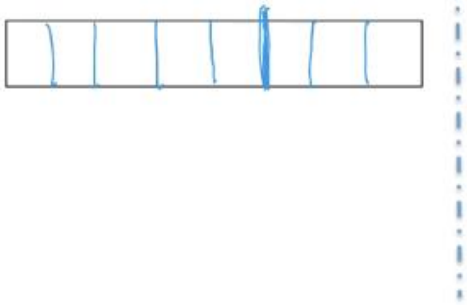
- Confront assumptions about what the student knows or does not know
- Engage in discussions of pedagogical moves (wait time, questioning for understanding, opportunities for revision …)
- Incorporate “look fors” across roles

Interactive Worked Example

Problem:

10 cups of soup fills 5/8 of a soup pot.

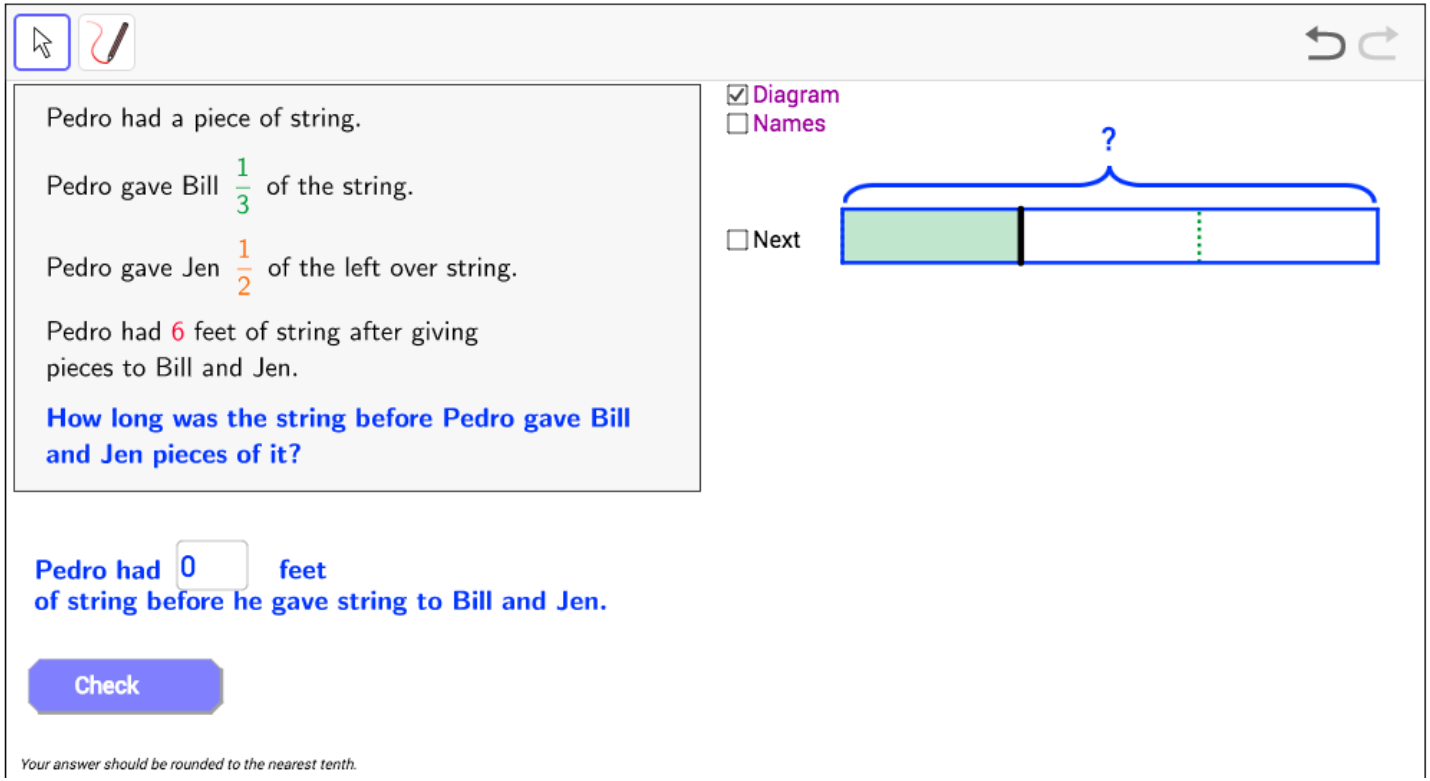
a) How many more cups of soup are needed to fill the pot to the top?
Use 2 visual representations to help solve this problem. Explain your solution.



b) How much of the soup pot will 1 cup fill? Use your representation to help explain your thinking.

