

Rational Numbers Playground: Applying and Refining a Model for Dynamic, Discussion-Based Professional Development

PIs: Chandra Orrill – Rethink Learning Labs – chandra.orrill@rethinklearning.com

Rachael Brown – Penn State Abington – reb37@psu.edu

Allan Cohen – University of Georgia – acohen@uga.edu



Project Description

In this design-based research project, we are refining a model for mathematics professional development. We engage middle grades teachers in playful, discussion-based exploration of fractions and proportions through tasks and dynamic "toys" as well as planning for classroom implementation. We are now adding "Connections", designed to support participants in transitioning from learners to teachers during the PD. For one group, Connections are reflection on paper, for the other, they are part of the PD discussion.

Emerging Model of Coherent Learning for Teaching (MCLT)

Stage	Explore	Connect	Apply
Activity	Playing	Representing	Planning
Activity Types	Conjecture testing, Mathematical argument, Sensemaking	Connection making, Pattern finding, Making sense of structures	Editing, Generating, Connecting, Applying
Driving Questions	How do we play with math?	How do we connect playfulness in math to traditional representations and standards?	How do we support students to play with content? Use tools and representations? In standards-based ways?
Roles	Participants: generate discussion Facilitators: Focus discussion on key mathematical values through questioning and highlighting key ideas		

Bars

- Mystery:** Given Situations 1, 2, and 3: Which, if any, show a proportional relationship between the lengths of the Bars? How do you know?

Explore: Constant

a. Original state of Bars for all scenarios	
b. Bars Scenario 1 (constant difference of 2)	
(c) Bars Scenario 2 (proportional relationship)	
(d) Bars Scenario 3 (inversely proportional relationship)	

Challenge task

- How can we figure out the values of the two bars in between the values we've recorded (scenario 2)?
 - Using ratio table?
 - Using Bars?
 - How does the Bars Toy help us answer this task?
 - How does finding the values in between the whole numbers help promote thinking about the invariant relationship in a proportion?
 - How does the Bars Toy compare to other representations you use in your classroom?

Connect: Quantities covary at a constant rate. The relationship between the quantities is constant while the magnitude of the quantities changes. Covariation is the restriction on this relationship. We intend this to be used to tie to ratio table representation and to think about the relationship between ratio tables and Bars as well as the affordances of each representation.

Fix These Tasks!

In a recent PD class, when we asked teachers to write real-world situations related to scenarios 1 & 2 in the Bars Toy, they gave us the following responses.

- Which Bars scenario does each describe?
- How did you know which bar scenario is referred to?
- What isn't working about each?
- Edit the scenario into a word problem that you could use with your own students.

Fix These Tasks!

- It's 3 parts fruit juice and 5 parts ginger ale. So, for whatever recipe you want to do, it's a ratio of 3 to 5.
- They're both racing at a constant speed, but red is moving faster than blue. So, we could ask questions about how far this person has gotten at different times.
- It's like when you go into the carnival and you pay 25 cents to get in then you pay for each ride.

Apply: Thinking about constant, covariation, and quantity, thinking about how situations need to be expressed for students to understand them, matching models to stories.



The work reported here was supported by the National Science Foundation under grant DRL-2201125, 2201126, 2201127. The opinions expressed here are those of the authors and may not reflect those of the NSF.