Diagramming with Pedro's String

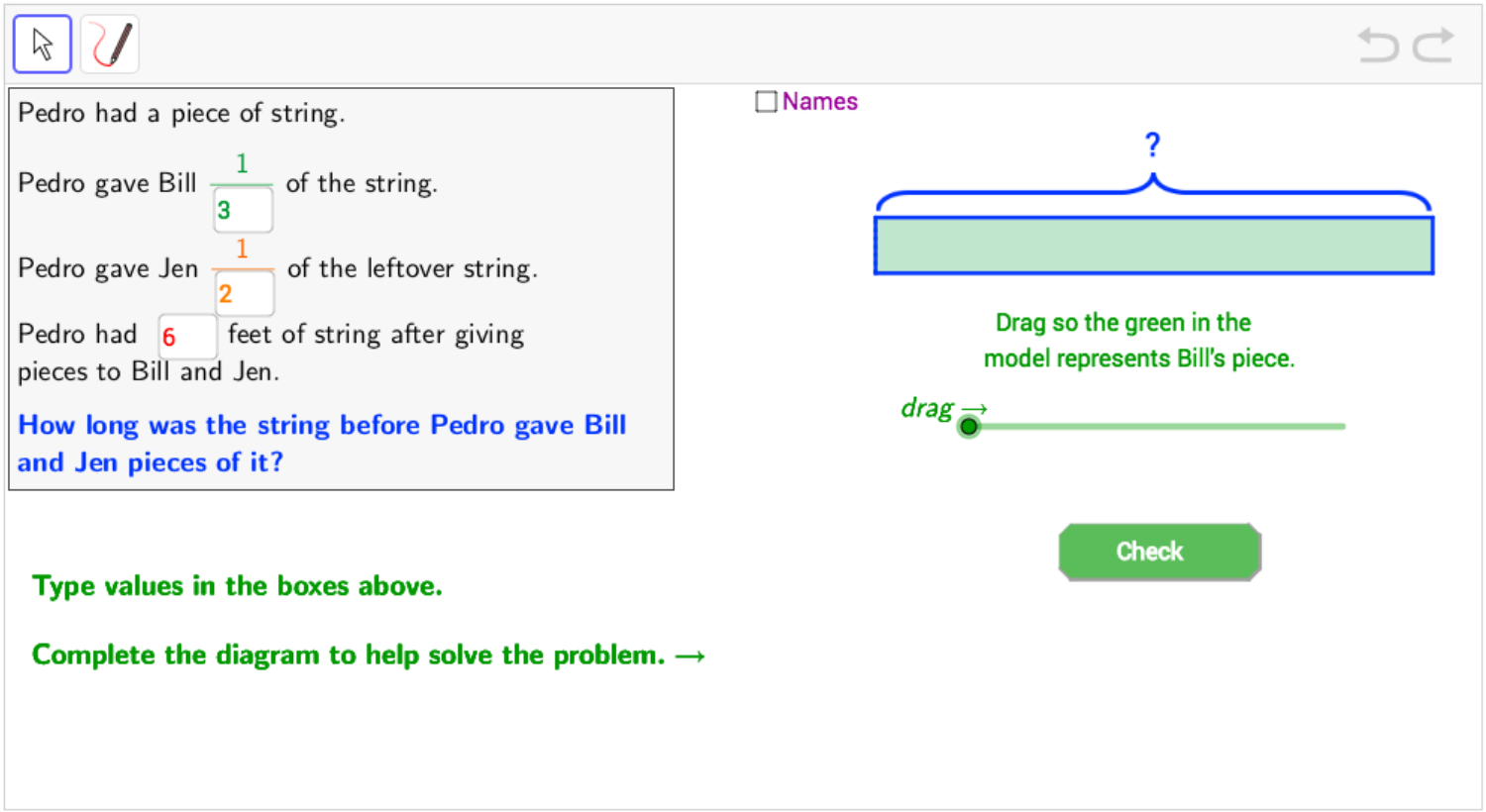
Pedro's String (1) with Pen Tool



Course

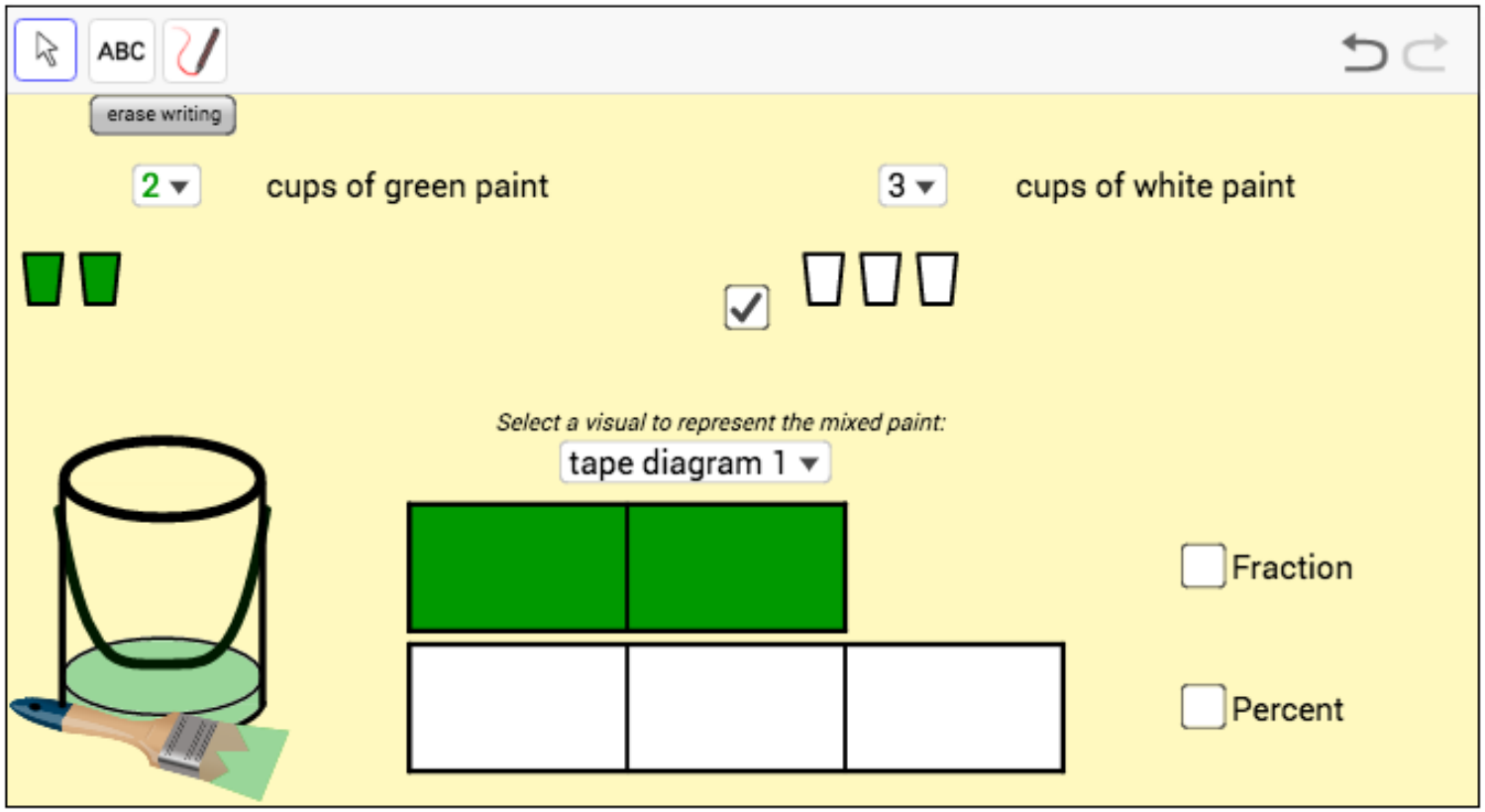
Pedro's String (Version 2)

Pedro's String (2) with Pen Tool



Mixing Paint

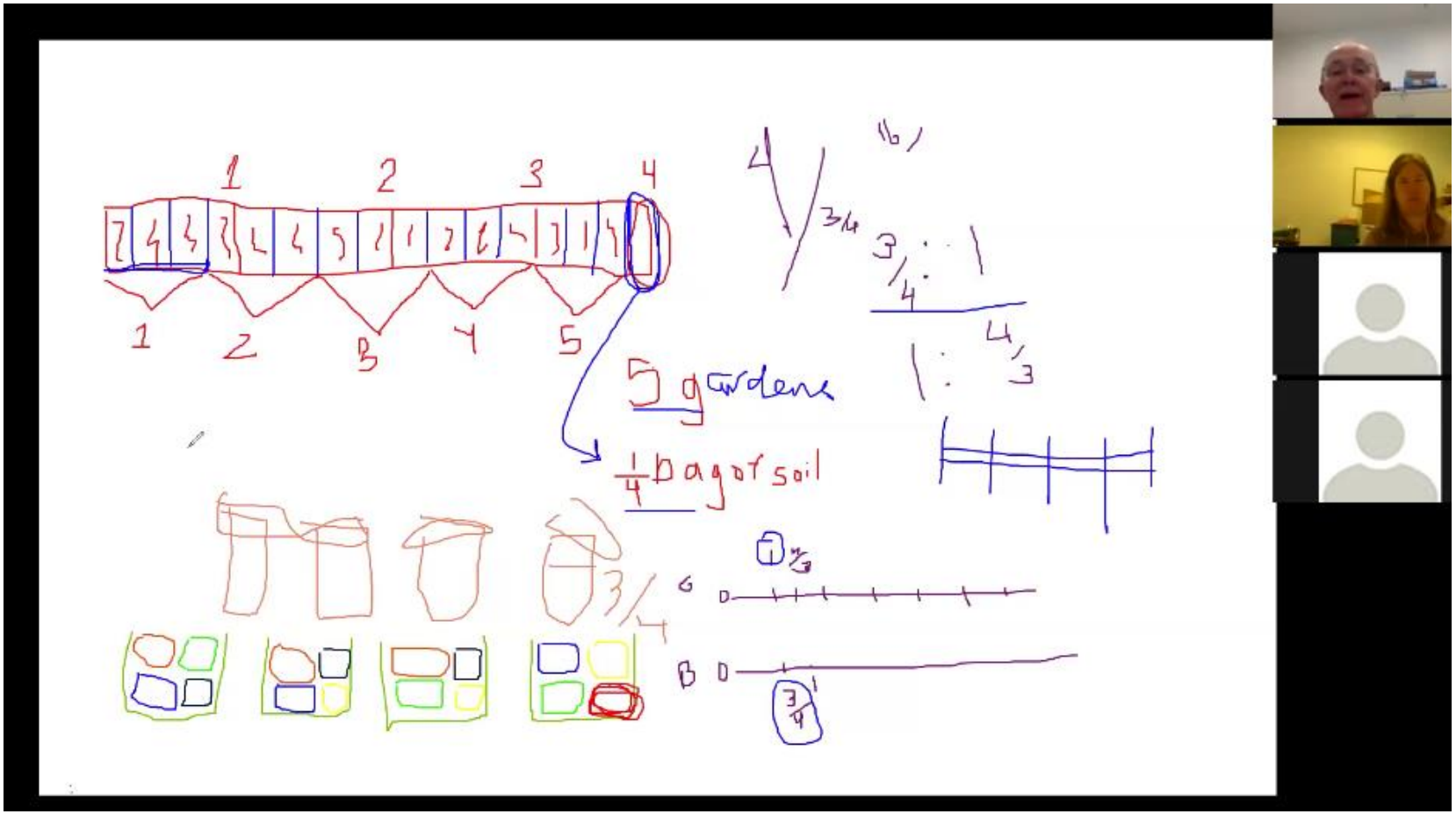
Mixing Paint (1)



Applets: Cross Role Engagement

- Provide multiple points of entry into tasks
- Provide “external” artifacts and engagements
- Incorporate a range of features and versions to support scaffolding
- Provide technical support resources for the range of expertise and experience

Collaborative Problem Solving



Whiteboards in Synchronous Sessions

Can support

- collaborative problem solving across role groups
- provide opportunities to share, examine, discuss, collaboratively create MVRs
- make related academic language explicit through ‘spoken’ explanations and discussion

Discussion Questions

- What's one *strategy* that you have used when implementing mathematics professional learning with educators of different professional roles ? *(With or without technology)*

- What's one *challenge* that arose when implementing mathematics professional learning with educators of different professional roles? *(With or without technology)*

Differentiating Professional Development:

Building Mathematics Knowledge for Teaching Struggling Learners

AMY BRODESKY

About the DPD Project

Goal: Improve math instruction for struggling learners by creating content-focused PD that is **differentiated** to teachers' varied needs

Audience: General Ed/Math & Special Educators (Grades 4-7)

3 Blended PD courses: Fractions, Decimals, and Integers

Field-test: 148 teachers from 21 districts

Gen. Ed/Math Teachers & Special Educators Vary in Their:

- Knowledge, teaching experience, and comfort with mathematics
- Knowledge, teaching experience, and comfort with struggling learners, including ones with disabilities
- Expectations for PD
- Professional training
- Roles and responsibilities in their schools

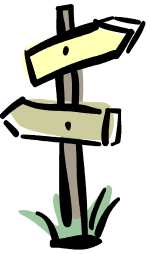
Our Guiding Principles for Differentiating

- Provide choices but not everything is a choice
- Teachers choose for themselves
- PD needs to provide support for making decisions

DPD Model: 3 Components

1) Core Activities that everyone does

- Essential content
- Common experiences



2) Choice Points that allow teachers to choose options and activities to individualize their learning

3) Self-Assessment and Reflection Opportunities to help teachers reflect on their own understandings and guide their choices

What is Core?

- **Core Activities** provide:
  - Essential content
  - Common experience that we want all participants to share as a part of a learning community

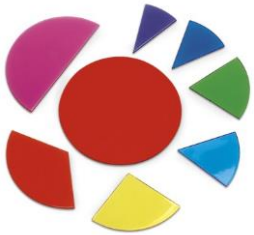
- To decide what is **Core**, we consider math standards, research on student learning and effective practices, and areas of difficulty for teachers and students

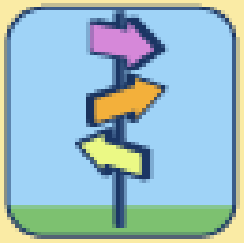
What are Choice Points?
Example

A. ***If you are new*** *to using manipulatives for fraction addition,* choose <u>one</u> of the following:

- Fraction Circles, Fraction Bars, or Pattern Blocks

B. ***If you have experience*** *using manipulatives for fraction addition,* choose <u>two</u> manipulatives to compare strengths and limitations





Choices

We design choice points that allow teachers to select options based on:

1. Prior Experience & Knowledge
2. Math Content
3. Level of Challenge
4. Topics
5. Type of Activity
6. Preferred Mode of Learning

Reflection and Self-Assessment

1. Do a Self-Check and Reflect Activity on the foundational concepts in Session 3. The activity's goal is to provide an opportunity to self-assess and reflect on your knowledge.

1.1 Select the button to answer multiple-choice questions and get immediate feedback.

Self-Check Activity

Note: This is meant to be a self-assessment activity and not a quiz. You will not be graded.

1.2 Think about your experience answering the questions.

- *Are there any topics that you would like to revisit and strengthen?*
- *Are there any topics that you would like to further explore?*

If you have questions or would like additional resources on a particular topic, send an email to the instructors.

How well did the Choice Points meet teachers' needs?

Teachers who selected "Some" or "A lot" (96%) n: 117

- Liked to be given choices
- Could customize experience to meet my prior knowledge
- Gave permission to start at comfort level
- Could work at my own pace
- Felt more Flexibility/Ownership of learning

Teachers who selected "Not at all" or "A little" (4%)

- Wanted to start from beginning
- Wanted to do all the activities

Challenges of Differentiation Model

- Developers need to develop a lot of activities/materials in order to have choices
- Teachers may choose what they are comfortable with and not what they need
- Teachers may overestimate their understanding and thus not be aware of their professional learning needs
- Making choices during PD may be new to teachers

PD Development and Facilitation: Working with a Mixed Audience

Development Process

- Prior projects: math & special educators
- Early pilot with special educators only Needs assessment of math and special educators

Facilitation:

- Present choices equitably
- Foster a supportive and respectful learning community
- Encourage collaboration with colleagues and balance individualized learning with partner/small group activities

Opportunities for Collaboration: Math Teachers and Special Educators

- Doing math tasks and sharing approaches
- Using diagnostic probes
- Examining and sorting student work
- Planning accessible math tasks and lessons
- F2F and Online discussions: "pair posts" and "discussion buddies"

Research and Evaluation: Working with a Mixed Audience

Our Concerns:

- How will special educators respond to math pre-assessment? Will people get scared off?

Approaches

- Use a variety of instruments – not just math
- Communicate messages to help participants feel comfortable with the instructions
- Interview teachers with different roles

Time for Questions and Discussion

1. Your Questions
2. Discussion:

   A. Where do you see the need to differentiate in your PD for educators with different roles? How do you differentiate?

   B. How do you promote collaboration among educators with different roles in your PD?

Topic Discussions

Topic Choices

Which one would you like to discuss?

A. Developing PD for mixed audiences

B. Implementing PD with mixed audiences

C. Research/Evaluation of PD w/mixed audiences

Discussion Questions

- What are the *benefits* and *implications* of working with mixed audiences on your chosen topic?

- What *challenges* have you faced in your chosen topic? What *strategies* do you find helpful for addressing challenges?

Be prepared to share 2 ideas with the whole group.

Wrap-Up

Share-Out

Each small group shares:

- What are 2 ideas or themes that stood out in your discussion?
  - Benefits and implications?
  - Challenges and strategies?

Ideas to Take Away

- What are 2 ideas that you will take away from today's session?

Contact Info

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Credits [Disclaimer /]

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